LTIC
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On the determinants of investment in innovative activities in business firms

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Some major premises

- Technological innovation (and imitation) as a fundamental driver of economic growth
  [with importance which grows as countries approach technological frontier]

- Even in ‘frontier countries’, technological innovation is necessary but not sufficient, alone, to determine sustained growth
  [as the recent crisis shows ‘Schumpeter’ is not enough, a deep re-consideration of Keynes is required]

- The processes of search and development leading to technological innovation often involves R&D but not always
  [it depends on sectors and technologies]

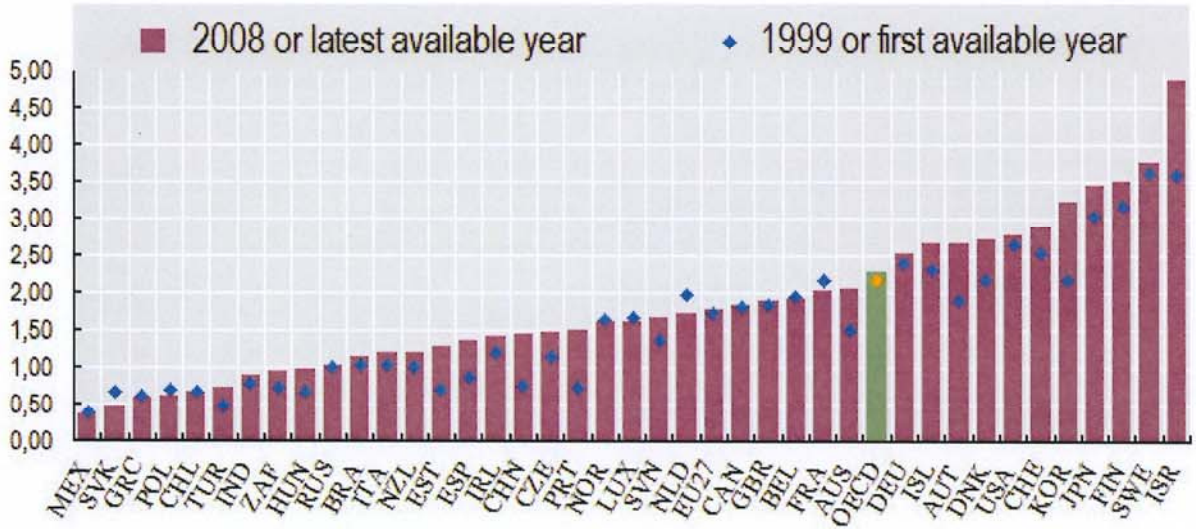
Patterns of R&D investment

- High inter-national variation
  [with R&D intensity correlated with per capita GDP … causation likely to run both ways]

