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This series is published in cooperation with the Program in Higher Education, School of Education, Boston College, Chesnut Hill, Massachusetts

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RoutledgeFalmer
New York and London
2000

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CHAPTER 9

Higher Education
The Social, Political, and Economic Driver of Mexico's Future

ELSA-SOFIA MOROTE AND JOHN L. YEAGER

In the 20th century, higher education was universally believed to be the foundation upon which a country's economic, social, political, and technological status rested. Global competition increased and nations became increasingly concerned about the quality and relevance of their educational programs. This was particularly true of emerging and developing countries, which were struggling to improve and compete on a more equal footing with the developed countries.

Nations that create well-developed higher education systems can provide the highly trained people necessary to compete effectively. Emerging market countries such as Mexico are seeking to increase their competitive position and are attempting to rapidly construct higher education systems that can be responsive to these challenges.

In the last years of the 20th century, Mexico experienced several major political, economic, and social changes. The economy improved as Mexico positioned itself as a major player within the North American and South American economic regions and became an active participant in the global economy. In addition to economic change, Mexico also opened its political system. Although the Revolutionary Institutional Party (PRI) was the dominant force in Mexican politics throughout the 20th century, successive political reforms have recently provided more opportunities for opposition parties. Further, its Congress is gradually becoming more outspoken as the number of opposition representatives increases (Big Emerging Markets [BEM], 1999).

The social situation in Mexico, however, has improved only slightly. Mexico possesses enormous human and economic potential, but some researchers, such as the Nobel laureate Gary Becker (1994), note that the rebellion in the poverty-stricken Mexican state of Chiapas has dramatized the existing inequality of living standards and that rapid economic development has the potential to increase these inequalities. Becker affirms that economic

development cannot be sustained if a nation neglects quality education for a sizable part of its population and fails to raise the living standards for all its citizens.

The link between education and economic development is a two-way process and most emerging market nations believe that the rapid expansion of educational opportunities holds the key to economic development. Mexico is not an exception to this phenomenon. Mexico's public policy concerning higher education underwent important changes in the 1990s, stressing quality, improving efficiency, and, above all, making education more relevant to social improvement and economic growth (Kent, 1995).

In this chapter we argue that in the 20th century higher education in Mexico has had a modest impact on the country's economic growth. From the 1980s until today there have been important changes in higher education in both its availability and quality. These changes reflect the efforts of the different stakeholders (government, universities and the private sector) to work together to bridge the gap between what industry needs and what it receives from the higher education system.

Higher education contributes to economic growth in three ways: the *transmission of knowledge* through extensive and varied teaching activities; *the production of knowledge* through research and creative activities of university faculty and students, and the development of activities through external organizations such as industry and business; and finally, the *diffusion of knowledge* from the external service activities of their faculty, staff, and students, and the performance of graduates once they participate in the workplace.

This chapter is organized as follows: (1) a brief recent history of Mexico focusing on its political and economic development, (2) Mexico as an emerging market country, (3) the context and function of the Mexican higher education system designed for the transmission of knowledge, (4) the production of knowledge through research and development, (5) the diffusion of knowledge through the contemporary role of higher education in meeting the social and economics need of the country, and finally (6) closing observations.

THE RECENT HISTORY OF MEXICO'S POLITICAL AND ECONOMIC DEVELOPMENT

Mexico, bordering the southern part of the United States, is a large country of more than 750,000 square miles, with a vast array of mineral resources. It is the second most populated country in Latin America. In 1998, Mexico had a population of approximately 98 million people, more than half residing in the country's central area. Mexico has a relatively young population; in 1997, for example, 36 percent of the population was under fifteen years of age (U.S. Agency for International Development [USAID], 1999). Its young and

rapidly growing population create problems in terms of the country's capacity to generate a sufficient number of new jobs (USAID, 1997). Nevertheless, because of its large internal market and wealth of natural resources, Mexico has had the opportunity to develop a foundation on which to build a growing economy. The economic development of Mexico in the last twenty years has been oriented to the globalization process. Its efforts to integrate its markets with the global marketplace are evidenced by its participation in the North American Free Trade Agreement (NAFTA), which together with European Union and Japan are the three largest markets in the world.

