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INNOVATION SYSTEMS AND TECHNOLOGICAL SPECIALIZATION IN LATIN AMERICA AND THE CARIBBEAN

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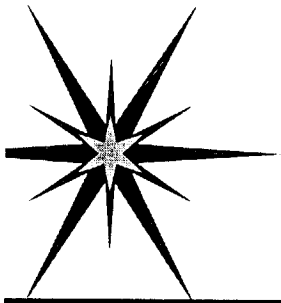

Innovation Systems and Technological Specialization in Latin America and the Caribbean

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Content

- Index of technological specialization
- The region's technological performance
- The systems of innovation
- What can be done?

What is the Index of Technological Specialization (ITS)?

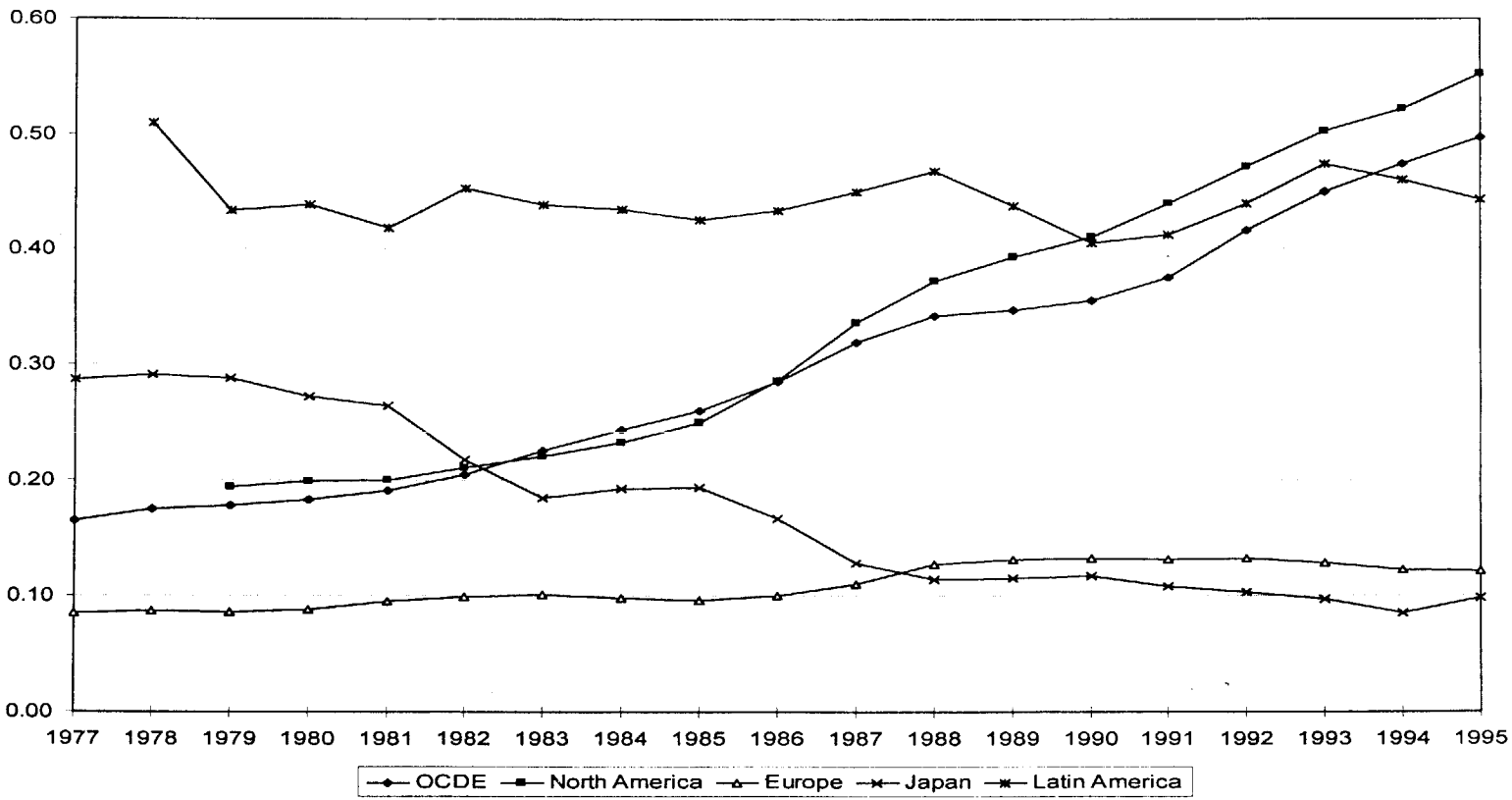
$$MS_i^H = \frac{\sum_{j \in H} X_{ij}}{\sum_{j \in H} X_j} \qquad MS_i^L = \frac{\sum_{j \in L} X_{ij}}{\sum_{j \in L} X_j}$$

