Laboratory of Economics and Management
Sant'Anna School of Advanced Studies

Piazza Martiri della Libertà, 33 - 56127 PISA (Italy)
Tel. +39-050-883-343 Fax +39-050-883-344
Email: lem@sssup.it Web Page: http://www.sssup.it/~LEM/

LEM
Working Paper Series

Technological Learning, Policy Regimes and Growth in a 'Globalized' Economy: General Patterns and the Latin American Experience

Carolina Castaldi*[†]
Mario Cimoli[§]
Nelson Correa[†§]
Giovanni Dosi[†]

*ECIS, Eindhoven Technology University, the Netherlands
[§]ECLAC, Santiago de Chile
[†]LEM, Sant'Anna School for Advanced Studies, Pisa, Italy

2004/01 January 2004

ISSN (online) 2284-0400

Technological Learning, Policy Regimes and Growth in a 'Globalized' Economy: General Patterns and the Latin American Experience*

Carolina Castaldi[†§] Mario Cimoli[‡] Nelson Correa[‡§]
Giovanni Dosi[§]

Abstract

The aim of this work is to investigate the role played by the so-called 'globalization' processes of the last couples of decades on the international patterns of technological learning and on the distribution of incomes and growth.

First, we re-assess the evidence on the general patterns of the current "globalizing" tendencies at various levels of observation and we argue that 'globalization' has not gone together with international convergence in technological capabilities and incomes. We also focus on trends related to the 'ICT revolution' and we highlight the relevance of 'retardation factors' in explaining the rather limited impact of this new techno-economic paradigm.

The last couple of decades have also witnessed the international diffusion (or, more often, the imposition) of *laissez-faire* policy regimes. Their revealed impact upon technological learning and growth, however, is at best mixed, or straightforwardly negative. We exploit the case of Latin American countries to study the dramatic effect of liberalization policies. We show how these policies may produce a 'vicious growth path' when a country is not able to decrease its technology gap and improve its trade balance at the same time. Indeed, the general evidence and the lessons learnt from the Latin American experience both powerfully hint 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. We argue that policy making still has unexploited degrees of freedom and we suggest that one way to go is re-thinking the role of international and domestic markets.

---

*This work is a development upon Dosi and Castaldi (2002) and Cimoli and Correa (2002).

†ECIS, Eindhoven Technology University, The Netherlands
‡ECLAC, Santiago de Chile
§LEM, Sant'Anna School of Advanced Studies, Pisa, Italy

1 Introduction

The purpose of the work which follows is to offer a frame of interpretation for the international patterns 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" processes 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). We shall also focus on trends related to the 'ICT revolution', highlighting the still rather limited impact of the New Economy and offering an interpretation in terms of 'retardation factors' which affect the establishment of new 'techno-economic paradigms' (Section 4). Together, we investigate the impact, especially upon developing countries, of those dimensions of 'globalization' having to do with the 'diffusion' or imposition of that particular policy regime of management of macro variables and market governance, which goes under the heading of *Washington Consensus* (cf. J. Williamson (1990)). Notwithstanding relevant international differences in the implementation procedures, the general philosophy grounding such a policy archetype has ultimately involved the commitment to (i) blood-and-tears macro-stabilization policies, (ii) 'private-is-better-than-public-no-matter-what' market governance policies, and (iii) quite unconditional, *most often asymmetric*, international liberalization of trade and financial flows. In this respect, an 'experiment' – striking both from an interpretative point of view and for its dramatic social outcomes – is offered by many Latin American countries over the past quarter of century. The evidence provides a powerful example of how *laissez-faire* policies may produce a 'vicious' growth path leading to 'low growth traps' whenever a country is not able to decrease its technology gap with respect to the international frontier and improve its trade balance at the same time (Section 5).

As we argue in Section 6, neither the contemporary evidence nor the theory

[1]More detailed discussions by two 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 (2003).

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. Fortunately, we suggest, policy variables continue to be available to the engineering of collective development processes.

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.

Indeed, the club of major innovators has been quite small over the whole period of around two centuries and half since British industrialization, 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)).

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

Rather, one finds some, although not overwhelming, evidence of *local* convergence, i.e. convergence 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).

Bimodality hints at a separating tendency between poor and rich countries, char-

Table 2: Estimates of trends in per capita GNP (1960 US$ and prices, 1750-1977).

Year	Developed countries		Third World		Gaps	
	(1) Total ($bn)	(2) per capita	(3) Total ($bn)	(4) per capita	(5)=(2)/(4)	(6) Ratio of most developed to least developed
1750	35	182	112	188	1.0	1.8
1800	47	198	137	188	1.1	1.8
1830	67	237	150	183	1.3	2.8
1860	118	324	159	174	1.9	4.5
1913	430	662	217	192	3.4	10.4
1950	889	1054	335	203	5.2	17.9
1960	1394	1453	514	250	5.8	20.0
1970	2386	2229	800	380	7.2	25.7
1977	2108	2737	1082	355	7.7	29.1

Source: Bairoch (1981).

acterized by markedly different income levels. At the same time, the other part of the story, as discussed at length in Quah (1997), is that the same shape of a given distribution may conceal very different intra-distribution dynamics. Is it the case that poor countries have been converging to a common income level and rich countries to their own high level of income, or the two modes are also the result of shifting in ranking between poor and rich countries? The issue at stake is the respective weight of *persistence* and *mobility* of countries inside the distribution. Quah (1997) finds evidence that the period 1960-1988 has been characterized by high persistence of relative rankings, notwithstanding some important exceptions. The main events contributing to mobility have been the 'growth miracles' of countries like Hong Kong, Singapore, Japan, Korea and Taiwan and 'growth disasters' including some sub-Saharan African countries, but also Venezuela which was the among the first richest countries in 1960 and has dramatically fallen in the 'poor' countries club.

At the same time, across-group differences in growth performances appear to be rather persistent. Similarly, one observes persistently wide and in some cases widening (such as in a few Latin American cases) productivity gaps *vis-à-vis* the international frontier (cf. Table 3 for estimates of labor productivity relative to the US).

As discussed also in van Ark and McGuckin (1999) all available evidence witnesses a persistent dispersion in productivity measures. More specifically, while countries in the OECD area appeared to have moved on average closer to the US benchmark, the same cannot be said for the rest of the world.

A delicate but crucial issue concerns the relation between patterns of technical

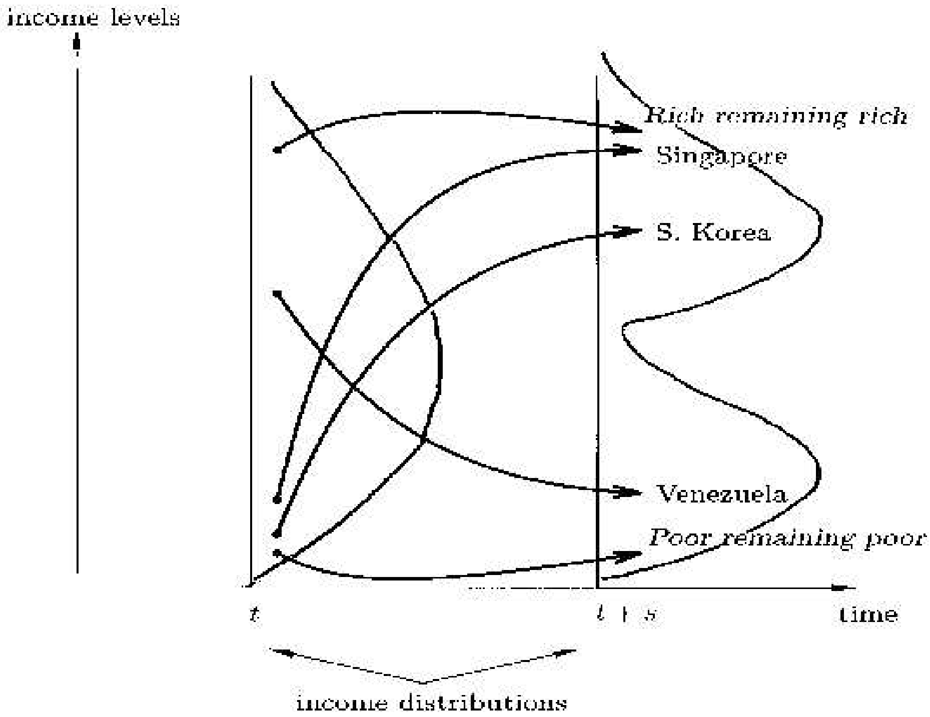


Figure 1: Evolving cross-country income distributions (Durlauf and Quah (1998))

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).

Table 3: 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) and Total Economy Database, Groningen Growth and Development Centre GGDC (2002a).

Table 4: Correlation coefficients between levels of Innovative Activity and GDP per capita.

	Correlation of GDP per capita with:	
Year	US patents per capita	R&D per capita
1890	0.20	
1913	0.38	
1929	0.56*	
1950	0.63*	
1963	0.73**	0.79**
1967	0.72**	0.69**
1971	0.74**	0.71**
1977	0.88**	0.61**
1985	0.78**	0.89**
1990	0.73**	0.94**
1995	0.68**	0.89**
1999	0.66**	0.85**

* Significance at 5% level
** Significance at 1% level

Source: Pavitt and Soete (1981) and own elaborations on OECD data (MSTI database and Patent database) and World Development Indicators 2001.

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 4. Moreover, innovative dynamism, measured by the growth of patenting by different countries in the US, always appears positively correlated with per capita GDP growth (as results from Table 5). 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. The link becomes again strong only in the second half of the 1990s, hinting at another change in regime.

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 (De Long (1988), Soete and

Table 5: Correlation coefficient between Innovative Activity and Output, 1890-1977, OECD countries.

	GDP growth (g) 1	GDP per capita growth (y) 2	US patents per capita at t=1 (PT) 3	US patents per capita growth (pt) 4	GDP per capita at t=1 (Y) 5
1890-1913					
g	1.00	0.60**	0.60**	-0.22	-0.18
y		1.00	0.20	0.05	-0.66*
PT			1.00	-0.61**	0.22
pt				1.00	-.67*
Y					1.00
1913-1929					
g	1.00	0.76*	-0.12	0.66*	-0.41
y		1.00	-1.21	0.67*	-0.62**
PT			1.00	-0.55**	0.38
pt				1.00	-0.43
Y					1.00
1929-1950					
g	1.00	0.82*	0.31	0.66*	0.37
y		1.00	0.41	0.58**	0.40
PT			1.00	0.22	0.56**
pt				1.00	0.67*
Y					1.00
1950-1970					
g	1.00	0.75*	0.38	0.89*	-0.76*
y		1.00	0.40	0.71*	-0.76*
PT			1.00	-0.48	0.63**
pt				1.00	-0.84*
Y					1.00
1970-1977					
g	1.00	0.91*	-0.67-	0.29	-0.47
y		1.00	-0.60**	0.16	-0.48
PT			1.00	-0.28	0.66*
pt				1.00	-1.16
Y					1.00
1985-1990					
g	1.00	0,95**	0.01	0.02	-0.27
y		1.00	-0.09	0.01	-0.3
PT			1.00	0.00	0,78**
pt				1.00	-0.05
Y					1.00
1990-1995					
g	1.00	0,94**	-0.33	0.18	-0.38
y		1.00	-0,45*	0.25	-0,43*
PT			1.00	-0.35	0,73**
pt				1.00 -0.26	
Y					1.00
1995-1999					
g	1.00	0,98**	-0.26	0,58**	-0,41*
y		1.00	-0.33	0,58**	-0,43*
PT			1.00	-0.08	0,68**
pt				1.00	-0.03
Y					1.00

* Significance at 5% level

** Significance at 1% level

Source: Pavitt and Soete (1981) and own elaborations on OECD data (Patent Database) and World development indicators 2001.

Verspagen (1993), Meliciani (2001), Laursen (2000), among others). In particular Fagerberg (1988) finds a close correlation between the level of 'economic development', in terms of per capita GDP, and the level of 'technological development', measured with the R&D investment level or with patenting activity.[2]

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 by a few successful latecomers (in different periods, 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 precisely 'globalization' stands for.

[2]His sample includes most world economies and covers the years 1960-1982.

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); 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 6 for the evidence on some major developed countries).

  Table 6: 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)

  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, one observes the persistence of striking international price differentials even in tradeable, low-trade-barriers, commodities (cf. the discussions in Rodrik (2002a) and Bradford (2003)).

- **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));
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 one observes significant ruptures in such patterns of specialization, such as in a few developing countries, they seem 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 (see also below).

- **Labor 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...[3] At the same time, persistently national labor markets have gone together with high and persistent asymmetries in the skills in the population: cf. Table 7 for evidence of cross-country differences in educational attainments.

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

Table 7: 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: United Nations, Human Development Report 2001.