Higher education has contributed to developing a competitive advantage over countries such as Japan and Korea. In a similar manner, higher education must contribute to the economic development of Mexico. Mexico's higher education sector is facing the challenge of improving and increasing both the quality and quantity of their services. It needs to develop more dynamic universities to successfully assist the country in its ongoing political and economic development transformation.

Mexico is confronting several political changes. Before 1997, there was no clear separation between the state and the PRI, which has ruled virtually unopposed since 1929.[1] The close ties between the PRI and the government were reinforced by substantial direct government participation in the country's economy. However, the economic crises of the 1980s and 1990s weakened the PRI, thereby permitting the development of other political parties and non-governmental organizations. Since the early 1980s, there has been a proliferation of popular organizations outside of the PRI demanding political change and social justice. These developments have been influenced by external changes in the international arena and internal transformations within Mexican society (Randall, 1995).

Transformation is not only occurring in Mexico's political system, but also in its economic system. The rapidly changing economy reflects external changes as well as significant internal political and economic shifts. Over the past thirty years, Mexico's economic policies have ranged between the poles of a free market economy and state-directed developments (Warnock, 1995).

The trend toward openness and expanded activity in the global marketplace was largely an outgrowth of the 1970s when Mexico became a major petroleum exporter. The country could not sustain its high level of economic expansion, and the bubble burst in the late 1970s with the collapse of world oil prices. This led the country into an economic decline in the latter part of 1982 and early 1983 that lasted until 1988, during which time Mexico experienced rapidly escalating inflation, negative GDP growth rates, and increasing unemployment (see Figure 9.1).

The economic expansion of the 1970s positively affected higher education. The government increased financial assistance to higher education, which also received support from international agencies such as the

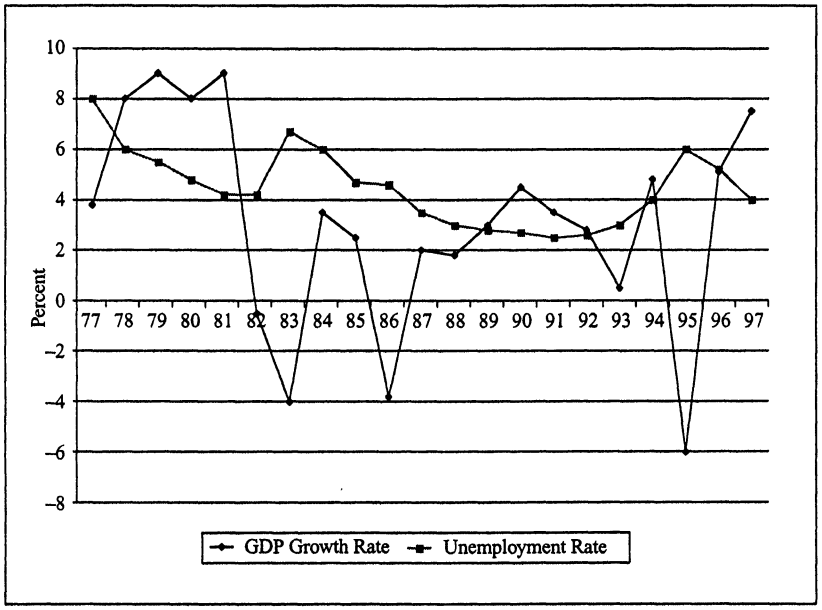

Figure 9.1. Unemployment rate versus gross domestic product (GDP) in Mexico.
Sources: Inter-American Development Bank (1999); Economic Commission for Latin America and the Caribbean (1986, p. 109).

Inter-American Development Bank and the World Bank. Both Mexican and international agencies and organizations strongly believed in the importance of the role of education in the industrial development of the country.

There were significant internal social and political pressures for changes as the middle classes pressed for greater educational opportunities. As a result, universities prepared themselves to receive a large number of new students, and undertook major curriculum changes in an attempt to better connect higher education with Mexico's needs (Rodrigez & Casanova, 1994).