- High inter-sectoral variation

- High inter-firm variation even within same sector and same country

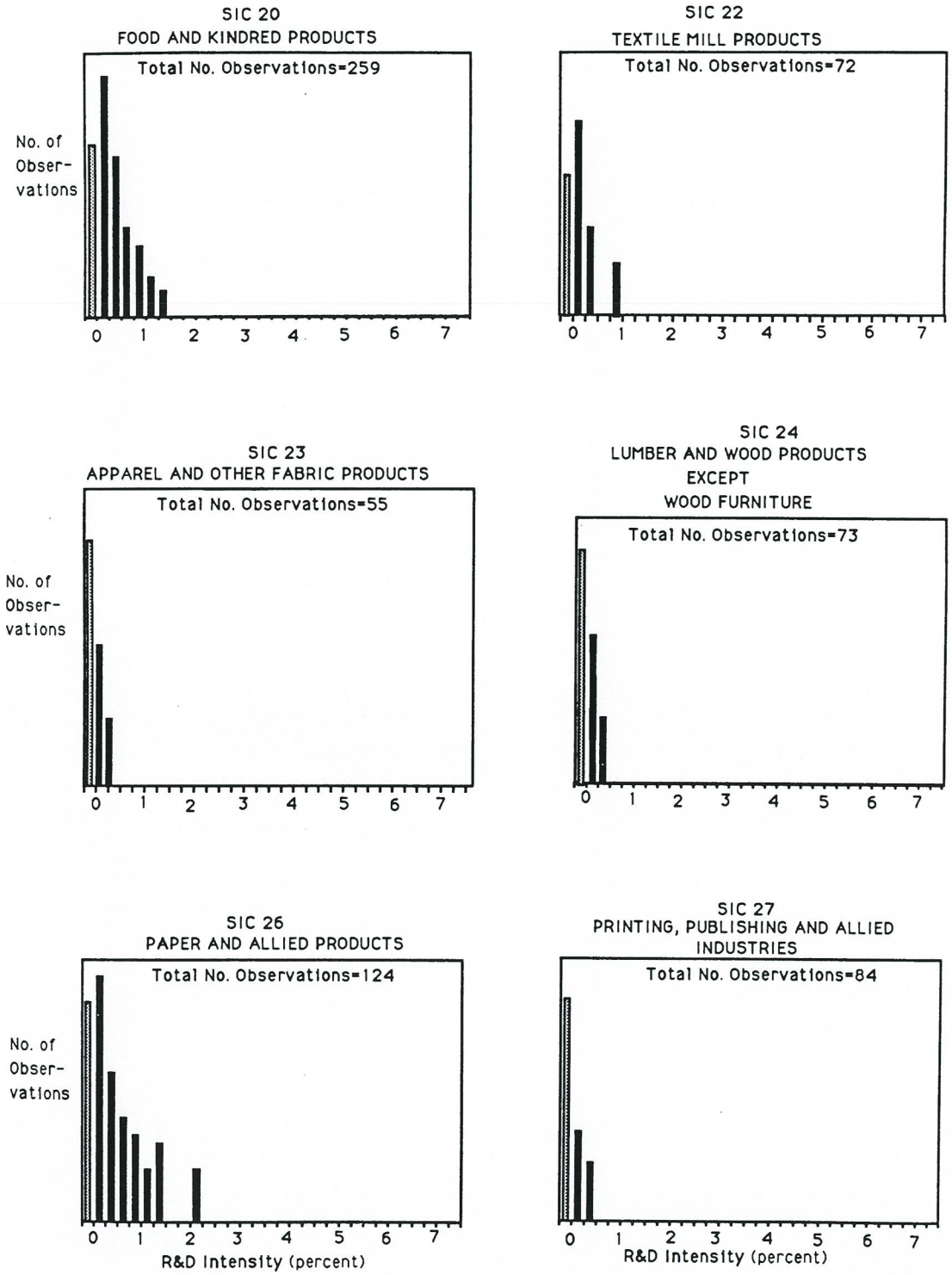
Gross Domestic Epxenditure on R&D as a percentage of GDP