$$ITS_i = \frac{MS_i^H}{MS_i^L}$$

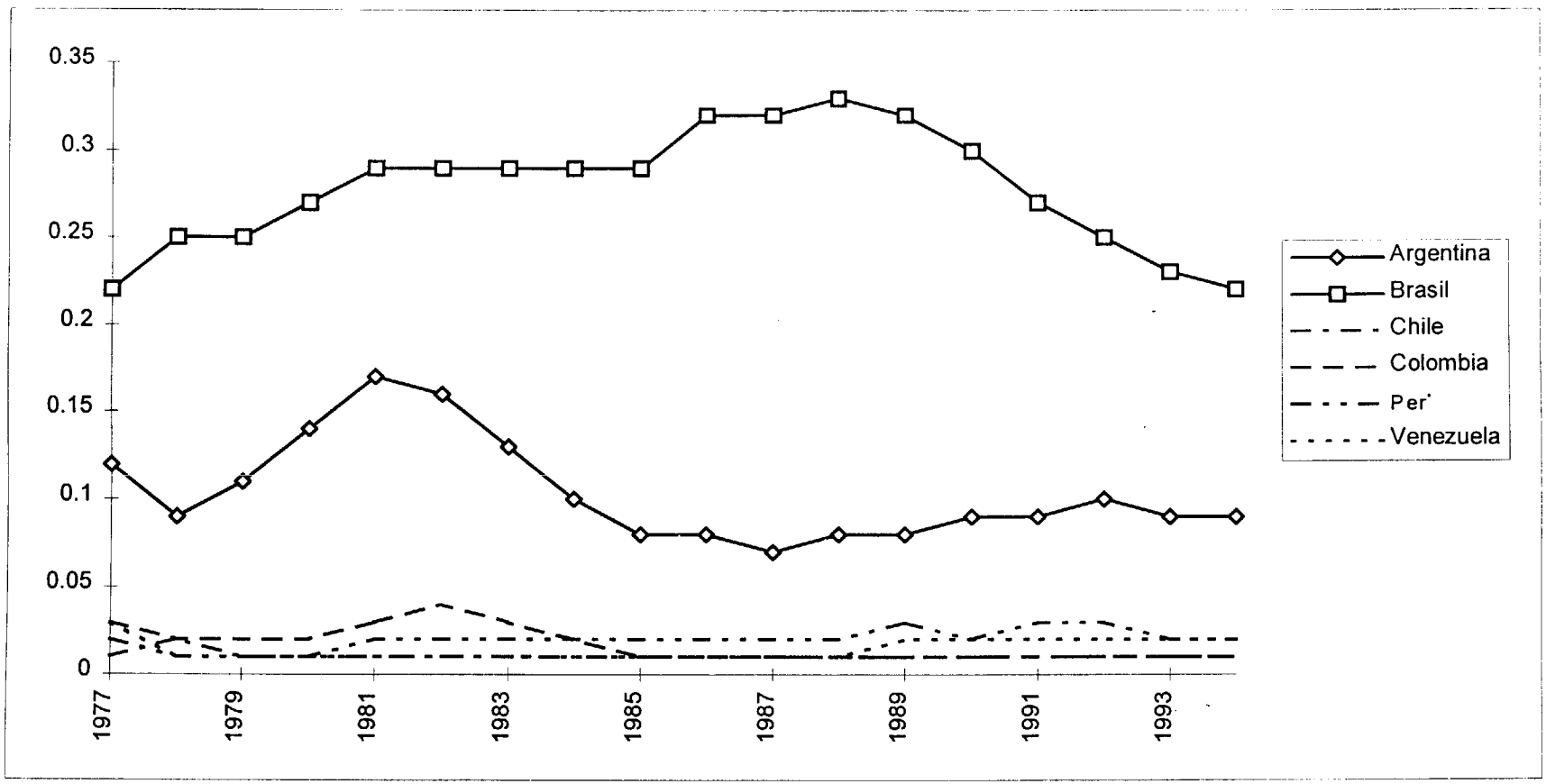
where,

X_{ij} = exports to the World (OECD) from country *i* in product group *j*
