Evolution of "development lag" and "development ratio"

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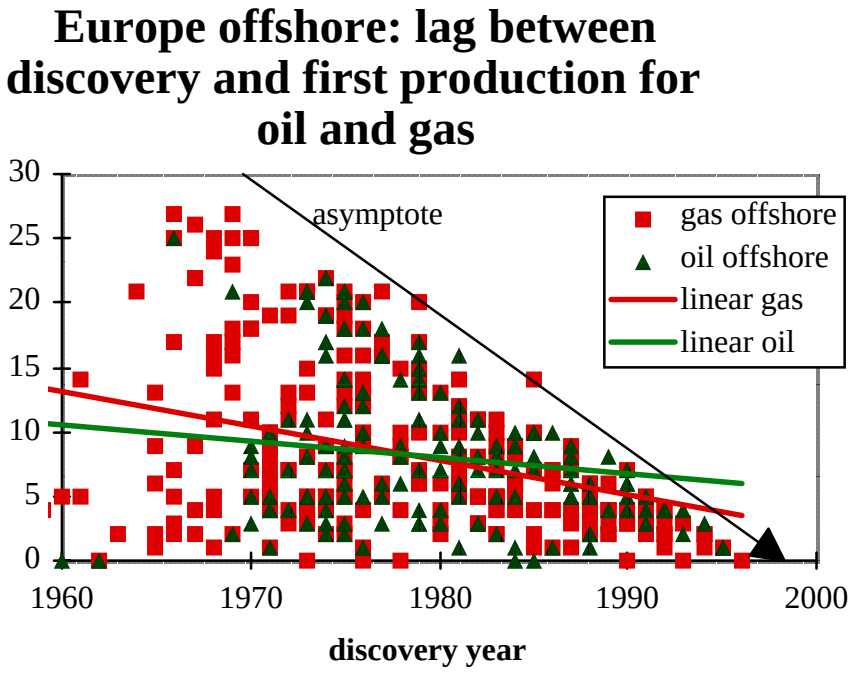
published in World Oil February 1998 p117-120 as **"Development ratio evolves as true measures of exploitation**"

-1-"Development gap" versus time:

As many offshore marginal fields are now put into production as available capacity nearby becomes available, it appears that "development lag" (years from discovery to first production) is decreasing. But, as development moves to difficult areas as West Shetlands, and, as the Foinaven development is two years behind schedule, it could be the other way. In order to check the evolution of development against time, we have plotted, by continent from the Petroconsultants database (18 000 fields), the "development lag" broken down between onshore (including the onshore/offshore) and offshore, between oil and gas. We will discuss only the graphs for Europe.

-figure 1:



The lag between discovery year and first production year versus discovery year is plotted on figure 1. The plot is limited vertically by the asymptote at 45° up to 1997, as the lag cannot be higher than the

difference from discovery date to present. Both linear trendlines for oil and gas are decreasing, but their interpretation is difficult, should they be compared to the middle of the domain; i.e; the bissectrice at 22.5°? As the average lag for now is about 7 years, a large number of recent (before 7 years) discovered fields are in the process of appraisal and the decision to develop is still to come.

The plot of figure 2 for onshore is for a longer period and the trendlines are less influenced by the asymptote and are more horizontal. The average onshore trend for now is about nil for oil and 2 years for gas.

-figure 2:

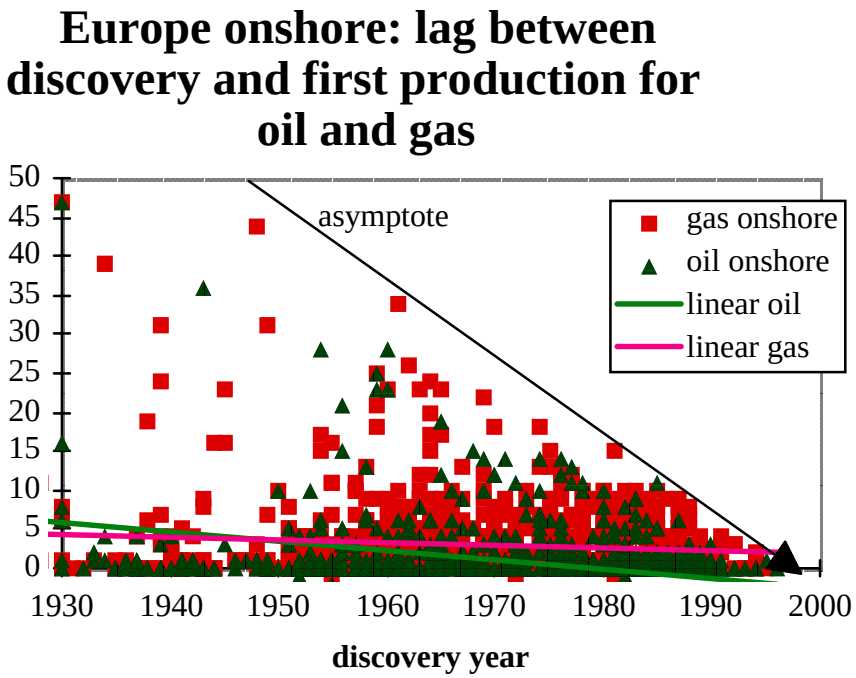
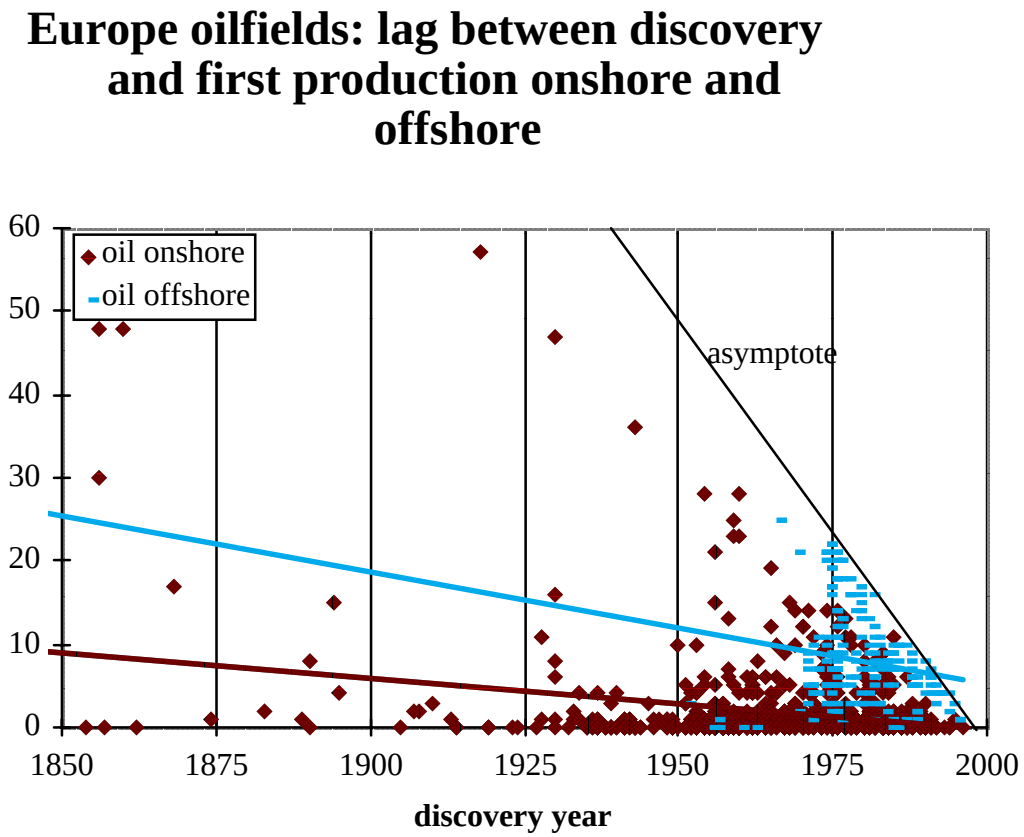