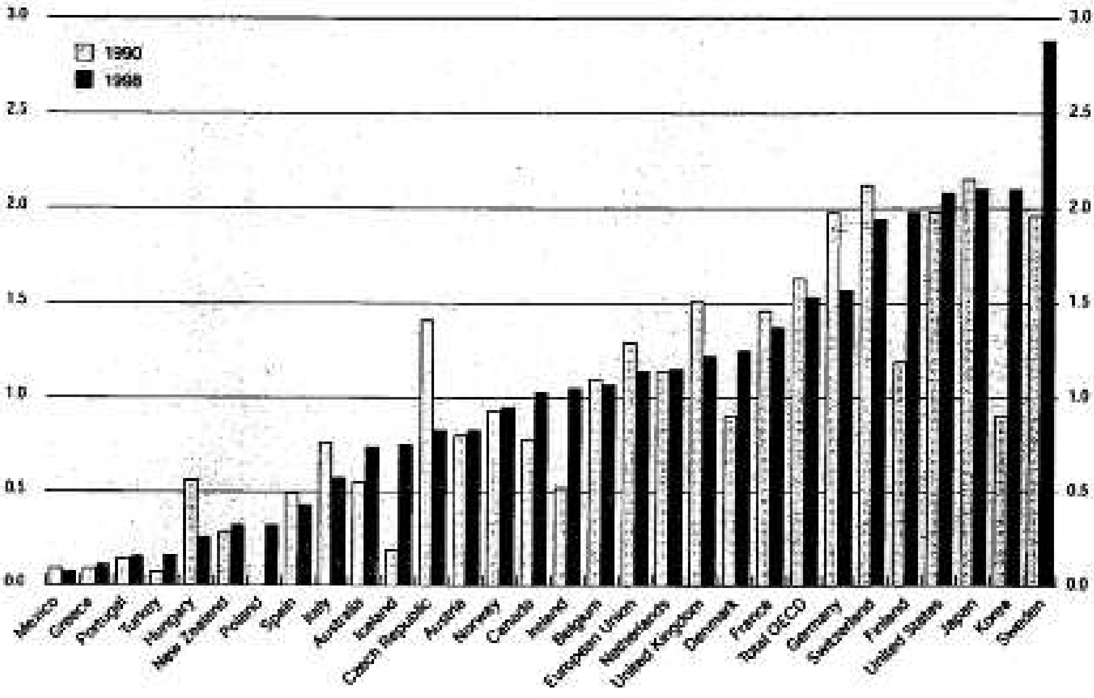


Figure 2: Intensity of firm level R&D in OECD countries. Source: OECD (2002).

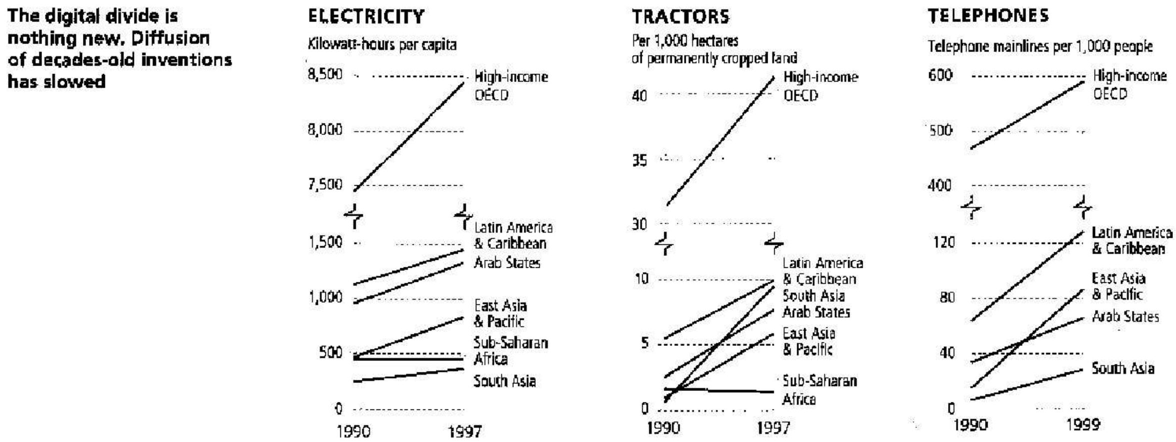
- **Patterns of generation and diffusion of innovations**

  One has already mentioned the continuing concentration of innovative activities — notwithstanding remarkable new entrants 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 by MNCs originating in countries different from that of their own origin 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 search activities occur within OECD countries (for discussion of the evidence cf. Patel and Pavitt (1997) and

Figure 3: Diffusion of "old" technologies, Source: United Nations, Human Development Report (2001).



(1999) and Cantwell (1992)).

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). Let us begin with the latter. Even in this case there is hardly any evidence of *generalized* patterns of convergence in their use at world level: see Figure 3. (We shall analyze the diffusion profile of "new" technologies below in Section 4.)

- **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 (see the discussion 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. In this respect, one of the major puzzles in international economics is the persistence of the so-called "Feldstein-Horioka puzzle". Feldstein and Horioka (1980) found a high correlation between national saving rates and domestic investment rates for OECD countries in the period 1960-1975. Recent cross-country estimates (Obstfeld and Rogoff (2000)) confirm a high correlation coefficient. Note that the higher is the correlation, the lower is capital mobility.[4] These results feed the puzzle because under a full integration of capital markets one would expect capital to flow to countries with higher expected returns. In principle savings should be directed to the most productive investments, hence one would predict that capitals from rich developed countries would contribute to investments in poor, but growing, developing countries. As discussed in Eatwell (1996), there are at least three elements that strongly point to an effective lack of integration across national capital markets. First, real rates of return persistently diverge and they diverge in ways which hardly seem to reflect just 'country risks'. Second, net capital flows tend to be directed to developed countries, the US in particular, and not to developing countries. Third, the capital flows directed to developing countries are more volatile and investments are usually in the most liquid financial assets. While foreign direct investment has recently increased for many developing countries, a huge amount of capital flows has instead been of a short-run, speculative nature.

- **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.[5] However, the piecemeal diffusion of **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] It should also be noted that this high correlation between saving and investment is not found at regional level, *within countries* (cf. Obstfeld and Rogoff (1996)), which hints at the specificity of the patterns of capital mobility across different institutional systems.

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

4 Globalization and the New Economy

In the analysis of international technological diffusion, ICT technologies deserves special attention. Recent developments in electronics and information processing technologies have certainly provided the ground for the emergence of a new 'techno-economic paradigm'. According to the seminal conjecture of Freeman and Perez (1988), the ICT revolution can be compared to other major techno-institutional revolutions of the past which ultimately revolutionized the entire socio-economic system such as those grounded in the introduction of the steam engine or of electricity. As in these other historical examples, also in the case of ICT one is dealing with far-reaching generic technologies that enter in a multiplicity of new products and in most production technologies.

Given all this, however, most available empirical evidence shows that the impact of the ICT revolution is still quite limited and asymmetric. The reasons behind this slow pace in the diffusion of the 'new economy' can be found in the very mechanisms underlying the emergence of any new techno-economic paradigm. Following the historical interpretation of Paul David (cf. David (1990, 2001)), one may recover deep analogies in the diffusion processes of electricity and computer. The **retardation factors** that have characterized the diffusion of e.g. electricity also appear in the processes of penetration of the new information technologies. Indeed a plausible conjecture is that there are retardation factors that necessarily accompany any technological revolution which have to do with painstaking processes of **co-evolution** and **co-adaptation** of **new technologies, new organizational forms, new institutions** and **new consumption patterns**. Even in the developed countries the diffusion of electricity took around 70 years, despite of the fact that electrical energy entailed a superior technology in most applications. The same, we suggest, applies to ICT technologies.

As just noted, retardation factors do not only concern the co-adaptation and refinement of different technologies, but also –and at least equally important– the interface between technology and society (social customs, consumption patterns, etc.).

The institutional co-evolution that accompanies the new technological paradigm entails the emergence of new institutional arrangements, for example new forms of trade and contracting such as e-commerce, e-markets, e-finance and the whole set of new arrangements that would be classified under the heading of New Economy. But one of the most important barrier in the development of these new institutional forms appears generally to be the lack of 'regulatory embeddedness'. For instance, who guarantees enforcement of contracts and integrity of markets and their operators? Which institutions should be designed and developed to provide regulatory embeddedness? All this poses big challenges to governments and economic agents and hints at a vast range of possible scenarios with respect to market structures, identities of the operators, future institutional settings.

Finally, it is useful to distinguish between *general* retardation factors, related to the global properties of ICT technologies, and *'retardation in the retardation'* factors that characterize the relative performance of single nations or single sectors.

with these premises in mind, let us consider some features of the patterns of diffusion of ICT in both production and consumption.[6]

4.1 Diffusion of new technologies in production and consumption

Diffusion of the new ICT technologies has occurred in a highly asymmetric way across countries and has apparently had so far a *relatively* small impact on the economy. It is useful to start by distinguishing the relative impact on production and consumption.

As for **production**, there has been an increasing investment in ICT capital for the last 30 years and a rising factory automation, from mechanical engineering to continuous cycle processes. However, one can safely claim that we are still in an initial phase of the diffusion of ICT technologies with a consistently unexpressed potential. These phenomena have concentrated in the leading industrialized countries, but even in the United States ICT investment represents less than 30% of total investment and the share reduces considerably for European countries. In Italy ICT investments are about 15% of the total (Colecchia and Schreyer (2002)).

Relatedly, the degree of automation in production has greatly increased, but circumstantial evidence suggests that this holds only for those countries leaders of industrial production. As an illustrative example, Table 8 provides the number of robotic units and mechanical arms installed for a sample of countries. After some normalization via national value added in manufacturing, one gets an estimate of the relative rates of diffusion of robotics. Japan is the leader, followed by the European countries and Korea, and finally by the US, at great distance.

A complementary but different picture comes out from data on expenditure for Information Technology which can be taken as a proxy for the overall automation of the economy. The percentages remain quite small in size (Table 9). Moreover the comparison of the two previous tables uncovers the puzzling position of the United States. The evidence indicates that Japan and Europe lag behind the US in terms of total automation (as proxied by the level of ICT investment), while on contrary the US lag behind in terms of factory automation (the same controversial evidence was

[6] In that a good deal of the evidence is unfortunately restricted, due to availability reasons, to OECD countries. However, the conclusions are likely to apply, *even more so*, to developing ones.

Table 8: Number of robotic units and mechanical arms installed, 2000.

Country	Number of units	Ratio to Industry Value Added (base=1000)
Japan	389.000	378
Germany	91.184	139
US	89.880	37
Italy	47.621	113
Korea	37.987	122

Source: Own elaborations on data from UCIMU (2001) and OECD.

already pointed out in Arcangeli, Dosi and Moggi (1991)).

As for **consumption**, the evidence again points to a diffusion of new technologies that is highly uneven across countries, even within the OECD. Table 10 reports on the strength of the IT infrastructure in a sample of countries. The ranking of countries now changes. US is far ahead in the 'informatization' of its society and the other developed countries follow at considerable distance (the only relevant exception comes from mobile phones).

Relatedly, another fundamental property of new techno-economic paradigms is the fact that they are of being associated also with the development and diffusion of a wide range of new products in consumption. So, for example, in the case of electricity, the 'revolution' has brought durable goods that would not have been possible without the new technology. Conversely, the 'ICT revolution', *so far*, has only marginally affected demand patterns. Consumption baskets remain quite sticky and no 'new good' has taken up the role that cars or refrigerators played in the previous phase of growth. Cross-country data confirm that ICT goods account at most for 6% of total household consumption. The main ICT goods included are telephone and tele-fax equipment and services, information processing, media and photographic equipment. (In Italy the share is only 3.8%, mainly mobile phones).

Table 11 and Figures 4 and 5 add further evidence on the uneven diffusion of ICT technologies. Note the impressive international differences in the diffusion of ICT technologies: compare for example Finland with Poland or East Asia with Latin America.

Table 9: IT expenditure (Information Technology, excluding Communication), as a percentage of GDP.

Country	1992	1996	2001
US	4.45	4.93	5.30
Japan	3.83	3.60	4.00
EU15	3.03	3.17	4.17
Sweden	4.37	4.73	6.77
UK	4.43	4.9	5.62
Netherlands	3.96	3.84	5.19
Denmark	3.94	4.1	4.99
France	3.59	3.74	4.75
Belgium	3.38	3.34	4.48
Finland	2.93	3.36	4.38
Germany	2.94	2.96	4.22
Austria	2.73	2.8	3.78
Norway	3.24	3.26	3.66
Italy	1.8	1.78	2.48
Ireland	2.35	2.18	2.25
Spain	1.62	1.56	1.94
Portugal	1.24	1.48	1.93
Greece	0.71	0.90	1.20

Source: Elaborations of Eurostat data.

Table 10: Indicators of ‘new economy infrastructure’ per 100 inhab., 2001.

