

European Spatial and Temporal Dynamics

Past and a Scenario for the Future

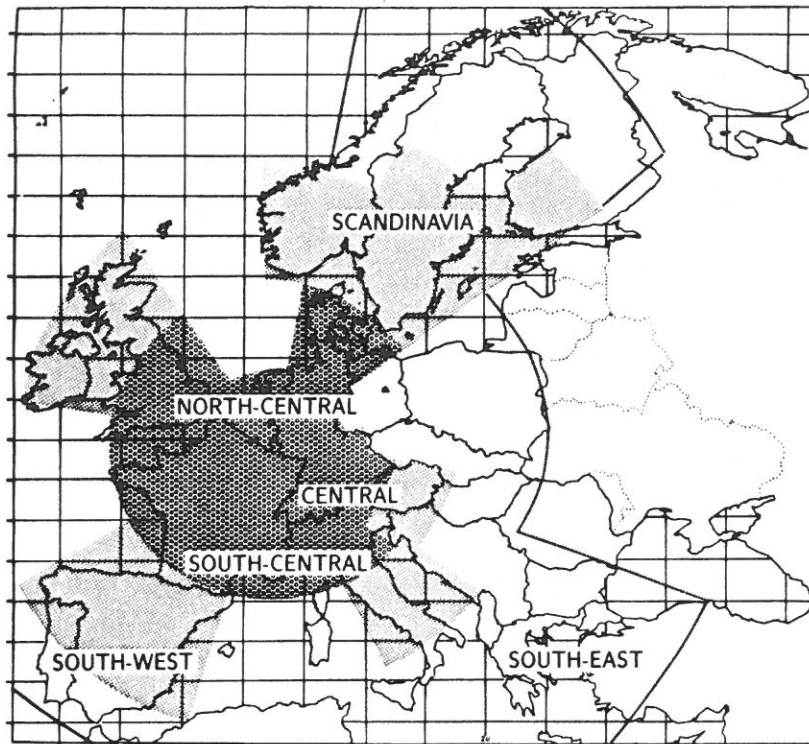
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1. Introduction

The objective of this short note is to quantify the dynamics of spatial and temporal development of energy, transport and communication in Europe. A number of indicators are used to describe the historical dynamics over the last 20 years (1965 to 1986). For energy indicators the earliest year for which consistent East-West energy balances are available (1970) has been used as starting point for the analysis. The data set includes the most important macro level data including population, GDP [in constant US \$ (1986)], primary and final energy consumption, passenger and freight transport, and automobile and telephone ownership. The rates of change are calculated on the basis of this data set and give the spatial and temporal patterns of absolute and per capita activity levels. In addition, the data are used to calculate intensity and efficiency indicators used in the analysis.

On the basis of the historical dynamics and the spatial heterogeneity within Europe, a scenario approach is used to describe possible future developments up to the year 2010. The scenario is consistent with the observed historical rates of change and follows the general philosophy of the "Two Speed Europe" Scenario. Both the historical description and the scenario focus only on the macro variables described above. The spatial resolution disaggregates Europe into five regions (see box). The scenario is intended to illustrate how the dynamics of change can be employed to identify possible future developments. This illustrative scenario does not give an exhaustive treatment of other important variables and it has not been tested for internal consistency (e.g. balance of trade, energy supply mix, or transport modal split).

A Geographical Taxonomy of Europe



Geographically Europe may be roughly divided into six zones based on geographical latitude: Scandinavia, North-central, Central, South-central, and finally South-western and South-eastern Europe. In addition to the geographical divisions based on latitude, we also distinguish between an European *core*, an European *rim* and finally the *periphery*.

The European *core* is characterised by highest levels of economic activity, mobility and intensiveness of economic and social interaction and integration. This intensity of activities and interactions thins out towards the European rim and especially towards the periphery. Due to its lack of integration Eastern Europe or the western part of the USSR could up to date even not be considered as part of the European periphery, showing instead a level of integration characteristic for distant continents like Africa or Latin America.

Different degrees of interconnectedness define whether a particular country belongs to the European core, rim or periphery. Thus no rigid delineation of the borders of regions following above spatial taxonomy is possible. Instead it depends on the particular indicator of economic, social or cultural integration considered. However, unless otherwise specified the following country breakdown is used defining zones of decreasing interaction from the European core out to its periphery:

<i>Core</i>	Belgium, Denmark, FRG, France, Italy, Luxembourg, Netherlands, Switzerland, United Kingdom.
<i>Rim</i>	Austria, Ireland, Finland, Norway, Spain, Sweden.
<i>Periphery</i>	Greece, Portugal, Turkey, Yugoslavia.
<i>Eastern EU</i>	Albania, Bulgaria, Czechoslovakia, GDR, Hungary, Poland, Romania.
<i>USSR</i>	Union of Soviet Socialist Republics

2. Historical Development

Table 1.A Absolute Values, 1965 (1970) to 1986, Population, GDP, Primary and Final Energy Consumption.