During the late 1980s, Mexico experienced relatively little GDP growth and it was not until the early 1990s that economic stability returned (see Figure 9.1). The economic crisis of the 1980s severely affected the growth of higher education enrollments. In this decade the enrollment growth was only 46.3 percent, a sharp decline from the 213 percent growth rate of the 1970s (Rodriguez & Casanova, 1994).

The economic stabilization in the first part of 1990s was mainly accomplished through the privatization of many state industries and firms, as well as the deregulation of trade. The capstone event was the signing of NAFTA in 1994, which brought together Mexico, Canada, and the United States into a

new trading bloc. However, this rapid expansion was followed by a second critical monetary event in late 1994, the devaluation of the peso. This major reversal of economic fortunes was immediately addressed through an increase in financing by the NAFTA partnership and a renewed affirmation of Mexico's willingness to continue to implement the NAFTA provisions. Thereafter, the country's political leaders fully committed Mexico to increased involvement in the global economy.

NAFTA's implementation has influenced not only Mexico's economic situation, but also its political and social spheres. The economic downturn and instability experienced in 1994 was accompanied by political and social turbulence. Despite Mexico's economic recovery in the last few years, social equity and a reduction in poverty have not been significantly improved.

Throughout the 1990s higher education has experienced a crisis, one in higher education enrollment growth, and the other in funding. The rapid increase in enrollments has adversely affected the quality of education. In higher education the requirements for student selection and quality were abandoned, and today the number of students is growing. The financial crisis has also resulted in a cutting of university salaries and in reducing resources that would enable institutions of higher education to improve their teaching methods and research activities (Organization for Economic Cooperation and Development [OECD], 1997). However, neoliberal international organizations and government officials seem to believe that the expanded educational system is inefficient and there is a need to eliminate excessive expenditures that have limited available resources (Puiggros, 1999).

MEXICO AS AN EMERGING MARKET

During the last two decades, Mexican political and economic development has matured to the point where it has been able to recover from several severe dislocations. The country has successfully coped with the economic recession of 1995 largely because of the economic adjustment programs begun at the end of 1994. It has succeeded in averting a sovereign default, has limited the inflationary impact of the financial crisis, and has gained access to international finance markets (USAID, 1997).

As an emerging market, Mexico is an active participant in the global economy and is opening its political system. To maintain these efforts, Mexico is receiving an increasing amount of international financial support from a variety of international programs. Mexico has participated in financial assistance programs from the International Monetary Fund (IMF), the U.S. government, and the Bank of Canada, as well as from banks of several Latin American countries. This assistance recognizes Mexico's importance to the world economy and the country's potential as a global player.

However, Mexico must not only depend on capital inflow from more advanced countries. It needs to continue to be fully engaged in the global economy and to expand its internal capacities if it is to develop and grow. These efforts include participating in trading groups, privatization of business and industry, eliminating trading barriers, and attracting outside investment among others.

Promoting Privatization of Businesses and Industries

From 1974 to 1993, Mexico obtained an estimated $23.4 billion from the privatization of government owned industries (BEM, 1997). Since the late 1980s, many of the country's state enterprises have been privatized, and more is contemplated in such areas as ocean port terminals, petrochemical plants, railroads, and long distance telephone services. These actions represent additional opportunities for increased foreign investment that can be used to upgrade and modernize operations that can in turn result in increased trade.

Encouraging Foreign Direct Investments

The government's commitment to foster international investing was evidenced in 1991 with the passage of a new industrial property law which has greatly strengthened patent and trademark protection. This action was followed in 1994 by a revision to bring Mexico's laws in conformity with NAFTA requirements. Since then, the government has implemented an active campaign to inform the public about intellectual property rights and to crusade against corruption. All these actions, coupled with stronger enforcement, have contributed to a more positive foreign investment environment in Mexico. For example, in 1995, foreign direct investment increased 66 percent with continued investments from the United States, its largest investor. From 1979 to 1997, foreign investments increased from approximately 3.5 million to $11 billion (BEM, 1997).