X_j = exports to the World (OECD) from all countries in product group *j*

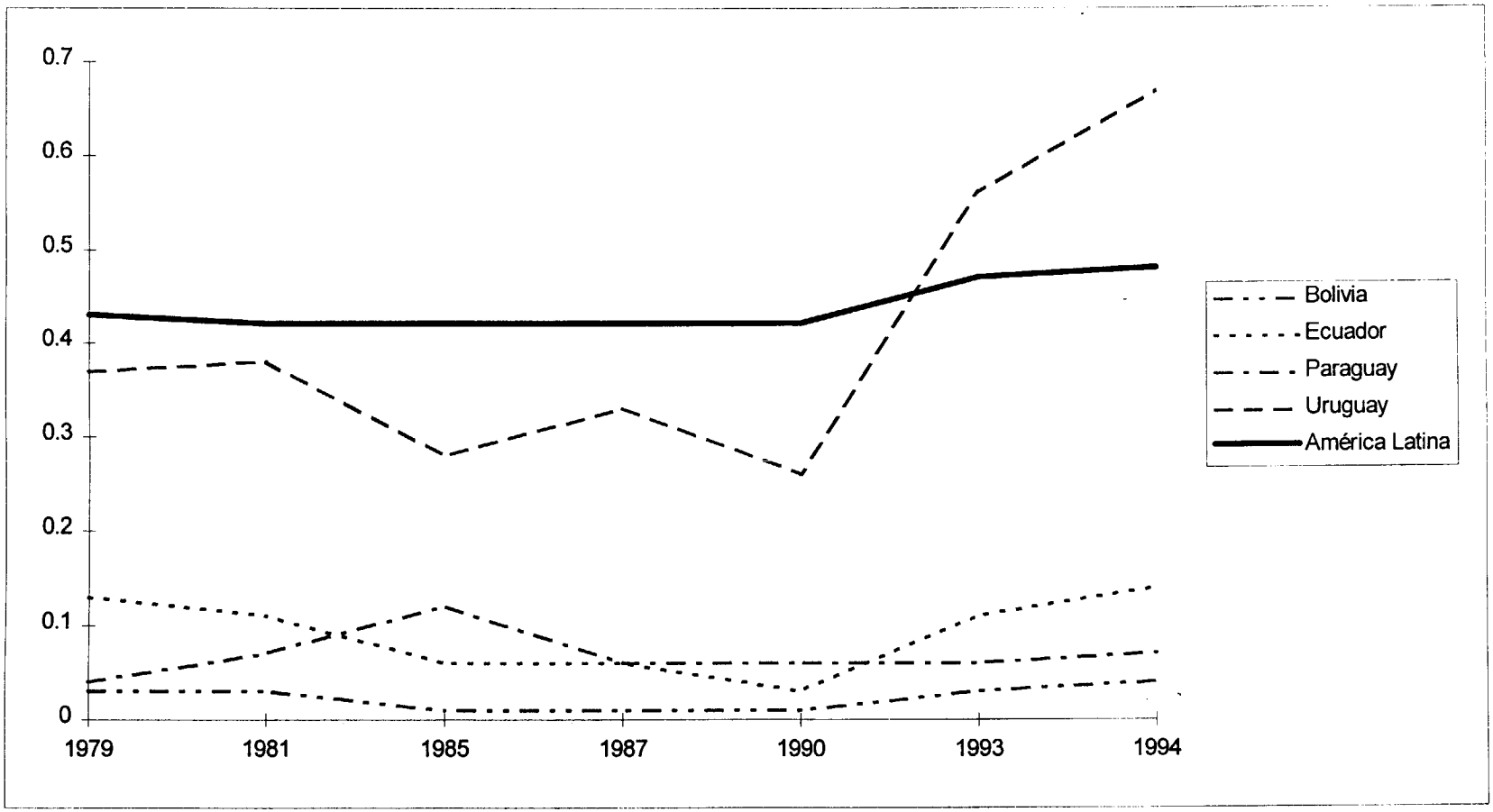
Latin American Countries' ITS, World Markets