	Population (10 ⁶)		GDP (10 ⁹ US \$ '86)		Primary (Mtoe)		Final (Mtoe)	
	1965	1986	1965	1986	1970	1986	1970	1986
Core	247	267	1725	3183	843	981	586	711
Rim	58	67	292	592	149	225	108	150
Periph.	68	94	68	177	58	123	42	82
W.Europe	373	428	2085	3951	1050	1328	736	943
E.Europe	100	114	129	250	291	436	197	277
USSR	231	281	302	696	783	1322	442	650
Europe	706	823	2517	4897	2124	3086	1374	1870

Table 1.B Absolute Values, 1965 to 1986, Passenger- and Ton-Kilometres, Cars and Telephones.

	Pass-km (10 ⁹)		Ton-km (10 ⁹)		Cars (10 ⁶)		Telephones (10 ⁶)	
	1965	1986	1965	1986	1965	1986	1965	1986
Core	1251	2698	509	784	38	104	45	154
Rim	205	471	113	262	5	20	11	33
Periph.	83	327	51	142	1	7	2	14
W.Europe	1538	3495	672	1188	43	131	58	200
E.Europe	256	639	343	527	2	15	7	18
USSR	407	1016	2227	4585	2	14	10	31
Europe	2201	5150	3243	6299	46	161	74	249

(See box on page 2 for definition of regions.)

Table 1 illustrates the development of population, GDP, primary and final energy, passenger- and ton-kilometres and number of cars and telephones for the five European regions. During the last twenty years the development has been rather rapid in all regions. For example, European GDP almost doubled, primary energy increased by one half, transport activities doubled and number of cars and telephones more than tripled. In comparison, the population growth has been rather modest, increasing throughout Europe by less than 20 percent, with the exception of the Periphery countries where population increased nearly twice as much. This means that economic activities and affluence per head of the population have increased significantly throughout Europe.

Table 2.A Per Capita (per GDP) Values, 1965 (1970) to 1986, GDP, Primary and Final Energy Consumption.

	GDP (10 ³ US \$ '86)		Primary (toe)		Final (toe)		Final/GDP (toe/10 ³ US \$ '86)	
	1965	1986	1970	1986	1970	1986	1970	1986
Core	7.0	11.9	3.3	3.7	2.3	2.7	0.3	0.2
Rim	5.0	8.8	2.5	3.4	1.8	2.2	0.3	0.3
Periph.	1.0	1.9	0.8	1.3	0.6	0.9	0.4	0.5
W.Europe	5.6	9.2	2.7	3.1	1.9	2.2	0.3	0.2
E.Europe	1.3	2.2	2.8	3.8	1.9	2.4	1.2	1.1
USSR	1.3	2.5	3.2	4.7	1.8	2.3	1.5	0.9
Europe	3.6	6.0	2.9	3.8	1.9	2.3	0.4	0.4

Table 2.B Per Capita (per GDP) Values, 1965 to 1986, Passenger- and Ton-Kilometres, Cars and Telephones.

	Pass-km (10 ³)		Ton-km (10 ³)		Cars (per 1000)		Telephones (per 100)	
	1965	1986	1965	1986	1965	1986	1965	1986
Core	5.1	10.1	2.1	2.9	152	390	18	58
Rim	3.5	7.0	1.9	3.9	79	303	18	48
Periph.	1.2	3.5	0.7	1.5	10	72	3	15
W.Europe	4.1	8.2	1.8	2.8	115	307	15	47
E.Europe	2.5	5.6	3.4	4.8	19	136	6	16
USSR	1.8	3.6	9.6	16.3	7	49	4	11
Europe	3.1	6.3	4.6	7.7	66	195	11	30

(See box on page 2 for definition of regions.)

Table 2 gives gives per capita activity levels and final energy to GDP intensity for the last twenty years illustrating the persistent heterogeneity among the European regions. In terms of development it is more important to observe per capita activity levels rather than national or regional absolute values. For instance, both the European Rim and the USSR have about the same aggregate GDP [600 10⁹ US \$ (1986) compared to 700, respectively]]. However, their per capita GDP differs by more than a factor of three. The numerical value of this gap may not be accurate due to the difficulties of converting Net Material Product in Roubles into GDP in constant Dollars. Depending on the methodology and underlying assumptions employed, higher per capita GDP values for Soviet Union and Eastern Europe can be found in the literature than given in this study.

