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Local and divergent patterns of technological learning within (partly) globalized markets : is there anything new? and what can policies do about it? : a concise guide

Citation for published version (APA):
Dosi, G., & Castaldi, C. (2002). *Local and divergent patterns of technological learning within (partly) globalized markets : is there anything new? and what can policies do about it? : a concise guide*. (LEM working paper series; Vol. 2002/22). Sant'Anna School of Advanced Studies.

Document status and date:
Published: 01/01/2002

Document Version:
Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

• A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
• The final author version and the galley proof are versions of the publication after peer review.
• The final published version features the final layout of the paper including the volume, issue and page numbers.

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Working Paper Series

Local and Divergent patterns of Technological Learning within (Partly) Globalized Markets

Is There Anything New? And What Can Policies Do About It? A concise Guide

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2002/22 **October 2003**

Local and Divergent Patterns of Technological Learning within (Partly) Globalized Markets

Is There Anything New? And What Can Policies Do about It? : A Concise Guide.*

Giovanni Dosi† Carolina Castaldi†

LEM Working Paper 2002-22

Abstract

In this work, we present an assessment of the nature and impact of current "globalizing" tendencies at various levels of observation. The evidence in this respect suggests that it has mostly concerned financial flows (especially short-term ones); to some extent trade flows; and only to very limited degrees, if any, the modes of access to new (and even 'old') technologies. A widely held prejudice is that 'globalization' goes hand in hand with international convergence in technological capabilities and incomes: in quite a few cases the opposite indeed holds. Conversely, such evidence powerfully hints at the continuing role of public policies in fostering the accumulation of technological knowledge and its economic exploitation. We suggest some taxonomies of the 'control' and 'state' variables which policies are likely to influence. Beyond the fading away wave of 'market fundamentalism' – we suggest– it is high time to pragmatically re-assess the role of markets as often powerful, but highly imperfect, mechanisms of decentralized search for and adaptation to technological and organizational novelties.

*Prepared for the seminar "New Paths of Development", organized by BNDES, Rio de Janeiro, September 12-13, 2002. Comments by several participants and in particular the discussants, Hélio Jaguaribe and Rubens Ricupero, are gratefully acknowledged. The title of the work on purpose partly mimicks that of Patel and Pavitt (1994), whose perspective we largely share.

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1 Introduction

The purpose of the note which follows is to offer a frame of interpretation for the international processes of technological innovation and diffusion, and their relations with income growth in general, but with a particular emphasis on the possible role played by the so-called "globalization" phenomenon of the last couple of decades.

The field to cover is huge, and our only ambition here can be to provide a rather telegraphic set of propositions and some suggestive evidence (much more may be found in the literature we shall draw upon).[1]

It is useful to start from the broad picture and recall some basic long-term features of technological accumulation and income growth, in particular in their international dimension (Section 2). Given those secular trends, which - as we shall see - tend to display divergence as the dominant characteristics, to what extent and in which directions are they influenced by the contemporary processes coming under the fashionable and rather fuzzy heading of "globalization"? In order to address the question one requires a clarifying detour, spelling out which phenomena - true or imagined - underlie "globalization" itself (Section 3). Next, in Section 4, we shall argue that neither the contemporary evidence nor the theory supports the view that "globalization" naturally goes hand-in-hand with international convergence: in quite a few cases, the opposite holds. Conversely one can identify some robust ingredients and processes underlying catching-up in technologies and incomes quite uncorrelated with so-called "globalization" tendencies. Together we shall discuss their underlying policy dimensions.

2 Technological and income divergence as secular patterns

The basic phenomenon to start from is indeed the highly skewed international distribution of innovative activities which has emerged since the Industrial Revolution (Dosi, Pavitt and Soete (1990)) starting from previously rather homogenous conditions at least between Europe, China and the Arab World (Cipolla (1965)). It is certainly true that technological "innovativeness" is hard to measure, but irrespectively of the chosen proxy, the picture which emerges is one with innovation highly concentrated in a small group of countries. An illustration using patents registered in the US is presented in Table 1.

[1] More detailed discussions by one of the authors are in Dosi, Pavitt and Soete (1990), Cimoli and Dosi (1995), Dosi, Freeman and Fabiani (1994) and Dosi, Orsenigo and Sylos Labini (2002).

Table 1: US patents granted, by country of applicant and year (% of non-US recipients)

		1883	1900	1929	1958	1973	1986	1990	1995	1999
OECD	Australia	1.11	2.33	1.96	0.60	0.92	1.14	1.01	1.00	1.02
	Austria	2.62	3.36	2.47	1.12	1.02	1.09	0.91	0.74	0.69
	Belgium	1.59	1.35	1.30	1.14	1.23	0.74	0.73	0.87	0.93
	Canada	19.94	10.54	10.25	7.99	6.20	4.01	4.33	4.61	4.64
	Denmark	0.56	0.46	0.71	0.74	0.70	0.56	0.37	0.44	0.70
	France	14.22	9.79	9.76	10.36	9.38	7.22	6.67	6.17	5.49
	Germany	18.67	30.72	32.36	25.60	24.25	20.80	17.72	14.49	13.42
	Italy	0.24	0.92	1.19	3.02	3.39	3.05	2.93	2.36	2.14
	Japan	0.16	0.03	1.40	1.93	22.10	40.35	45.43	47.64	44.70
	Netherlands	0.24	0.75	1.57	5.71	3.03	2.20	2.23	1.75	1.79
	Norway	0.32	0.49	0.71	0.61	0.42	0.25	0.26	0.28	0.32
	Sweden	0.95	1.32	3.19	4.64	3.40	2.70	1.79	1.76	2.01
	Switzerland	1.75	2.27	4.46	8.80	5.79	3.70	2.99	2.31	1.84
	UK	34.55	30.52	22.23	23.45	12.56	7.37	6.49	5.42	5.13
Eastern Europe (including Russia)		0.40	1.49	1.62	0.55	2.53	1.13	0.35	0.27	0.29
NICs		0.40	1.12	1.03	1.31	1.36	1.50	3.19	7.33	12.09
	Israel						0.58	0.70	0.84	1.07
	Singapore						0.01	0.03	0.12	0.21
	Taiwan						0.63	1.70	3.55	5.31
	Korea						0.14	0.52	2.54	5.12
	Hong Kong						0.09	0.12	0.19	0.22
Others		3.28	2.54	3.07	2.43	1.72	2.19	2.61	2.59	2.79
Of which:										
Latin America	Argentina						0.05	0.04	0.07	0.06
	Brazil						0.08	0.09	0.14	0.13
	Mexico						0.11	0.07	0.09	0.11
	Venezuela						0.06	0.05	0.06	0.06

Source: US Patent Office

The club of major innovators has been quite small over the whole period of around two centuries and half, with both restricted entry (with Japan as the only major entrant in the 20th century, and Korea and Taiwan as recent additions) and a slow pace of change in relative rankings.