Due to its unique strategic geographical position between North and South America and the Atlantic and Pacific Oceans, and the extensive trading relations that it has developed during the last decade, Mexico has a strong base for future economic development. Nevertheless, as Adam Smith (1976) stressed, the "wealth of a nation" is not found in gold, silver, or a favorable trade balance, but in its *human resources*. During its turbulent history in the second half of the 20th century, Mexico began the process of social, political and economic transformation, which has had a profound impact on its higher education system.

If Mexico is to achieve sustainable economic growth, it must create the appropriate conditions for higher education to contribute to economic growth through the transmission, production, and dispersal of knowledge.

TRANSMISSION OF KNOWLEDGE: HIGHER EDUCATION IN MEXICO

Higher education reflects the social, political, and economic needs of society, as well as the plans and priorities of the government. The government is responsible for the establishment of national policy and for providing funding to public higher education, therefore, it represents a major controlling factor in the growth and development of these institutions. The institutions themselves do not have the ability to independently undertake the necessary initiatives. Consequently, institutions are often placed in the position of responding, as opposed to initiating. Since public institutions are heavily dependent upon the government for support, the fiscal ability of public institutions coincides closely with existing economic conditions, and as the country's economic fortunes change, so do those of the higher education.

To understand higher education in Mexico today, it is necessary to understand the development of Mexican society and culture. Mexican society has its roots in the Spanish colonization that took place in the early 1500s, and much of the development in its higher education institutions reflect this Spanish influence. In 1551, the Spanish Crown established the first university in Mexico, the University of Mexico. The second university, the University of Guadalajara, was established more than two hundred years later in 1791. In the late 18th century, the government founded four additional colleges: the College of Engraving, the College of Fine Arts of San Carlos, the Botanical Garden, and the Royal Mining Institute (Osborn, 1976). These institutions were established to educate the elite of Mexican society.

The revolutionary and postrevolutionary periods of the 19th century were filled with great turbulence and political uncertainty. Many universities were closed and reopened several times, resulting in a substantial degradation of these institutions. Modern educational reform in Mexico dates from the 1910 reopening of the National University of Mexico, which was closed in 1895. In 1921, Alvaro Obregon was elected president and succeeded in returning political stability to Mexico. Jose Vasconcelos, a famous writer and philosopher, became the Minister of Education and gave immediate attention to the establishment of a modernized school system. Compulsory, free, secular education was the objective of the state. However, in the 1920s and early 1930s political and economic obstacles remained, and this was reflected in the relative lack of development of the education system. It was not until the presidency of Lazaro Cardenas (1934–1940) that Mexico achieved a stable government and that the state's educational efforts achieved high priority status and sustained funding (Osborn, 1976).

Mexico has a system of education that is organized into primary, mid-level or lower secondary, upper secondary, technical education, teacher training, and higher education (see Figure 9.2).