In general, Table 2 indicates persistent gaps between the European regions: both in the North–South and in the West–East dimension. On average the European Core and Rim have higher per capita economic activity (GDP) and affluence as expressed by passenger travel, car and telephone ownership. At the same time their economies are more material and energy efficient as illustrated by the final energy and goods transport intensities. Energy and goods transport efficiencies are lowest in Eastern Europe and the Soviet Union. At the same time this could mean that the efficiency improvement potentials in these areas are tremendous. Some of them are exploited in the Two-Speed Europe Scenario developed below.

Table 3 gives the absolute and per capita (per GDP) growth rates resulting from Tables 1 and 2. In general the relatively low per capita activity levels of the East and the Periphery are associated with higher growth rates. This means that these regions are catching up with the European Core and Rim in relative terms. On the whole it should be noted that population has the lowest growth rates followed by primary and final energy. GDP growth rates are generally higher, pointing to the fact that the elasticity of energy to GDP growth was smaller than one over the 1970 to 1986 period. In fact, this is illustrated by the negative growth rates in the final energy to GDP ratio in all regions, except in the still industrializing Periphery. Absolutely the highest growth rates can be observed for automobiles and telephones followed by passenger travel in all regions. These growth rates are consistently higher in the Periphery and the East compared to the Core and Rim. Thus, consumer goods and services have faster growth throughout Europe than the overall economic activity.

The higher growth rates prevailing towards the European Periphery and Eastern Europe mean that these regions have to some degree been successfully catching-up to the European Core. Still the dominance of Western Europe is pervasive as shown in Table 4. Fifty percent of the European population generate 80 percent of the GDP, own 80 percent of the cars and telephones and account for 70 percent of all passenger-kilometres in Europe. This they achieve by consuming only about 40 percent of the primary energy and transporting less than 20 percent of all European ton-kilometres.

The difference between the European Core and the other regions has gradually been converging in per capita terms (Table 5). The most successful catching-up over the last 20 years has been achieved by the European Rim countries (Austria, Ireland, Spain and Scandinavia). Typical per capita values in this region have come close to those of the

Table 3.A Absolute (1), per Capita (2) and per GDP (3) Growth Rates, 1965 to 1986, Population, GDP, Primary and Final Energy Consumption.

	Population		GDP		Primary		Final		
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(3)
Core	0.4	3.0	2.6	1.0	0.7	1.2	0.9	-1.3	
Rim	0.7	3.4	2.7	2.6	2.0	2.1	1.4	-0.9	
Periphery	1.5	4.7	3.1	4.8	3.4	4.3	2.8	0.3	
W.Europe	0.7	3.1	2.4	1.5	0.9	1.6	1.0	-1.0	
E.Europe	0.6	3.2	2.6	2.5	2.0	2.2	1.7	-0.6	
USSR	0.9	4.1	3.1	3.3	2.4	2.5	1.5	-2.8	
Europe	0.7	3.2	2.5	2.4	1.4	1.9	1.3	-0.9	

For energy indicators growth rates refer to period 1970-1986.

Table 3.B Absolute (1) and per Capita (2) Growth Rates, 1965 to 1986, Passenger- and Ton-Kilometres, Cars, and Telephones.

	Pass-km		Ton-km		Cars		Telephones	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Core	3.7	3.3	2.1	1.7	5.0	4.6	6.0	5.6
Rim	4.1	3.3	4.1	3.4	7.4	6.6	5.5	4.8
Periphery	6.8	5.2	5.0	3.5	11.7	9.9	9.1	7.5
W.Europe	4.0	3.3	2.8	2.1	5.5	4.8	6.1	5.4
E.Europe	4.4	3.9	2.1	1.6	10.4	9.9	4.9	4.3
USSR	4.5	3.5	3.5	2.5	10.8	9.8	5.7	4.7
Europe	4.1	3.4	3.2	2.5	6.1	5.3	5.9	5.2

(See box on page 2 for definition of regions.)

European Core (within 10 to 20 percent). The European Periphery and Eastern Europe have been catching-up with the European Core too, albeit with per capita economic activity and consumption levels still significantly below the European Core. This does not however apply to the material and energy intensiveness and efficiency of these regions compared to the European Core. This is most vividly exemplified by the example of the Soviet Union, where energy efficiency and transport intensities are a factor 4 to 5 more unfavorable than the average for the European Core countries.