At the same time, since the Industrial Revolution, one observes the explosion of diverging income patterns, starting from quite similar pre-industrial per capita level. Bairoch (1981) presents estimates showing that before the Industrial Revolution the income gap between the poorest and the richest countries was certainly smaller than the ratio 1 to 2 and probably of the order of only 1 to 1.5. Conversely, the dominant tendency after the Industrial Revolution is one with fast increasing differentiation among countries and overall divergence. Even in the Post World War II period, commonly regarded as an era of growing uniformity, the hypothesis of global convergence, that is convergence of the whole population of countries toward increasingly similar income levels, does not find support from the evidence (De Long (1988), Easterly *et al.* (1992), Verspagen (1991), Soete and Verspagen (1993), Durlauf and Johnson (1992) and Quah (1996)). Rather, one finds some, although not overwhelming, evidence of local convergence, i.e. within subsets of countries grouped according to some initial characteristics such as income levels (Durlauf and Johnson (1992)) or geographical locations. The typical patterns are impressionistically illustrated in Figure 1 from Durlauf and Quah (1998), showing the appearance of a two-humped distribution of countries with low (*albeit positive*) transition probabilities between the "poor" and "rich" clubs (and *vice versa* too).

At the same time, across-group differences in growth performances appear to be significant. Similarly, one observes persistently wide and in some cases widening (such as in a few Latin American cases) productivity gaps *vis-á-vis* the international frontier (cf. Table 2 on labor productivity; see also van Ark and McGuckin (1999)).

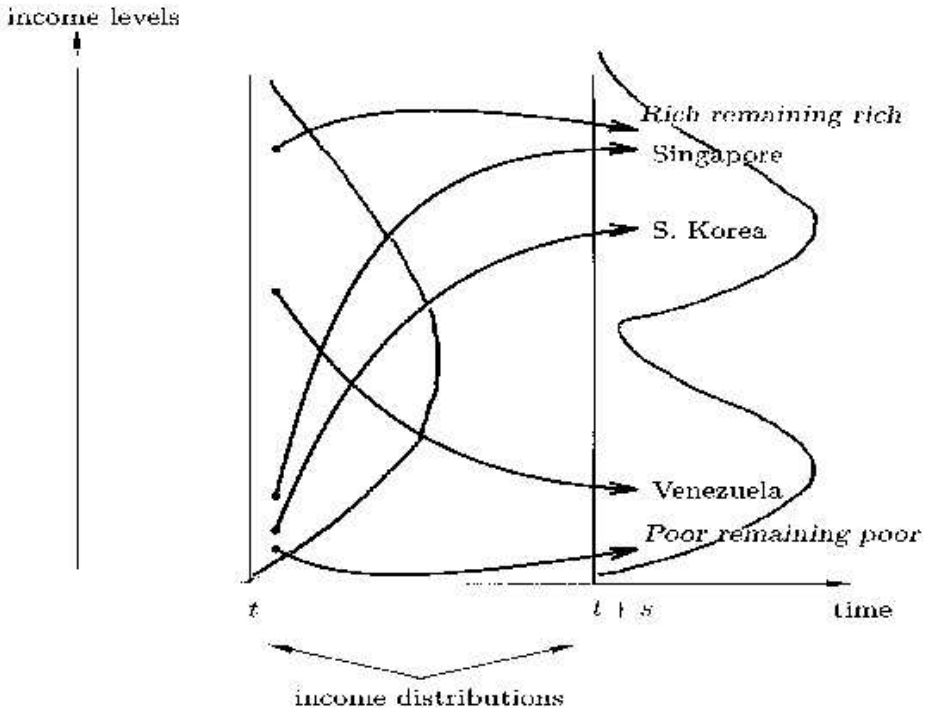


Figure 1: Evolving cross-country distribution of per capita income (from Durlauf and Quah (1998)).

Table 2: Labor productivity relative to US (Real GDP per hour worked)

		1870	1913	1950	1973	1990	1998
OECD	Austria	61.3	56.8	32.0	64.0	79.9	78.4
	Belgium	96.4	71.9	48.9	71.2	91.2	97.2
	Denmark	69.8	69.9	51.9	69.9	72.0	75.8
	Finland	38.2	36.5	33.8	58.2	67.3	74.4
	France	61.3	56.2	46.0	76.0	97.9	97.6
	Germany	68.9	59.2	31.5	62.2	72.9	76.9
	Ireland			29.5	41.5	72.0	78.3
	Italy	46.7	41.6	34.6	67.1	80.0	80.8
	Netherlands	108.0	80.3	52.7	82.2	100.2	88.6
	Norway	53.3	46.9	47.0	65.1	87.8	94.8
	Spain			20.6	45.8	63.0	63.5
	Sweden	54.2	50.4	56.0	76.0	74.7	76.0
	Switzerland	68.0	64.5	70.1	78.2	83.3	71.8
	UK	113.3	84.2	62.7	67.3	71.2	79.5
	Australia	154.7	107.0	76.2	72.8	74.1	77.9
	Canada	76.0	86.9	81.7	83.2	78.2	75.4
	Japan	20.4	21.1	16.4	48.8	63.3	65.2
	US	100.0	100.0	100.0	100.0	100.0	100.0
Latin America	Argentina			48.7	45.1	32.0	38.9
	Brazil			19.6	24.4	23.4	22.8
	Chile			36.8	37.6	31.8	38.2
	Colombia			22.1	24.0	25.0	24.0
	Mexico			28.2	37.6	33.5	29.1
	Peru			22.3	26.2	15.0	15.2
	Venezuela			86.3	81.2	48.2	39.7
Asian NICs	Hong Kong			59.4	31.6	53.2	54.3
	Singapore				28.7	41.8	52.6
	Korea				15.3	27.1	33.7
	Taiwan				18.4	32.9	44.0

Source: Maddison (2001), Total Economy Database at Groningen Growth and Development Centre GGDC (2002a).