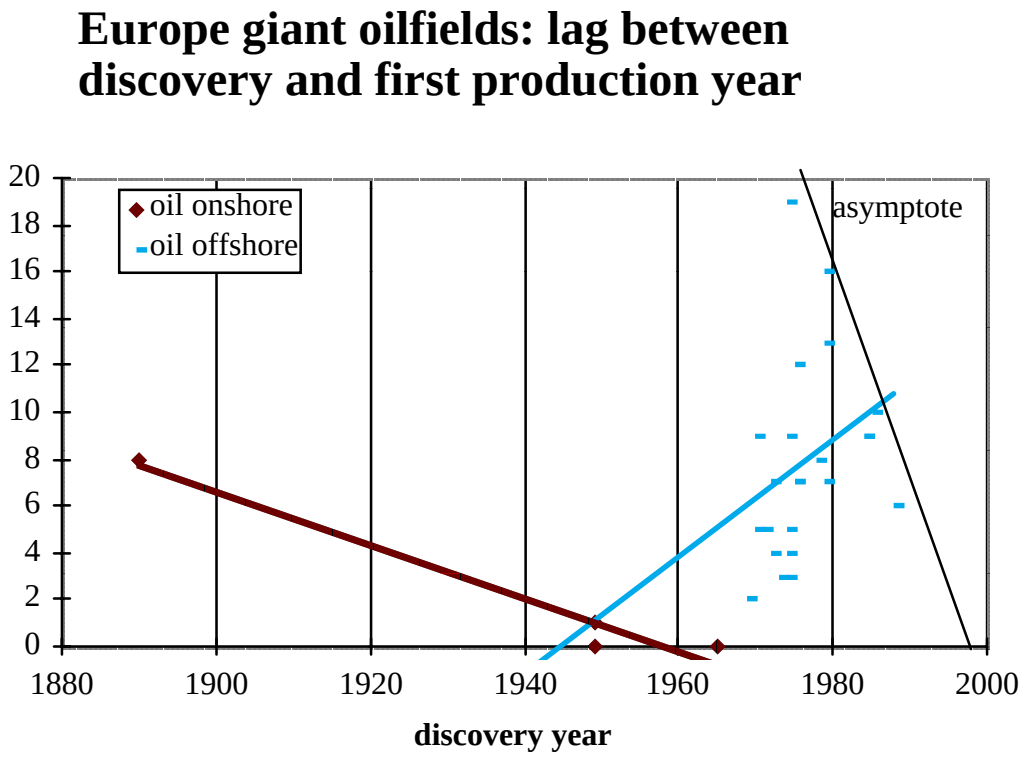
Figure 3 combines onshore and offshore for oilfields, comparing the trendlines.

-figure 3:



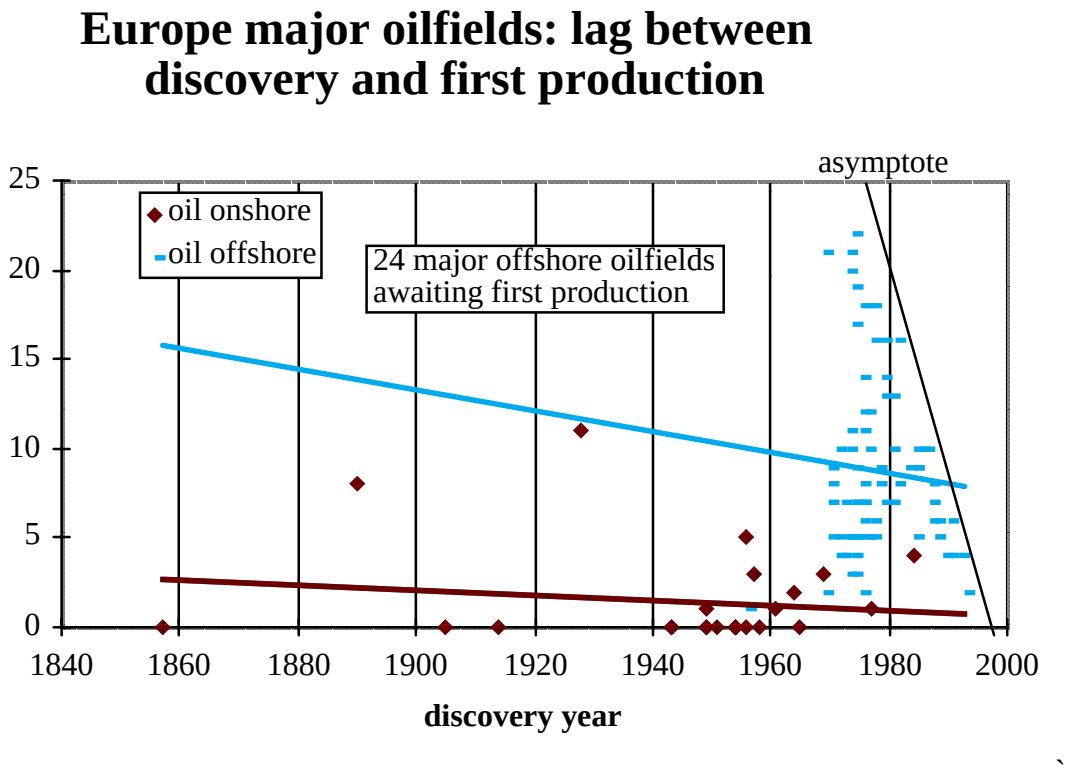
But if we plot only for giant fields (>500 Mboe) on figure 4, the result is completely different and chaotic, as there are only few onshore giants and the trendline for offshore is increasing.

-figure 4:



The same plot limited to major fields (>100 Mboe) on figure 5 is more meaningful. The average lag has almost not changed (about 2 years) for onshore major fields for the last century and for offshore for the last twenty years the lag is around 10 years. There are 24 major offshore oilfields still waiting first production: 14 developing, 6 appraising, 2 awaiting development and 2 discoveries.

-figure 5:

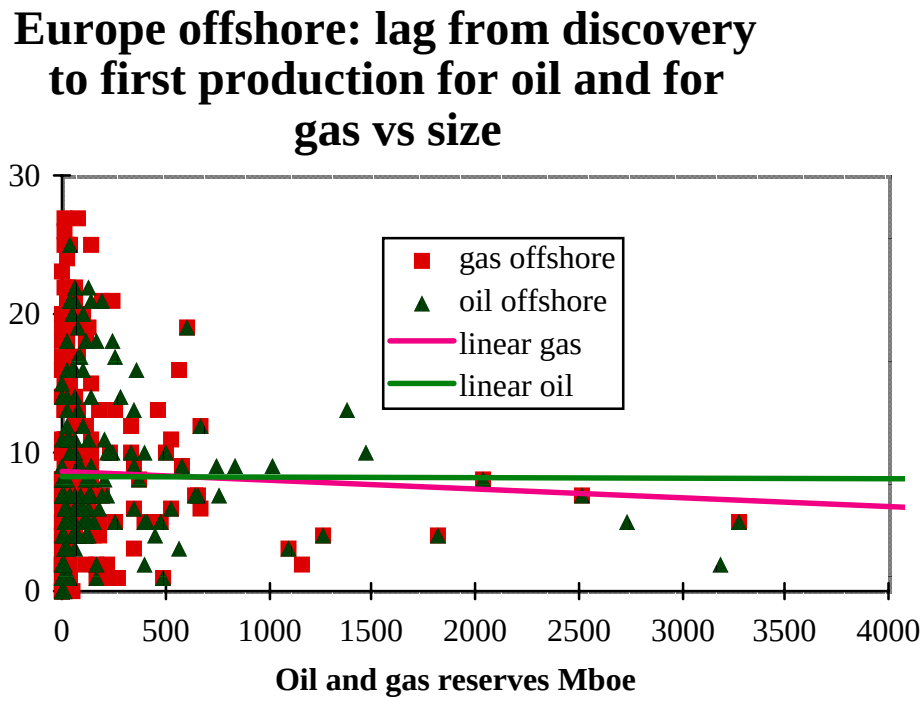


We conclude that the development lag versus date is not a useful parameter to study, and have accordingly considered other relationships.