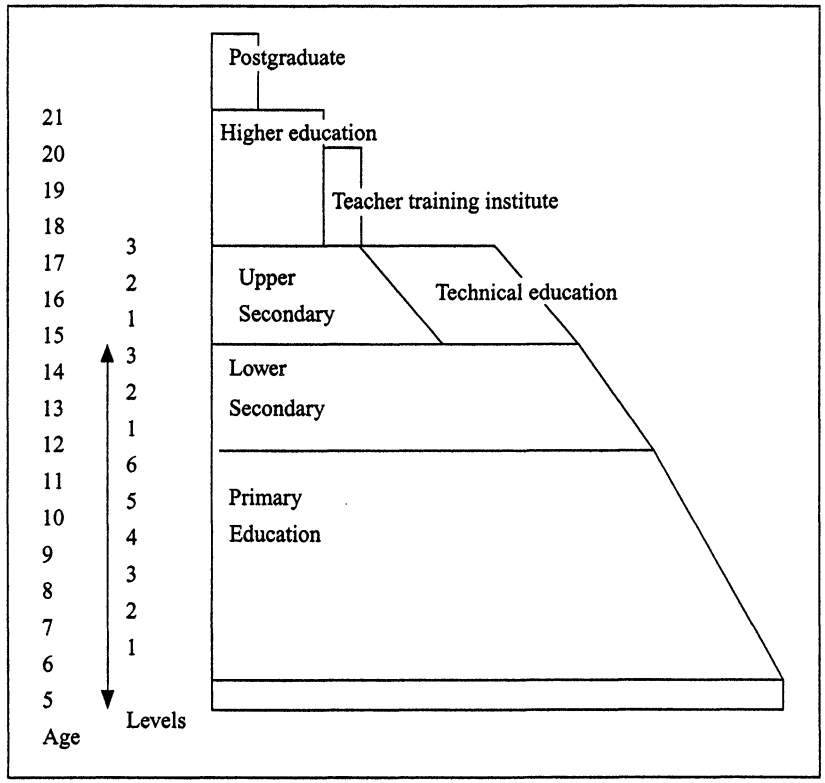

Figure 9.2. Structure of Mexico's formal education system: 1999.

Sources: Husen & Neville (1994) and Secretary of Education–National Association of Higher Education Institions and Universities (1999).

Basic education comprises preschool, primary school, and the lower secondary school. Until 1992, six levels of primary education were compulsory by constitutional mandate. Upon completing middle-level education (primary education and lower secondary), students followed one of two streams for the next three to four years: technical studies preparing graduates for the world of work, or upper secondary preparing students for higher education (Husen & Neville, 1994). Upon completion of an upper secondary program, students are admitted to study at higher education institutions. Although for many years there was no standard procedure for student admissions, in the early 1990s a number of institutions established entrance examinations, and national competency tests were developed for graduates within certain professions (Kent, 1995).

Mexico's higher education system is divided into four primary subsystems: (1) public universities—thirty-nine institutions that account for approximately 60 percent of all enrollments; (2) National Technical Institutes, a national network of eighty-seven institutions with 14 percent of all enrollments; (3) private institutions; more than 180 mostly small institutions that represent 40 percent of the higher education institutions but only 15 percent of total enrollments; and (4) public and private teacher's colleges and institutions with specialized teacher training programs (Puglisi, 1995; OECD, 1997).

In 1994, more than 1,358,000 students were enrolled in higher education. Advanced degree programs were closely associated with research activities within universities, and almost 55,000 students were engaged in various types of postgraduate study with approximately 5.6 percent pursuing doctoral work (OECD, 1997). The OECD estimated that approximately 250 students graduate annually at the doctoral level, which is extremely low for a country of approximately 98 million inhabitants.

In Mexico, as well as in many other Latin American countries, enrollment in public universities dominates higher education. While private institutions have greater operating autonomy than public institutions, they have the added responsibility for generating their own sources of financing. Independent funding status, while challenging, is also a positive factor. It allows them to be more competitive by responding to changing socioeconomic conditions more rapidly than public institutions, which have broader social obligations. They are, however, not totally independent, because the government does have the ability to regulate programs and the curriculum of private institutions through its power of certification (OECD, 1997).

Funding directly affects the number of students that are admitted to public institutions and the number of faculty employed. In spite of the yearly variability in funding, the government has continually supported increased development of the higher education sector. This increased funding has given institutions the ability to provide larger pools of trained people to meet the needs of industry and society.

Furthermore, government/university interactions have changed, indicating that the leadership has begun to accept change and innovation. Between the 1970s and 1990s there were a number of major adjustments among stakeholders in Mexico, including union leaders, leading scientists and academics, politicians, businesspeople, and donors. In addition there were changes in the duties and responsibilities of rectors and students (see Table 9.1).