Table 3: Correlation coefficients between levels of Innovative Activity and GDP per capita. Source: Pavitt and Soete (1981).

Year	1890	1913	1929	1950	1963	1967	1971	1977
Correlation of GDP per capita with:								
- US patents per capita	0.2	0.38	0.56*	0.63*	0.73**	0.72**	0.74**	0.88**
- R&D per capita					0.79**	0.69**	0.71**	0.61**

* Significance at 5% level

** Significance at 1% level

Note: 'US patents per capita' is the number of patents granted by US Patent Office to all countries in the sample.

A delicate but crucial issue concerns the relation between patterns of technical change and patterns of economic growth. Of course, technological learning involves many more elements than simply inventive discovery and patenting. Equally important activities are imitation, reverse engineering, adoption of capital-embodied innovations, learning by doing and learning by using (Freeman (1982), Dosi (1988), Patel and Pavitt (1994)). Moreover, technological change goes often together with organizational innovation. Still, it is important to notice the existence of significant links between innovative activities (measured in a rather narrow sense, i.e. in terms of patenting and R&D activities) and GDP per capita (for the time being, we shall avoid any detailed argument on the direction of causality).

As discussed in Dosi, Freeman and Fabiani (1994), evidence concerning OECD countries appears to suggest that the relationship between innovative activities and levels of GDP has become closer over time and is highly significant after World War II (see Table 3). Moreover, innovative dynamism, measured by the growth of patenting by different countries in the US, always appears positively correlated with per capita GDP growth. The link is particularly robust between 1913 and 1970. Conversely, a sign that the regime of international growth might have changed in the 1970s, is that in this period the relation gets weaker and loses statistical significance.

In general, at least since World War II, the rates of growth of GDP appear to depend on: (i) domestic innovative activities, (ii) the rates of investment in capital equipment and (iii) international technological diffusion (Fagerberg (1988), De Long (1988), Soete and Verspagen (1993), Meliciani (2001), Laursen (2000), among others).

In turn, capability of innovating and quickly adopting new technologies is strongly correlated with successful trade performance (Dosi, Pavitt and Soete (1990)).

Moreover, despite technological diffusion taking place at rather high rates, at least among OECD countries, important specificities in "national innovation systems" persist, related to the characteristics of the scientific and technical infrastructure, local user-producer and other institutional and policy features of each country (Lundvall (1992), Nelson (1993), Archibugi, Howells and Michie (2001)).

To repeat, the dominant tendency throughout the foregoing picture hints at long-term divergence in relative technological capabilities, production efficiencies and incomes. Together come however two more hopeful messages.

First, notwithstanding prominently divergent patterns, one has also witnessed secularly increasing average **levels** of technological knowledge within most countries (and together also in the **levels of per capita income**). Second, while it holds true that the "innovators club" has been remarkably small and sticky in its membership, one ought to notice both the possibility of entry to a few successful latecomers (in different epoques, the US, Germany and Japan being the most striking examples) and also the possibility of falling behind by very promising candidates (cf. the vicissitudes of Argentina over the last century).

Given all that, how is such a long-term scenario affected by those recent changes of the economic and political relations in the international arena collectively coming under the name of "globalization"?

In order to offer some tentative answer, one ought to start by specifying what one precisely means and whether the purported phenomena have any empirical substance.

3 A necessary detour: "Globalization" of what?

Let us briefly go through a few domains in which an often anecdotal literature identifies the forces of "globalization". (For much more detailed analyses that we largely share, cf. Eatwell (1996), Stiglitz (2002) and Meier, Stiglitz and Stern (2000), Kleinknecht and ter Wengel (1998); see also Bowles (2002) and the discussion in Berger and Dore (1996) and Hollingsworth and Boyer (1997)).

- **International trade**

  A "globalizing" process of international trade did indeed take place since World War II at quite rapid rates. However, in order to put things into perspective, remember that the ratio of international trade (exports and imports) over GDP of many countries overtook that of 1913 only around the late 70s/early 80s (see Table 4 for the evidence on some major developed countries).

Moreover, note that the institutional and tariff impediments to "globalization" have remained the highest in activities in which developing countries are often more competitive such as agricultural products, textile, etc.

Finally, note the persistence of striking international price differentials even in tradeable, low-trade-barriers, commodities (cf. the discussions in Rodrik (2002a) and Bradford (2002)).

- **Production by multinational companies**

  There is some evidence that multinational companies have somewhat increased production activities outside the home country. However note that:

  1. multi-nationalization of production has mainly been an intra-OECD phenomenon, with limited impact, if any, upon developing and ex-communist countries (cf. Kleinknecht and ter Wengel (1998));

Table 4: Exports and imports of goods as a percentage of GNP (current prices)

	1913	1950	1973	1994
France	30.0	21.4	29.2	34.2
Germany	36.1	20.1	35.3	39.3
UK	47.2	37.1	37.6	41.8
Netherlands	60.0	70.9	74.8	89.2
US	11.2	6.9	10.8	17.8
Japan	30.1	16.4	18.2	14.6

Source: Kleinknecht and ter Wengel (1998)

  2. at least with respect to OECD, country specific patterns of specialization often continue to be rather persistent and path-dependent (cf. Meliciani (2001) and Scarpetta, Bassanini, Pilat e Schreyer (2000);
  3. when they are not, such as in a few developing countries, this seems to be mostly the outcome of major macroeconomic and institutional shocks (cf. many Latin American countries) with a highly controversial impact upon production and technological capabilities (cf. Cimoli and Correa (2002); see also below).

- **Labour markets**

  Not by any far cry, have labor markets "globalized", with the partial exception of the top tail of the skills distribution (i.e. engineers, scientists, managers, etc.)

together with "new economy gurus" of various sorts, actors and football players... [2] At the same time, persistently national labour markets have gone together with high and persistent asymmetries in the skills in the population: cf. Table 5 for evidence of cross-country differences in educational attainments.

[2]For a discussion of the lack of globalization of labour markets and its implications cf. Rodrik (2002a).