-2-"Development lag" versus size

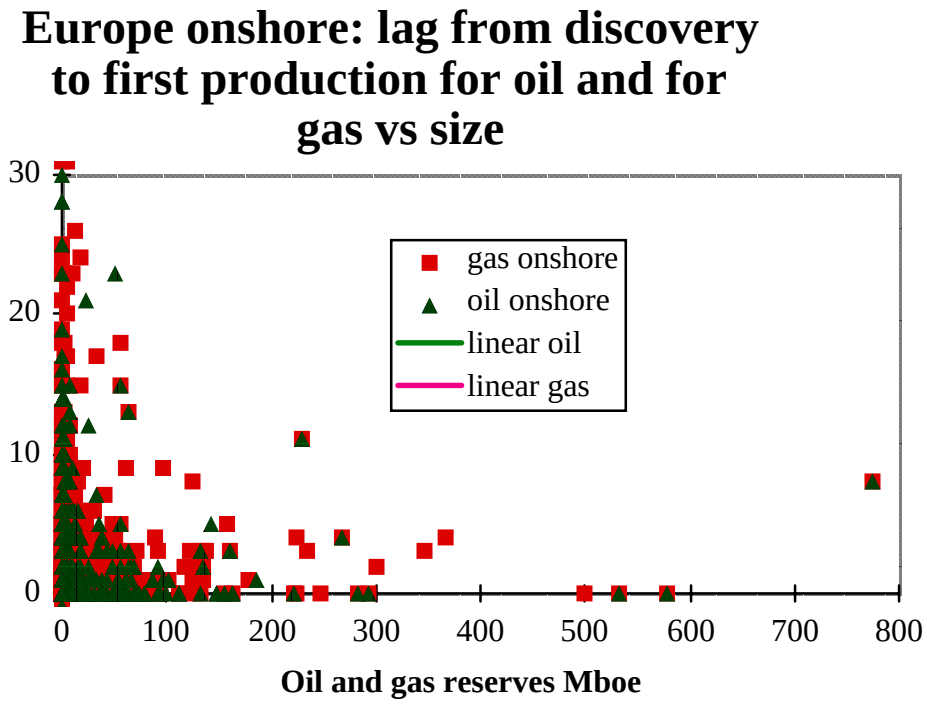
Figure 6 plots the same development lag versus the global reserve size (Mboe with gas equivalence 1 boe=10 kcf) for offshore fields. The trendline for oil is horizontal around 7 years, meaning that size has little influence, for gas the average is also 7 years for smaller fields and larger fields are surprizingly developed faster than oil!

-figure 6:



For onshore fields on figure 7, the result is similar but with faster development. Oilfields are developed within an average of 2 years whatever is the size. Gasfields take 3 yeras for smaller fields and 1 year for larger fields.

-figure 7:



Development lag versus size does not bring anything of interest about the evolution of development.

-3-"Development ratio"

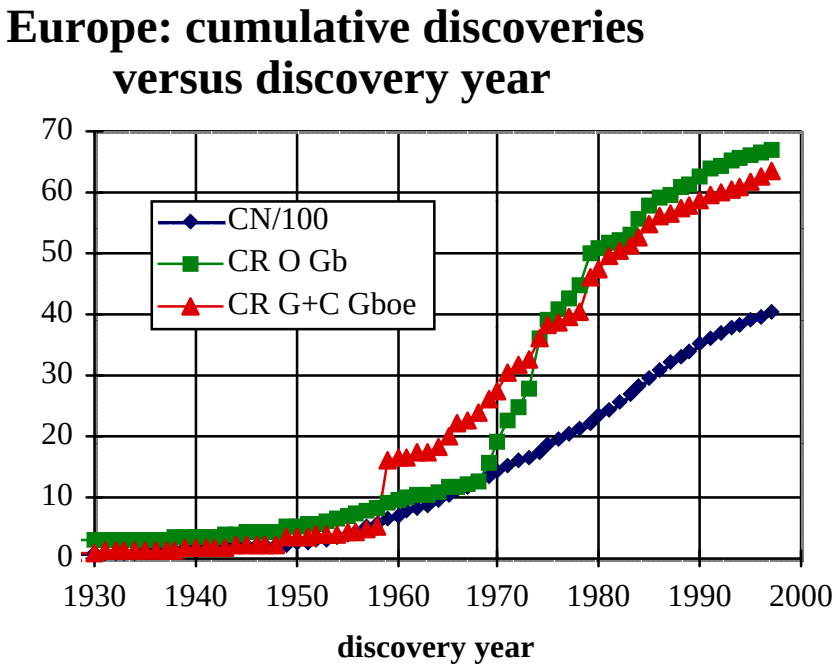
-3-1-Europe

We have studied the development ratio, being the percentage of discoveries going into first production, first, by plotting separetely cumulative discoveries versus discovery year and, second, by plotting cumulative fields going into first production versus first production year.

"Evolution of development lag and development ratio"

Figure 8 displays the cumulative discoveries (in number and in reserves of oil and gas+ccondensate) versus discovery time. This "creaming curve" flattens sharply since 1990 compared to a sharp increase from 1970 to 1990.

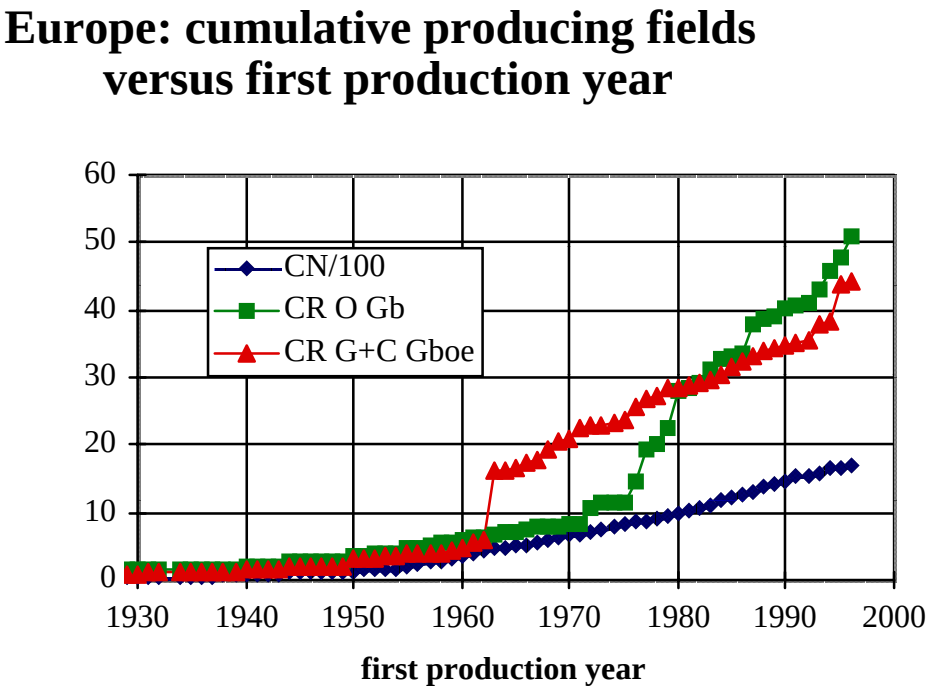
-figure 8:



"Evolution of development lag and development ratio"

Figure 9 displays the cumulative number and reserves of producing fields versus the first year of production.