Selected Latin American Countries' ITS, OECD Market



Selected Latin American Countries' ITS, Latin American Market (II)



The technological performance of Latin America and the Caribbean:Conclusions

- Weaker than countries with similar resource endowment and level of development
- Long term trends have been improving but on account mainly of Mexico's free trade zones
- Performance improves in the North American and Latin American Markets suggesting economic integration and distance are also key factors explaining technological upgrading
- Highest performance is concentrated in three largest countries:Brasil, Mexico and Argentina

The Innovation Systems in Action

- Flawed technological infrastructure
- Limited and fragmented linkages
- Low and misguided public and private investment in innovation
- Insufficient human capital accumulation

Linkages

- Producer supplier links are uncooperative and conflictive
- University research is still too 'basic'
- Firms would seem to require simple and applied knowledge, if any

Research and development expenditure

	1980	1985	1990
Percentage of GDP			
World Total	1.85	2.22	2.55
Developed countries	2.22	2.62	2.92
Developing countries	0.52	0.54	0.64
Latin America & Caribbean	0.44	0.43	0.40
Africa	0.28	0.25	0.25
Other	0.65	0.68	0.85
Million dollars			
World Total	208 370	271 850	452 590
Developed countries	195 798	258 834	434 265
Developing countries	12 571	13 016	18 325
Latin America & Caribbean	3 635	3 062	2 860
Africa	1 081	921	1 139
Other	7 855	9 033	14 326
Structure of R&D			
World Total	100.00	100.00	100.00
Developed countries	93.97	95.21	95.95
Developing countries	6.03	4.79	4.05
Latin America & Caribbean	1.74	1.13	0.63
Africa	0.52	0.34	0.25
Other	3.77	4.34	6.88

Source: UNESCO, *Statistical Yearbook*, 1994

Scientists and Engineers in R&D

	1980	1985	1990
Number			
World total	3 920 754	4 402 867	5 223 614
Developed countries	3 452 128	3 834 251	4 463 798
Developing countries	468 626	568 616	759 816
Latin America and the Caribbeean	86 901	125 395	162 930
Africa	51 324	56 761	73 081
Other	330 401	386 460	523 805
R&D Expenditure per Scientist and Engineer in R&D (dollars)			
World total	53 145	61 744	86 643
Developed countries	56 718	67 506	97 286
Developing countries	26 825	22 891	24 118
Latin America and the Caribbeean	41 829	24 419	17 554
Africa	21 062	16 226	15 585
Other	23 774	23 374	27 350

Source: UNESCO, *Statistical Yearbook*, 1994.