	Internet hosts (per 10.000)	Estimated PCs	Cellular mobile subscribers	Broadband penetration *
Argentina	1.2	5.3	18.6	-
Brazil	1.0	6.3	16.7	-
Chile	0.8	8.4	34.0	-
Colombia	0.1	4.2	7.6	-
France	1.3	33.7	60.5	60
Germany	2.9	33.6	68.3	95
Italy	1.2	19.5	83.9	44
Japan	5.6	34.9	58.8	108
Mexico	0.9	6.9	21.7	-
Peru	0.1	4.8	5.9	-
UK	3.7	36.6	78.3	25
US	37.1	62.3	44.4	321
Uruguay	2.1	11.0	15.5	-
Latin America [1]	0.9	6.7	17.2	-
World [2]	1.7	11.5	25.4	-
Europe [3]	4.2	30.9	75.1	-

1 Simple average, 7 countries

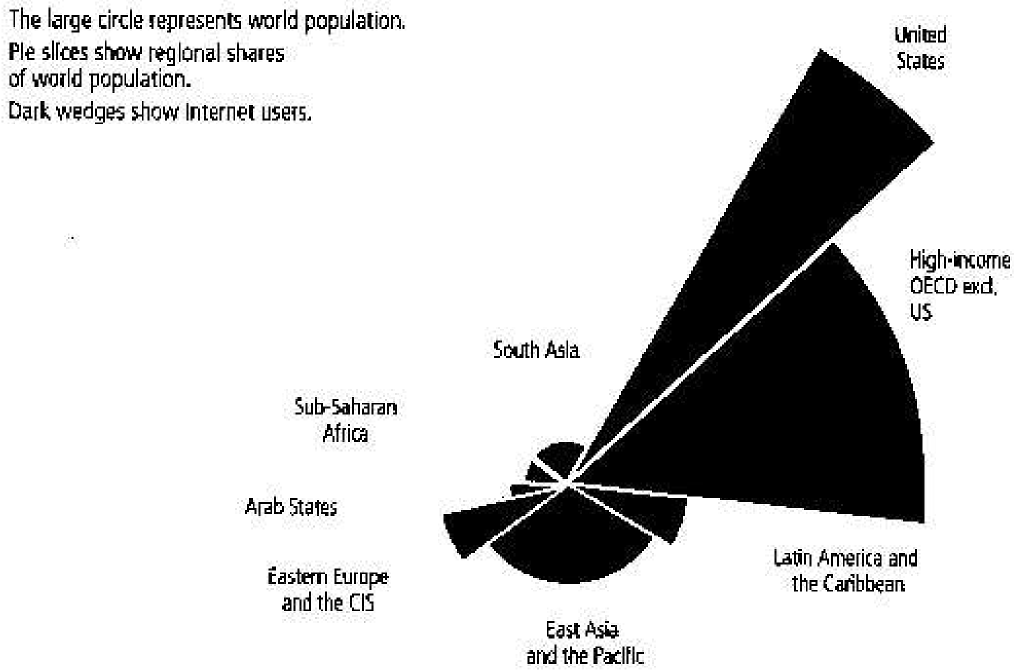
2 Simple average, 149 countries

3 Simple average, 12 countries (Italy, France, Germany, Belgium, Luxembourg, Netherlands, United Kingdom, Spain, Portugal, Denmark, Grecce, Ireland).

* Number of DSL, cable, modem lines and other broadband connections, from OECD (2002).

Source: Elaborations on data from International Telecommunication Union (ITU).

Figure 4: Intensity of Internet use in different countries and regions. Source: United Nations, Human Development Report (2001)).



	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 5: Uneven growth in the percentage of Internet users.

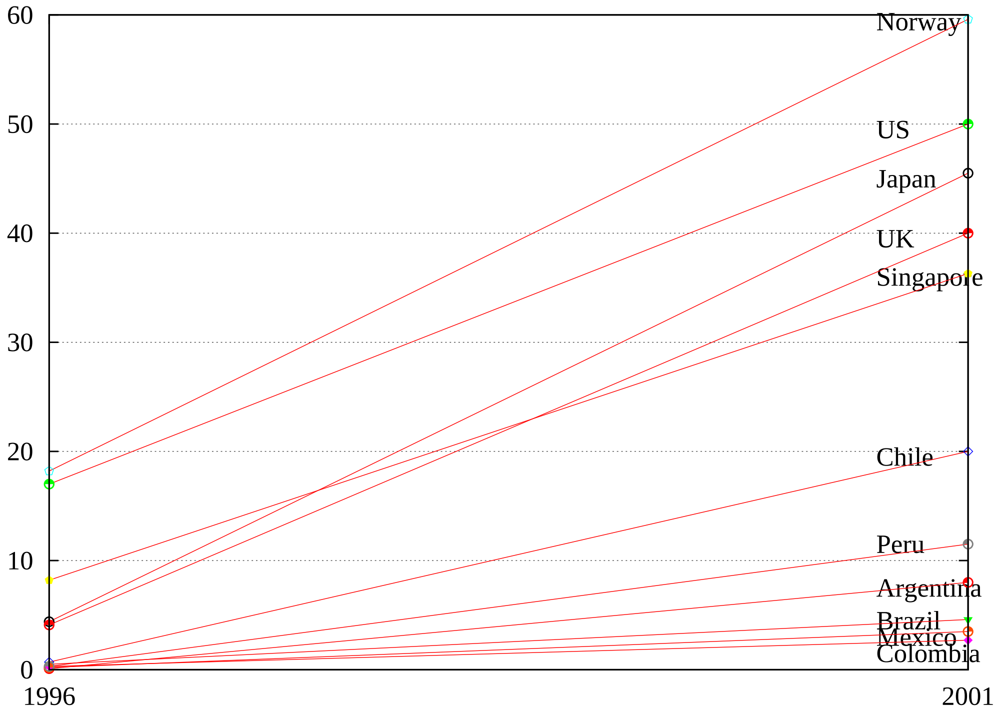


Table 11: Indexes of ICT diffusion

		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 United Nations Millennium indicators.

Table 12: Share of ICT manufacturing in total manufacturing value added, 2000

	Total ICT manufacturing	Computer and office equipment
Finland	21.66	0.01
Korea* (1)	17.40	4.38
Japan (2,3)	14.02	2.20
US	12.75	2.55
UK	9.65	1.69
Sweden	6.96	0.42
Netherlands	6.82	0.55
Denmark	6.55	0.97
France	6.27	0.62
Germany* (1,2)	4.99	0.44
Italy	3.44	0.31
Spain	3.24	0.62
"MNC platforms"		
Ireland* (1)	18.74	10.42
Mexico	8.10	3.08

* 1999

1. Rental of ICT goods (7123) is not available.
2. ICT Wholesale (5150) is not available.
3. Includes only part of computer related activities.

Source: Our own elaborations on OECD estimates, based on national sources; STAN and National Accounts databases, September 2002.

Table 13: Share of ICT services in total business services value added, 2000.

	Total ICT services	Telecom services	Computer and related services
Sweden	12.64	4.50	5.67
Finland	11.94	5.51	3.67
Netherlands	11.51	2.19	3.85
UK	10.62	3.72	4.18
US	10.61	4.42	4.38
Denmark	9.70	3.20	2.63
Spain	9.68	5.87	2.06
France	9.13	2.83	4.04
Italy	8.41	3.39	3.63
Korea* (1)	7.49	0.55	1.74
Japan (2,3)	7.37	5.47	1.77
Germany* (1,2)	6.71	3.42	3.29
"MNC platforms"			
Ireland* (1)	14.69	5.06	6.96
Mexico	4.34	3.12	0.21

* 1999

ICT services include Telecom services, Computer and related services, ICT wholesale and Rental of ICT goods.

1. Rental of ICT goods (7123) is not available.
2. ICT Wholesale (5150) is not available.
3. Includes only part of computer related activities.

Source: Our own elaborations on OECD estimates, based on national sources; STAN and National Accounts databases, September 2002.

4.2 Retardation factors

The foregoing evidence largely supports the view that the 'ICT revolution' is far from having expressed its full potential yet. 'Technological revolutions' display long diffusion processes, because they entail co-evolution and co-adaptation of new technologies, new organizational forms, new institutions, new consumption patterns:

> "The eventual supplanting of an entrenched techno-economic regime involves profound changes whose revolutionary nature is better revealed by their eventual breadth and depth of the clusters of innovation that emerge than by the pace at which they achieve their influence. Exactly because of the breadth and depth of the changes entailed, successful elaboration of a new 'general purpose' technology requires the development and coordination of a vast array of complementary tangible and intangible elements: new physical plant and equipment, new kinds of workforce skills, new organizational forms, new forms of legal property, new regulatory framework, new habits of mind and patterns of taste." (David (2001), p.53)

These are indeed the structural retardation factors common to both the older electricity-based techno-economic paradigm and the new ICT-based one (see David (1990) for an illuminating comparison between the fates of the 'dynamo' and of the 'computer'). As recently emphasized by Perez (2002), in the process of establishment of new techno-economic paradigms, sheer technological factors are deeply intertwined with social ones:

> "Each technological revolution, originally received as a bright new set of opportunities, is soon recognized as a threat to the established way of doing thing in firms, institutions and society at large.
>
> The new techno-economic paradigm gradually takes place as a different 'common sense' for effective action in any area of endeavor. But while competitive forces, profit seeking and survival pressures help diffuse the changes in the economy, the wider social and institutional spheres where change is also needed are held back by strong inertia stemming from routine, ideology and vested interests. [...]
>
> It is thus that the first 20 or 30 years of diffusion of each technological revolution lead to an increasing mismatch between the economy and the social and regulatory systems." (Perez (2002), p.26)

4.2.1 E-commerce and e-business: a paradigmatic example

As a revealing illustration of 'retardation factors' at work, let us consider the cases of *e-business* and *e-commerce*, as such examples of new ICT-based forms of trade that have developed inside what is commonly called the New Economy. Trading, purchasing and selling through the Internet are showing new forms of inter-firm and firm-to-consumer relationships. Impressively growing, e-commerce remains however quite small in size. Even in the United States, certainly the leading country in terms of diffusion, the US Department of Commerce (2002) estimates that e-commerce still accounts for only a 1% share of total US retail. Table 14 provides illustrative evidence that consumers still rely very little on the Internet for their purchases, the more so if one considers that the figures do not provide any insight on the actual value of the goods and services bought on line (actually the definitions used are not very stringent: a person is considered an active consumer even if she only buys a book from Amazon.com!). Hence, even more so, the low percentages of individuals purchasing on the Internet indicate that the process is still in a very early take-off phase.

Table 14: Individuals purchasing over the Internet, 2001 or latest available year.

Percentages	Individuals ordering goods or services over the Internet (a)	Individuals using the Internet (b)	Ratio (a)/(b)
Sweden	28.5	76.0	37.5
Denmark	23.3	62.0	37.5
US	22.5	58.4	38.5
UK	20.9	55.0	38.0
Canada	14.6	60.8	24.0
Netherlands	11.4	57.0	20.0
Finland	11.2	63.7	17.6
France	1.9	38.0	5.0
Italy	1.7	18.5	9.2

Source: OECD (2002).

Regarding firms, OECD (2001) provides estimates of the share of businesses that are actively selling and buying on-line and confirms that the Internet channel is still under-used by firms. Table 15 provides information on the relevance of Internet sales in total sales of companies that are active in e-commerce. Even in Finland only 0.39% of big firms (reasonably a handful) rely on Internet for more than a half of their sales. It should also be noted that percentages are generally higher for big firms than for small firms. This is in line with all empirical evidence showing that bigger firms have higher rates of adoption of ICT technologies. Here lies one of the possible additional factors of retardation for countries notably characterized mostly by small and medium-sized

Table 15: Distribution of e-commerce sales by firm size, Europe, 2000. Percentage of businesses in a country whose sales over the Internet as a share of total sales are higher than a given percentage.

	Small businesses (10-49 employees)					
Sales B2B	> 1%	> 2%	> 5%	> 10%	> 25%	> 50%
Denmark	11.36	8.92	6.48	3.15	0.74	0.37
Sweden	10.26	8.36	6.82	4.37	1.33	0.00
Finland	9.23	7.06	4.83	2.40	0.84	0.16
Norway	7.22	4.63	3.18	1.65	0.38	0.14
UK	6.63	5.13	3.32	1.51	0.50	0.27
Austria	5.73	5.40	3.71	1.94	0.65	0.24
Greece	4.08	3.47	2.70	1.76	0.70	0.63
Portugal	3.30	2.20	1.34	0.76	0.23	0.14
Italy	2.25	1.52	1.21	0.86	0.24	0.13
Spain	1.06	0.82	0.66	0.62	0.28	0.22

	Large businesses (more than 250 employees)					
Sales B2B	> 1%	> 2%	> 5%	> 10%	> 25%	> 50%
Sweden	19.16	14.50	10.57	7.37	2.46	
Finland	16.60	9.18	5.86	3.32	0.39	0.39
Denmark	16.22	9.45	5.34	3.29	1.23	1.23
Norway	13.57	7.20	5.82	1.94	0.28	
UK	10.63	6.81	5.30	2.94	1.28	0.41
Spain	9.71	5.87	3.84	2.51	1.57	0.51
Austria	8.25	4.85	2.55	1.82	0.85	0.24
Portugal	7.50	4.44	2.98	1.76	0.54	0.31
Greece	5.63	3.75	3.13	3.13	1.25	0.63
Italy	5.16	3.50	2.63	1.93	0.35	0.18

Source: OECD (2002), E-commerce Pilot Survey 2001.

firms, such as Italy. At the same time this may hint at a potential for increasing returns that may sustain market concentration.