-figure 9:



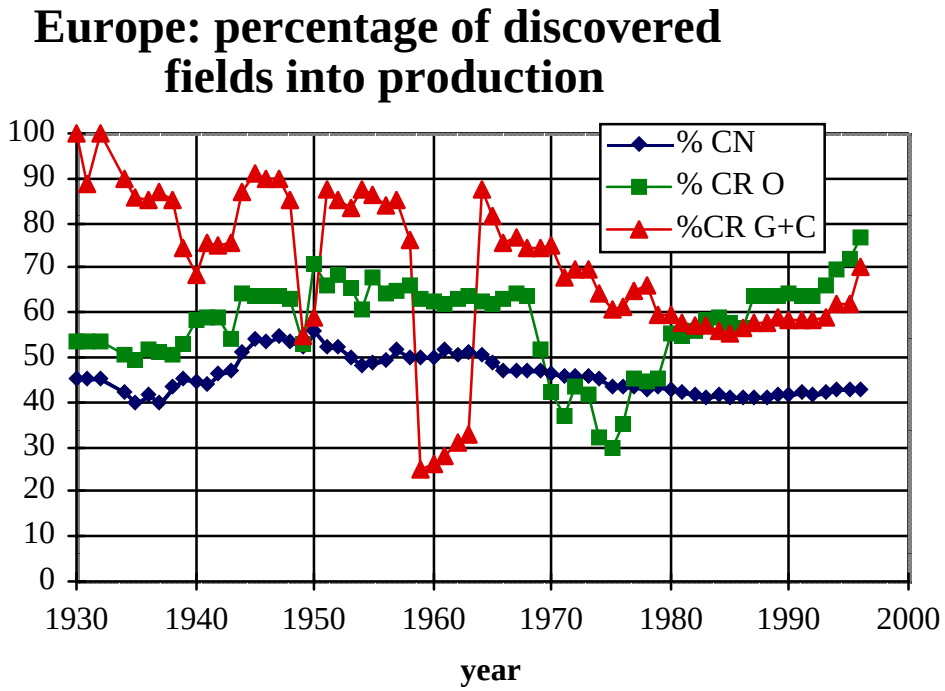
There has been a sharp increase for oil since 1975 and an even greater one since 1992 (Troll oil is an important addition). For gas the slope started in 1962 with the Anglo-Dutch basin, but has accelerated for the last five years, in particular with Troll gas (reserves included with the production of Troll oil).

"Evolution of development lag and development ratio"

Figure 10 displays the "development ratio"which is the percentage of discovered fields going into production expressed in number (CN=cumulative number) and in reserves (CR=cumulative reserves) for oil and gas+condensate.

For the last 60 years, less than 50% of discovered fields have been developed (average of around 40% for the last 15 years). The percentage of gas reserves was high around 1930. It went down to 60% during the 80s and up to 70% (with Troll) now. The percentage of oil reserves averaged 60% for most of the last 60 years but lately increased to almost 80%. Europe is pushing the development of the discovered oil, probably because of less discovery.

-figure 10:



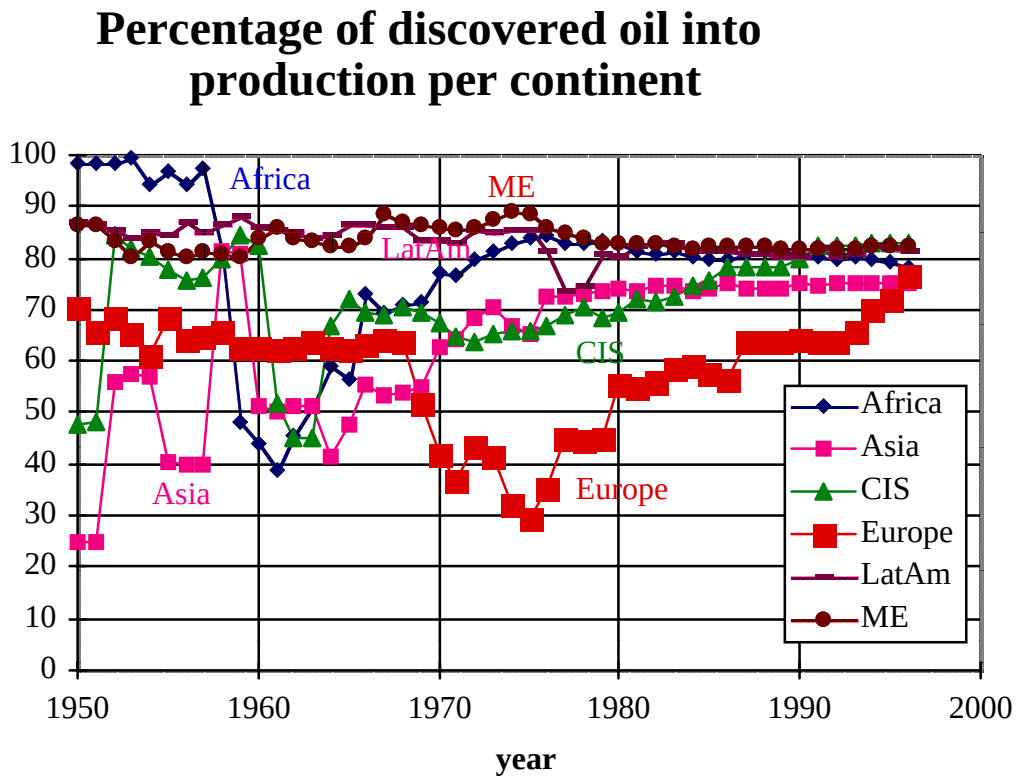
-3-2-Other continents:

We have done the same study for all other continents outside North America, but we display only the synthesis for "development ratio" for oil reserves, gas+condensatereserves and for number of discoveries.