The catching-up with the European Core, as illustrated in the higher absolute and per capita growth rates in the European Rim, Periphery and in Eastern Europe, have thus reduced the absolute and per capita differences *relative to each other*. The real dilemma of catching-

Table 4.A Share of European Regional Aggregates in European Total (Percent), 1965 (1970) to 1986, Population, GDP, Primary and Final Energy Consumption.

	Population		GDP		Primary		Final	
	1965	1986	1965	1986	1970	1986	1970	1986
Core	35.0	32.4	68.5	65.0	39.7	31.8	42.6	38.0
Rim	8.2	8.2	11.6	12.1	7.0	7.3	7.9	8.0
Periphery	9.7	11.4	2.7	3.6	2.7	4.0	3.1	4.4
W.Europe	52.9	52.0	82.9	80.7	49.4	43.0	53.5	50.4
E.Europe	14.2	13.8	5.1	5.1	13.7	14.1	14.3	14.8
USSR	32.7	34.2	12.0	14.2	36.9	42.9	32.2	34.8
Europe	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4.B Share of European Regional Aggregates in European Total (Percent), 1965 to 1986, Passenger- and Ton-Kilometres, Cars, and Telephones.

	Pass-km		Ton-km		Cars		Telephones	
	1965	1986	1965	1986	1965	1986	1965	1986
Core	56.8	52.4	15.7	12.5	81.2	64.9	60.9	61.8
Rim	9.3	9.1	3.5	4.2	9.9	12.7	14.2	13.0
Periphery	3.8	6.3	1.6	2.3	1.4	4.2	3.0	5.5
W.Europe	69.9	67.9	20.7	18.9	92.5	81.9	78.0	80.3
E.Europe	11.7	12.4	10.6	8.4	4.1	9.6	8.8	7.1
USSR	18.5	19.7	68.7	72.8	3.5	8.7	13.1	12.5
Europe	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(See box on page 2 for definition of regions.)

up is that *absolute per capita differences* (Table 6) have not been reduced, but have grown rather despite the higher growth rates in the lagging regions. The only exception is per capita and per GDP energy consumption, where the per capita gap has declined in absolute terms. In contrast, the absolute per capita gap for all other indicators has increased compared to the European Core. The most extreme example is the automobile ownership levels between the Core and the USSR. Per capita car ownership lagged by 145 cars per 1000 population in 1965, a gap which has widened to 340 by 1986.

This illustrates that while higher growth rates towards the Periphery and Eastern Europe may reduce disparities between the regions in *relative terms*, the historical evidence suggests that *absolute per capita differences* are persistent and even widening with increasing

Table 5.A Per Capita (per GDP) Values of European Regional Aggregates (as Percent of Core Values in 1986), 1965 (1970) to 1986, GDP, Primary and Final Energy Consumption.

	GDP		Primary		Final		Final/GDP	
	1965	1986	1970	1986	1970	1986	1970	1986
Core	58.6	100.0	90.2	100.0	86.5	100.0	122.7	100.0
Rim	42.1	73.8	67.0	91.3	66.9	83.8	131.8	113.6
Periphery	8.4	15.8	21.0	35.7	21.0	32.7	200.0	209.1
W.Europe	-	-	-	-	-	-	-	-
E.Europe	10.9	18.4	75.5	104.1	70.3	91.4	559.1	504.6
USSR	11.0	20.7	88.3	128.1	68.8	86.8	663.6	422.7
Europe	-	-	-	-	-	-	-	-

Table 5.B Per Capita Values of European Regional Aggregates (as Percent of Core Values in 1986), 1965 to 1986, Passenger- and Ton-Kilometres, Cars, and Telephones.

	Pass-km		Ton-km		Cars		Telephones	
	1965	1986	1965	1986	1965	1986	1965	1986
Core	50.1	100.0	70.1	100.0	39.0	100.0	31.7	100.0
Rim	34.8	69.3	66.0	132.3	20.2	77.7	31.3	84.2
Periphery	12.0	34.4	25.2	51.4	2.6	18.5	5.6	25.4
W.Europe	-	-	-	-	-	-	-	-
E.Europe	24.9	55.5	116.7	161.6	4.8	34.7	11.1	27.1
USSR	17.4	35.8	327.9	554.8	1.8	12.7	7.3	19.3
Europe	-	-	-	-	-	-	-	-

(See box on page 2 for definition of regions.)

affluence levels. Table 6 also illustrates that future scenarios have to take into account this "path dependency" between the development paths of the European regions by considering mainly the (different) dynamics (growth rates) between regions. Normative kind of scenario approaches, for instance considering a progressive homogenization of per capita resource consumption and economic activity levels (e.g. Eastern Europe achieving in the future a similar automobile ownership rate than prevailing in the European Core) appear highly misleading in view of historical experience. An approach considering explicitly path dependency and differential growth rates is illustrated in the Two-Speed Europe Scenario sketched out below.

