Investment in Telecommunication Infrastructure

Tobias Veith

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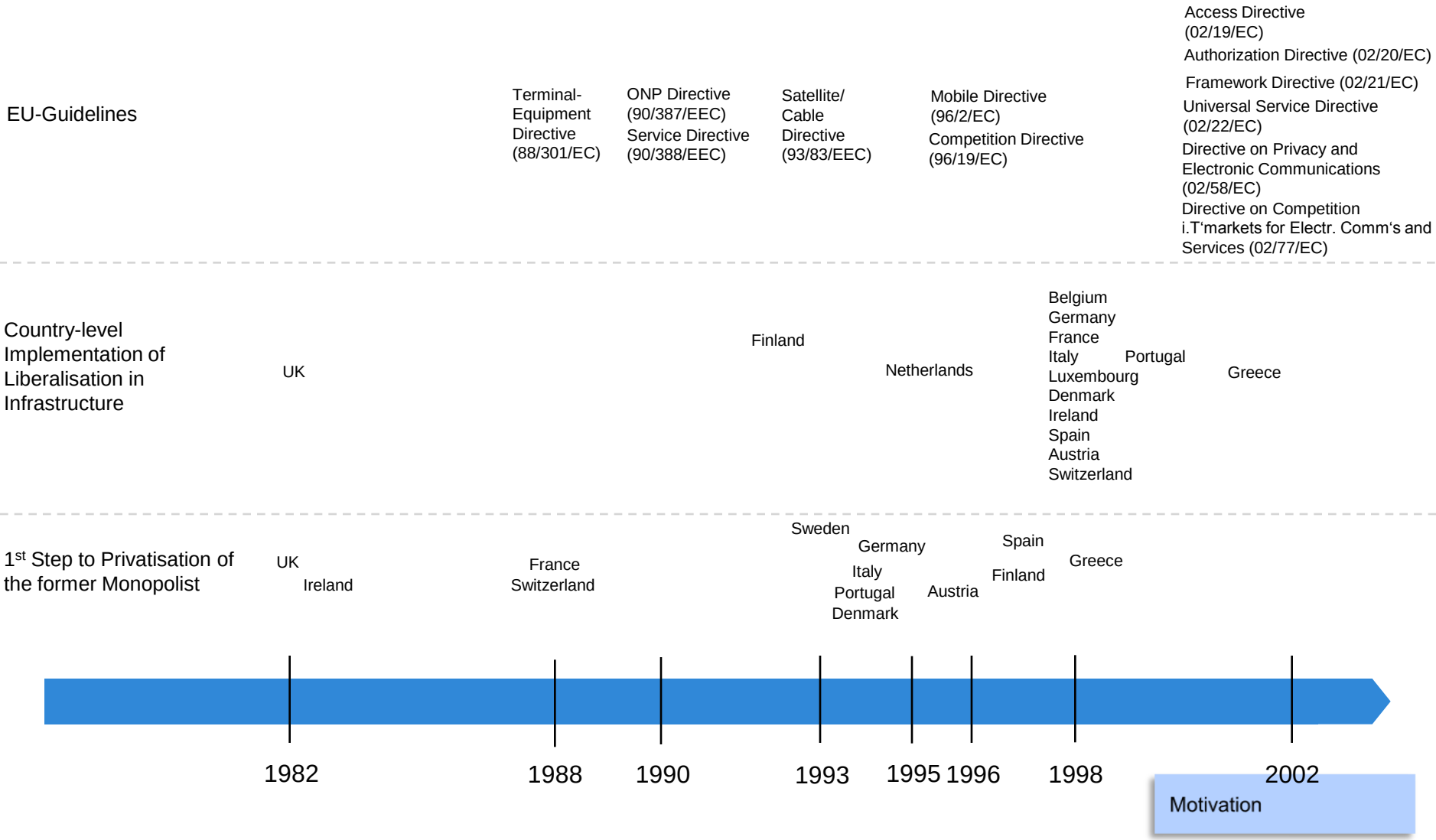
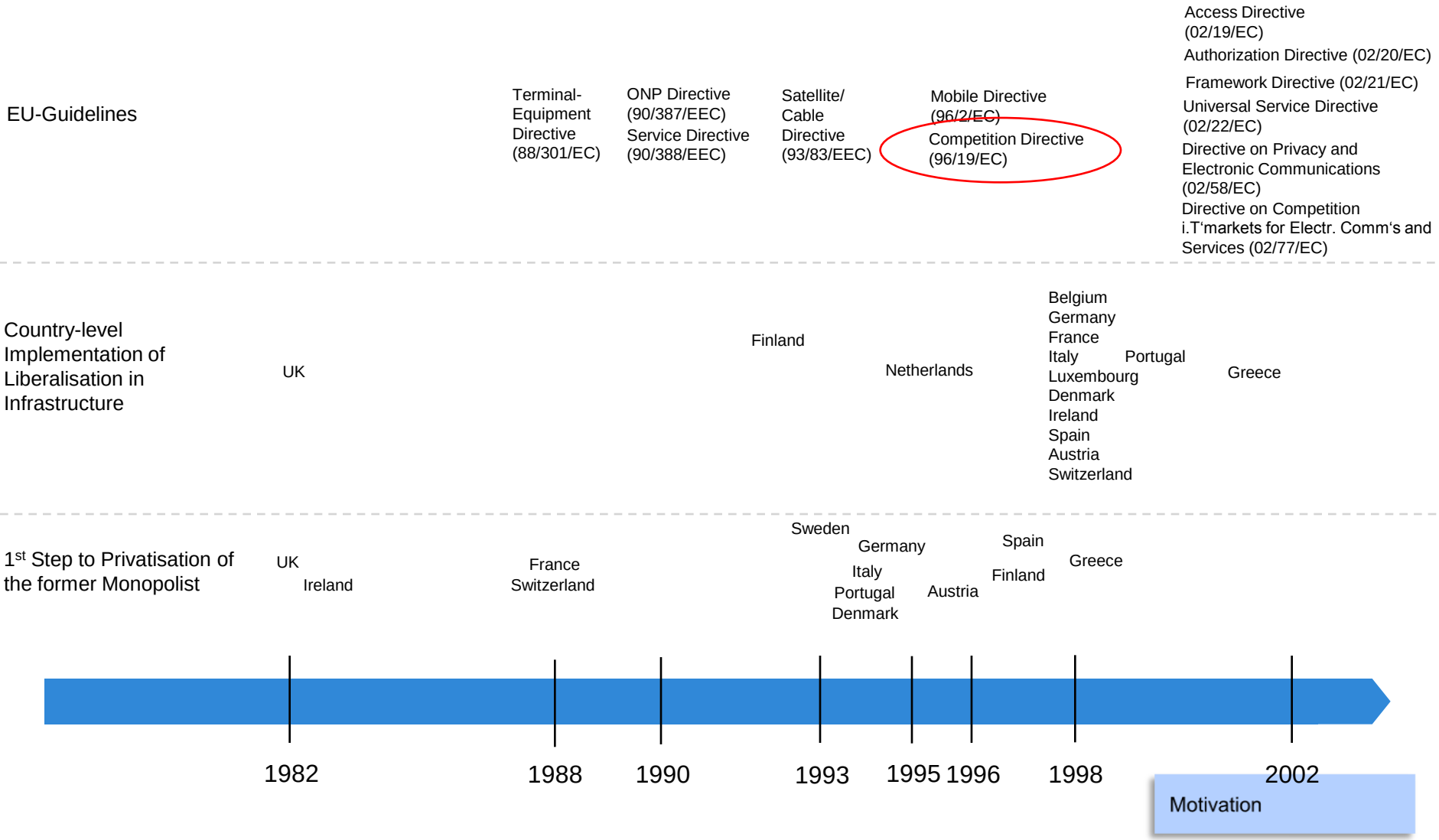
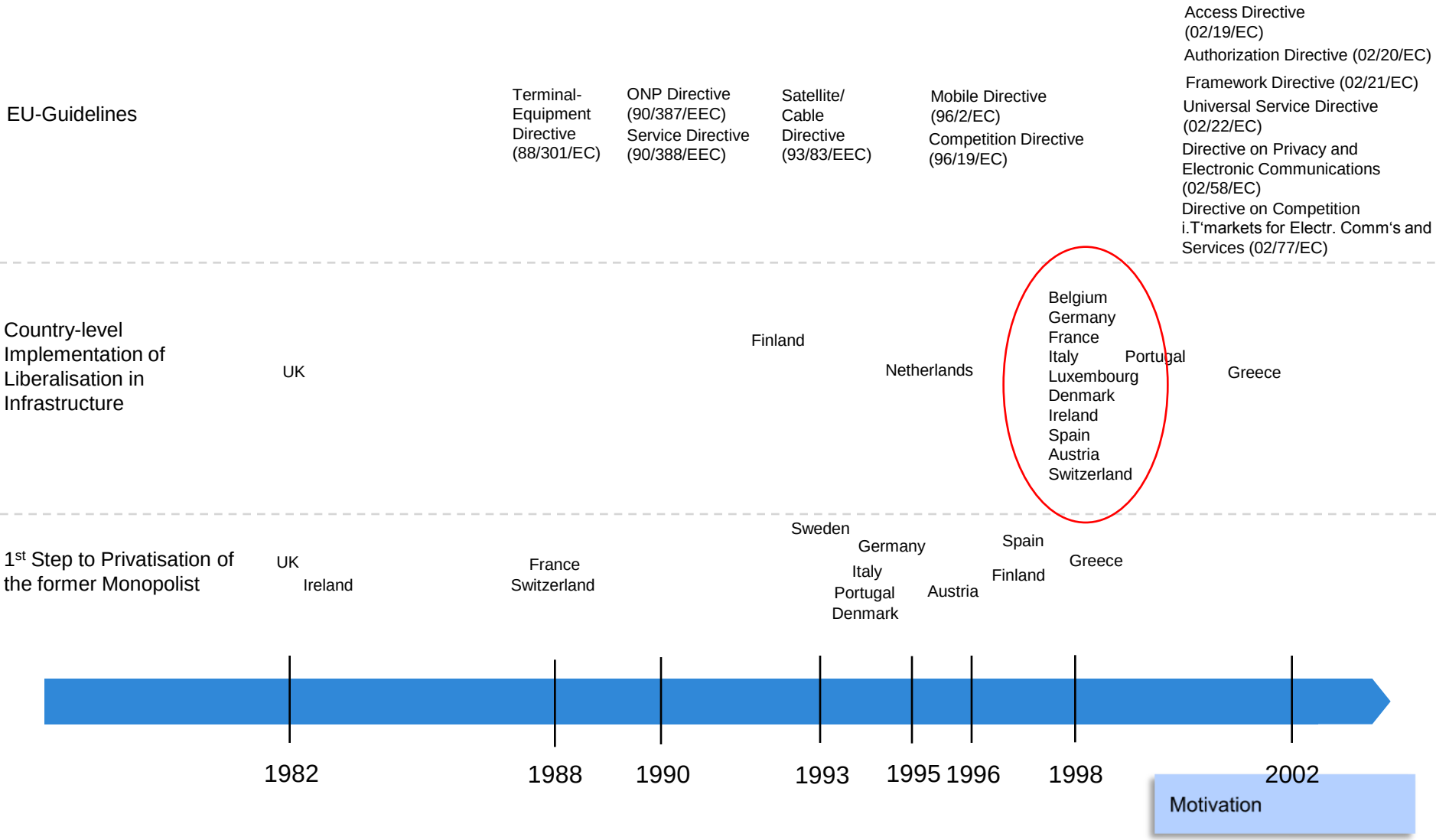
Steps of Telecommunications Liberalization and Privatization