Table 5: Mean years of schooling

		1970	1980	1990	2000
OECD	Australia	10,2	10,3	10,4	10,9
	Austria	7,4	7,3	7,8	8,4
	Belgium	8,8	8,2	8,9	9,3
	Canada	9,1	10,3	11,0	11,6
	Denmark	8,8	9,0	9,6	9,7
	Finland	6,1	7,2	9,4	10,0
	France	5,7	6,7	7,0	7,9
	Germany	-	-	9,9	10,2
	Ireland	6,8	7,5	8,8	9,4
	Italy	5,5	5,9	6,5	7,2
	Japan	7,5	8,5	9,0	9,5
	Netherlands	7,8	8,2	8,8	9,4
	New Zealand	9,7	11,5	11,3	11,7
	Norway	7,2	8,2	11,6	11,9
	Portugal	2,6	3,8	4,9	5,9
	Spain	4,8	6,0	6,4	7,3
	Sweden	8,0	9,7	9,5	11,4
	Switzerland	8,5	10,4	10,1	10,5
	UK	7,7	8,3	8,8	9,4
	US	9,5	11,9	11,7	12,0
NICs	Israel	8,1	9,4	9,4	9,6
	Singapore	5,1	5,5	6,0	7,1
	South Korea	4,9	7,9	9,9	10,8
	Hong Kong	6,3	8,0	9,2	9,4
Latin America	Argentina	6,2	7,0	8,1	8,8
	Brazil	3,3	3,1	4,0	4,9
	Chile	5,7	6,4	7,0	7,6
	Mexico	3,7	4,8	6,7	7,2
	Venezuela	3,2	5,5	5,0	6,6
World	Mean	4,2	4,9	5,8	6,4
	Standard deviation	2,6	2,8	2,9	2,8
	Coefficient of variation	1,6	1,8	2,0	2,3

Source: Human Development Report 2001

Figure 7. **Trends in the intensity of business-funded R&D relative to GDP**

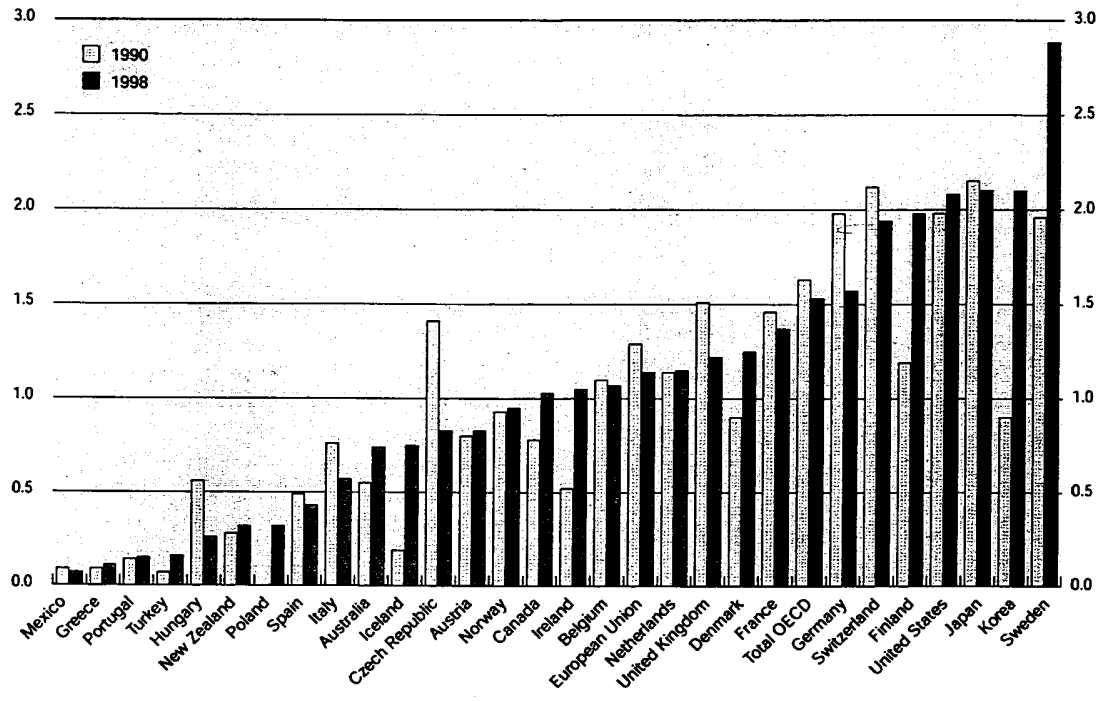


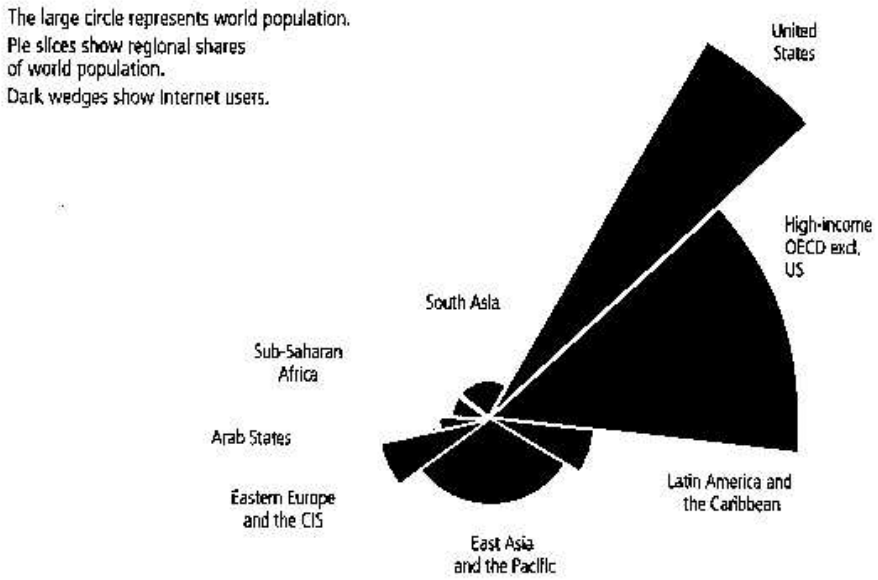
Figure 2: Intensity of firm level R&D in OECD countries. Source: OECD (2000).