All stakeholders recognize the importance of education to the growth and development of the country, and as a result the government has attempted to encourage the expansion of educational activities. Mexico's overall funding commitment to education has experienced positive growth since the recovery from the economic crisis of the early 1980s. Between 1980 and

Table 9.1. Changes in the dominant relationships and values among basic personnel in higher education in Mexico

1970s and 1980s	1990s
Rectors as coalition chieftains and power-brokers	Rectors as managers, aided by expert staff, interested in stability, competition for funds and public respect
Unions mobilized for wage raises and influence	Leading scientist and academics participating in evaluations, funding decisions, and development strategies
Student groups demanding free access and influence	Individual students as clients and investors, interested in jobs
Political parties mobilized within universities, the only political liberal zones of an authoritarian political system	Businesspeople and donors interested in making decisions and developing the economy
Government as "benevolent" funder and seeker of political stability	Federal and state governments as selective funders and guardians of quality and efficiency
Association of Rectors as political buffer for resolving major conflicts and as formal vehicle for legitimizing government's plans	Association of Rectors pushing for participation in designing evaluation policies, while not losing political influence
Demand-led expansion: regulation by political relationships and entitlement pressures	Expenditure-led and evaluation-led policies: regulation by incentives and demonstration of results

Source: Kent (1995).

1998, the proportion of the GNP the government provided for all educational sectors increased from 4.7 to 5.9 percent and higher education's share has remained relatively stable ranging between 0.54 to 0.76 percent of the GNP. The years in which educational support lagged has coincided with downturns in the general economy; from 1983 to 1989 Mexico experienced a downturn in economic growth, which paralleled downturns in education support (see Table 9.2).

There are two types of financial support provided by the government. The first is the transfer of public funds to higher education institutions as general institutional grants. The second is the transfer of public funds to students

Table 9.2. Mexico's support to education in relation to its gross national product

Year	Total education as % of GNP	Higher education as % of GNP
1980	4.70	0.65
1981	4.20	0.56
1982	4.00	0.66
1983	3.80	0.57
1984	4.20	0.60
1985	4.00	0.54
1986	3.90	0.56
1987	3.70	0.56
1988	3.50	0.56
1989	3.80	0.63
1990	4.00	0.67
1991	4.40	0.66
1992	4.70	0.74
1993	5.60	0.60
1994	5.80	0.65
1995	5.50	0.60
1996	5.80	0.65
1997	5.70	0.70
1998	5.90	0.76

Sources: Secretary of Education–National Association of Higher Education Institutions and Universities (1993, 1999); Hayashi (1992); United Nations Education, Scientific, and Cultural Organization (1997).

to provide general student aid support. Article 135 of the Constitution stipulates that all public education (including higher education) should be tuition free. Students receive financial aid for living expenses, but individual institutions are responsible for deciding the amount and who will receive such aid. At the national level, the National Council of Sciences and Technology (CONACYT) and the National Council of Technological Teaching (NCTT) also provides student loans. CONACYT also provides support for sponsored research and development projects. Other important sources of funds are those generated by individual private and public universities, funds through sources such as student services, professional examination fees, and lotteries.

Some universities also generate funds from the operation of selective business ventures, such as agronomic businesses, or the operation of industrial enterprises. Finally, most institutions also receive donations from corporations and individuals.

Institutions of higher education have responded to the shifting and changing needs of the nation, some in response to governmental funding plans, others by initiating activities responding to the external marketplace. In either case, changes are occurring that are embedded in the context of Mexico's transforming political, social, and economic conditions.

Mexico's expanding oil-exporting economy of the 1970s permitted the government to increase financial support to universities. This is reflected in the increase of employed faculty from about 25,000 professors in 1970, 70,000 in 1980, and more than 100,000 in 1985 (United Nations Educational, Scientific, and Cultural Organization [UNESCO], 1997). However, in 1983 the economic recession, hyperinflation, and growing unemployment all had an extremely negative impact on higher education. For example, from 1983 to 1988, professors' salaries lost almost 40 percent of their real earning power. Enrollments per 100,000 inhabitants, which had increased between 1980 and 1985 from 1,381 to 1,599, fell rapidly as a result of the economic crisis, to a low of 1,477 enrollments per 100,000 inhabitants in 1992. The enrollment rates began to increase again in 1993, with 1,509 students per 100,000 inhabitants. In 1998 it had risen to 1,833 (see Figure 9.3). The number of professors increased from 140,000 in 1993 to 190,824 in 1998. However, it is important to note that the growth in the mid-1990s was predominantly in private institutions (Kent, 1995). This situation raises doubts about the accessibility to higher education of lower income students, since the tuition-free public institutions did not fully participate in this growth.