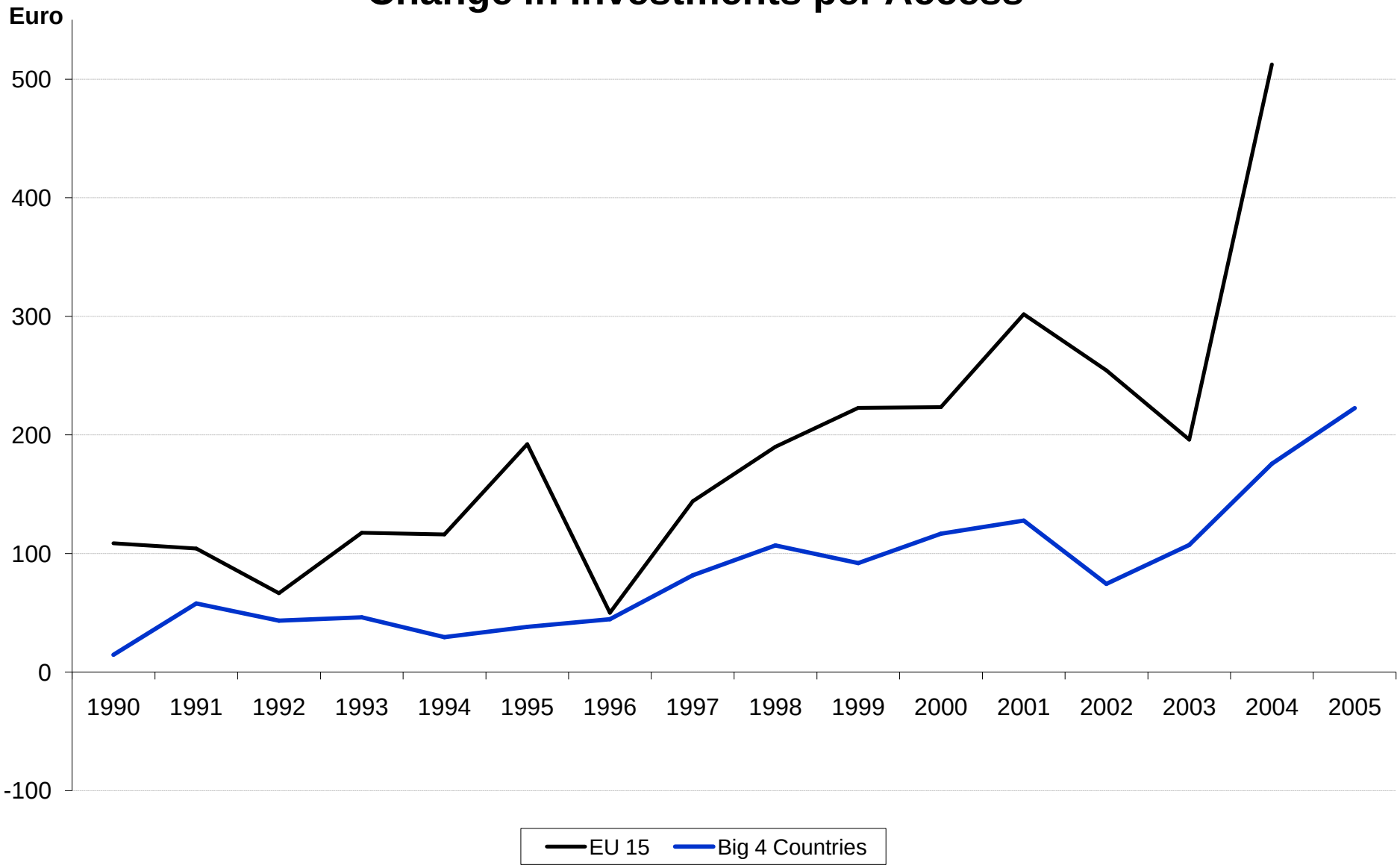
Steps of Telecommunications Liberalization and Privatization