- **Patterns of generation and diffusion of new technologies**

  One has already mentioned the continuing concentration of innovative activities — notwithstanding remarkable outliers to this pattern such as Finland, Korea, Taiwan and to a lower extent Brazil and India.

  Not surprisingly, such patterns in innovative outputs are matched by persistent international differences in the share of resources devoted to formal technological learning (also revealed by privately financed R&D). So, while Korea has overtaken quite a while ago "developed " countries like Italy, most LDCs continue to display negligible levels of private investments in R&D (cf. Figure 2).

  At the same time, the internationalization of innovative activities by MNCs beyond the home countries has somewhat increased, but one is still talking about rather low proportions. Most studies indicate that patenting abroad by MNCs is of the order of 10-15% of their total patenting, roughly comparable to their share in the total patenting of the guest countries. Moreover, most of these foreign



	Internet users (as percentage of population)	
	1998	2000
United States	26.3	54.3
High-income OECD (excl. US)	6.9	28.2
Latin America and the Caribbean	0.8	3.2
East Asia and the Pacific	0.5	2.3
Eastern Europe and CIS	0.8	3.9
Arab States	0.2	0.6
Sub-Saharan Africa	0.1	0.4
South Asia	0.04	0.4
World	**2.4**	**6.7**

Figure 3: Intensity of Internet use in different countries and regions (Human Development Report (2001)).

search activities occur within OECD countries (for discussion of the evidence cf. Patel and Pavitt (1997) and (1999) and Cantwell (1992)).

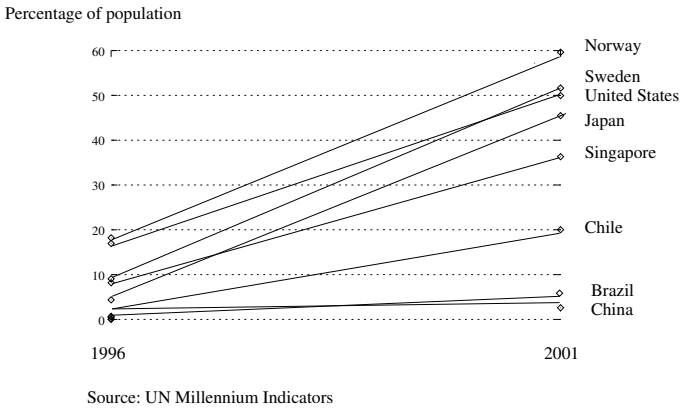
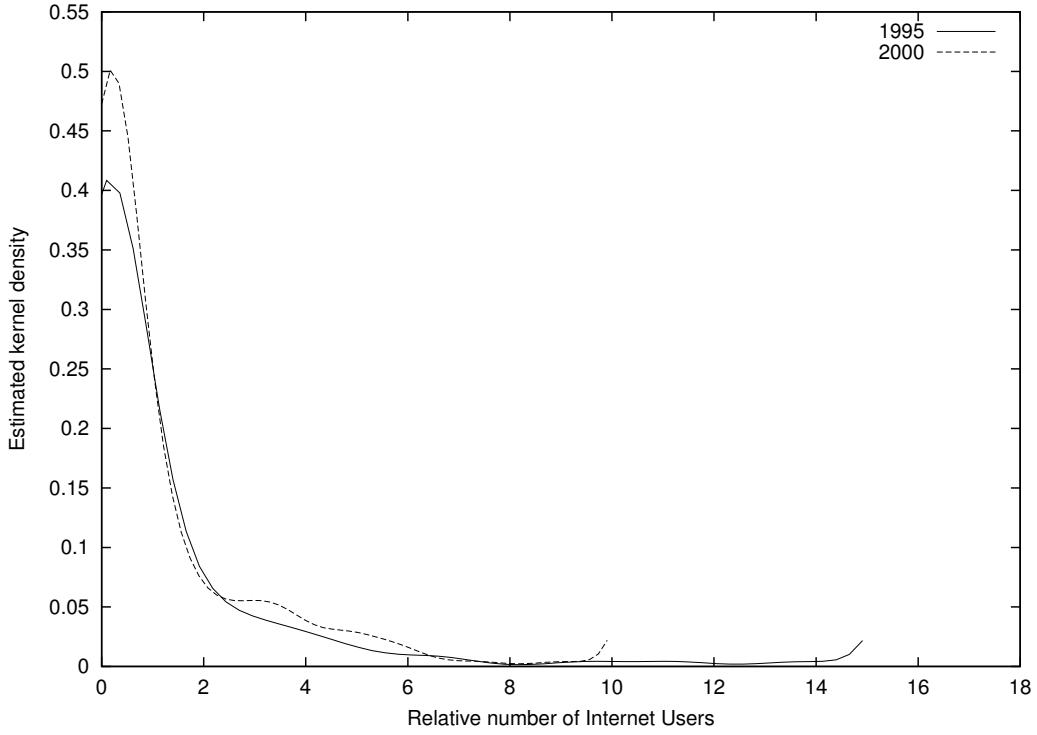


Figure 4: Uneven growth in the percentage of Internet users.

Certainly, ICT technologies have determined easier diffusion of **information**. However, there is hardly any evidence of a generalized acceleration in the rates of **adoption** of both "new" (e.g. ICT-related) and "old" technologies (from telephones to tractors). Table 6 and Figures 3, 4 and 5 show evidence for uneven diffusion of ICT technologies.[3] Note also the impressive international differences in the diffusion of ICT technologies: compare for example Finland with Poland or East Asia with Latin America.

[3]Distributions in Figure 5 are obtained from kernel density estimation for all countries covered by UN Millennium indicators (around 100 countries). Note the increase in the peak of the distribution, pointing to a marked difference between developing and developed countries.