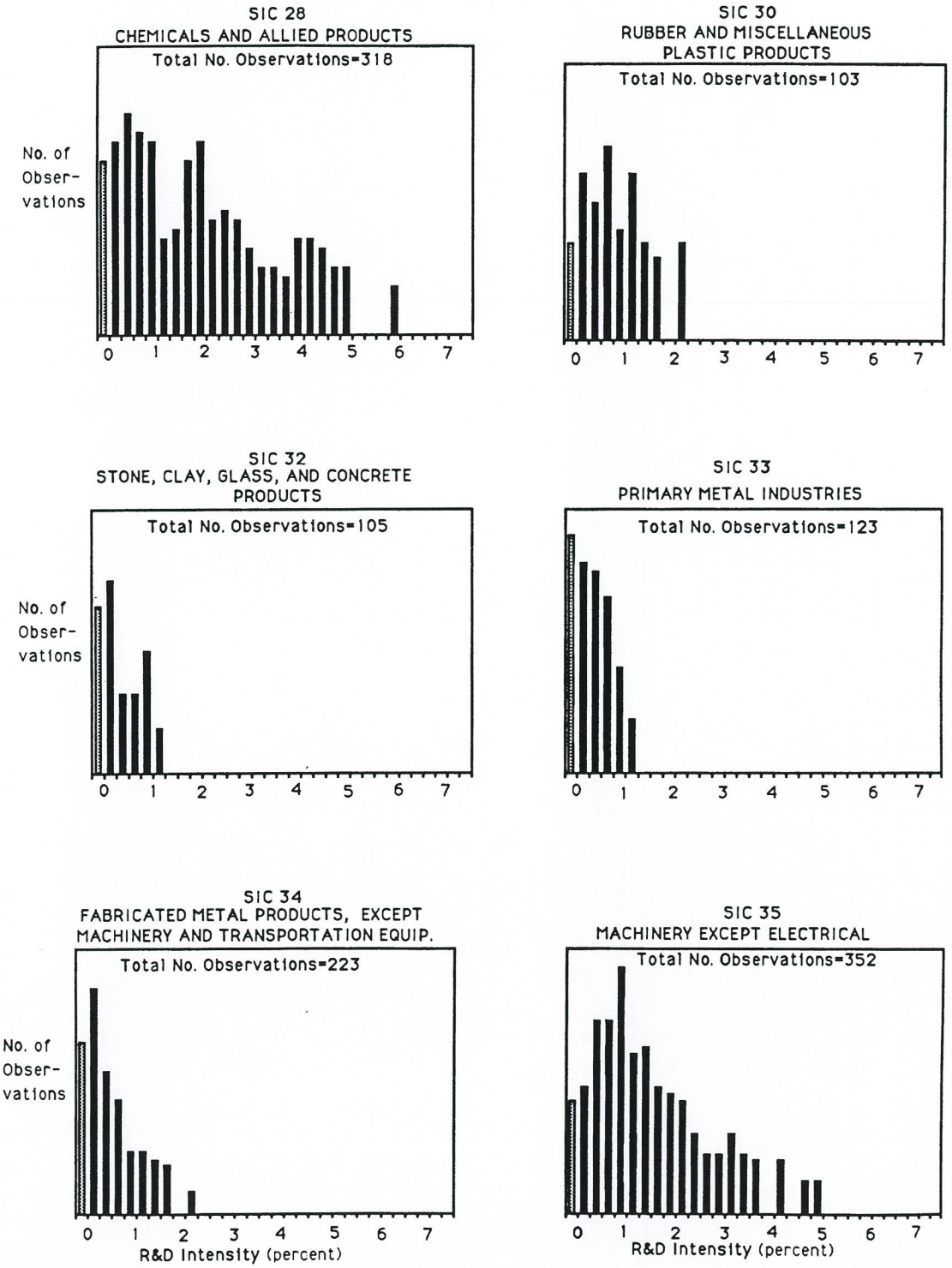


R&D intensity in manufacturing sectors, average over 2000 – 2005

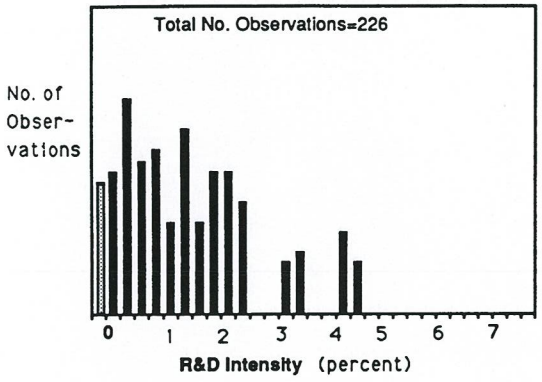
	CAN	DEN	FIN	FRA	DEU	ITA	JPN	KOR	NLD	ESP	SWE	GBR	USA
MANUFACTURING	4,42	8,95	10,40	9,72	7,54	2,36	10,87	8,54	6,13	2,84	12,88	7,03	9,94
Food products, beverages and tobacco	0,61	3,45	2,56	1,65	0,78	0,45	2,47	2,20	1,94	1,09	1,51	1,34	2,04
Textiles, textile products, leather and footwear	1,30	2,89	1,95	1,81	2,56	0,43	2,67	1,15	1,94	1,67	3,16	0,4	1,79
Wood and products of wood and cork	0,44	1,01	0,88	3,52	0,25	0,13	0,83	0,32	0,24	0,44	0,53	..	0,57
Pulp, paper,paper products, printing and publishing	3,45	0,68	1,94	0,34	0,38	0,46	1,21	0,40	0,51	0,43	3,01	..	1,47
Coke, refined petroleum products and nuclear fuel	3,03	0,00	1,74	4,73	1,12	0,12	0,84	1,51	0,22	1,76	4,96	11,10	2,00
Chemicals and chemical products	9,55	33,38	14,67	21,07	13,74	4,42	24,32	6,82	12,14	7,40	17,00	23,94	20,48
Chemicals excluding phamaceutical	1,69	14,71	5,18	11,15	9,43	3,75	18,07	7,35	8,5	2,94	8,37	6,94	5,83
Pharmaceuticals	29,81	41,42	57,62	33,11	23,49	5,42	33,37	5,71	30,41	17,28	21,1	42,51	44,05
Rubber and plastics products	0,47	3,96	5,23	6,71	3,25	1,96	6,24	3,16	2,3	1,83	3,66	0,93	3,03