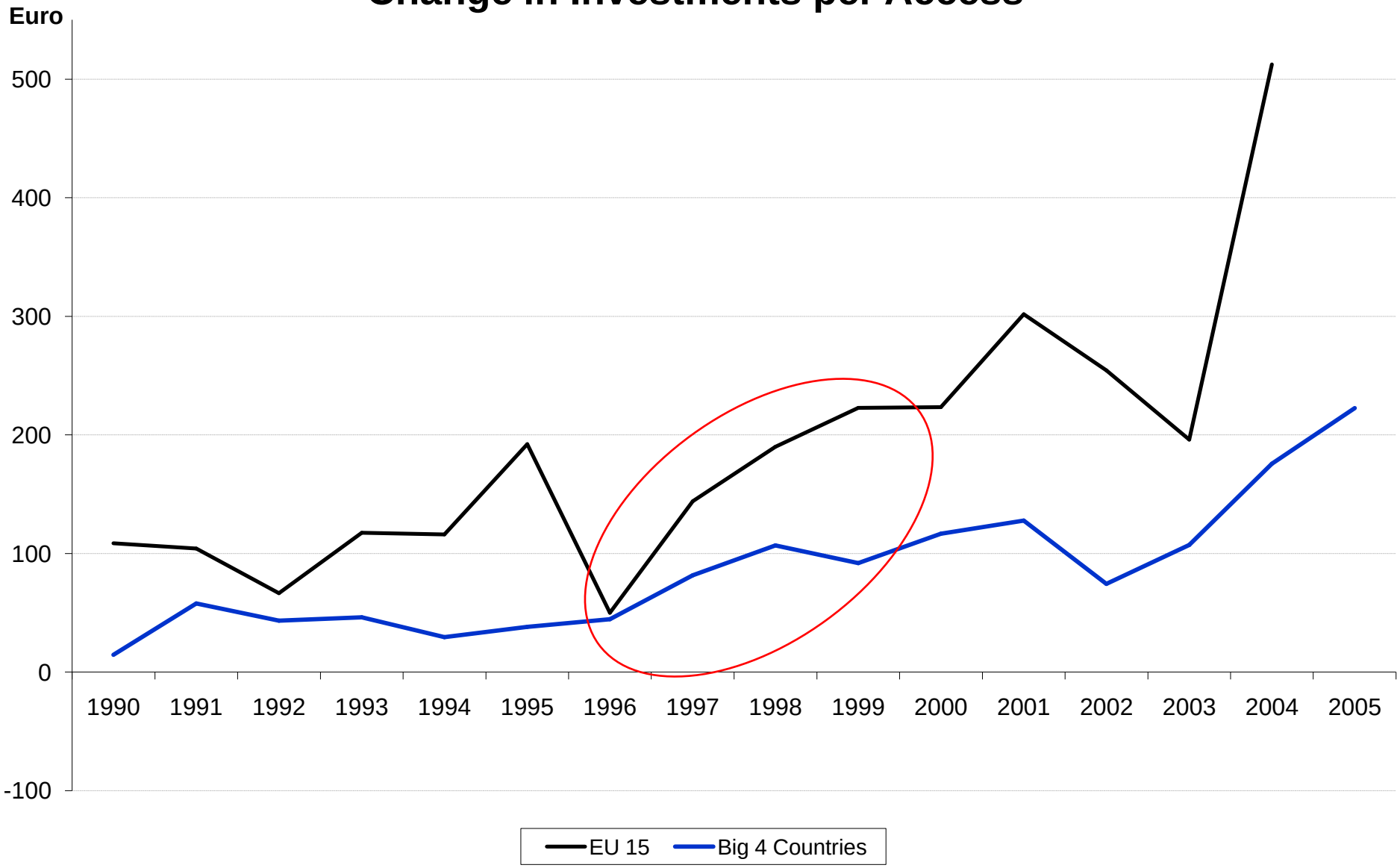
Steps of Telecommunications Liberalization and Privatization