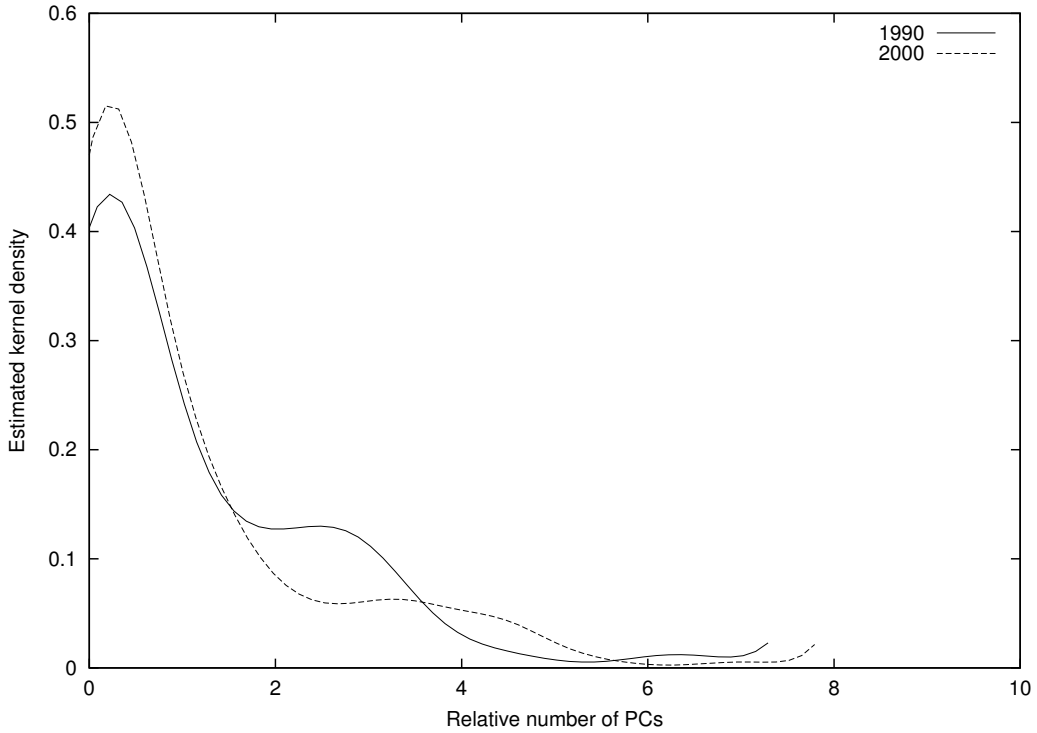


Figure 5: Indicators of ICT diffusion: empirical cross-country distributions (Gaussian kernel estimates) for the relative number of Internet users and the relative number of personal computers in two different years. Source: own elaborations upon ITU data.

Table 6: Indexes of ICT diffusion

		Internet users (% of population)			Personal computers per 100 population		
	Country	1991	1996	2001	1991	1996	2000
OECD	Australia	1,1	3,3	37,2	16	29	47
	Austria	0,3	3,1	31,9	8	17	28
	Belgium	0,0	3,0	28,0	10	22	34
	Canada	0,6	6,7	43,5	13	25	39
	Denmark	0,2	5,7	44,7	13	30	43
	Finland	1,4	16,8	43,0	11	27	40
	France	0,1	2,6	26,4	7	16	30
	Germany	0,3	3,1	36,4	10	21	34
	Italy	0,0	1,0	27,6	5	9	18
	Japan	0,0	4,4	45,5	7	16	32
	Netherlands	0,5	5,8	32,9	11	23	39
	Norway	1,4	18,2	59,6	15	32	49
	Sweden	1,2	9,1	51,6	13	29	51
	Switzerland	1,2	4,6	40,4	11	34	50
	UK	0,2	4,1	40,0	12	22	34
	US	1,2	17,0	50,0	23	36	59
NICs	Hong Kong	0,1	4,8	45,9	6	19	35
	Korea	0,1	1,6	51,1	5	13	24
	Taiwan	0,1	2,8	33,7	7	26	48
	Singapore	0,2	8,2	36,3	4	10	22
	Israel	0,2	2,1	23,1	7	16	25
Latin America	Argentina		0,1	8,0	1	3	5
	Brazil	0,0	0,5	4,6	0	2	5
	Chile		0,7	20,0	2	4	8
	Colombia		0,3	2,7		2	4
	Mexico	0,0	0,2	3,5	1	3	6
	Peru		0,3	11,5		2	4
	Venezuela		0,3	5,3	1	3	5
Average	World	0,3	1,4	11,0	5	7	10
	OECD	0,6	6,8	39,9	12	24	39
	NICs	0,1	3,9	38,0	6	17	31
	Latin America	0,0	0,3	7,9	1	3	5
Standard deviation (World)		0.4	3.1	16.1	5	10	14

Source: Elaborations on UN Millennium indicators

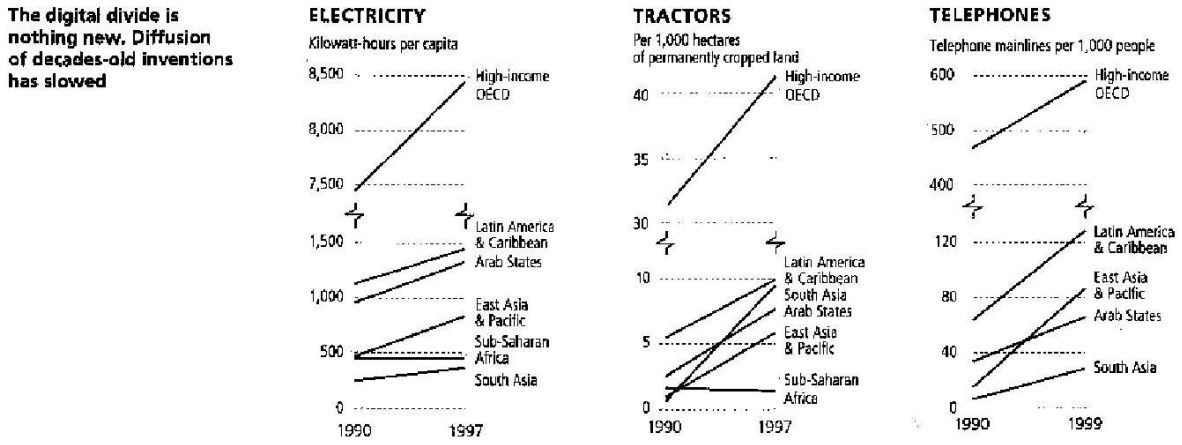


Figure 6: Diffusion of "old" technologies, Source: Human Development Report (2001).