More generally, we suggest that the (relatively) low diffusion of e-businesses is associated with two fundamental bottlenecks, namely:

1. the lack of a thorough **regulatory embeddedness** of such transactions (e.g. in terms of enforcement of contracts) that affects reputation mechanisms (i.e., ultimately, **institutional retardation factors**);

2. the need for reliable ‘coding technologies’ which guarantee that on line transactions are safe and data are protected (i.e., sheer **technological barriers**).

Consider in particular the institutional barriers to innovation diffusion. New forms of trade such as the ones implied by e-commerce and e-finance bring in the forefront delicate issues related to the ‘integrity’ of the new markets. With the new technologies it becomes more difficult, for example, to check the identity of economic agents and to sanction deviant behaviors. The existing institutions that provide the ‘regulatory embeddedness’ for “old” transactions are no longer sufficient to guarantee the new forms of trade. In particular new arrangements are needed to ensure integrity and enforcement of contracts.

The interpretation we want to propose here is that any historical emergence of new forms of trading has been associated with the development of new institutional mechanisms aimed at providing trading processes in some governing institutions. A very old example with bearings on contemporary issues is discussed in Milgrom, North and Weingast (1990), concerning the emergence of the Law Merchant System protecting Medieval fairs. Such institutional system was able to ensure the effectiveness of reputation mechanisms even when the trade arena enlarged beyond a critical level whereby traders were not meeting the same trading partners on a regular basis. The new institution succeeded in creating incentives for merchants both to behave honestly and to sanction deviant behavior by others. And this was achieved using crucially less information than would be needed to instill perfect information for all agents in the system, a condition way too costly to fulfill. There is a lesson here for the “new economy” in its needs to develop reputation mechanisms, forms of community identification and tools for contract enforcement.

Take this example just as suggestive illustration of more general *co-evolutionary requirements* linking the diffusion of new technological paradigms and the painstaking developments of new institutional arrangements governing microeconomic interactions.

Another – equally important and deeply related – level of analysis regards the impact of broad *policy regimes* upon both processes of knowledge accumulation and ultimately growth patterns. It happens that at the level of policy and institutional design Latin America represents a striking *albeit* socially sad "experiment".

5 *Laissez-faire* regimes, trade openness and technology gaps in Latin America: a "low growth trap"

The last couple of decades of "globalization" have gone hand-in-hand with powerful efforts to impose a policy regime grounded in rather extreme forms of economic orthodoxy, which in the case of developing countries has gone under the name of "Washington Consensus". Of that Latin America has been an exemplar victim.

Indeed, for the past quarter of century most Latin American countries have been undergoing a process of structural adjustment which has included, among other policy measures, the elimination of the trade barriers adopted during the 'import substitution' industrialization phase, the privatization of large domestic firms and the de-regulation of the labor and financial markets.

Let us consider in particular the tangled relationships between technology, trade and growth, against the background of the orthodox prescription according to which openness was crucial for industrialization and would have enhanced growth opportunities in developing countries (Krueger (1980, 1997), Srinivasan and Bhagwati (1999)).

Several years into this process, one is in the position to assess the link between trade liberalization and growth and indeed it does not turn out to work the way it had been expected. The poor results of liberalization as a strategy for supporting a prosperous growth path are increasingly emerging. Moreover, the weakness of such a purported link does not merely appear to be a pathology specific to certain countries and/or historical accidents. Rather, it is a widespread pattern that most of the Latin American countries have proved to be unable to achieve the growth rates that prevailed in the 'import substitution' period (Rodriguez and Rodrik (1999), ECLAC (2002), Ocampo (2003)).

We present an analysis of the growth pattern in Latin America and of how it depends not only on balance-of-payments conditions and the characteristics of the specialization pattern, but also on differences in technology and the capacity to capture the latter's benefits. The differences in technology and their dynamics will be introduced among many variables that determine growth potential through the effect of what will be referred to below as the 'technology gap multiplier'. Together, the analysis will also demonstrate that the incentives created by trade liberalization do not

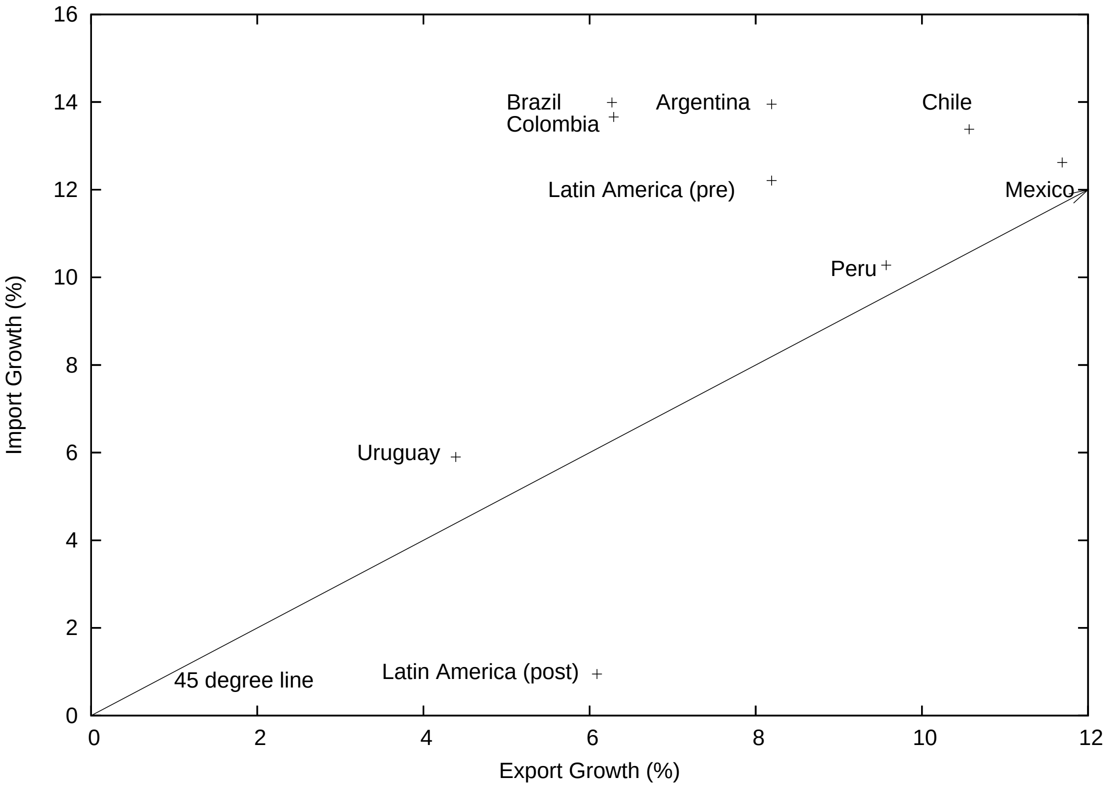


Figure 6: Import and export growth rates in the post-reform periods (Latin America calculated as an average of all countries). Source: Cimoli and Correa (2002) on ECLAC data.

necessarily stimulate a virtuous growth path compatible with long-term equilibrium in foreign balances.

5.1 Liberalization strategies and performance

One way to determine how policies aimed at trade liberalization and the adoption of an "outward" orientation have influenced growth is to investigate the main tendencies and constraints that characterized the Latin American economies following economic reform (Ocampo (2003)).

Let us start by comparing a few relevant macro-variables referring to different key periods before and after the implementation of reforms. For our purpose here, it is useful to distinguish between:

(i) the 'Import Substitution Golden Age' (IS Golden Age), which includes the years 1950-1973 for all countries in our sample;

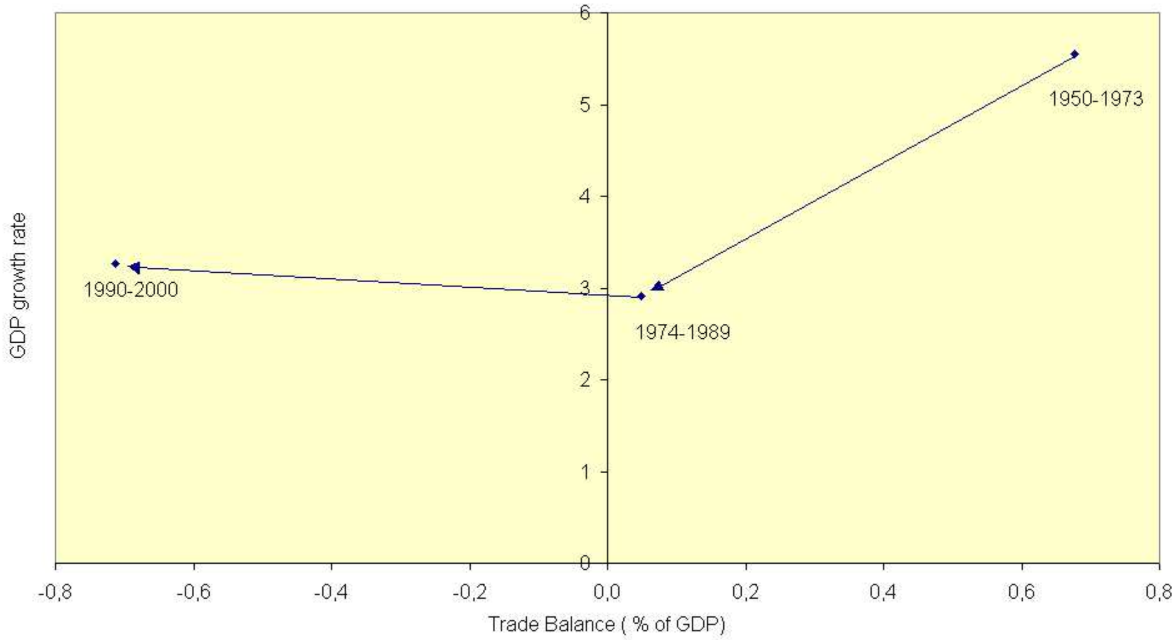


Figure 7: Average growth rate and trade balance in the region (19 Latin American countries, 1950-2000, weighted average). Source: Own elaborations on ECLAC data.

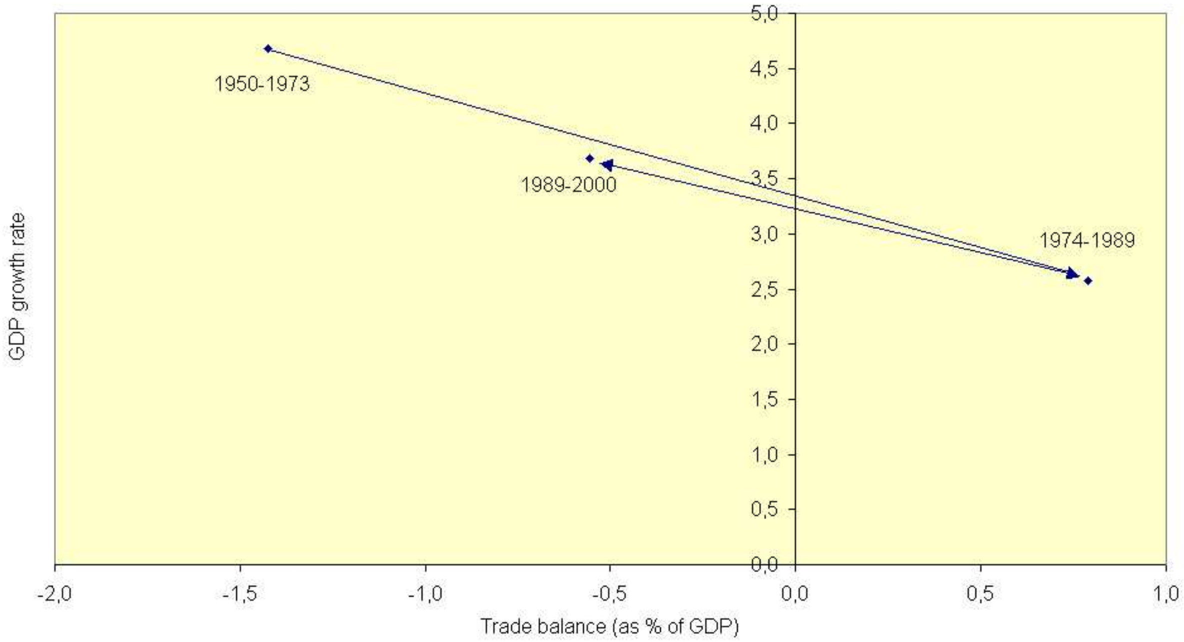


Figure 8: Average growth rate and trade balance in the region (7 Latin American countries, 1950-2000, simple average). Source: Own elaborations on ECLAC data.