Change in Investments per Access



Change in Investments per Access



Hypotheses

H1: Upcoming competition in line with infrastructure liberalisation has strongly increased quality investments.

H2: In regions with a higher population concentration an adequate level of infrastructure could be installed at lower investment costs than in areas with a lower population concentration.

H3: The lower the level of infrastructure quality the higher are investments in quality upgrades.

H4: Foreseeing forthcoming competition in line with the transition of European guidelines to national law, incumbents and new entrants have increased quality investments before the date of liberalization.

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H2: In regions with a higher population concentration an adequate level of infrastructure could be installed at lower investment costs than in areas with a lower population concentration.

H3: The lower the level of infrastructure quality the higher are investments in quality upgrades.

H4: Foreseeing forthcoming competition in line with the transition of European guidelines to national law, incumbents and new entrants have increased quality investments before the date of liberalization.

Data

- aggregated data for EU 15 countries between 1990 and 2005
- data sources: ITU annual data, Eurostat, SourceOECD, OECD Regulatory Index
- financial data are discounted using the CPI 95

Descriptive Statistics 1990 and 2005

	1990				2005			
	Mean	Std. Deviation	Mini-mum	Maxi-mum	Mean	Std. Deviation	Mini-mum	Maxi-mum
log (inv. per access)	2.764	0.429	1.900	3.657	3.424	0.313	3.118	4.144
gov. participation (-1)	0.923	0.204	0.350	1	0.283	0.294	0	1
market share comp. nat. (-1)	0.005	0.018	0	0.070	0.295	0.170	0	0.630
log (std. access) (-1)	6.709	0.607	5.264	7.505	6.725	0.607	5.220	7.473
log (empl. per access)	-2.179	0.133	-2.375	-1.861	-2.272	0.171	-2.532	-1.834
log (GDP p.c.) (-1)	4.043	0.254	3.460	4.286	4.597	0.135	4.314	4.911
share urban pop.	0.727	0.144	0.467	0.964	0.750	0.136	0.551	0.973

Econometric Model

Standard Model:

$$I^*_{jt} = X_{jt} b + \nu_{jt}$$

Investment Adjustment Model:
(similar to Greenstein et al. (1995))

$$I_{jt} = I_{jt-1} + a(I^*_{jt} - I_{jt-1}) + \eta_{jt}$$

$$I_{jt} = I_{jt-1}\alpha + X_{jt}\beta + \varepsilon_{jt}$$

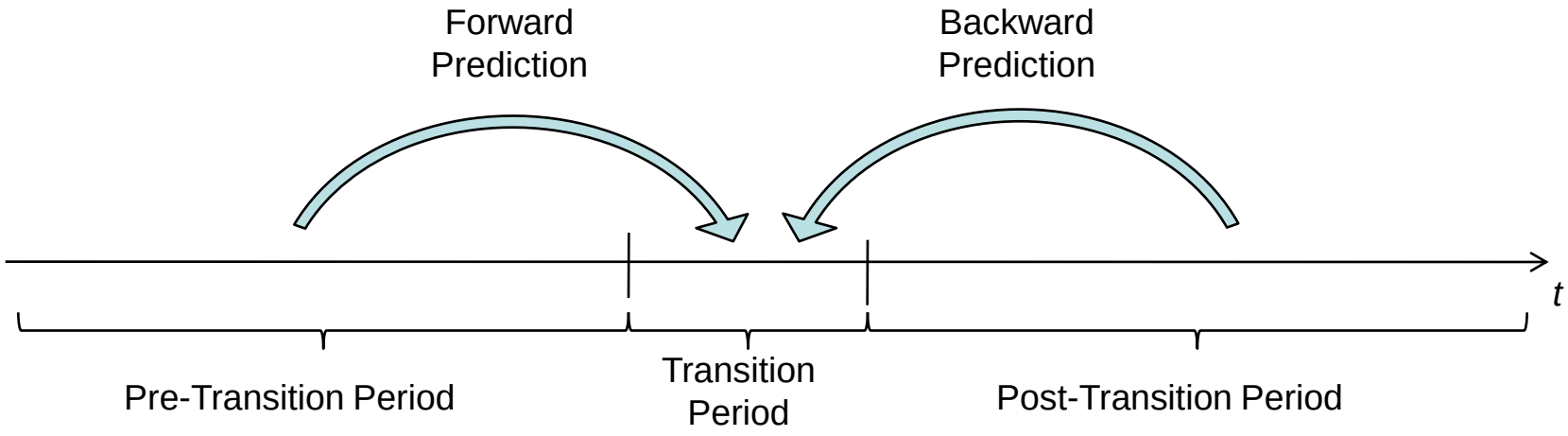
$$I^*_{jt} = X_{jt} b + \nu_{jt}$$

$$\alpha = 1 - a$$

$$\beta = ab$$

$$\varepsilon_{jt} = a\nu_{jt} + \eta_{jt}$$

Estimation Procedure



Starting Point:

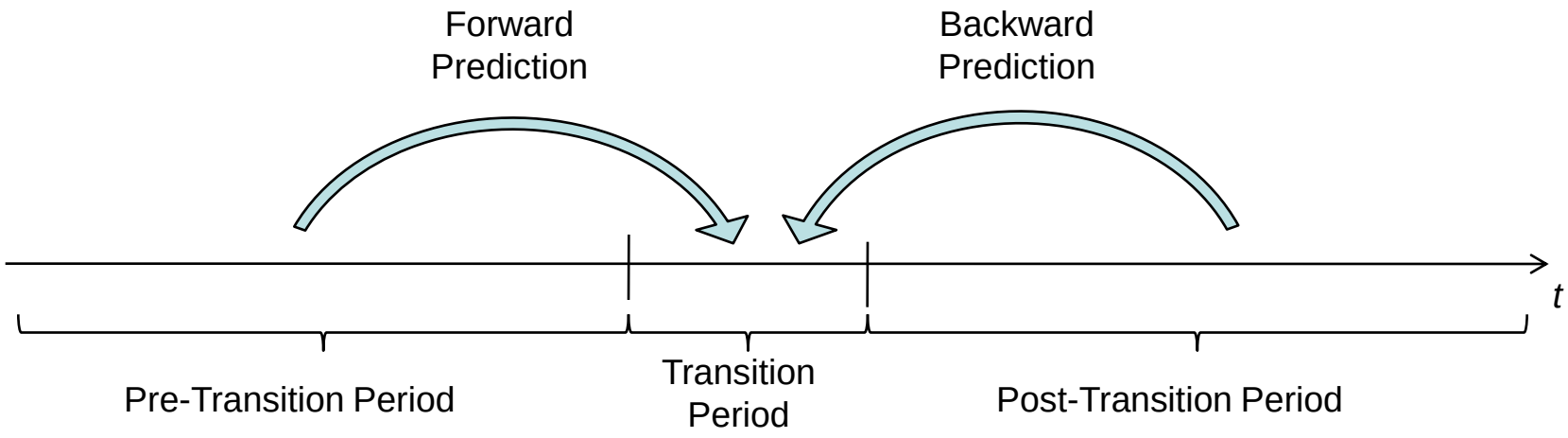
$$\hat{I}_{jt} = I_{jt-1}\hat{\alpha} + X_{jt}\hat{\beta}$$

Deviation Observation – Estimation:

$$Dev_{jt} = I_{jt} - \hat{I}_{jt}$$

$$Dev_{jt} = I_{jt-1}(\alpha - \hat{\alpha}) + X_{jt}(\beta - \hat{\beta}) + \varepsilon_{jt}$$

Estimation Procedure



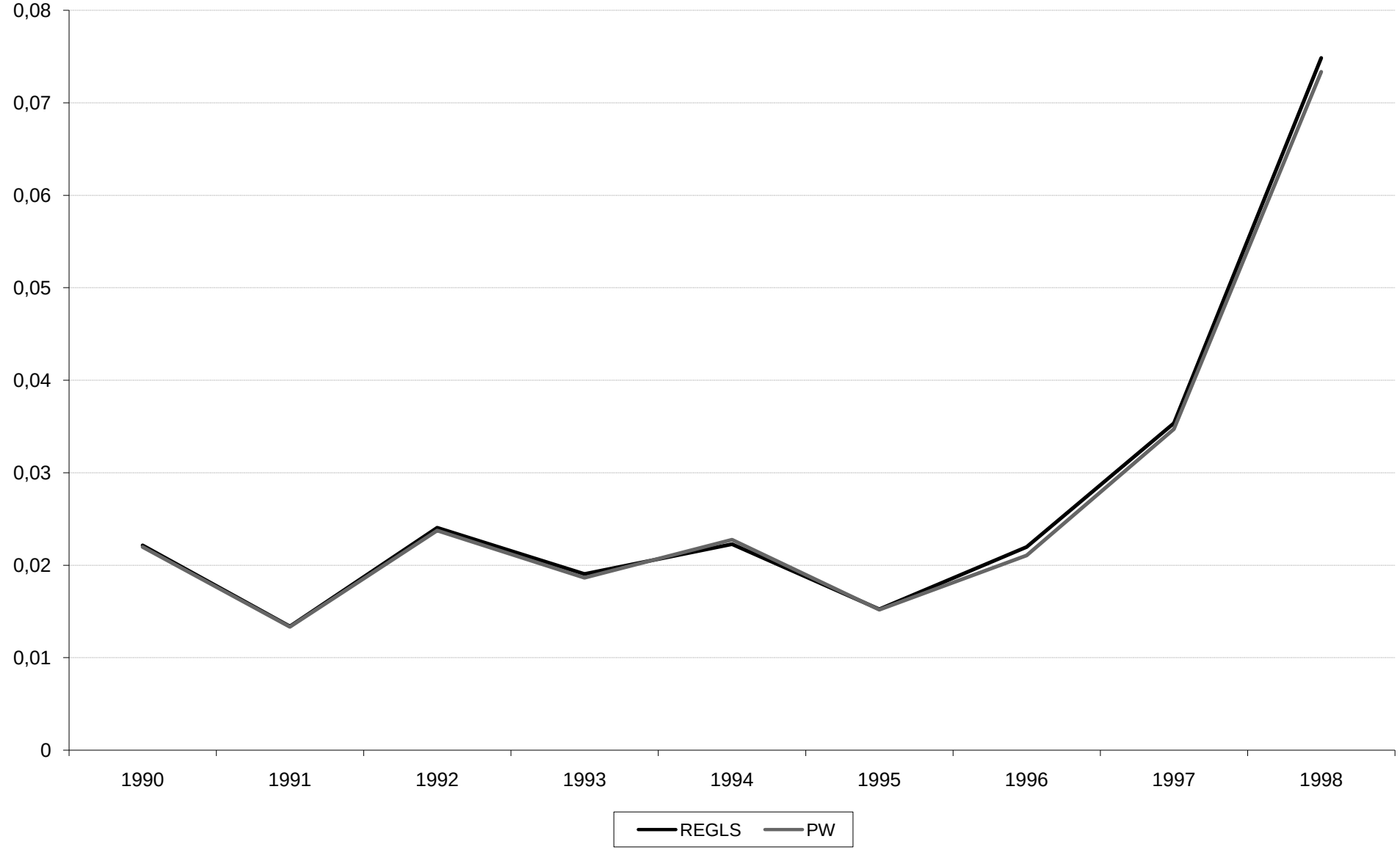
Possible Outcomes:

1) The Transition Period significantly differs from the Post-Transition Period but not from the Pre-Transition Period.
2) The Transition Period significantly differs from the Pre-Transition Period but not from the Post-Transition Period.
3) The Transition Period significantly differs from the Pre-Transition Period and from the Post-Transition Period.
4) The Transition Period does not significantly differ neither from the Pre-Transition Period nor from the Post-Transition Period.

Estimation Results

	forward oriented predictions			backward oriented predictions		
	Mean	**Std. Err.**	**t-Value**	**Mean**	**Std. Err.**	**t-Value**
Prediction Period equals Transition Period						
REGLS	0.036	0.008	4.465	-0.003	0.006	-0.548
PW	0.038	0.008	4.530	-0.000	0.008	-0.048
Prediction Period begins and ends one period earlier						
REGLS	0.002	0.007	0.251	-0.002	0.006	-0.330
PW	0.006	0.006	1.004	-0.001	0.006	-0.268
Prediction Period begins and ends one period later						
REGLS	0.066	0.011	5.884	0.005	0.007	0.692
PW	0.066	0.011	5.905	0.005	0.007	0.694
Prediction Period begins one period earlier and ends equal to the Transition Period						
REGLS	0.004	0.006	0.641	-0.003	0.005	-0.561
PW	0.012	0.006	0.022	-0.003	0.005	-0.533
Prediction Period begins equal to the Transition Period and ends one period earlier						
REGLS	0.025	0.009	2.880	0.003	0.007	0.451
PW	0.027	0.009	3.010	0.004	0.008	0.538
Prediction Period begins one period later and ends equal to the Transition Period						
REGLS	0.041	0.010	4.055	0.014	0.008	1.705
PW	0.040	0.010	4.042	0.013	0.008	1.706
Prediction Period begins equal to the Transition Period and ends one period later						
REGLS	0.048	0.009	5.461	0.001	0.006	0.146
PW	0.051	0.009	5.650	0.001	0.006	0.154
Prediction Period begins one period earlier and ends one period later than the Transition Period						
REGLS	0.008	0.006	1.388	0.000	0.005	0.068
PW	0.021	0.006	3.296	0.000	0.005	0.066
Prediction Period begins one period later and ends one period earlier than the Transition Period						
REGLS	0.022	0.010	2.222	0.012	0.009	1.442
PW	0.022	0.010	2.185	0.012	0.008	1.431

Deviation Plots



Conclusions

- Investments per access strongly increased since 1990s
  possible reasons: upcoming competition, quality change on service level
- in countries with high population concentration investment costs are lower
- effect of the share of standard access lines on quality investments is unclear depending on the estimation method
- increase in investments is observable not with the date of the national installation of competition but even in the transition period

Thank you for your attention.

Tests of Integration

	Fisher Test		Fisher Test (trend)		Im Pesaran Shin Test		IPS Test (trend)	
	ADF Tau	p-Value	ADF Tau	p-Value	ADF Tau	p-Value	ADF Tau	p-Value
log (inv. per acc.)(-1)	10,199	1,000	29,958	0,468	-1,266	0,844	-1,509	0,997
gov. participation(-1)	73,471	0,000	36,560	0,190	-1,718	0,204	-2,053	0,676
share std. acc. (-1)	26,606	0,640	12,504	0,998	-1,365	0,730	-1,968	0,805
log (empl. per acc.)	35,796	0,215	29,421	0,496	-2,103	0,614	-0,931	0,991
share urb. pop.	16,462	0,979	34,549	0,259	-2,137	0,559	-0,692	1,000
log (GDP p.c.)(-1)	11,880	0,999	130,539	0,000	-1,661	0,279	-2,686	0,015
m.s. comp. nat. (-1)	5,436	1,000	17,690	0,963				

Tests of Cointegration

	Pedroni (ADF)				Kao (ADF)	
	w/in dimension		b/w dimension			
	ADF Tau	p-Value	ADF Tau	p-Value	ADF Tau	p-Value
without comp. param.	-1.566	0.059	-2.185	0.014	-2.276	0.011
with comp. param.	1.765	0.961	0.523	0.700	-2.654	0.004