Other non-metallic mineral products	0,91	0,63	1,15	2,66	1,82	0,45	4,17	1,97	0,99	1,00	2,17	0,86	1,72
Basic metals	2,01	1,20	2,80	3,67	1,81	0,55	3,28	1,45	2,48	0,98	5,34	1,13	1,07
Fabricated metal products, except machinery and equipment	1,27	1,02	3,90	0,88	1,11	0,27	2,24	1,24	0,95	0,94	1,96	0,57	1,12
Machinery and equipment, n.e.c.	3,59	8,15	5,90	6,20	5,81	2,64	8,66	5,44	8,58	3,99	10,87	5,90	7,94
Office, accounting and computing machinery	52,14	18,30	149,98	26,44	14,48	6,05	228,94	14,48	218,74	13,55	34,74	1,77	29,09
Electrical machinery and apparatus, n.e.c.	4,15	10,32	11,71	11,68	3,50	1,57	20,50	5,28	6,73	4,44	12,19	8,75	4,68
Radio, television and communication equipment	38,73	31,44	35,42	48,88	28,67	13,23	13,94	24,08	87,17	13,52	51,12	25,47	42,86
Medical, precision and optical instruments	..	17,64	14,14	17,35	13,30	6,52	33,86	8,79	8,23	7,67	20,48	7,87	44,54
Motor vehicles, trailers and semi-trailers	2,97	2,73	4,04	28,20	17,59	10,58	16,38	16,62	6,16	4,75	27,14	8,86	16,65
Other transport equipment	12,71	1,16	7,22	30,24	21,44	20,53	7,76	4,75	3,29	14,85	21,00	28,30	24,14
Manufacturing n.e.c. and recycling	2,08	0,84	4,82	2,45	1,38	0,46	6,34	1,53	0,39	0,97	3,40	0,40	1,23

TWO-DIGIT INDUSTRY R&D INTENSITY (R&D/SALES) DISTRIBUTIONS
Source: Cohen and Klepper, R&D Intensity Distributions, AER 82/4, 1992