Private Sector Investment

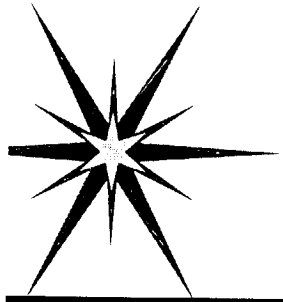
- Few firms invest in R&D
- The investment/sales ratio is low
- R&D expenditure heavily concentrated in state firms
- Firms that do innovate are more motivated by "individual" commitments than by economic determinants
- Competitiveness is based on low-wages and use of natural resources

Human capital formation

- Improved enrolment
- Quality is falling:
  - Teacher/pupil ratios
  - Expenditure per pupil
  - Numbers of contact hours and failure rates
- Secondary education curriculum emphasises 'encyclopedic' approach
- Public universities are bureaucratic, heavily politicised and poorly financed
- Vocational training schemes are few and far between

What can be done? The context for technological policy

- The importance of macroeconomic policies
- The technology policy is perceived as a concession to the scientific lobby
- This policy is viewed as a luxury that poor countries cannot afford
- Policies to be proposed should be simple, cheap and easy to implement



Long-term policy options

- Lack of Schumpeterian Entrepreneurs
  - Programs to develop new firms
  - Foreign direct investment
  - Deregulation
- Asymmetric Information
  - Awareness campaigns
  - Incentive contracts
  - Reduction of transaction and influence costs
  - Insurance of technological risk instead of credit
- Failures in the Incentive System
  - Innovation incentives:prizes, tax breaks and direct support for R&D

Strengthening of Traditional Technology Policy

- Programs to disseminate “best practice” technologies.
- Strengthening of technological information networks.
- Financing of innovation and other technological expenditure: learning and demonstration effect.
- Transfer of successful intra-regional experiences.
- Deregulation, information and tax incentives (?) to promote strategic alliances.

Public Technological policy

- Lack of clarity in objectives
- No priorities
- Complex and detailed policies
- Technological organisations are rarely assessed
- Little accountability and results by policy beneficiaries

Reasons for the Investment Performance

- Perceptions and capabilities of firms are more on the marketing and financial areas
- Lack of Schumpeterian entrepreneurs
- Short-terms perspectives
- Poor information and knowledge about the relevance of innovation and training
- Failures of the incentive system

Structure of the Expenditure in Innovation

- Concentration in government and academic institutions
- Concentration in non-manufacturing sectors (agriculture, health, social)
- Concentration in basic and applied research instead of experimental development

S&T and R&D Expenditure

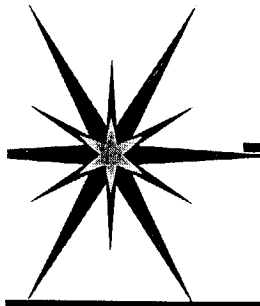
Percentages of GDP

	Early 1980s	Early 1990s
Argentina (R&D)	0.47	0.30
Bolivia (R&D)	0.07	0.10
Brazil (S&T)	0.72	0.78
Chile (R&D)	0.41	0.71
Colombia (S&T)	0.10	0.50
Costa Rica (S&T)	0.14	0.50
Cuba (R&D)	0.72	0.93
Dominican Republic (R&D)	0.35	n.a.
Ecuador (R&D)	0.13	0.16
El Salvador (R&D)	0.10	0.16
Guatemala (R&D)	0.08	0.15
Honduras (R&D)	0.10	0.20
Jamaica (R&D)	0.10	0.03
Mexico (S&T)	0.44	0.48
Nicaragua (S&T)	0.25	0.40
Panama (R&D)	0.16	0.08
Paraguay (R&D)	0.12	0.29
Peru (R&D)	0.30	0.22
Trinidad and Tobago (R&D)	0.10	0.08
Uruguay (R&D)	0.22	0.59
Venezuela (S&T)	0.34	0.47

Sources: Oro and Sebastián (1993), Peres (1994) and UNESCO.