(ii) a 'Pre-Trade Reforms' period of shocks and adjustments (Pre-Reforms);

(iii) a 'Post-Trade Reforms' regime (Post-Reforms).

Most analyses only investigate the last two periods and basically refer to the timing of the 'Before reforms' and 'After reforms' periods used in Stallings and Peres (2000) and Ramos (1997). The 'Before reforms' period is defined as a quite long set of years which in fact covers a rather uncertain phase including also the 'lost decade' of the 80s. For some countries this period does *not* entail trade liberalization, but most often does present rather wild restrictive macro-policy shocks. We choose to include in our analysis also the IS Golden Age. Hence, we are able to detect even more dramatically the impact of liberalization reforms upon Latin American countries.

As the region opened up, it did witness a large increase in both exports and imports (see Table 16). Exports rose after economic reforms were implemented, but import requirements increased even more, thus *tightening further* the trade balance constraint on GDP growth (see Figure 6). Overall, empirical evidence shows that the average growth rate of GDP decreased dramatically after the liberalization reforms. Together the trade deficit widened (see Figure 8). Indeed, both import and export elasticities appear significantly higher in the last period, but the elasticity of imports remains generally greater than the elasticity of exports. In that, the role played by the balance of payments as a determinant of domestic economic performance emerged clearly in the post-reform period (see also Moreno-Brid (1999), Perez and Moreno-Brid (1999), Frenkel and Gonzalez (1999), Holland et al. (2001)).

Moreover, if economic and trade performance of most countries in the region appear to deteriorate after liberalization reforms as compared to the uncertain phase of the 'Pre-Reforms' period, the evidence is *a fortiori* stronger when the comparison is carried out with respect to the Golden Age. Table 17 reports ratios of the relevant indicators between different periods and also includes comparisons with the corresponding US values.

In addition to aggregate growth performance and trade balance changes it is useful to look at the specialization patterns of Latin American countries countries and at how these have changed after the liberalization reforms.

Table 18 provides a synthetic appreciation of the 'dynamic quality' of export specialization of various economic regions.[7] Japan and the Asian Tigers appear to have been the most successful in reaping the benefits from fast growing markets, while Latin American countries exports have been mainly in commodities characterized by low income elasticity with respect to international demand.

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

Country	**Period**	**Years**	Growth rate g_y	Import elasticity η_m	Export elasticity η_x	Change in Productivity gap (ψ)	Trade/tech. multiplier λ
Argentina	IS Golden Age	1950-1973	3,49	0,42	0,71	-	-
	Pre-Reform	1974-1990	0,34	-3,10	14,29	0,89	-0,29
	Post-Reform	1991-2000	3,44	4,06	2,38	1,18	0,29
Brazil	IS Golden Age	1950-1973	7,20	0,80	0,78	-	-
	Pre-Reform	1974-1989	4,07	-0,27	1,98	0,58	-2,13
	Post-Reform	1990-2000	2,63	5,33	2,39	1,41	0,26
Chile	IS Golden Age	1950-1973	3,64	1,45	0,60	-	-
	Pre-Reform	1974-1984	1,63	-0,38	3,81	1,69	-4,48
	Post-Reform	1985-1998	6,75	1,98	1,57	0,79	0,40
Colombia	IS Golden Age	1950-1973	5,20	0,57	0,88	-	-
	Pre-Reform	1974-1989	4,12	0,82	1,28	0,61	0,74
	Post-Reform	1990-1999	2,50	5,47	2,52	0,68	0,12
Mexico	IS Golden Age	1950-1973	6,56	0,66	0,69	-	-
	Pre-Reform	1974-1985	10,90	0,91	1,38	0,73	0,81
	Post-Reform	1986-2000	3,44	3,67	3,40	0,80	0,22
Peru	IS Golden Age	1950-1973	5,12	1,19	0,99	-	-
	Pre-Reform	1974-1989	0,75	-5,46	2,85	-0,77	0,14
	Post-Reform	1990-2000	4,05	2,54	2,36	1,13	0,44
Uruguay	IS Golden Age	1950-1973	1,55	-0,12	-0,25	-	-
	Pre-Reform	1974-1977	3,67	-0,14	4,23	0,47	-3,44
	Post-Reform	1978-2000	1,89	3,13	2,33	1,06	0,34
Latin America *	IS Golden Age	1950-1973	4,68	0,79	0,73	-	-
	Pre-Reform	1974-1989	2,58	0,37	2,36	0,43	1,17
	Post-Reform	1990-2000	3,69	3,31	2,22	1,15	0,35

*Simple averages; the productivity gap is calculated with data for Chile until 1998 and for Columbia until 1999.

Table 16: Indicators of growth and trade balance performance for three different periods. The table reports average growth rates of income g_y, elasticities of imports η_m and exports η_x and comparison with US figures. The last column (ψ) reports the change in productivity gap, i.e. the percentage change in productivity for the country relative to the same change in the international technological frontier. Thus a value higher than 1 stands for catching-up. Source: Own elaborations on ECLAC statistics and Bureau of Economic Analysis (US Department of Commerce).

Country	Period	Growth rate		Import elasticity		Export elasticity	
		g_y	g_y^{US}	η_m	η_m^{US}	η_x	η_x^{US}
Argentina	(1950-1973)/(1974-1990)	10,27	1,27	-0,13	0,95	0,05	0,85
	(1950-1973)/(1991-2000)	1,02	1,10	0,10	0,58	0,30	0,81
	(1974-1990)/(1991-2000)	0,10	0,86	-0,77	0,61	6,00	0,95
Brazil	(1950-1973)/(1974-1989)	1,77	1,23	-2,92	0,96	0,39	0,90
	(1950-1973)/(1990-2000)	2,74	1,24	0,15	0,58	0,33	0,72
	(1974-1989)/(1990-2000)	1,55	1,01	-0,05	0,60	0,83	0,80
Chile	(1950-1973)/(1974-1984)	2,22	1,32	-3,83	0,90	0,16	1,29
	(1950-1973)/(1985-1998)	0,54	1,28	0,73	0,72	0,38	0,57
	(1974-1984)/(1985-1998)	0,24	0,96	-0,19	0,80	2,43	0,44
Colombia	(1950-1973)/(1974-1989)	1,26	1,23	0,70	0,96	0,68	0,90
	(1950-1973)/(1990-1999)	2,08	1,26	0,10	0,60	0,35	0,74
	(1974-1989)/(1990-1999)	1,65	1,03	0,15	0,62	0,51	0,82
Mexico	(1950-1973)/(1974-1985)	0,60	1,29	0,73	0,91	0,50	1,36
	(1950-1973)/(1986-2000)	1,91	1,24	0,18	0,68	0,20	0,61
	(1974-1985)/(1986-2000)	3,17	0,96	0,25	0,75	0,41	0,45
Peru	(1950-1973)/(1974-1989)	6,86	1,23	-0,22	0,96	0,35	0,90
	(1950-1973)/(1990-2000)	1,26	1,24	0,47	0,58	0,42	0,72
	(1974-1989)/(1990-2000)	0,18	1,01	-2,15	0,60	1,20	0,80
Uruguay	(1950-1973)/(1974-1977)	0,42	1,22	0,85	0,97	-0,06	2,04
	(1950-1973)/(1978-2000)	0,82	1,31	-0,04	0,72	-0,11	0,73
	(1974-1977)/(1978-2000)	1,95	1,07	-0,04	0,75	1,82	0,36
Latin America	(1950-1973)/(1974-1989)	1,82	1,23	2,12	0,96	0,31	0,90
	(1950-1973)/(1990-2000)	1,27	1,24	0,24	0,58	0,33	0,72
	(1974-1989)/(1990-2000)	0,70	1,01	0,11	0,60	1,07	0,80

Note: The values are calculated as the ratio between different periods.

Table 17: Variation of main economic indicators in the different development phases (1950-2000) for Latin American countries and in comparison with the US. Source: Own elaborations on ECLAC statistics and Bureau of Economic Analysis (US Department of Commerce).

Table 18: 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.

Geographically, two separate patterns appear to have emerged for Mexico and the Central American countries, on the one hand, and South America, on the other. The South American countries have intensified their specialization in natural resources and standardized commodities. These are now highly capital-intensive industries with low domestic value added. Firms producing for local markets - which are labor-intensive and engineering-intensive - have suffered most from trade liberalization and market deregulation initiatives. Conversely, countries such as Mexico and the Central American nations have greatly globalized their manufacturing and assembly activities based on cheap labor. The structural features of the specialization pattern have affected the capacity to achieve equilibrium on the current account (Katz and Stumpo (2001)).

The Chilean experience is an interesting one, which at a first look is in conflict with the thrust of our argument. Indeed, between the mid-1980s and the end of the 1990s, Chile experienced an impressive rate of growth for a country whose export bundle consisted almost exclusively of natural resource-based products and standardized commodities characterized by low income elasticity of demand. However, emerging difficulties in diversifying manufacturing output and in developing local technological and productive linkages (Moguillansky (1999)) suggest that even Chile might find it hard to keep average growth rates comparable with the 'import substitution golden age' (Ocampo (2002)).

5.2 The 'low growth trap' and its structural determinants

A synthetic way to capture the relationships between trade, technology and growth is by empirically estimating the parameters of the simple model presented in Cimoli and Correa (2002) (more details are in the Appendix). Its key property is the specification of how changes in exports determine the growth potential of domestic income in an open economy. The multiplicative effect of trade depends both on a country's import elasticity and on its capacity to decrease a gap in technology (approximated here by a gap in labor productivity) with respect to the international technological frontier. The model can be considered as a sort of "abacus" which reproduces different scenarios characterized by specific linkages between technology gaps, demand for imports and growth rates. The key parameter is the 'trade/technology gap multiplier' (cf. the Appendix for a more rigorous definition).

In particular, the value of the "multiplier" (λ, see the Appendix) may yield *virtuous growth patterns* where export impulses are amplified by shrinking technological gaps with respect to the international frontier and import elasticities are relatively low (so that λ is greater than 1). Hence, domestic income may grow faster than exports.

Conversely, one may get *vicious patters* whenever income elasticities are high and/or technology gaps do not shrink sufficiently rapidly, or even widen (thus, λ is less than 1). Hence a country in order to balance its foreign account must grow slower than the growth of its exports.

In Latin America, the 'trade/technology multiplier' did in fact decline after the liberalization process, dropping to less than 1,[8] the export-led orientation in many Latin American countries came together with a sharp increase in import elasticities which was less than compensated by some acceleration in the catch-up in relative productivity (cf. Figure 9)[9]. For Latin America as a whole the average trade/technology multiplier fell from 1.17 to 0.35 in the post-reform period. A vicious growth pattern came out to be reinforced. This contrasts sharply with the experience of some Asian economies, such as Korea, where the technological multiplier has increased in recent decades. The trade multiplier for Korea rose from 1.01 to 1.42 between 1970-1980 and 1981-1999. In this case, it is interesting to note that the technology gap shrank ($\psi > 1$) and, at the same time, the elasticity of demand for imports decreased. Thus, a virtuous growth pattern was established.

It is also interesting to compare the "equilibrium rates" consistent with foreign-accounts, as estimated on the ground of Eq. 1 (cf. Appendix) with the observed rates (Table 20). In most countries the latter happen to be higher than the equilibrium ones, *even if lower than the growth rates of the Import Substitution "Golden Age".*

One of the ultimate outcomes is obviously shrinking surpluses and emerging balance-of-trade deficits. In turn, this is likely to trigger restrictive macro policies aimed at reducing internal absorption and inducing positive net flows on the capital accounts.

5.3 Some microeconomic roots of persistent technology gaps: low knowledge content of specialization patterns and forms of new dualism

Let us begin to explore the micro-dynamics of production and technological learning underlying Latin American Countries (for empirical evidence and an analytical formal-

[8]The productivity gap ψ is calculated in term of labor productivity gap *vis-à-vis* the United States, taken to represent the 'technological frontier' itself. However, this result does not change if we compare with Korea.

[9]The case of Chile is exceptional in that its estimated trade/technology multiplier takes a negative value since import elasticities fall from 1973 to 1984. This is at least partly due to cyclical factors since imports imports shrink in the end years due to the crisis which peaked in 1982.