Table 6.A Per Capita (per GDP) Values of European Regional Aggregates [as Absolute Difference to Core Values (in Parenthesis)], 1965 (1970) to 1986, GDP, Primary and Final Energy Consumption.

	GDP (10 ³ US \$ '86)		Primary (toe)		Final (toe)		Final/GDP (toe/10 ³ US \$ '86)	
	1965	1986	1970	1986	1970	1986	1970	1986
Core	(7.0)	(11.9)	(3.3)	(3.7)	(2.3)	(2.7)	(0.3)	(0.2)
Rim	-2.0	-3.1	-0.8	-0.3	-0.5	-0.4	0.0	0.0
Periphery	-6.0	-10.0	-2.5	-2.4	-1.7	-1.8	+0.2	+0.2
W.Europe	-	-	-	-	-	-	-	-
E.Europe	-5.7	-9.7	-0.5	+0.2	-0.4	-0.2	+1.0	+0.9
USSR	-5.7	-9.4	-0.1	+0.1	-0.5	-0.4	+1.2	+0.7
Europe	-	-	-	-	-	-	-	-

e.g. 1965 Rim per capita GDP [(10³ US \$ 1986)]: 5.0, Core: 7.0; Difference: -2.0 10³ \$ per capita.

Table 6.B Per Capita Values of European Regional Aggregates (as Absolute Difference to Core Values [in Parenthesis]), 1965 to 1986, Passenger- and Ton-Kilometres, Cars, and Telephones.

	Pass-km (10 ³)		Ton-km (10 ³)		Cars (per 1000)		Telephones (per 100)	
	1965	1986	1965	1986	1965	1986	1965	1986
Core	(5.1)	(10.1)	(2.1)	(2.9)	(152.4)	(390.3)	(18.2)	(57.2)
Rim	-1.5	-3.1	-1.3	+1.0	-73.4	-86.9	-0.2	-9.1
Periphery	-3.9	-6.6	-1.3	-1.4	-142.4	-318.1	-15.0	-42.9
W.Europe	-	-	-	-	-	-	-	-
E.Europe	-2.5	-4.5	+1.4	+1.8	-133.6	-254.8	-11.8	-41.9
USSR	-3.3	-6.5	+7.6	+13.6	-145.5	-340.9	-14.0	-46.4
Europe	-	-	-	-	-	-	-	-

(See box on page 2 for definition of regions.)

Up to now we have only discussed the historical development in Europe at a high level of abstraction and regional aggregation. However as important and interesting the regional mean-values and their changes over time might be, it is also necessary to keep track of the heterogeneity and differences within and between the countries aggregated into particular regions in the present study. Thus, the variance may be as important as the mean. This is illustrated in Table 7, where the range (factor difference between the highest and lowest per capita

levels) between the extremes of countries within the five regions and within the whole of Europe is illustrated.

Table 7.A Range (Factor Difference Between Countries with Highest and Lowest *per Capita* or *per GDP* Values) Within and Between European Regional Aggregates, 1965 (1970) to 1986, GDP, Primary and Final Energy Consumption.

	GDP		Primary		Final		Final/GDP	
	1965	1986	1970	1986	1970	1986	1970	1986
Core	2.8	2.5	2.0	1.8	2.1	1.9	3.0	2.2
Rim	2.4	2.8	4.4	3.4	4.6	3.3	2.0	1.6
Periphery	2.9	3.4	1.9	2.2	1.5	1.9	2.2	1.8
W.Europe	25.5	19.8	9.8	7.4	8.5	6.3	5.0	4.6
E.Europe	5.1	5.8	5.4	4.1	4.4	4.4	1.7	1.7
USSR	-	-	-	-	-	-	-	-
Europe	25.5	19.8	9.8	7.4	8.5	6.3	11.8	10.3
countries:	CH	CH	S	S	S	NOR	RO	Al
	TR	TR	TR	TR	TR	TR	CH	CH

e.g. 1965 per capita GDP [(10³ US \$ 1986)] Switzerland: 15.08, Turkey: 0.59; Factor Difference (15.08/0.59): 25.5.