Investment in Innovation

- Aggregated expenditure
- Specialized human resources
- R&D structure
- Private sector investment



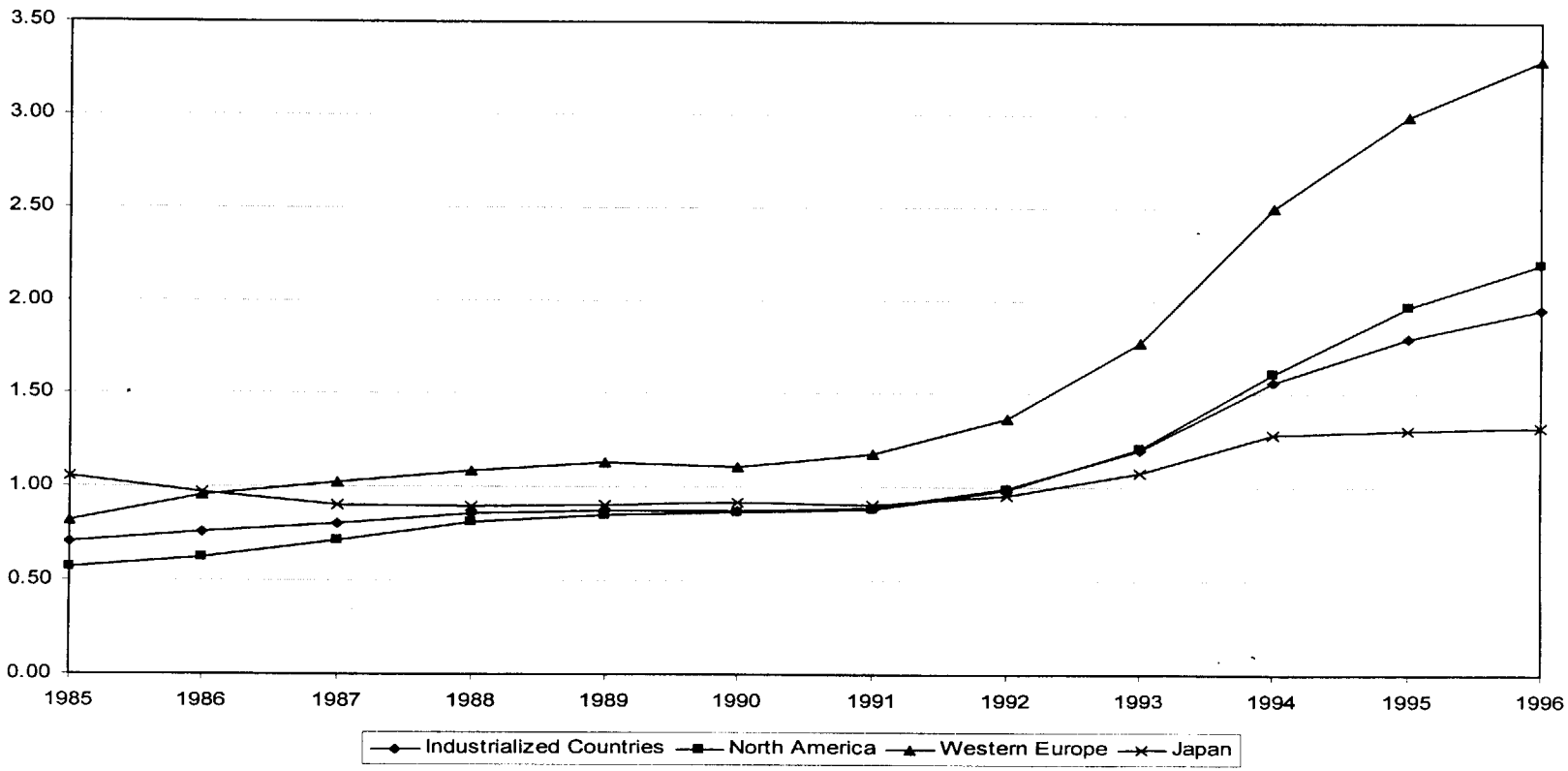
Technological infrastructure

- R&D organisations do not satisfy demand
- Inflexible and bureaucratic
- High turnover of staff
- Low moral among staff
- Face severe financial restrictions