"Evolution of development lag and development ratio"

Figure 11 shows the percentage of discovered oil into production. Presently every curve finishes around 80% (meaning that 20% of discovered oil reserves are still undeveloped). But most of continents were around this figure in 1980, only Europe has increased its ratio for the last 5 years.

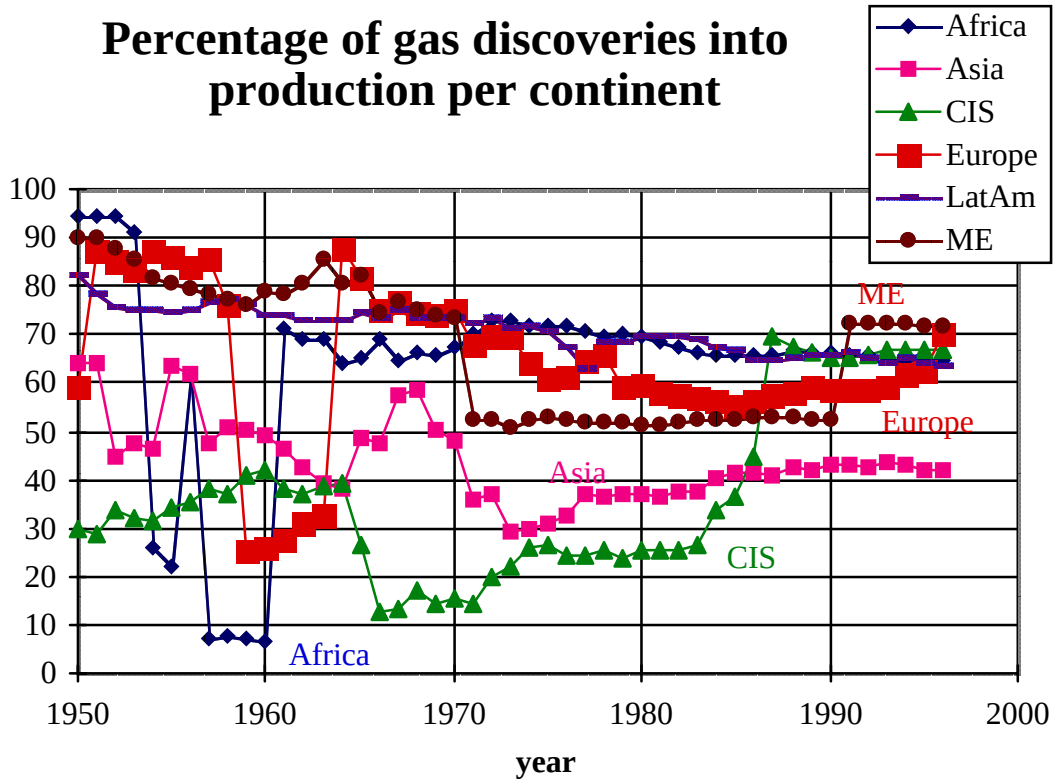
-figure 11:



"Evolution of development lag and development ratio"

The gas "development ratio is much more chaotic than oil on figure 12, but at the end all continents outside Asia have a ratio of 70% when Asia has only 40%. CIS went up sharply from 1983 to 1987 (Western Siberia) and Middle East in 1991 with North Field.

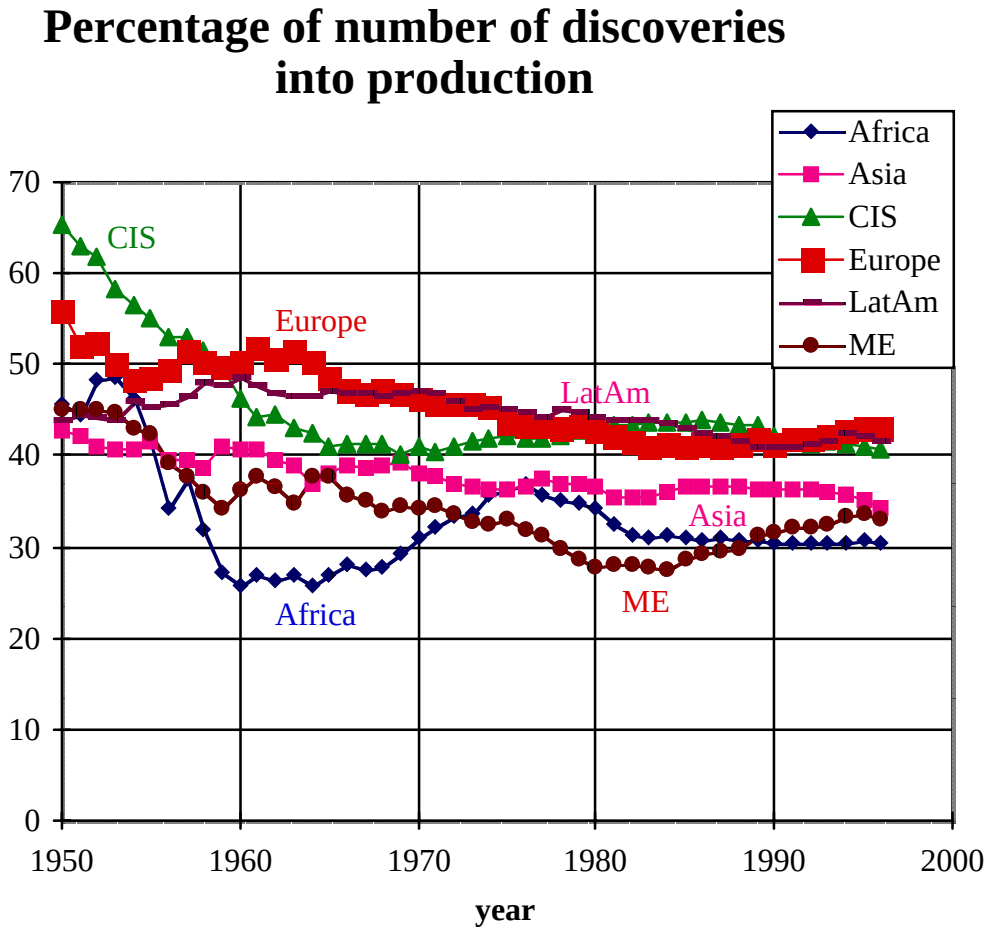
-figure 12:



"Evolution of development lag and development ratio"

Figure 13 displays the "development ratio of the number of discoveries (oil and gas combined). Europe, Latin America and CIS have deveoped 40% of their discoveries, when Asia, Africa and Middle East have only developed around 30%.

-figure 13:



-4-World outside N.America:

The last **USGS** open-file report 97-463 (Klett et al) gives:

	oil Gb	gas Tcf	NGL Gb
world	1608	6753	109
US+Canada	189	1048	33
world outside US+Canada	1419	5706	76

Petroconsultants file gives for the world outside N.America

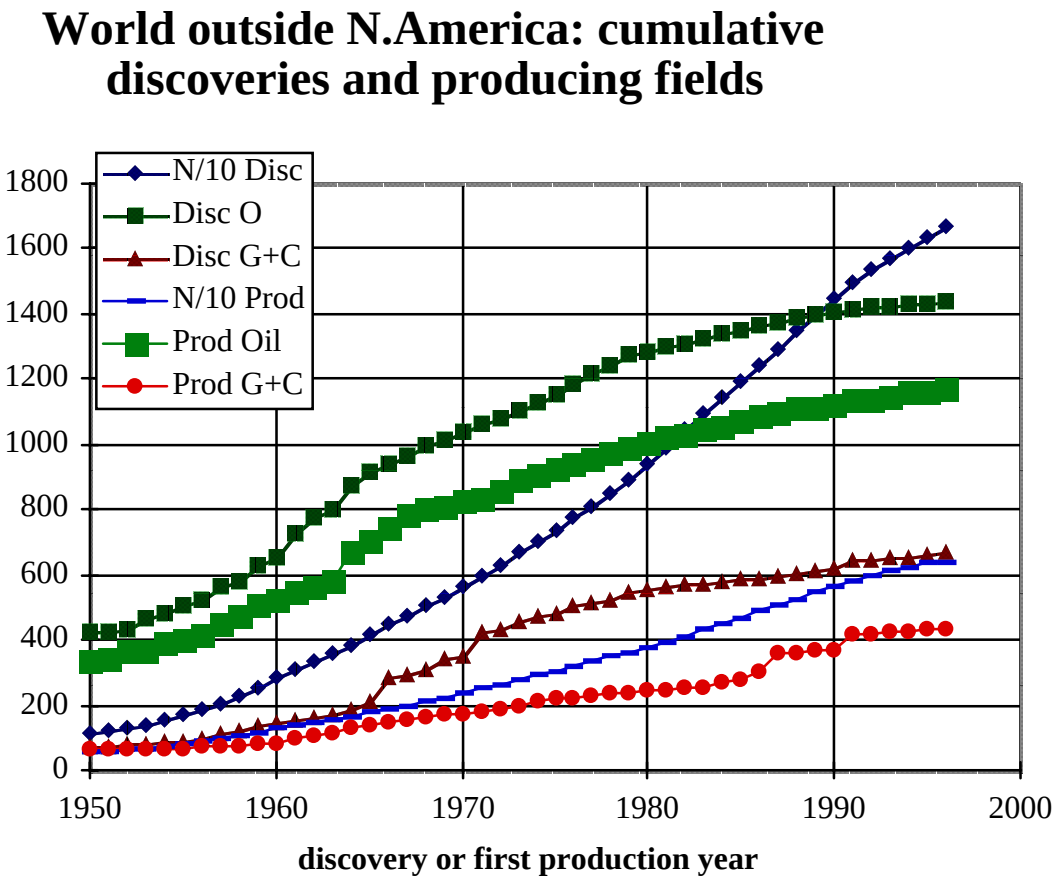
	number	oil Gb	gas+cond Gboe (1boe=10kcf)
discovered	16700	1442	667
developed	6410	1168	438
undeveloped	10000	270	230

"Evolution of development lag and development ratio"

The study of decline of major fields has shown that the Petroconsultants proven+probable values are optimistic, in particular for CIS as the Russian classification was based on the maximum theoretical recovery, stated by Khalimov in 1993 (he presented this classification in the WPC of 1979!) as grossly exaggerated.

Figure 14 displays the cumulative number of discoveries and fields put into production from 1950 to now. If the number of discoveries is still raising, the reserves of oil and gas+condensate is flattening as the reserves are put into production