Table 7.B Range (Factor Difference Between Countries with Highest and Lowest *per Capita* Values) Within and Between European Regional Aggregates, 1965 to 1986, Passenger- and Ton-Kilometres, Cars, and Telephones.

	Pass-km		Ton-km		Cars		Telephones	
	1965	1986	1965	1986	1965	1986	1965	1986
Core	2.7	1.7	2.1	1.9	1.8	1.5	3.2	1.9
Rim	4.4	2.4	3.6	4.5	9.2	2.0	5.5	3.3
Periphery	2.3	4.0	5.2	2.3	11.1	5.1	5.6	4.7
W.Europe	10.6	7.2	14.0	5.4	82.5	18.5	35.5	10.6
E.Europe	3.5	5.0	5.2	2.7	14.6	13.0	9.8	14.3
USSR	-	-	-	-	-	-	-	-
Europe	10.6	9.4	33.5	14.7	86.8	27.8	45.4	53.0
countries:	DK	CH	BUL	USSR	S	D	S	S
	TR	Al	Port	TR	Al	Al	Al	Al

(See box on page 2 for definition of regions.)

Table 7 shows that while there may be a slow convergence tendency within Europe, the convergence is more pronounced between the countries *within* a particular region than between the countries at a European scale. Thus, while the disparities between the leading and the lagging countries in the Core and Rim have been reduced, the difference between the countries at a European scale remains persistent with very slow disparity reductions. The largest reduction in the differences between per capita extremes in Europe are to be observed for car ownership rates and transported ton-kilometres, whereas the reduction in the factor difference between per capita GDP and energy consumption levels (by about 30 percent) has been much smaller. Finally, the disparities in telephone ownership rates between countries in Europe have even widened over the last 20 years, illustrating in particular the increasing communication gap of Eastern Europe compared to the European Core.

It should be noted that the North-South differentials within Western Europe proper (e.g., between Switzerland and Sweden on one extreme and Turkey and the other) are in most cases as important (if not more important) than the differences between countries in an East-West context. Also the relative positioning between the top and last ranking countries has proven remarkable stable over the last 20 years. Switzerland and Sweden showing the highest levels of per capita economic activity, affluence and energy and material efficiency and Albania and Turkey being on the other extreme with per capita consumption levels between 2 to 10 percent (factor differences ranging between 10 to 50) of the most affluent European countries.

3. Scenario of Future Development

This illustrative scenario describes a future where the Periphery and the East do achieve higher development rates than the European Core and Rim. This is consistent with the observed spatial and temporal dynamics described above. Lower levels of absolute and per capita development go along with higher growth rates and lead to a certain degree of catch-up with the Core. Furthermore, the scenario includes substantial efficiency improvements in the lagging regions especially in the East and the USSR. Efficiency improvements in these regions are stimulated in part with technological and financial assistance from the environment-conscious European core. It is assumed that the efficiency improvements would result in only marginal increases in energy and goods transport in Eastern Europe. Efficiency improves further in the leading regions (Core and Rim) as well. Altogether, the Two-Speed

Europe scenario results in the narrowing of the relative gap between the leading and lagging regions, but unfortunately the absolute difference continues to grow.

Table 8.A Absolute (1), per Capita (2) and per GDP (3) Growth Rates, 1986 to 2010, Two-Speed Europe Scenario, Population, GDP, Primary and Final Energy Consumption.

	Population		GDP		Primary		Final		
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(3)
Core	0.0	2.2	2.2	0.1	0.1	0.3	0.2	-1.8	
Rim	0.3	2.8	2.5	1.4	2.6	1.8	1.5	-1.0	
Periph.	1.1	5.3	4.0	4.3	3.1	4.7	3.5	-0.6	
W.Europe	0.3	2.5	2.2	0.9	0.6	1.1	0.8	-1.4	
E.Europe	0.4	3.9	3.5	0.9	0.5	1.3	0.9	-2.5	
USSR	0.6	3.6	3.0	0.4	-0.2	1.7	1.1	-1.8	
Europe	0.5	2.8	2.3	0.7	0.3	1.4	0.9	-1.3	

Table 8.B Absolute (1) and per Capita (2) Growth Rates, 1986 to 2010, Two-Speed Europe Scenario, Passenger- and Ton-Kilometres, Cars and Telephones.