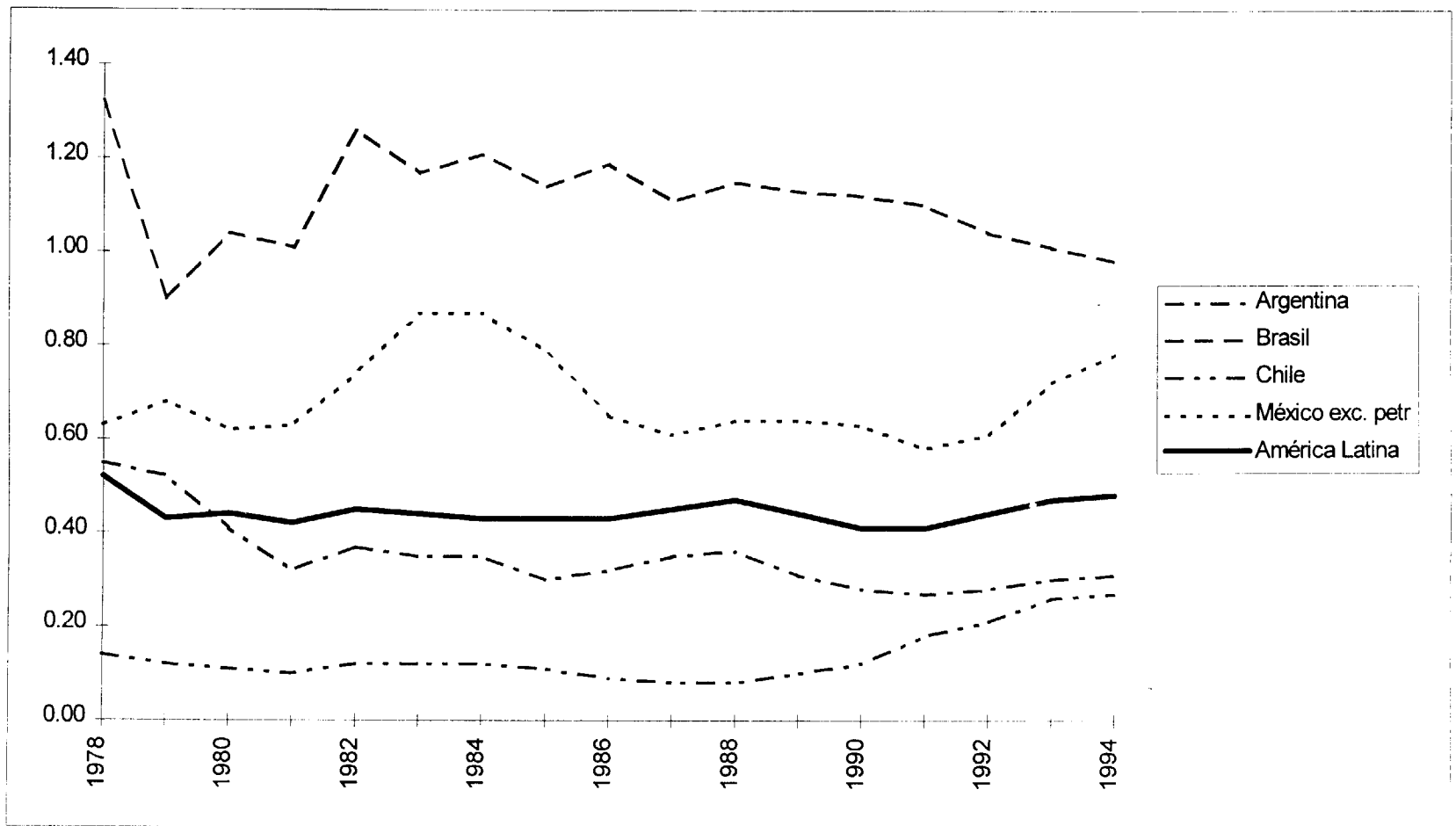
The Latin American Innovation Systems

- **Differences:**
  - R&D expenditure
  - Human resources in R&D
  - Depth of the national systems
- **Similarities:**
  - Origins, objectives, organizational structure
  - Policy perspectives and instruments
  - Changes in the late 1980s