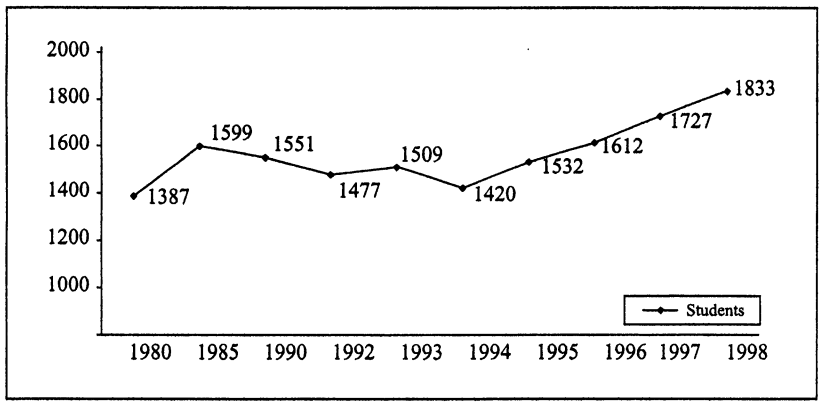

Figure 9.3. Higher Education in Mexico: Number of students per 100,000 inhabitants.

Sources: UNESCO (1997); Secretary of Education–National Association of Higher Education Institions and Universities (1999).

Accessibility to higher education is a major concern for any country trying to promote economic expansion. It is held that it is necessary for students to complete at least twelve years of schooling in the new knowledge-based global economy if they are to contribute to the modernization of Mexico. The Institute of Higher Education Study in Technology in Monterrey conducted a study in 1995 on the education cycle beginning with primary school through university, focusing on the rate at which students complete or continue their studies at each level. The findings were staggering: of those who started primary school, only 14.2 percent finish preparatory (high school, secondary), and only 2.2 percent finish technical school. Furthermore, only 9 percent went on to universities and fewer than 1 percent to postgraduate studies. Almost 84 percent of students who enter the education system do not complete twelve years of schooling (Puglisi, 1995). In December 1994, President Zedillo, aware of the seriousness of this situation, pledged that all Mexican children would complete high school by the end of his administration (2000). If these proposed improvements come even close to being successfully implemented, they would have a profound impact on higher education by providing a larger and better-qualified pool from which institutions can select students. It would also create a steep increase in the demands for rapid institutional growth and at the end of the 1990s there is evidence of a growing number of students attending universities.

Accessibility to higher education is not the only concern; quality and type of knowledge and skills acquired are also important. Mexican businesses and industries need students with specific skills, which at the present are not matched by those provided by universities. A study by American Chamber/Mexico concluded that "if a profile of 21st-century Mexican employee were pared down to a few absolute necessities, it would include language and communication skills, state of art computer skills, strong math and science skills and proficiency in English" (Puglisi, 1995, p. 28). However, in 1995, fields with lower enrollments in higher education included communications, math, and computer sciences—areas identified as in the greatest need.

The skills acquired by the labor force directly affect economic growth. Figure 9.4 indicates that the industrial labor force (including technical and scientific activities) has decreased since 1985, which could cause problems for a country trying to promote economic growth and employment. Furthermore, the labor force is growing in the service sector, exclusive of technical and scientific areas, which requires less highly trained people. Agriculture does not generally require a highly trained workforce, but this sector has also declined over the years, due, in part, to the migration from the rural to urban areas, and as a consequence of the concentration of economic and political power in Mexico City.