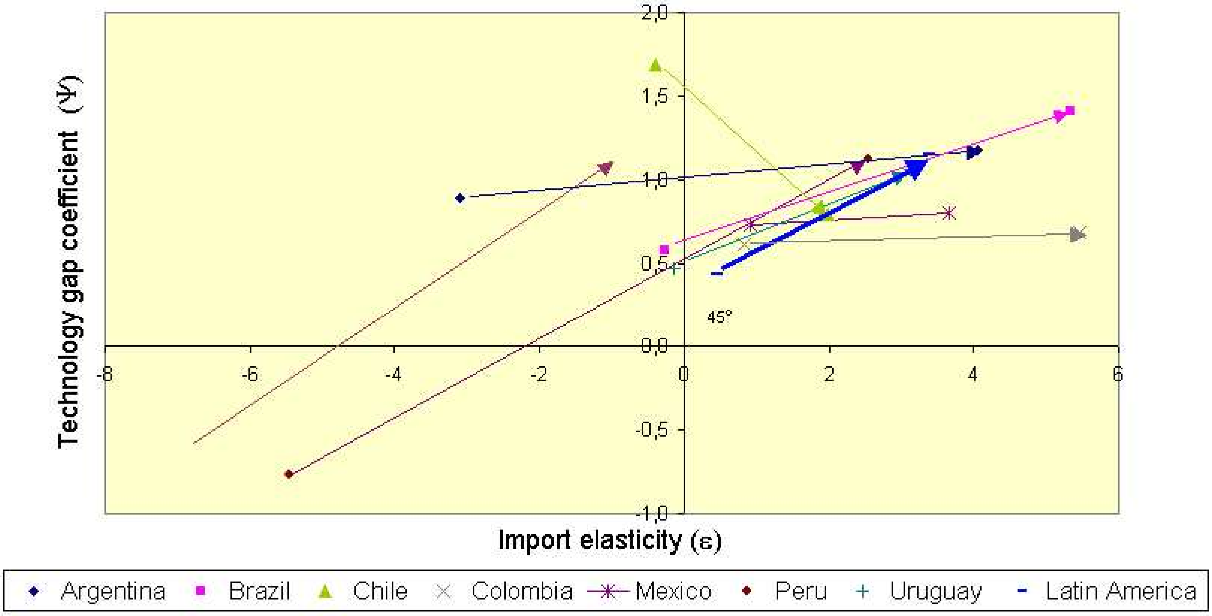


Figure 9: The trade/technology multiplier $\lambda = \psi/\epsilon$ in the Latin American countries. Source: own elaborations on ECLAC data. Note: Each point of departure and arrival of the arrow represents the trade/technology multiplier in the pre- and post-reform periods respectively. Note that the higher the coefficient, the faster is catching-up in productivity.

Country	Period	Years	Import Elasticity (ϵ)	Tech. Gap Multiplier (ψ)
Argentina	IS Golden Age	1950-1973	0,42	-
	Pre-Reform	1974-1990	-3,10	0,89
	Post-Reform	1991-2000	4,06	1,18
Brazil	IS Golden Age	1950-1973	0,80	-
	Pre-Reform	1974-1989	-0,27	0,58
	Post-Reform	1990-2000	5,33	1,41
Chile	IS Golden Age	1950-1973	1,45	-
	Pre-Reform	1974-1984	-0,38	1,69
	Post-Reform	1985-1998	19,8	0,79
Colombia	IS Golden Age	1950-1973	0,57	-
	Pre-Reform	1974-1989	0,82	0,61
	Post-Reform	1990-1999	5,47	0,68
Mexico	IS Golden Age	1950-1973	0,66	-
	Pre-Reform	1974-1985	0,91	0,73
	Post-Reform	1986-2000	3,67	0,80
Peru	IS Golden Age	1950-1973	1,19	-
	Pre-Reform	1974-1989	-5,46	-0,77
	Post-Reform	1990-2000	2,54	1,13
Uruguay	IS Golden Age	1950-1973	-0,12	-
	Pre-Reform	1974-1977	-0,14	0,47
	Post-Reform	1978-2000	3,13	1,06
Latin America	IS Golden Age	1950-1973	0,79	-
	Pre-Reform	1974-1989	0,37	0,43
	Post-Reform	1990-2000	3,31	1,15

Table 19: The structural change in Latin America (before/after reform). Source: own elaborations on ECLAC data.

After Reform	Country	Actual growth rate	Estimated "equilibrium" growth rate	Trade balance (% GDP) First year	Last year	Diff.
1991 - 2000	Argentina	3.44%	2.37%	1.47%	-3.76%	-5.24%
1990 - 2000	Brazil	2.63 %	1.66%	3.16%	-1.23%	-4.38%
1985 - 1998	Chile	6.75%	4.21%	7.45%	3.39%	-4.07%
1990 - 1999	Colombia	2.50%	0.78 %	3.78%	-3.52%	-7.30%
1986 - 2000	Mexico	3.41 %	2.55 %	3.62%	7.22%	3.60%
1990 - 2000	Peru	4.05 %	4.24 %	0.81%	0.16%	-0.63%
1978 - 2000	Uruguay	1.89%	1.49%	1.96%	-3.37%	-5.32%

Table 20: Growth rates and trade balances (after reform). Source: Cimoli and Correa (2002).

ization, see Cimoli and Katz (2001), and ECLAC (2000, 2002)).

So far, we have mostly discussed aggregate patterns concerning e.g. productivity, export and income growth. However, the transition to *laissez-faire*, free-trade, regimes has also implied profound changes in the sectoral composition of output, in the patterns of technology accumulation and diffusion, and in the 'demography' of firms. It is in the underlying microeconomics that one has to ultimately nest the interpretation of the worsening trade/technology multipliers in Latin America.

In the first place, the weak link between exports and growth may be understood as the result of a new dualism in the production system and in the pattern of technology accumulation which has emerged as an effect of the liberalization shocks. There is little doubt that such shocks have increased competitive selection and induced strong modernization pressures. However, the final outcomes in terms of knowledge accumulation are much more blurred. Many production activities have been seriously disrupted by trade liberalization and by the massive inflow of imports, particularly in technology-intensive fields, which have rapidly begun to de-verticalize their production organization technologies, replacing domestically-produced intermediate inputs with cheaper (and sometimes better) imported ones and reorganizing themselves more as assembly-type operations based on a much higher unit import content.

At the same time, the disappearance of many activities along the 'value chain' of production has often broken down local networks of user-producer links and the related processes of knowledge diffusion.

The heterogeneity of responses has been quite striking, not only across production sectors, but also across individual firms within narrowly defined industries. Thus, failure and success tend to occur side by side even within the same production activity. The share of "large" firms - either local subsidiaries of transnational corporations or domestically-owned conglomerates - in GDP increased significantly during the adjustment process, while countless SMEs were forced to exit the market altogether.

Only a very small group of "modernized" domestic-owned and export-oriented firms are becoming global in terms of their production orientation and their capacity to acquire and creatively build upon foreign technology in international networks. Note also that even these "modernized" firms are, in fact, characterized by fewer linkages with domestic institutions of higher education and with local research centers and laboratories than in the past.

In terms of specialization patterns, following the trade reforms, many of Latin American economies increased their share of production in a) natural resources and natural resource processing industries (such as pulp and paper, iron and steel, vegetable oil, etc.) and b) maquila industries (that is largely assembly activities in sectors like electronics, television sets and video equipment, etc.).[10] Conversely, other industries, such as footwear, garments and furniture, and industries that produce engineering- and knowledge-intensive products (capital goods, agricultural machinery, machine tools, pharmaceuticals), have seen their share decline throughout the continent.

In fact a fundamental paradox stands out. After trade liberalization Latin America as a whole did *not* witness any adjustment in the specialization profiles toward more labor intensive sectors, but - if anything - toward more resource-intensive *and capital-intensive* production structures.

At the same time the share of the *informal sector* in total employment appears to have dramatically increased (cf. Table 21).[11] In this respect, even the "Import Substitution Golden Age" did not fare particularly well: even in presence of a sustained GDP growth, Table 21 shows that one is hardly able to absorb within the 'formal' sector a constant share of the labor force attracted to urban areas. However, the last couple of decades have been particularly disappointing. The end result is a widening *dualism* whereby an increasing share of the whole economy is composed of activities typically characterized by a low knowledge content and low opportunities for technological and

[10] Another sector which grew, in *some countries*, is the automotive one, but in this case, first, liberalization was no shock on local producers because there were none but mostly subsidiaries of world multinationals, and, second, the latter have been able, when needed, to bargain tariff and trade exceptions.

[11] The distinction between 'formal' and 'informal' sector follows the rather expansive definition provided by ECLAC, trying to capture the traditional activities as opposed to the non-traditional ones (thus, in addition to personal services it includes all commercial and manufacturing activities undertaken in entities with less than 5 workers).

Year	Formal sector	Informal sector
1950	69.2	30.8
1970	70.4	29.6
1980	69.8	30.2
1990	57.0	43.0
1999	51.6	48.4

Table 21: Percentage share of total employment in urban areas. Source: Cimoli and Correa (2002).

organizational learning.

Another relevant issue is the role played by large domestic firms and subsidiaries of multinational enterprises (MNEs). Subsidiaries of MNEs, in e.g. motor vehicles, other consumer durables, etc., have adopted the technologies developed by their parent companies in industrialized countries. Conversely, a few - too few perhaps - domestic Latin American firms during the 'IS Golden Age' tried to pursue economies of scale and learning procedures which happened to enable them to compete in the international market after the economy was opened up. This involved the adaptation of production and product designs for the domestic market, to begin with, as well as efforts to improve organization and increase production capacity. Examples of such firms include large groups in the chemicals, brewing and glass container sectors, which did not only increase their production capacity to internationally visible levels, but revealingly also carried out earlier R&D activities during the IS phase.

Under brutal policy shocks it happened that the long-term accumulation of local technological capacity has been hampered by the replacement of engineers with machines in the process of re-organizing production. Obviously, some of the engineering activities carried out in plant during the import substitution period, either to extend the life cycle of old machines or to perform technical activities, are now "embodied" in the new pieces of equipment, which also results in a substantial reduction in employment of engineers and technicians. Similarly, entire R&D and project engineering departments have been eliminated as firms have become part of worldwide integrated production systems and R&D and engineering efforts have been transferred to headquarters. The same is observed in the case of public firms providing telecommunications, electricity and transport services, which, after privatization, discontinued their domestic R&D and engineering departments and relied instead on their respective central offices for technology and engineering services. These changes in the organization of production forcefully entail the "destruction" of human capital and domestic

Table 22: Number of researchers (per thousand labour force).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Germany	-	241.9	234.3	-	-	231.1	230.2	235.8	237.7	255.3	*242.8*
Canada	65.1	67.1	70.1	74.1	77.9	80.5	83.9	87.1	90.3	93.5	96.7
France	123.9	129.8	141.7	145.9	149.2	151.2	154.8	154.7	156.9	160.4	*161.7*
Italy	77.9	75.2	74.4	74.4	75.7	75.5	76.4	76.1	76.8	*77.2*	*77.6*
Japan	582.8	598.3	622.4	641.1	658.9	673.4	617.4	625.4	652.8	658.9	*676.7*
UK	133	128	131	135	142	146	146	146.5	158.7	*163.1*	*169.4*
US	-	960.5	-	964.8	*976.3*	987.7	*1050.9*	1114.1	*1130.7*	*1168.1*	*1205.4*
Argentina	1.02	0.97	0.93	0.89	0.75	0.69	0.51	0.5	0.5	0.48	-
Brazil	1.86	1.92	1.98	1.99	1.7	1.49	-	-	-	-	-
Chile	1.15	1.17	1.17	1.16	1.17	1.15	1.18	1.19	1.19	1.2	1.3
Mexico	2.25	2.28	2.3	1.81	1.48	1.34	-	-	-	-	-
Venezuela	1.7	1.75	1.77	1.76	1.82	1.95	2.03	2.13	2.2	-	-

Note: The data in italics are estimated.
Source: Own elatorations on Main Science and Technology Indicators, OECD, 2001 and on data from Ricyt (2000).

technological capabilities and their replacement with "capital embodied" technologies and with foreign-supplied R&D and engineering services (see Table 22 for evidence on the striking difference in the number of people involved in research in Latin American countries compared to a few other countries). Some of the skills and technological capabilities made redundant by the new production organization arrangements can and have been successfully transferred to other areas of the economy, e.g. to a newly emerging and rapidly expanding software industry, for example. Others, however, have remained idle.

In the last resort, the emerging patterns of production specialization turn out to be strongly biased against domestic knowledge generation (cf. also the discussion in Cimoli and Katz (2001) and ECLAC (2002)). This process means that, while Latin America does actively participate in the globalization of production, its participation in the "globalized" scientific and technological activities is very limited, as multinational companies transfer only a limited amount of their R&D activities to the region.