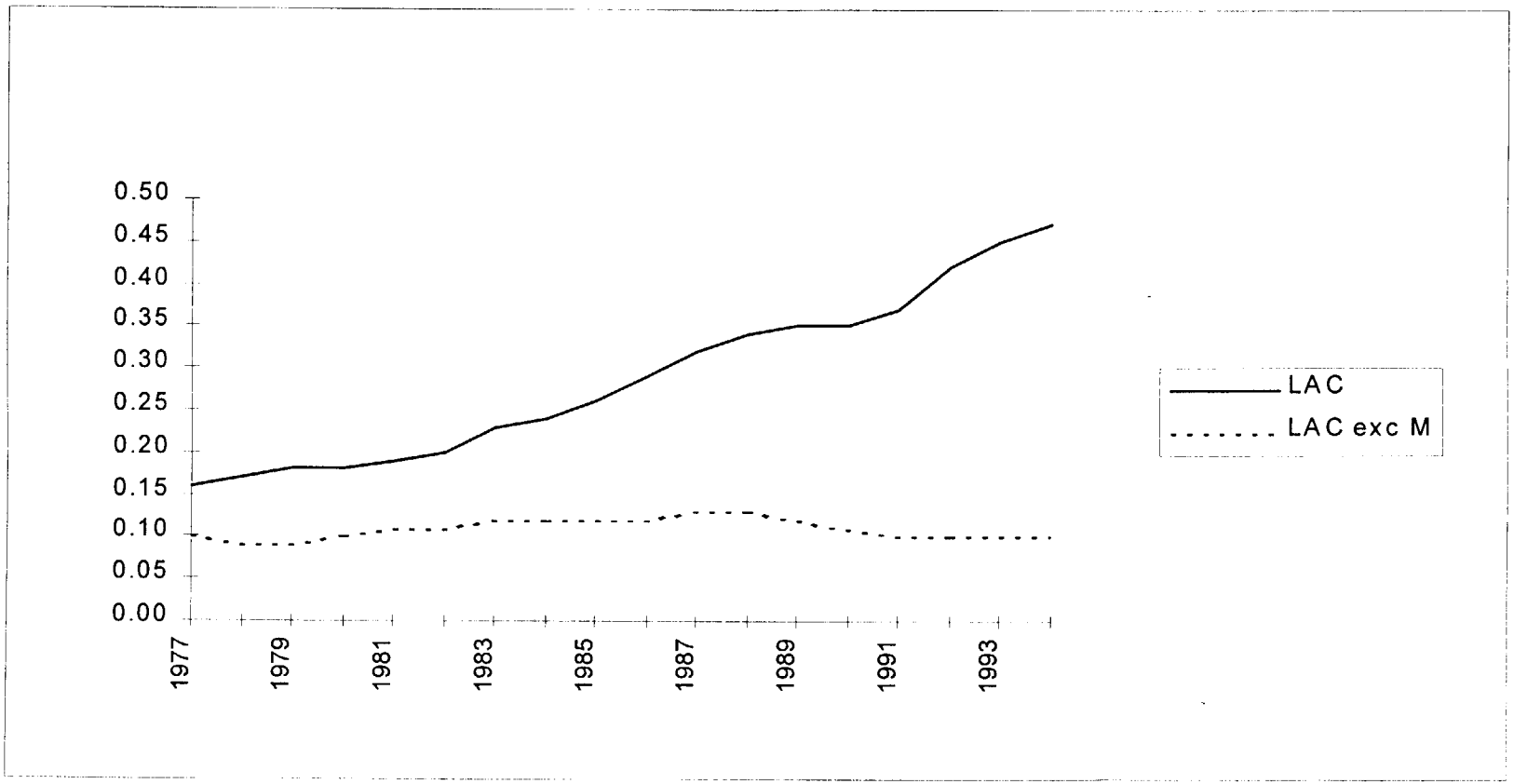
South Korea's ITS, World Market



Selected Latin American Markets Countries' ITS, Latin American Market (I)



Latin America and the Caribbean Countries' ITS, OECD Market



ITS by Regions, OECD Market