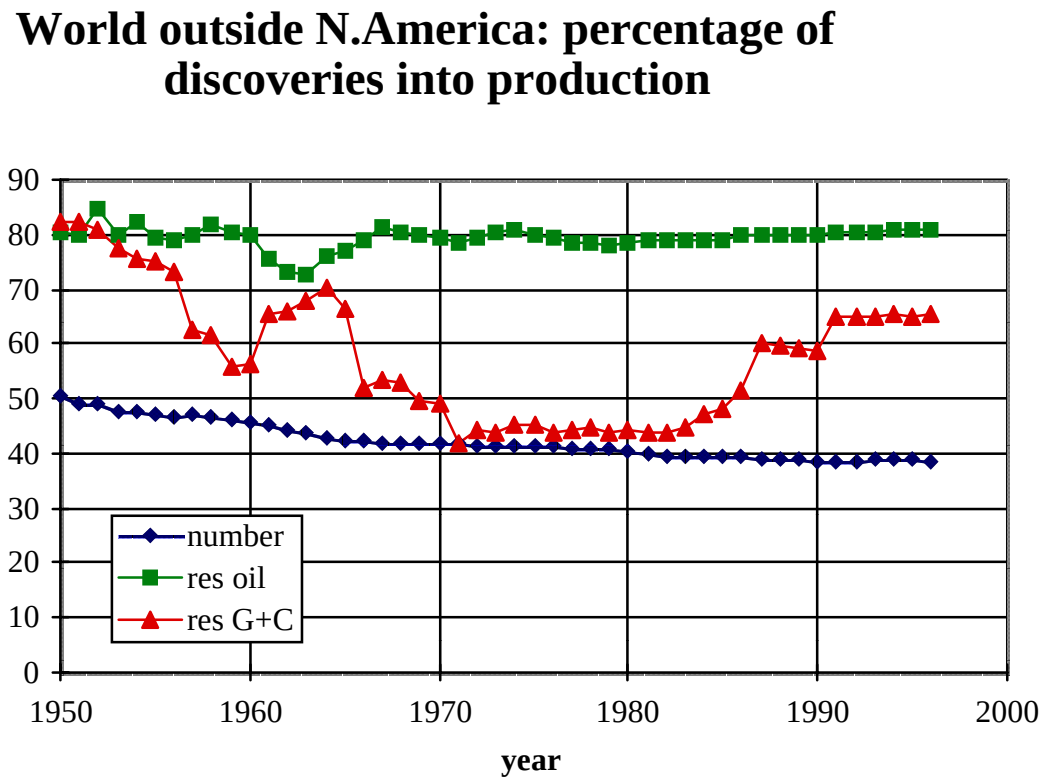
-figure 14:



"Evolution of development lag and development ratio"

Figure 15 displays the world's (outside N.America) "development ratio" for number of fields, reserves of oil and gas+condensate. Since 1970 the ratio for oil is flat at 80% as the number of discoveries at 40%. Only the"development ratio for gas has raised from 40% to 65%.

-figure 15:



As there are some missing date of first production in the file, the breakdown on the present status of production gives a little different figures for 1997. We include also the abandoned and shut-in fields into the producing category (they were not in the graphs) and we separate the rest into the developing category and the others category (discovery, appraisal, awaiting and no data).

"Evolution of development lag and development ratio"

We obtain the following:

		number of fields				oil Gb				gas Tcf		
	product.	develop.	others	total	product.	develop.	others	total	product.	develop.	others	total
Africa	801	105	1305	2211	106	5	21	131	302	30	103	435
Asia	1760	146	1684	3590	101	3	7	111	311	105	244	660
CIS	1518	153	1500	3171	230	12	28	270	1381	277	470	2129
Europe	2465	173	1408	4046	55	5	7	67	436	33	79	548
LatAm	1988	62	1220	3270	154	3	9	167	312	33	51	396
ME	368	106	403	877	604	55	43	703	1293	245	169	1707
W-US+C	8900	745	7520	17165	1251	83	115	1449	4035	724	1117	5876
				percentage to the total								
		number of fields				**oil Gb**				**gas Tcf**		
	product.	develop.	others	total	product.	develop.	others	total	product.	develop.	others	total
Africa	36	5	59	100	80	4	16	100	69	7	24	100
Asia	49	4	47	100	91	3	7	100	47	16	37	100
CIS	48	5	47	100	85	4	10	100	65	13	22	100
Europe	61	4	35	100	83	7	10	100	80	6	14	100
LatAm	61	2	37	100	92	2	5,7	100	79	8	13	100
ME	42	12	46	100	86	8	6,1	100	76	14	10	100
W-US+C	52	4	44	100	86	6	8	100	69	12	19	100

For the number of fields, there are 44% of fields yet-to-develop, with Europe the least (35%) and Africa the most(59%). For oil reserves, 8% are yet-to-develop, with Latin America the least (6%) and Africa the most (16%). For gas reserves, 19% are yet-to-develop, with Middle East the least (10%) and Asia the most (37%).

-Conclusions:

The "development lag", years from discovery to first production, is not a useful parameter.

The "development ratio", percentage of discoveries put into production, is a more interesting parameter. For the world outside N.America, it has little changed from 1970 to now, being that only 40% of discoveries have been developed, representing 80% of oil reserves and 65% of gas+condensate reserves. The gas reserves ratio has increased during the 80s and now has flattened. Only Europe shows an increase in its development ratio of oil and gas in the last 5 years because of North Sea (in particular Troll): it is an exception for the world.

These yet-to-develop discoveries represent more than 7000 fields totalling more than 100 Gb for oil and 1000 Tcf for gas. As long as the development is not decided, they should not be reported as proved as they are by most countries, but as probable. Most of them are marginal fields with problems and should be put in the non-conventional resources. They will be handled only if nothing else is discovered and if the oil price rises.

There is no visible trend that the percentage of undeveloped fields should diminish drastically in the near future. Developing the "undeveloped" is the challenge of the oil and gas industry, as is the "nonconventional" and the "undiscovered".

-Acknowlegdments:

Petroconsltants is thanked for allowing use of their database for plotting these graphs.

-References:

-Khalimov E.V. 1993 "Classification of oil reserves and resources in the Former Soviet Union" AAPG vol.77/9, Sept, p1636
-Klett T.R., T.S.Ahlbrandt, J.W., G.L.Dolton 1997 " Ranking of the world's oil and gas provinces by known petroleum volumes" USGS open-file report 97-463
-Petroconsultants 1997 database IRIS 21