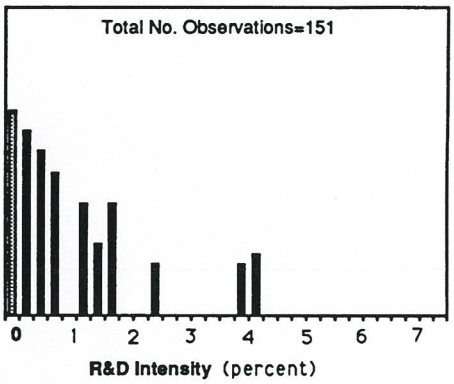



SIC 28
CHEMICALS AND ALLIED PRODUCTS
Total No. Observations=318
No. of Observations
0 1 2 3 4 5 6 7
SIC 30
RUBBER AND MISCELLANEOUS PLASTIC PRODUCTS
Total No. Observations=103
0 1 2 3 4 5 6 7
SIC 32
STONE, CLAY, GLASS, AND CONCRETE PRODUCTS
Total No. Observations=105
No. of Observations
0 1 2 3 4 5 6 7
SIC 33
PRIMARY METAL INDUSTRIES
Total No. Observations=123
0 1 2 3 4 5 6 7
SIC 34
FABRICATED METAL PRODUCTS, EXCEPT MACHINERY AND TRANSPORTATION EQUIP.
Total No. Observations=223
No. of Observations
0 1 2 3 4 5 6 7
R&D Intensity (percent)
SIC 35
MACHINERY EXCEPT ELECTRICAL
Total No. Observations=352
0 1 2 3 4 5 6 7
R&D Intensity (percent)

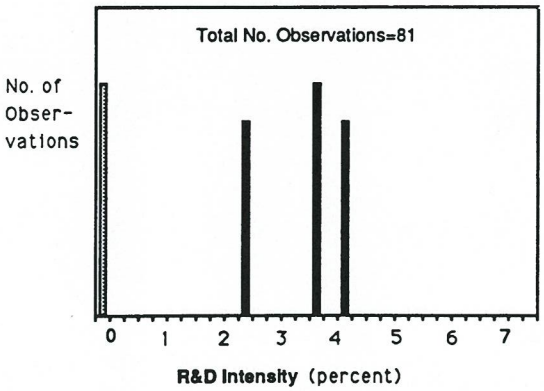
SIC 36
ELECTRICAL AND ELECTRONIC MACHINERY, EQUIPMENT, AND SUPPLIES



SIC 37
TRANSPORTATION EQUIPMENT



SIC 38
MEASURING, ANALYZING AND CONTROLLING INSTRUMENTS; PHOTOGRAPHIC, MEDICAL AND OPTICAL GOODS; WATCHES AND CLOCKS



NACE	Total Number of firms	Patenting firms	%	NACE	Total Number of firms	Patenting firms	%
151	407	3	0.74	261	236	15	6.36
155	298	1	0.34	262	143	7	4.90
158	624	12	1.92	263	212	9	4.25
159	221	4	1.81	264	124	2	1.61
15	2060	24	1.17	266	573	8	1.40
171	296	3	1.01	267	244	5	2.05
172	413	6	1.45	26	1692	56	3.31
173	406	4	0.99	273	166	3	1.81
175	290	19	6.55	275	333	7	2.10
177	251	3	1.20	27	848	27	3.18
17	1906	38	1.99	281	1145	16	1.40
182	1360	5	0.37	284	522	11	2.11
18	1403	5	0.36	285	1772	31	1.75
191	271	1	0.37	286	324	32	9.88
193	869	16	1.84	287	973	52	5.34
19	1285	19	1.48	28	4930	158	3.20
202	104	5	4.81	291	661	87	13.16
203	281	3	1.07	292	1494	139	9.30
205	200	3	1.50	293	214	26	12.15
20	795	13	1.64	294	457	60	13.13
211	126	3	2.38	295	1185	197	16.62
212	548	14	2.55	297	199	34	17.09
21	674	17	2.52	29	4236	547	12.91
221	198	1	0.51	30	112	7	6.25
222	755	7	0.93	311	252	14	5.56
22	964	8	0.83	312	213	21	9.86
23	91	1	1.10	316	594	45	7.58
241	273	26	9.52	31	1329	92	6.92
243	179	8	4.47	322	211	13	6.16
244	267	75	28.09	32	406	24	5.91
245	184	4	2.17	332	198	23	11.62
246	230	14	6.09	33	668	73	10.93
24	1177	132	11.21	342	141	4	2.84
251	256	16	6.25	343	394	45	11.42
252	1569	103	6.56	34	574	54	9.41
25	1825	119	6.52	35	395	25	6.33
				361	1434	48	3.35
				362	282	8	2.84
				366	211	15	7.11
				36	2027	85	4.19