- **Financial Markets**

  The liberalization of financial markets has been indeed the most striking phenomenon which has forcefully taken off over the last quarter of a century (cf. Blundell-Wignall and Browne (1991)). Just to provide an order of magnitude, in the 90's one day of foreign exchange trade was typically more than hundred times bigger than world yearly trade (see Eatwell (1996)). Together, barriers to capital movements have hurriedly come down and with that has grown also the volatility of financial flows. Remarkably, however, even in this case, "globalization" has gone much faster with respect to 'hot', short-term, speculative finance, with much lower impact — if any — upon long-term activities of investment and production (as discussed for the Latin American case in Ocampo (2002)). A plausible conjecture is indeed that in a few countries the latter activities have been made more marginal and more 'national'. At the same time, savings and investments have remained stubbornly national (on the so-called "Feldstein-Horioka puzzle" and its persistence, cf. Feldstein and Horioka (1980), Obstfeld and Rogoff (1996), Eatwell (1996)).

- **Institutional arrangements**

  Certainly, the current "globalized" regime of international and political relations is linked with the diffusion, or in many circumstances the **imposition** at gun point of specific institutional set-ups, drawn from a particular form of Western capitalism — the *laissez-faire* Anglo-Saxon one —, ranging from Stock Exchanges to Intellectual Property Right regimes.[4] However, the piecemeal diffusion of

[4]Cf., among others, Coriat (2002) and Stiglitz (2002).

elements of the "Anglo-Saxon model" is far from producing an international convergence to a unique institutional archetype, notwithstanding the violence through which it is often forced upon the international community by the organizations enforcing the so-called 'Washington consensus' (for thorough discussions see Berger and Dore (1996), Stiglitz (2002), Krugman (1999), Rodrik (2002b).

4 Beyond the "Globalization hype": on some ingredients of technological catch-up

In a nutshell, if our interpretation is correct, so-called "globalization" has mainly to do with: a) the international liberalization of capital movements and b) (a rather asymmetric) liberalization of trade flows, while bearing rather controversial effects upon the international patterns of technological learning and the related distribution of growth possibilities among countries.

First, a myth to dispell is that "globalization" — in the sense of higher international integration— comes naturally together with "convergence" or higher uniformity in technological capabilities. As argued at greater length in Pavitt (1999) and (2002), and Dosi, Orsenigo and Sylos Labini (2002), **knowledge as distinct from sheer information**, tends to be rather sticky in its transmission, embodied as it often is, in specific people, organizations and local networks.

Second, in a world characterized by multiple forms of localized increasing returns, greater integration may well lead to phenomena of **increasing differentiation** with self-reinforcement and lock-in of particular production activities, specialization patterns, technological capabilities (or lack of them).[5]

Putting it another way, it is easy to show that a world which becomes, at some level, increasingly integrated — but not (roughly) identical in initial conditions, institutions, technological capabilities, mechanisms of economic interaction, etc. — might be subject to various forms of "local" virtuous or vicious circles.

Third, the impact of greater integration is likely to depend on the modes through which it is implemented. The experience of many Latin American countries is a good case to the point. When macro ('globalizing') shocks suddenly induce higher selection upon domestic firms (especially in Latin America), massive mortality of firms does often entail an apparent reduction of the productivity gap *vis-á-vis* the international frontier. But this seems to come together — at least in Latin America — with striking increases in both unemployment rates (i.e. transitions of parts of the labour force —

[5]On the point, within a growing literature, see the complementary arguments of Arthur (1994), Dosi, Pavitt and Soete (1990), Krugman (1996), Antonelli (1995), Cimoli (1988).

as Joe Stiglitz put it — from low productivity to zero productivity states) and with tightening foreign-balance constraints to growth, in turn the joint outcome of relatively low elasticities of exports to world growth and high elasticities of imports to domestic growth (cf. Cimoli and Correa (2002)).

But then, if not "globalization", what are the relative invariant ingredients and processes, if any, driving technological catching-up? It is not a question that can be throughly answered in a short paper. Suffice to mention here that a variety of studies have pointed at particular combinations between forms of corporate organizations and institutional set-ups as particularly conducive or detrimental to technological accumulation.

In fact, the comparison between the experience of Far Eastern countries and Latin American ones is particularly revealing (cf. Amsden (1989) and (2002), Wade (1990), Kim and Nelson (2000), Dosi, Freeman and Fabiani (1994), among others). Table 10 dramatizes some of the most striking differences between those diverse comparative dynamics.

First, the level of public investment in education and R&D has been sensibly higher in most East Asian countries than in Latin America. At the end of the 80s all the four Asian Tigers already had an output of graduate engineers greater than that of Japan and also greater than most Latin American and OECD countries (cf. Table 7; see also the evolution in time of a few indicators of science and education for South Korea). Second, and complementary, private investment has been stronger and has affected crucially growing sectors. Third, governments of East Asian countries have balanced market regulations and incentives for specialized technological learning. Fourth, and relatedly, patterns of specialization for these countries have moved towards growing sector characterized by high income elasticities. Table 9 provides a synthetic appreciation of the 'dynamic quality' of export specialization of various economic regions.[6] Japan and the Asian Tigers appear to have been the most successful in reaping the benefits from fact growing markets.

Ultimately, success or failure appear to depend on the **combinations** of different institutional arrangements and policies, in so far as they affect **learning processes** by individuals and organizations, on the one hand, and **selection processes** (including of course market competition), on the other.

[6] In the elaborations presented, 'dynamic' ('declining') commodities are the ones showing an above (below) average growth of international demand in the OECD world.

Table 7: Engineers, Science and Maths students as a percentage of population, 1987.

	Engineering	Engineering, science and maths
Japan	0.34	0.40
Brazil	0.13	0.24
South Korea	0.54	0.76
Singapore	0.61	0.73
Taiwan	0.68	0.78

Source: Kim (1993).

Table 8: South Korea: Science and Education Indicators (1953-1987).

	1953	1970	1987
Literacy (%)	22	89	99
Middle School (12-14 years)(%)	21	53	99
High School (15-17 years)(%)	12	29	83
College/University (%)	3	9	26
Scientists/Engineers (No.)	4,157	65,687	361,920
Corporate R&D laboratories (No.)	-	1	455
Researchers (No)			
-Government	-	2,477	9,184
-Universities	-	1,918	17,415
-Private Industry	-	925	26,104
Total	-	5,320	52,783
R&D/GNP(%)	0.1	0.3	1.9

Source: Kim (1993).