	Pass-km		Ton-km		Cars		Telephones	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Core	2.5	2.5	0.7	0.6	0.6	0.6	2.2	2.1
Rim	3.3	3.0	1.8	1.5	1.0	0.8	2.4	2.1
Periph.	5.2	4.0	4.8	3.6	5.0	3.8	7.3	6.1
W.Europe	3.0	2.6	1.6	1.3	1.0	0.7	2.8	2.4
E.Europe	2.8	2.4	0.7	0.2	2.8	2.5	6.5	6.1
USSR	3.1	2.5	-0.0	-0.6	4.5	3.9	7.8	7.1
Europe	2.9	2.5	0.4	-0.1	1.7	1.2	4.1	3.6

(See box on page 4 for definition of regions.)

Table 8 shows the assumed growth rates of the pertinent variables. With the exception of the Periphery, the population growth in Europe stabilizes at annual increases on the order of only a few tenths of a percent. Most of the achieved growth in value added, mobility and consumption is, therefore, directly translated into improvement of per capita activity levels. Population growth is just above one percent in the Periphery clipping a bit off the rather impressive absolute growth rates in other variables. Nevertheless, the per capita GDP growth rate is

still the highest in the Periphery closely followed by Eastern Europe. The lowest per capita growth rate is achieved in the Core. Thus, the relative gap in the level of economic development narrows during the next two decades.

Per capita primary energy growth rate is on the average two percentage points lower than the per capita GDP growth. This indicates a high degree of decoupling between economic development and energy requirements in all regions, with the exception of the Rim where per capita primary energy grows a bit faster than the per capita GDP. In per capita terms primary energy needs actually fall in the Soviet Union (-0.2 percent per year). This is due to rather lavish current levels of primary energy consumption that are due to both relatively low efficiency of the energy system itself and low efficiency of final energy (fuels and heat) utilization. The scenario assumes substantial improvements of the energy sector in both Eastern Europe and the USSR. Thus, overall the final energy growth rates are higher than those for primary energy due to pervasive nature of efficiency improvement in the scenario. However, the energy-economy link continues to weaken as well. The final energy to GDP ratio continues to decrease in all regions as reflected in negative growth rates shown in Table 8. The highest rate of decoupling is achieved in Eastern Europe followed by the USSR and the already very efficient Core. The lowest rate is in the Periphery largely due to currently low energy availability (especially when compared with Eastern Europe and the Soviet Union).

With the exception of Eastern Europe and the USSR, the mobility increases faster in per capita terms than economic growth (GDP), while the freight transport increases at the lower rate everywhere. Thus, mobility grows and transport of goods decreases leading to a higher overall economic efficiency. The growth of mobility and communication is reflected in the rapid increase of telephone and automobile ownership.

The higher rates of growth in the lagging regions lead to a certain degree of catch-up with the leading regions, but in terms of the achieved per capita activity levels the actual gap increases (Table 9). For example, the ratio of per capita GDP between the Periphery and the Core narrows from 16 to 25 percent between 1986 and 2010, but the absolute difference grows from 10 to 15 thousand US \$ (1986). In fact, the per capita GDP increases by a factor of 2.6 in the Periphery and by more than a factor of two in Eastern Europe and the USSR, but the lead of the Core and Rim is too great for the lagging regions to be closed in mere two decades. At the growth rates given in the scenario,

Table 9.A Per Capita (per GDP) Values, 1986 to 2010, Two-Speed Europe Scenario, GDP, Primary and Final Energy Consumption.

	GDP (10 ³ US \$ '86)		Primary (toe)		Final (toe)		Final/GDP (toe/10 ³ US \$ '86)	
	1986	2010	1986	2010	1986	2010	1986	2010
Core	11.9	20.0	3.7	3.7	2.7	2.8	0.2	0.1
Rim	8.8	16.0	3.4	4.4	2.2	3.2	0.3	0.2
Periph.	1.9	5.0	1.3	2.7	0.9	2.0	0.5	0.4
W.Europe	9.2	15.4	3.1	3.6	2.2	2.7	0.2	0.2
E.Europe	2.2	5.0	3.8	4.3	2.4	3.0	1.1	0.6
USSR	2.5	5.0	4.7	4.5	2.3	3.0	0.9	0.6
Europe	6.0	10.3	3.8	4.0	2.3	2.8	0.4	0.3

Table 9.B Per Capita (per GDP) Values, 1986 to 2010, Two-Speed Europe Scenario, Passenger- and Ton-Kilometres, Cars and Telephones.