Number of patents for each 2 digit sector and a selection of nested 3 digit setctor

General property

- Tendency of private actors to under invest in R&D

  [since Nelson (1959) and Arrow (1962) we know about systematic differences between social and private returns to innovative search]

Determinants of propensity to invest

- First order determinants
  - Technology-specific technological opportunities
  - Technology-specific modes of doing search
    [an important incidental: given the Italian sectoral composition of industrial output, trying to reach the 3% Lisbon objective is not only impossible but somewhat silly]

- Little role of appropriability
  (above a minimum threshold)
  Indeed misplaced emphasis on IPR: an increase in their scope and tightness does not have effects on the rates of innovation ... on the contrary ‘tragedy of anti-commons’

- Some evidence of cash-flow constraints on R&D
  - Especially in ‘market-based’ (mostly Anglo-Saxon) economies
  - Especially concerning new firms

Role of public agencies and policies

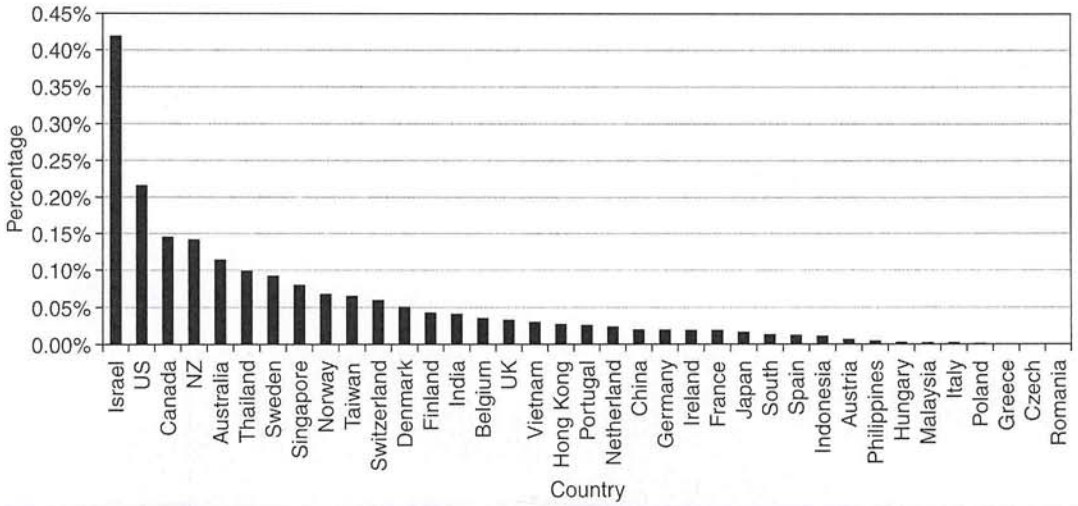
- Government funding for start-ups
  [NB: in the US, Small Business Investment Company (SBIC) and Small Business Innovation Research (SBIR) account for around 60% of venture capital]

- Limited ‘additionality’ of R&D subsidies and tax rebates

- Fundamental public role in
  - Generation of new knowledge (from universities to public labs)
  - Knowledge-related infrastructures
- Major mission-oriented programmes

  [the contemporary equivalent of military and space programmes in the 50’s, 60’s, 70’s]

Toward an innovation-friendly Keynesianism?



Percentage of venture investment over GDP various countries and regions
Source: Hall and Lerner (2010)