Estimation Results

	RE	LSDV-C	DPD	RE	LSDV-C	DPD	RE	LSDV-C	DPD
	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)
log (inv. per access) (-1)	0.950 *** (0.022)	0.685 *** (0.069)	0.858 ***	0.950 *** (0.022)	0.681 *** (0.069)	0.847 *** (0.023)	0.951 *** (0.022)	0.673 *** (0.069)	0.831 *** (0.023)
Directive				0.009 (0.010)	0.000 (0.011)	0.011 * (0.007)	0.008 (0.010)	0.003 (0.009)	0.011 * (0.006)
imple-Mentation				0.008 (0.010)	-0.003 (0.010)	0.012 (0.008)			
share comp. nat.							0.001 (0.039)	0.052 * (0.031)	0.081 *** (0.025)
gov. part. (-1)	0.016 (0.015)	0.005 (0.021)	-0.030 ** (0.013)	0.020 (0.015)	0.005 (0.021)	-0.020 (0.014)	0.015 (0.016)	0.001 (0.021)	-0.031 ** (0.013)
share std. access (-1)	-0.054 (0.120)	0.077 (0.175)	-0.143 ** (0.061)	-0.027 (0.134)	0.063 (0.182)	-0.079 (0.070)	-0.081 (0.139)	0.160 (0.158)	0.011 (0.071)
log (empl. per access)	0.020 (0.036)	0.182 *** (0.051)	0.105 *** (0.026)	0.015 (0.035)	0.185 *** (0.051)	0.102 *** (0.027)	0.045 (0.038)	0.212 *** (0.060)	0.073 *** (0.027)
log (GDP p.c.) (-1)	-0.054 (0.037)	0.050 (0.068)	0.168 *** (0.037)	-0.061 * (0.036)	0.046 (0.076)	0.152 *** (0.040)	-0.056 (0.037)	0.023 (0.062)	0.148 *** (0.039)
share urban population	0.054 (0.052)	-5.140 ** (2.531)	-0.264 *** (0.081)	0.055 (0.051)	-5.158 ** (2.555)	-0.229 *** (0.084)	0.048 (0.052)	-7.540 *** (2.825)	-0.144 * (0.083)
Intercept	0.390 ** (0.094)		0.201 (0.123)	0.402 *** (0.091)		0.250 * (0.134)	0.456 *** (0.107)		0.197 (0.129)
country trends	Yes	yes	yes	Yes	yes	yes	Yes	Yes	yes
obs.	225		225	225		225	220		220
Wald Chi2(df)	88480.06 (22)		14077.82(6)	87404.60 (24)		13834.84 (8)	75824.52 (24)		14647.35 (8)

Estimation Results

	RE Coeff. (std.d.)		LSDV-C Coeff. (std.d.)		DPD Coeff. (std.d.)		RE Coeff. (std.d.)		LSDV-C Coeff. (std.d.)		DPD Coeff. (std.d.)		RE Coeff. (std.d.)		LSDV-C Coeff. (std.d.)		DPD Coeff. (std.d.)	
log (inv. per access) (-1)	0.950	***	0.685	***	0.858	***	0.950	***	0.681	***	0.847	***	0.951	***	0.673	***	0.831	***
	(0.022)		(0.069)		(0.022)		(0.022)		(0.069)		(0.023)		(0.022)		(0.069)		(0.023)	
Directive							0.009		0.000		0.011	*	0.008		0.003		0.011	*
							(0.010)		(0.011)		(0.007)		(0.010)		(0.009)		(0.006)	
imple-Mentation							0.008		-0.003		0.012							
							(0.010)		(0.010)		(0.008)							
share comp. nat.													0.001		0.052	*	0.081	***
													(0.039)		(0.031)		(0.025)	
gov. part. (-1)	0.016		0.005		-0.030	**	0.020		0.005		-0.020		0.015		0.001		-0.031	**
	(0.015)		(0.021)		(0.013)		(0.015)		(0.021)		(0.014)		(0.016)		(0.021)		(0.013)	
share std. access (-1)	-0.054		0.077		-0.143	**	-0.027		0.063		-0.079		-0.081		0.160		0.011	
	(0.120)		(0.175)		(0.061)		(0.134)		(0.182)		(0.070)		(0.139)		(0.158)		(0.071)	
log (empl. per access)	0.020		0.182	***	0.105	***	0.015		0.185	***	0.102	***	0.045		0.212	***	0.073	***
	(0.036)		(0.051)		(0.026)		(0.035)		(0.051)		(0.027)		(0.038)		(0.060)		(0.027)	
log (GDP p.c.) (-1)	-0.054		0.050		0.168	***	-0.061	*	0.046		0.152	***	-0.056		0.023		0.148	***
	(0.037)		(0.068)		(0.037)		(0.036)		(0.076)		(0.040)		(0.037)		(0.062)		(0.039)	
share urban population	0.054		-5.140	**	-0.264	***	0.055		-5.158	**	-0.229	***	0.048		-7.540	***	-0.144	*
	(0.052)		(2.531)		(0.081)		(0.051)		(2.555)		(0.084)		(0.052)		(2.825)		(0.083)	
Intercept	0.390	**			0.201		0.402	***			0.250	*	0.456	***			0.197	
	(0.094)				(0.123)		(0.091)				(0.134)		(0.107)				(0.129)	
country trends	Yes		yes		yes		Yes		yes		yes		Yes		Yes		yes	
obs.	225				225		225				225		220				220	
Wald Chi2(df)	88480.06 (22)				14077.82(6)		87404.60 (24)				13834.84 (8)		75824.52 (24)				14647.35 (8)	

Estimation Results

	RE Coeff. (std.d.)		LSDV-C Coeff. (std.d.)		DPD Coeff. (std.d.)		RE Coeff. (std.d.)		LSDV-C Coeff. (std.d.)		DPD Coeff. (std.d.)		RE Coeff. (std.d.)		LSDV-C Coeff. (std.d.)		DPD Coeff. (std.d.)	
log (inv. per access) (-1)	0.950	***	0.685	***	0.858	***	0.950	***	0.681	***	0.847	***	0.951	***	0.673	***	0.831	***
	(0.022)		(0.069)		(0.022)		(0.022)		(0.069)		(0.023)		(0.022)		(0.069)		(0.023)	
Directive							0.009		0.000		0.011	*	0.008		0.003		0.011	*
							(0.010)		(0.011)		(0.007)		(0.010)		(0.009)		(0.006)	
imple-Mentation							0.008		-0.003		0.012							
							(0.010)		(0.010)		(0.008)							
share comp. nat.													0.001		0.052	*	0.081	***
													(0.039)		(0.031)		(0.025)	
gov. part. (-1)	0.016		0.005		-0.030	**	0.020		0.005		-0.020		0.015		0.001		-0.031	**
	(0.015)		(0.021)		(0.013)		(0.015)		(0.021)		(0.014)		(0.016)		(0.021)		(0.013)	
share std. access (-1)	-0.054		0.077		-0.143	**	-0.027		0.063		-0.079		-0.081		0.160		0.011	
	(0.120)		(0.175)		(0.061)		(0.134)		(0.182)		(0.070)		(0.139)		(0.158)		(0.071)	
log (empl. per access)	0.020		0.182	***	0.105	***	0.015		0.185	***	0.102	***	0.045		0.212	***	0.073	***
	(0.036)		(0.051)		(0.026)		(0.035)		(0.051)		(0.027)		(0.038)		(0.060)		(0.027)	
log (GDP p.c.) (-1)	-0.054		0.050		0.168	***	-0.061	*	0.046		0.152	***	-0.056		0.023		0.148	***
	(0.037)		(0.068)		(0.037)		(0.036)		(0.076)		(0.040)		(0.037)		(0.062)		(0.039)	
share urban population	0.054		-5.140	**	-0.264	***	0.055		-5.158	**	-0.229	***	0.048		-7.540	***	-0.144	*
	(0.052)		(2.531)		(0.081)		(0.051)		(2.555)		(0.084)		(0.052)		(2.825)		(0.083)	
Intercept	0.390	**			0.201		0.402	***			0.250	*	0.456	***			0.197	
	(0.094)				(0.123)		(0.091)				(0.134)		(0.107)				(0.129)	
country trends	Yes		yes		yes		Yes		yes		yes		Yes		Yes		yes	
obs.	225				225		225				225		220				220	
Wald Chi2(df)	88480.06 (22)				14077.82(6)		87404.60 (24)				13834.84 (8)		75824.52 (24)				14647.35 (8)	