Table 9: Dynamic efficiency of the Regional Patterns of Specializations: ratio of market shares in OECD imports in 'dynamic' vs 'declining' commodities, 1961-1989.

	Period					
					of which	
	1963-1971		1971-1989		1979-1989	
USA	1,22	1,22	1,63	1,39	1,72	1,60
Japan	2,45	3,52	1,64	3,15	3,40	3,34
EU (12 members)	1,52	1,23	1,55	1,21	1,98	1,40
Eastern Europe	0,41	0,38	0,58	0,53	0,83	0,25
Central and Latin America	0,38	0,22	0,21	0,39	0,28	0,36
Four Asian Tigers	1,48	2,29	2,38	2,58	3,40	3,08

Note: 'Dynamic' commodities are those which have undergone above average growth of OECD trade (imports) over the considered period.

Source: Elaborations by O. Mandeng on the CAN databank, ECLAC, Santiago de Chile.

Table 10: Divergence in National Systems of Innovation and Production in the 1980's and the 1990's

East Asia	**Latin America**
Expanding education system with high proportion of engineering studies	Deteriorating education system with proportionally lower output of engineers
Rapid growth of scientific and technical activities at enterprise level, especially R&D	Slow growth stagnation or decline of enterprise level R&D and other learning activities
Progressive integration of production design, marketing and research activities within the firm	Weakening of both R&D or decline of enterprise marketing (especially on foreign markets)
Development of strong science-technology infrastructure	Weakening of science-technology infrastructure
Strong influence of Japanese models of management and networking organization	Continuing influence of outdated management models
High levels of investment	Generally lower level of investment
Heavy investment in advanced telecommunications	Slow development of modern telecommunication
Strong and fast-growing electronic industries with high exports	Weak electronic industries with low exports
More generally, patterns of specialization favoring commodities with high income elasticities	Specialization in low income elasticity goods
Growing participation in international technology networks and agreements	Low level of international networking in technology
Rather sophisticated policy efforts aimed at fostering technological learning and generalizing rent-seeking even under regimes of protection of domestic markets (until the 80s)	From generalized protection with little anti-rent seeking safeguards to "wild market regimes" with little learning incentives
Relative egalitarian income distribution	Very unequal income distribution —and increasingly so—

More generally, a taxonomy might be useful on the levels (i.e. of the "control" and "state" variables) at which policies operate. Certainly, the historical experience shows a great variety of country and sector-specific combinations between the types of policies illustrated above. Some subtle regularities and trade-offs nonetheless emerge.

DOMAINS OF POLICY INTERVENTION	POLICY MEASURES
(i) Technological opportunities	Science policies, graduate education, 'frontier' technological projects
(ii) Technological capabilities	Broader education and training policies, policies affecting organization-embodied knowledge, diffusion policies.
(iii) Incentives and selection mechanisms	Policies affecting e.g. R & D subsidies; anti-trust and competition; trade; entry and bankruptcy, allocation of finance; markets for corporate ownership, IPR and more generally appropriability regimes
(iv) Institutional set-ups governing the distribution of information and the patterns of interactions amongst different types of agents (e.g. banks, shareholders, firm managers, workers,...)	Quite overlapping with the above, covering also e.g. labour market rules, within-firms arrangements for information-sharing mobility and control, etc.
(v) The identity of agents— *in primis* the nature, structure, ownership, etc. of business firms	From the formation of state-owned firms to their privatization, from 'national champions' policies to policies affecting MNCs investments

First, a regularity, holding from 19th century Europe and US all the way to con temporary times, is the centrality of public agencies, such as universities and public policies in the generation and establishment of new technological paradigms (Dosi (1982)).

Second, and relatedly, "incentives are often not enough". A crucial role of policies is to affect the **capabilities** of the actors, especially in the foregoing case of new technological paradigms, but also in all cases of catching-up whereby no reasonable incentive structure might be sufficient to motivate private actors to surmount big technological lags.

Third, market discipline is helpful in so far as it weeds out the low performers and rewards the high performers within particular populations of firms. However, nothing guarantees that too high selective shocks will not wipe out the entire populations

themselves, thus also eliminating any future learning possibility.

Fourth, policies —especially those aimed at catching-up — generally face the need to balance measures aimed at capability building (and also at protecting the "infant learner") with mechanisms stifling inertia and rent-seeking. For example, the latter are indeed one of the major element missing in the old Latin American experience of import substitution while the former are what is lacking under many more recent "liberalization" policies.

5 Conclusions

Amongst the many drawbacks of current 'globalization' patterns, one of the most serious ones for the long-term is the disempowerment of national governments and even supernational institutions (such as the EU) of many of the policy instruments which 'made the West grow rich', —paraphrasing Rosenberg and Birdzell (1987) — and also allowed in the past a few developing countries to get out of the poverty trap and join the club of the relatively rich exploiters of fast technological learning. Needless to say, also the mechanisms and degrees of disempowerment are different across the world: in some cases, to repeat, it is an item of imposed packages; in other (even less justifiable!) cases, it is a self-inflicted hardship paddled by market Talibans. However, such a disruptive side of the current 'globalization' mode luckily has not yet gone far enough. Still, policy making has a lot of unexploited degrees of freedom (and in different ways this applies from Brazilia to Brussels to Washington). As there are signs that the orgy of market fanatism is wearing out, it is high time to start focusing also on the policies and institutions fostering technological learning and its diffusion, across and within countries. That is, it is time to build a "new consensus" prominently featuring the exploration of forms of institutional governance which render knowledge accumulation and its efficient economic exploitation (at least partly) consistent with interests of profit-motivated agents. In all that, the existence of well-functioning markets is often, although not always, likely to play a central role. However, as Joe Stiglitz has repeatedly emphasized[7], the world is full of "market failures" (*in primis* the intrinsic failure associated with any purely market-driven generation of knowledge). Hence, a **sobering thought**: let us refine upon a pragmatic view of domestic and international markets, seen as instrumental to the achievement of more fundamental objectives — concerning e.g. productivity, income growth, welfare, etc.— rather than being objectives in their own rights.

[7]Cf. for example Stiglitz (1994).

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