To sum up, Latin America's poor growth performance in the wake of liberalization strategies encapsulates a complex set of issues related to the interaction between trade balances, specialization patterns and the process of technological learning. Certainly, the trade liberalization shock has acted upon both exports and imports, inducing a significant increase in both. However, the 'bad' patterns of specialization, biased in favor of commodities characterized by low income elasticities, has meant a relatively tighter foreign balance constraint to growth, less than compensated by some catching-up in relative productivity *vis-à-vis* the international frontier. The end result appears to be a "vicious" pattern of export-led growth. At the same time, the "modern" part of the economy has shrunk, yielding a dual production structure with relatively small dynamic enclaves floating within a sea of relatively stagnant and marginal activities.

Finally, knowledge-intensive industries appear to be losing ground as a proportion of GDP while non-tradable activities, natural resource processing industries and "maquila"-type assembly operations (catering mostly to United States markets) increase their share. The sources of technological change and productivity growth have also shifted significantly, with a rapidly increasing share of external (foreign) sources emerging at the expense of domestic ones.

6 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 dispel 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 (2003), **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).[12]

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

[12]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).

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 labor force — 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 23 dramatizes some of the most striking differences between those diverse comparative dynamics.

In a nutshell, Korea - as well as other far-eastern economies - have been able to “twist around” absolute and relative prices and channel the resources stemming from “static” comparative advantages toward the development of activities characterized by higher learning opportunities and demand elasticities (Amsden (1989)). And they did that in ways which penalized rent-seeking behaviors by private firms. In fact, the major actors in technological learning have been large business groups - the chaebols - which were able at a very early stage of development to internalize skills for the selection of technologies acquired from abroad, their efficient use and their adaptation and, not much later, were able to grow impressive engineering capabilities (cf. Kim (1993), from which Tables 24 and 25 are also drawn).

Table 23: 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—

Table 24: 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).

This process has been further supported by a set of institutions and networks for improving human resources (Amsden (1989)). All this sharply contrasts with the Latin American experience, where the arrangement between the State and the private sector has often been more indulgent over inefficiencies and rent-accumulation.

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.

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.

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

Table 25: 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).

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.

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. labor 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

7 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[13], 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. Certainly both the recent changes in international – political and economic – relations and the ongoing "ICT revolution" are reshaping the opportunities and constraints facing policy making and "institutional engineering" but by no means have decreased their importance. On the contrary: they urgently demand new forms of governance which one is only beginning to explore.

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

Appendix

The model used for our empirical analysis is a simplified version of the one in Cimoli, Dosi and Soete (1993) and Cimoli (1988, 1994). Its key elements may be summarized as follows.

A first element bears on the links between trade specialization and national consumption pattern, which are approximated by the income elasticity of imports. Second, the balance of trade determines the growth rate differential between trading economies, as conjectured by Harrod trade multiplier and the well-known Kaldorian export-based models (Harrod (1933), Kaldor (1966, 1975), Dutt (2001), Lawson et al. (1989), McCombie and Thirlwall (1994), Thirlwall (1979, 1997)). A third element stresses the importance of technology "gaps", which are approximated by differences in productivity growth.

Indeed one seminal root of the model draws back to 'technology gap' insights from the '60s on technology and trade (cf. Posner (1961), Freeman (1963), Hirsch (1965), Hufbauer (1966), Vernon (1966)). This approach focuses upon international asymmetries in technology as the main determinant of trade flows and patterns of specialization. Technological knowledge is distinguished from any 'free food': on the contrary its idiosyncratic appropriation nurtures competitive advantages to the early innovative firms and countries. Moreover, the dynamic conjecture is that asymmetries in innovative capabilities largely account for the evolution of each country's pattern of specialization and growth. In Posner (1961), the pattern of trade is explained by countries' initially asymmetric access to technological knowledge in a world characterized by similar demand patterns. In this context, trade between countries is bound to continue if differences in their respective abilities to innovate and imitate persist. After a certain lag at least some countries are able to imitate the new commodities, thereby eliminating the basis for trade, but the process persistently occurs (cf. the seminal contributions of Freeman (1963) and Hufbauer (1966)). During the innovation process the effects of patents, commercial secrecy and static and dynamic economies of scale are the main determinants of trade patterns. Conversely, once imitation occurs, more traditional processes of adjustment in production cost and competitiveness will determine the specialization. In Hirsch (1965) and Vernon (1966), technological asymmetries are associated with distinct phases in a technological evolution and a specific international distribution of innovative capabilities in the production of new commodities.[14]

[14]The 'technology gap' intuition is generalized, in different veins, in the structuralist/evolutionary perspective (cf. amongst others, Dosi, Pavitt and Soete (1990), Metcalfe (1989), Soete and Verspagen (1993), Amable (1993), Fagerberg (1988), Cimoli and Soete (1992)) and by the whole 'new-trade'/ 'new-growth' literature (cf. Aghion and Howitt (1994) for a thorough presentation of an even larger

Recalling the original expression of the Harrod trade multiplier and including in it a technology gap, the trade multiplier of our model may be expressed as:

$$g_y = \frac{\psi}{\epsilon} g_x \tag{1}$$

$$\psi = \frac{g_\pi}{g_{\pi^*}} \quad \text{and} \quad \epsilon = \frac{g_m}{g_y}$$

where

g_y : the 'home country' income growth rate,
ψ : the technological gap multiplier,
g_π : the productivity growth rate in the home country,
g_{π^*} : the productivity growth rate at the technological frontier,
ϵ : the income elasticity of imports,
g_m : the import growth rate,
$\frac{\psi}{\epsilon}$: the trade multiplier,
g_x : the export growth rate (in turn, the joint outcome of the growth of world demand and the world income elasticity of demand for exports).

For simplicity, call $\lambda = \frac{\psi}{\epsilon}$ the 'trade/technology gap multiplier'.

As compared to a standard "Kaldorian" model of growth driven/constrained by foreign trade balances, the innovation here is that foreign demand impulses are "modulated" by the dynamics of the 'technology gap' between the home country and the rest of the world (and, *in primis*, developed countries). Here, for unavailability of additional data concerning e.g. product quality and product innovation, etc., one is forced to approximate such gap with a measure of labor productivity. The dynamics in ψ amplifies or shrinks the impact of foreign demand growth upon domestic growth. That is, changes in domestic income are not only a function of foreign demand and demand for imports, but are also dependent on the productivity gap and on the domestic capacity to upgrade technology and diffuse it massively throughout the production system. When ψ=1, the productivity growth rate is the same in the domestic and foreign economies. Thus, if ψ is greater than 1, the domestic economy is reducing the gap with respect to the foreign one. The converse applies when ψ is less than 1. In the literature on technology and trade, ψ has been called the *technological gap multiplier* (Cimoli, Dosi and Soete (1993); Cimoli (1994)).

literature grounded on assumptions nearer to economists' standards).

References

Aghion, P. and Howitt, P. (1994), *Endogenous growth theory*, Cambridge, MA: MIT press.

Amable, B. (1993), National effects of learning, international specialization and growth paths, in D. Foray and C. Freeman (eds.), *Technology and the Wealth of Nations*, London: Pinter Publishers.

Amsden, A.H. (1989), *Asia's Next Giant: South Korea and Late Industrialization*, Oxford: Oxford University Press.

Amsden, A.H. (2001), *The Rise of "The Rest", 1850-2000: Late Industrialization Outside the North Atlantic Economies*, Oxford: Oxford University Press.

Antonelli, C. (1995), *The Economics of Localized Technological Change and Industrial Dynamics*, Boston: Kluwer Publishers.

Arcangeli, F., Dosi, G. and Moggi, M. (1991), Patterns of diffusion of electronics technologies: An international comparison with special reference to the Italian case, *Research Policy*, 20, 515-529.

Archibugi, D., Howells, J. and Michie, J. (2001), *Innovation Policy in a Global Economy*, Cambridge: Cambridge University Press.

Arthur, W.B. (1994), *Increasing Returns and Path-Dependence in the Economy*, Ann Arbor: University of Michigan Press.

Bacha, E. L. (1978), An interpretation of unequal exchange from Prebisch-Singer to Emanuel, *Journal of Development Economics*, 5.

Bairoch, P. (1981), The main trends in national economic disparities since the industrial revolution in P. Bairoch and M. Levy-Leboyer, eds. *Disparities in Economic Development since the Industrial Revolution*, Oxford: Macmillan.

Bassanini, A. and Scarpetta, S. (2002), Growth, technological change, and ICT diffusion: recent evidence from OECD countries, *Oxford Review of Economic Policy*, **18**, 324-344.

Berger, S. and Dore, R. (1996), *National Diversity and Global Capitalism*, Ithaca and London: Cornell University Press.

Blundell-Wignall, A. and Browne, F. (1991), *Macroeconomic consequences of financial liberalisation: a summary report*, Working paper 98, OECD Department of Economics and Statistics.

Bowles, S. (2002), Globalization and Redistribution: Feasible Egalitarianism in a Competitive World in R. Freeman, ed., *Inequality Around the World*, Oxford: Macmillan.

Bradford, S. (2003), Paying the price: final goods protection in OECD countries, *Review of Economics and Statistics*, **85**, 24-37.

Cantwell, J. (1992), The Internationalization of Technological Activity and its Implications for Competitiveness, in D. Granstrand, L. Håkanson and S. Sjólander (eds.), *Technology, Management and International Business*, Chichetser and New York: Wiley.

Cimoli, M. (1988), Technological gaps and institutional asymmetries in a North-South model with a continuum of goods, *Metroeconomica*, **39**, 245-274.

Cimoli, M. (1994), Look-in and specialisation (dis) advantages in a structuralist model with endogenous growth, in J. Fagerberg, N. von Tunzelman and B. Verspagen (eds.), *The Dynamics of Technology, Trade and Growth*, London: Edgar Elgar.

Cimoli, M. and Correa, N. (2002), *Trade openness and technological gaps in Latin America: a "low growth" trap*, LEM, Sant'Anna School of Advanced Studies, Working paper 2002/14.

Cimoli, M. and Dosi, G. (1995), Technological paradigms, patterns of learning and development: an introductory roadmap, *Journal of Evolutionary Economics*, **5**, 243-68.

Cimoli, M., Dosi, G. and Soete, L. (1993), Innovation diffusion, institutional differences and patterns of trade: a North-South Model", in P.A. David, G. Dosi and F. Arcangeli, eds., *Technology Diffusion and Economic Growth. International and National Policy Perspectives*, Vol.3., Oxford University Press.

Cimoli, M. and Katz, J. (2001), *Structural Reforms, Technological Gaps and Economic Development: A Latin American Perspective*, document presented at the DRUID-Nelson and Winter Conference (Aalborg, 12-15 June), (http://www.business.auc.dk/druid/conferences/nw/).

Cimoli, M. and Soete, L. (1992), A Generalized Technology Gap Model, *Economie Appliquée*, 3.

Cipolla, C. M. (1965), *Guns and Sails in the Early Phase of European Expansion, 1400-1700*, London: Collins.

Colecchia, A. and Schreyer, P. (2002), ICT Investment and Economic Growth in the 1990s: Is the United States a Unique Case? A Comparative Study of Nine OECD Countries, *Review of Economic Dynamics*, **5**, 408-442.

Coriat, B. (2002), The New Global Intellectual Property Rights Regime and its Imperial Dimension. Implications for "North/South" Relations, presented at the Seminar 'New Paths of Development' organized by *BNDES*, Rio de Janeiro, September, 12-13, 2002.

David, P.A. (1990), The Dynamo and the Computer: An Historical Perspective of the Modern Productivity paradox, *American Economic Review Papers and Proceedings*, **80**, 355-361.

David, P.A. (2001), Understanding Digital Technology's Evolution and the Path of Measured Productivity Growth: Present and Future in the Mirror of the Past, in E. Brynolfsson and B. Kahin (eds.), *Understanding the Digital Economy*, Cambridge, MA: MIT Press.

De Long, B. J. (1988), Productivity growth, convergence and welfare, *American Economic Review*, **78**, 1138-54.

Dosi, G. (1982), Technological paradigms and technological trajectories: a suggested interpretation, *Research Policy*, **11**, 147-62.

Dosi, G. (1988), Sources, procedures and microeconomic effects of innovation, *Journal of Economic Literature*, **26**, 1120-171.

Dosi, G. and 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 2002-22, Sant'Anna School of Advanced Studies, Pisa.

Dosi, G., Freeman, C. and Fabiani, S. (1994), The process of economic development: introducing some stylized facts and theories on technologies, firms and institutions, *Industrial and Corporate Change*, **3**, 1-45.

Dosi, G., Orsenigo, L. and Sylos Labini, M. (2003), *Technology and the Economy*, forthcoming in N.J. Smelser and R. Swedberg (eds.), *Handbook of Economic Sociology*, 2nd ed.

Dosi, G., Pavitt, K. and Soete, L. (1990), *The Economics of Technical Change and International Trade*, London: Harvester Wheatsheaf.

Durlauf, S.N. and Johnson, P.A., (1992), *Local versus global convergence across national economies*, NBER Working paper 3996.