Estimation Results

	RE	LSDV-C	DPD	RE	LSDV-C	DPD	RE	LSDV-C	DPD
	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)
log (inv. per access) (-1)	0.950 *** (0.022)	0.685 *** (0.069)	0.858 ***	0.950 *** (0.022)	0.681 *** (0.069)	0.847 *** (0.023)	0.951 *** (0.022)	0.673 *** (0.069)	0.831 *** (0.023)
Directive				0.009 (0.010)	0.000 (0.011)	0.011 * (0.007)	0.008 (0.010)	0.003 (0.009)	0.011 * (0.006)
imple-Mentation				0.008 (0.010)	-0.003 (0.010)	0.012 (0.008)			
share comp. nat.							0.001 (0.039)	0.052 * (0.031)	0.081 *** (0.025)
gov. part. (-1)	0.016 (0.015)	0.005 (0.021)	-0.030 ** (0.013)	0.020 (0.015)	0.005 (0.021)	-0.020 (0.014)	0.015 (0.016)	0.001 (0.021)	-0.031 ** (0.013)
share std. access (-1)	-0.054 (0.120)	0.077 (0.175)	-0.143 ** (0.061)	-0.027 (0.134)	0.063 (0.182)	-0.079 (0.070)	-0.081 (0.139)	0.160 (0.158)	0.011 (0.071)
log (empl. per access)	0.020 (0.036)	0.182 *** (0.051)	0.105 *** (0.026)	0.015 (0.035)	0.185 *** (0.051)	0.102 *** (0.027)	0.045 (0.038)	0.212 *** (0.060)	0.073 *** (0.027)
log (GDP p.c.) (-1)	-0.054 (0.037)	0.050 (0.068)	0.168 *** (0.037)	-0.061 * (0.036)	0.046 (0.076)	0.152 *** (0.040)	-0.056 (0.037)	0.023 (0.062)	0.148 *** (0.039)
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country trends	Yes	yes	yes	Yes	yes	yes	Yes	Yes	yes
obs.	225		225	225		225	220		220
Wald Chi2(df)	88480.06 (22)		14077.82(6)	87404.60 (24)		13834.84 (8)	75824.52 (24)		14647.35 (8)

Estimation Results

	RE	LSDV-C	DPD	RE	LSDV-C	DPD	RE	LSDV-C	DPD
	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)	Coeff. (std.d.)
log (inv. per access) (-1)	0.950 *** (0.022)	0.685 *** (0.069)	0.858 ***	0.950 *** (0.022)	0.681 *** (0.069)	0.847 *** (0.023)	0.951 *** (0.022)	0.673 *** (0.069)	0.831 *** (0.023)
Directive				0.009 (0.010)	0.000 (0.011)	0.011 * (0.007)	0.008 (0.010)	0.003 (0.009)	0.011 * (0.006)
imple-Mentation				0.008 (0.010)	-0.003 (0.010)	0.012 (0.008)			
share comp. nat.							0.001 (0.039)	0.052 * (0.031)	0.081 *** (0.025)
gov. part. (-1)	0.016 (0.015)	0.005 (0.021)	-0.030 ** (0.013)	0.020 (0.015)	0.005 (0.021)	-0.020 (0.014)	0.015 (0.016)	0.001 (0.021)	-0.031 ** (0.013)
share std. access (-1)	-0.054 (0.120)	0.077 (0.175)	-0.143 ** (0.061)	-0.027 (0.134)	0.063 (0.182)	-0.079 (0.070)	-0.081 (0.139)	0.160 (0.158)	0.011 (0.071)
log (empl. per access)	0.020 (0.036)	0.182 *** (0.051)	0.105 *** (0.026)	0.015 (0.035)	0.185 *** (0.051)	0.102 *** (0.027)	0.045 (0.038)	0.212 *** (0.060)	0.073 *** (0.027)
log (GDP p.c.) (-1)	-0.054 (0.037)	0.050 (0.068)	0.168 *** (0.037)	-0.061 * (0.036)	0.046 (0.076)	0.152 *** (0.040)	-0.056 (0.037)	0.023 (0.062)	0.148 *** (0.039)
share urban population	0.054 (0.052)	-5.140 ** (2.531)	-0.264 *** (0.081)	0.055 (0.051)	-5.158 ** (2.555)	-0.229 *** (0.084)	0.048 (0.052)	-7.540 *** (2.825)	-0.144 * (0.083)
Intercept	0.390 ** (0.094)		0.201 (0.123)	0.402 *** (0.091)		0.250 * (0.134)	0.456 *** (0.107)		0.197 (0.129)
country trends	Yes	yes	yes	Yes	yes	yes	Yes	Yes	yes
obs.	225		225	225		225	220		220
Wald Chi2(df)	88480.06 (22)		14077.82(6)	87404.60 (24)		13834.84 (8)	75824.52 (24)		14647.35 (8)