	Pass-km (10 ³)		Ton-km (10 ³)		Cars (per 1000)		Telephones (per 100)	
	1986	2010	1986	2010	1986	2010	1986	2010
Core	10.1	18.3	2.9	3.4	390	447	58	95
Rim	7.0	14.2	3.9	5.6	303	363	48	80
Periph.	3.5	8.9	1.5	3.5	72	178	15	60
W.Europe	8.2	15.2	2.8	3.8	307	362	47	83
E.Europe	5.6	10.0	4.8	5.0	136	242	16	65
USSR	3.6	6.5	16.3	14.0	49	122	11	58
Europe	6.3	11.4	7.7	7.6	195	260	30	71

(See box on page 2 for definition of regions.)

it would take the other regions more than hundred years to achieve the same GDP per capita as the Core would have toward the end of the next century (Rim 100 years, Periphery 102 years, Eastern Europe 130 years and the USSR 195 years). This clearly illustrates the emerging dichotomy of Europe with four times higher per capita GDP levels in the leading compared with the lagging regions.

Energy development is less heterogeneous with the actual gap slowly closing between the regions. The range between the highest (the USSR) and lowest (Periphery) per capita primary energy requirements closes from 3.6 to 1.7 and it is even lower for final energy in 2010 at 1.5. Nevertheless, despite a trend toward homologization of energy use, the Core remains the most energy-efficient region. In terms of the final

energy to GDP ratio, it is six times as efficient as Eastern Europe and the USSR in 2010. Here again, the gap opens despite large improvements in the lagging regions. The overall efficiency improvements throughout the economy also lead to more homogeneous per capita goods transport requirements of between 3.4 and 5.6 thousand ton-kilometres. A large exception is the Soviet Union with 14 thousand ton-kilometres (2.5 times higher than the next highest requirements in the Rim and still higher than in present day US). The differences in mobility (in terms of per capita passenger-kilometres) follow very closely the per capita GDP levels with the exception of Eastern Europe with a much higher mobility to GDP ratio than any other region. The relative gap in automobile and telephone ownership also narrows to about a factor of two by the year 2010 albeit resulting in large absolute per capita differences. For example, in the Core almost every individual would have a telephone and almost every second one an automobile whereas in the Soviet Union only every second one would own a telephone and every 10th individual would have a car. Even by 2010 no other region would exceed the automobile ownership levels that persisted in the Core in 1986. Thus, the scenario describes the diffusion of automobiles as the least pervasive development in future Europe, due to the development of new alternatives assumed in the scenario. In all other variables at least one other region (usually the Rim) exceeds by 2010 the levels prevailing in the Core in 1986.

Table 10 shows that the sheer size of the Soviet Union over-weighs in the long-run in terms of absolute regional activity levels compared with the other European regions. By 2010 it dominates half of the activity variables in absolute terms: It has the largest population, primary and final energy consumption, and the largest absolute levels of goods transport. The Core leads in terms of the other four variables by 2010: It has the highest GDP and mobility and most automobiles and telephones. Thus, in terms of economic power, population and other salient characteristics, the Two-Speed Europe scenario results in a bipolar structure – the richest and the poorest are the two strongest regions by the year 2010.

Table 10.A Absolute Values, 1986 to 2010, Two-Speed Europe Scenario, Population, GDP, Primary and Final Energy Consumption.

	Population (10 ⁶)		GDP (10 ⁹ US \$ '86)		Primary (Mtoe)		Final (Mtoe)	
	1986	2010	1986	2010	1986	2010	1986	2010
Core	267	270	3183	5389	981	1006	711	755
Rim	67	72	592	1143	225	313	150	229
Periph.	94	124	177	618	123	338	82	247
W.Europe	428	464	3951	7150	1328	1658	943	1230
E.Europe	114	125	250	624	436	535	277	374
USSR	281	326	696	1632	1322	1462	650	979
Europe	823	916	4897	9406	3086	3654	1870	2584

Table 10.B Absolute Values, 1986 to 2010, Two-Speed Europe Scenario, Passenger- and Ton-Kilometres, Cars and Telephones.

	Pass-km (10 ⁹)		Ton-km (10 ⁹)		Cars (10 ⁶)		Telephones (10 ⁶)	
	1986	2010	1986	2010	1986	2010	1986	2010
Core	2698	4927	784	916	104	120	154	256
Rim	471	1017	262	400	20	26	33	57
Periph.	327	1102	142	432	7	22	14	74
W.Europe	3495	7046	1188	1749	131	168	200	387
E.Europe	639	1244	527	624	15	30	18	81
USSR	1016	2135	4585	4570	14	40	31	189
Europe	5150	10425	6299	6942	161	238	249	658

(See box on page 2 for definition of regions.)