Durlauf, S.N. and Quah, D. (1998), *The new empirics of economic growth*, London School of Economics, Center for Economic Performance, Discussion paper 384.

Dutt, A. (2001), *Income Elasticities of Imports, North-South Trade and Uneven Development*, Notre Dame, Indiana, University of Notre Dame, mimeo.

Easterly, W., King, R., Levine, R. and Rebelo, S. (1992), *How do national policies affect long-run growth? A research agenda*, World Bank, Discussion paper.

Eatwell, J. (1996), *International Financial Liberalisation: The Impact on World Development*, ODS UNDP, Discussion paper 12.

ECLAC (Economic Commission for Latin America and the Caribbean) (2000), *Equity, Development and Citizenship* (LC/G.2071/Rev.1-P), Santiago, Chile. United Nations publication, Sales No. E.00.II.G.81.

ECLAC (Economic Commission for Latin America and the Caribbean) (2002), *Globalization and development* (LC/G.2157(SES.29/3)), document prepared for the Twenty-ninth session of ECLAC (Brasilia, Brazil, 6-10 May), Santiago, Chile.

Fagerberg, J. (1988), Why growth rates differ, in G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete *Technical Change and Economic Theory*, London: Pinter Publisher.

Fagerberg, J. , Hansson, P.G., Lundberg, L. and Melchior, A. (1997), *Technology and international trade*, Cheltenham, UK: Edward Elgar.

Feldstein, M. and Horioka, C. (1980), Domestic saving and international capital flows, *Economic Journal*, **90**, 314-29.

Freeman, C. (1963), The plastic industry: a comparative study of research and innovation, *National Institute Economic Review*, No. 26.

Freeman, C. (1982), *The Economics of Industrial Innovation*, London: Francis Pinter.

Freeman, C. and Perez, C. (1988), Structural crises of adjustment: business cycles and investment behavior, in G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete (eds.), *Technical Change and Economic Theory*, London: Pinter.

Frenkel, R. and González, M. (1999), Apertura comercial, productividad y empleo en Argentina, in V. Tokman and D. Martínez (eds.), *Productividad y empleo en la apertura económica*, Lima, ILO Regional Office for Latin America and the Caribbean, International Labour Organization (ILO).

GGDC (2002a), Total Economy Database, http://www.eco.rug.nl/ggdc, Groningen Growth and Development Centre, University of Groningen.

GGDC (2002b), ICOP Industry Database, http://www.eco.rug.nl/ggdc, Groningen Growth and Development Centre, University of Groningen.

Harrod, R. (1933), *International Economics*, Cambridge: Cambridge University Press.

Hirsch, S. (1965), The US electronics industry in international trade, *National Institute Economic Review*, 34.

Holland, M., Vieira, F. V. and Canuto, O. (2001), *Economic Growth and the Balance of Payments Constraint in Latin America*, mimeo.

Hollingsworth, R. and Boyer, R., (eds.) (1997), *Contemporary Capitalism: The Embeddedness of Institutions*, Cambridge: Cambridge University Press.

Hufbauer, G. C. (1966), *Synthetic Materials and the Theory of International Trade*, London: Buckworth.

ITU(2003), *Telecommunication indicators*, International Telecommunication Union

Laursen, K. (2000), *Trade Specialisation, Technology and Economic Growth: Theory and Evidence from Advanced Countries*, Cheltenham, UK: Edward Elgar.

Lawson, T., Palma, J. G. and Sender, J. (1989), Kaldor's contribution to economics: an introduction, *Cambridge Journal of Economics*, **13**, 1-8.

Lundvall, B.A. (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London: Pinter Publisher.

Kaldor, N. (1966), *Causes of the Slow Rate of Economic Growth in the United Kingdom*, Cambridge: Cambridge University Press.

Kaldor, N. (1975), What is wrong with economic theory?, *Quarterly Journal of Economics*, **89**, 347-57.

Katz, J. and Stumpo, G. (2001), *Regmenes sectoriales, productividad y competitividad internacional*, CEPAL Review, No. 75 (LC/G.2150-P), Santiago, Chile, December.

Kennedy, C. and Thirlwall, A. P. (1979), Import Penetration, Export Performance and Harrod's Trade Multiplier, *Oxford Economic Papers*, **31**, 303-323.

Kim, L. (1993), National system of industrial innovation: dynamics of capability building in Korea, in R. Nelson (ed.), *National Innovation Systems, Oxford: Oxford University Press.*

Kim, L. and Nelson, R.R. (2000), *Technology, Learning and Innovation: Experiences of Newly Industrialising Economies*, Cambridge: Cambridge University Press.

Kleinknecht, A. and ter Wengel, J. (1998), The myth of economic globalisation, *Cambridge Journal of Economics*, **22**, 637-647.

Krueger, A. O. (1980), Trade policies as an input for development, *American Economic Review*, **70**, 288-292.

Krueger, A. O. (1997), Trade policy and economic development: how we learn, *American Economic Review*, **87** 1-22.

Krugman, P.R. (1996), *The Self-Organizing Economy*, Cambridge, MA, and Oxford: Blackwell Publishers.

Krugman, P.R. (1999), *The Return of Depression Economics*, New York: W.W. Norton.

Kuznets, S. (1980), Recent population trends in less developed countries, and implications for international income inequality, in R. A. Easterlin (ed.), *Population and Economic Change in Developing Countries*, Chicago, Illinois: University of Chicago Press.

Maddison, A. (2001), *The World Economy: a Millennial Perspective*, Paris: OECD.

McCombie, J. and Thirlwall, A. P. (1994), *Economic Growth and the Balance of Payments Constraint*, New York: St Martin's Press.

Meier, G.M., Stiglitz, J.E. and Stern, N. (2000), *Frontiers of Development Economics: the Future in Perspective?*, Oxford: Oxford University Press.

Meliciani, V. (2001), *Technology, Trade and Growth in OECD countries*, London, New York: Routledge

Metcalfe, S. (1989), Trade, technology and evolutionary change, in R. Harrington et al. (eds.), *Money, Trade and Payments*, MIT Press.

Milgrom, P.R., North, D.C. and Weingast, B.R. (1990), The Role of Institutions in the Revival of Trade: the Law Merchant, Private Judges, and the Champagne Fairs, *Economics and Politics*, 2, 1-23.

Moguillansky, G. (1999), *La inversión en Chile: el fin de un ciclo de expansión?*, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC)/Fondo de Cultura.

Moreno-Brid, J. C. (1998), On capital inflows and the balance-of-payments constrained growth model, *Journal of Post-Keynesian Economics*, 21, 2, Winter.

Moreno-Brid, J. C. (1999), Mexico's economic growth and the balance of payments constraint: a cointegration analysis, *International Review of Applied Economies*, 13, 2, May.

Nelson, R.R. (1993), *National Innovation Systems*, Oxford: Oxford University Press.

Obstfeld, M. and Rogoff, K. (1996), *Foundations of International Macroeconomics*, Cambridge, MA: MIT Press.

Obstfeld, M. and Rogoff, K. (2000), *The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?*, NBER, working paper 7777, Cambridge, MA.

Ocampo, J. A. (2002), *Globalization and Development*, presented at the Seminar 'New Paths of Development' organized by *BNDES*, Rio de Janeiro, September, 12-13, 2002.

Ocampo, J. A. (2003), *Lights and Shadows in Latin American Structural Reforms*, Informes y estudios especiales series, No. 14, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

OECD (2000), *A New Economy? The changing role of innovation and information technology in growth*, Paris: OECD.

OECD (2001), *Information and Technology Outlook: Highlights*, Paris: OECD.

OECD (2002), *Measuring the Information Economy*, Paris: OECD.

Patel, P. and Pavitt, K. (1994), Uneven (and divergent) technological accumulation among advanced countries: evidence and a framework of explanation, *Industrial and Corporate Change*, **3**, 759-787, reprinted in K. Pavitt (1999).

Patel, P. and Pavitt, K. (1997), The technological competencies of world's largest firms: complex and path-dependent, but not much variety, *Research Policy*, **26**, 141-56.

Pavitt, K. (1999), *Technology Management and Systems of Innovation*, Cheltenham, UK: Edward Elgar.

Pavitt, K. (2002), *Knowledge about knowledge since Nelson and Winter: a mixed record*, SPRU Electronic Working papers 83.

Pavitt, K. and Soete, L. (1981), International differences in economic growth and the international location of innovation, in H. Giersch (ed.), *Emerging Technologies: Consequences for Economic Growth, Structural Change and Unemployment*. Tubingen: JCB Mohr.

Perez, C. (2002), *Technological Revolutions and Financial Capital*, Cheltenham, UK: Edward Eldgar.

Pérez, E and Moreno-Brid, J. C. (1999), Terms of trade, exports and economic growth in Central America: a long-term view, *Banca Nazionale del Lavoro Quarterly Review*, 211, December.

Posner, M. V. (1961), International trade and technological change, *Oxford Economic Paper*, **13**, 323-341.

Prebisch, R. (1950), *The Economic Development of Latin America and its Principal Problems*, New York: United Nations.

Quah, D. (1996), Twin peaks: growth and convergence in models of distribution dynamics, *Economic Journal*, **106**, 1045-1055.

Quah, D. (1997), Empirics for growth and distribution: stratification, polarization and convergence clubs, *Journal of Economic Growth*, **2**, pp.27-59.

Ramos, J. (1997), *Neo-liberal structural reforms in Latin America: the current situation*, CEPAL Review, No. 62 (LC/G.1969-P), Santiago, Chile, August.

Ricyt(2000), *El Estado de la Ciencia: Principales Indicadores de Ciencia y Tecnologia Iberoamericanos/Interamericanos 2000*, Buenos Aires: Ricyt.

Rodríguez, F. and Rodrik, D. (1999), *Trade Policy and Economic Growth: A Skeptic's Guide to Cross-National Evidence*, NBER Working Paper, No. W70801, Washington, D.C.

Rodrik, D. (2002), *Feasible Globalisations*, Harvard University, mimeo.

Rodrik, D. (2002), After Neoliberalism, What?, presented at the Seminar 'New Paths of Development' organized by *BNDES*, Rio de Janeiro, September, 12-13, 2002.

Rosenberg, N. and Birdzell, L.E. Jr. (1987), *How the West Grew Rich*, New York: Basic Books Ed.

Scarpetta, S., Bassanini, A., Pilat, D. and Schreyer, P. (2000), *Economic growth in the OECD area: recent trends at the aggregate and sectoral level*, OECD Economics Department working papers 248.

Soete, L. and Verspagen, B. (1993), Technology and growth: the complex dynamics of catching up, faling behind and taking over, in A. Szirmai, B. van Ark and D. Pila, eds., *Explaining Economic Growth*, Amsterdam: Elsevier Science Publishers.

Srinivasan, T.N. and Bhagwati, J. (1999), *Outward Orientation and Development: Are Revisionist Right?*, Working Paper, No. 806, New Haven, Connecticut, Economic Growth Center, Yale University.

Stallings, B. and Peres, W. (2000), *Growth, Employment, and Equity: The Impact of the Economic Reforms in Latin America and the Caribbean*, New York, Brookings/ECLAC.

Stiglitz, J.E. (1994), *Wither Socialism?*, Cambridge, MA: MIT Press.

Stiglitz, J.E. (2002), *Globalization and its Discontents*, New York: W.W. Norton.

Thirlwall, A. P. (1979), The balance of payments constraint as explanation of international growth rate differences, *Banca Nazionale del Lavoro Quarterly Review*, March.

Thirlwall, A. P. (1997), Reflections on the concept of balance of payments constrained growth, *Journal of Post Keynesian*, 3.

UCIMU (2001), *Rapporto di settore 2001*, UCIMU, Associazione Costruttori Italiani Macchine Utensili, Robot e Automazione.

US Department of Commerce (2002), *Digital Economy Report 2002*, Washington, DC.

van Ark, B. and McGuckin, R.H. (1999), International comparisons of labor producitivity and per capita income, *Monthly Labor Review*, July, 33-41.

van Ark, B., Inklaar, R. and McGuckin, R. (2002) "Changing Gear" Productivity, ICT and Services: Europe and the United States, Groningen Growth and Development Center, working paper GD-60.

Vernon, R. (1966), International investment and international trade in the product cycle, *Quarterly Journal of Economics*, **80**, 190-207.

Verspagen, B. (1991), A new empirical approach to catching up or falling behind, *Structural Change and Economic Dynamics*, **2**, 359-380.

Verspagen, B. (1993), *Uneven Growth between Interdependent Economies: an Evolutionary View on Technology Gaps, Trade, and Growth*, Avebury, Aldershot, UK: Ashgate Pub.

Wade, R. (1990), *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialisation*, Princeton: Princeton University Press.

Williamson, J. (1990), What Washington Means by Policy Reform, in Williamson, J. (ed.), *The Progress of Policy Reform in Latin America*, Institute for International Economics.