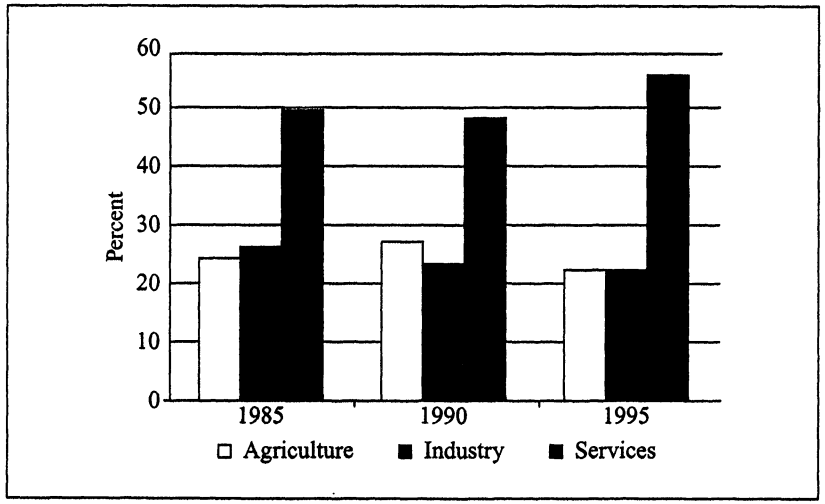

Figure 9.4. Labor force by major sectors.
Source: Inter-American Development Bank (1999).

Training young people for employment in an emerging Mexican economy will require the revision of existing programs: the development of new work-related programs, and the participation of employers who will hire the graduates. If Mexico is to achieve sustainable economic growth, it must have a national pool of an appropriately trained workforce, a significant number of which must be provided by its higher education system. This training has to be in all fields of knowledge, and requires investing in research and development activities. Thus, Mexico must not only transmit knowledge, but also produce knowledge.

THE PRODUCTION OF KNOWLEDGE: RESEARCH AND DEVELOPMENT

Mexican higher education institutions have expanded their research capabilities in direct response to government programs, as well as to increased pressure from business and industry. While research and development activities have increased, expenditures are still extremely modest in comparison to its more economically developed NAFTA trading partners. At the current level of expenditures, it will take many years before Mexico begins to fully realize the benefits of these modest investments in higher education.

Expansion of research activities—particularly those associated with the sciences, computing, and information sciences—must be increased at a faster rate than research activities associated with the arts, humanities, and social

sciences. This will create tensions within the system and the need for refocusing institutional management activities. While most of the pressure for these changes has been from outside to the universities, it is imperative that the universities initiate appropriate programs to maintain and sustain these changes and become the initiators of research and development activities. This is important because such a large percentage of Mexico's government budget for research and development goes to universities. To capitalize on these investments, it will be necessary that an appropriate infrastructure for higher education be established, including facilities, equipment, and technological support such as effective computing and communication systems. It will be difficult to maintain these research activities because they are expensive, but without such investments there is little hope that universities can effectively conduct research and development activities that are competitive on a global basis.

While public institutions have been reactive rather than proactive, private institutions have demonstrated a much greater amount of flexibility and willingness to meet the needs of business and industry by developing curricula for specific skills. Since private institutions are enrollment driven, it is imperative that they develop quality programs that can attract tuition-paying students who, upon graduation, are gainfully employed. Private institutions of higher education have demonstrated greater willingness to initiate new academic programs. It should be noted, however, that few private institutions actively undertake new research and development activities, but rather concentrate primarily on teaching. One reason for this is that the government largely provides the research funds that are used mostly to support public institutions.

CONACYT is responsible for providing support to stimulate research and development (R&D). It was reorganized in 1990 to facilitate a national priority to encourage R&D. As a result, between 1989 and 1993 national research and development expenditures increased 140 percent, from $564 million to $1,375 million, or the equivalent of 0.3 percent of the GNP (Salazar & Lorey, 1997).

The number of researchers in Mexico had been on the increase for more than twenty years. During the economic downturn of the 1980s, the government established the National System of Researchers to assist in retaining the most highly qualified staff at research institutions (OECD, 1997). However, by the late 1980s, continued growth of research was challenged by several issues: (1) the numbers and quality of available human resources, (2) the ability to obtain advanced degrees out of the country, (3) limits on the number of available scholarships, (4) appropriate infrastructure and support material, (5) publication of research results, and (6) access to research from other countries. To begin to address these issues it was necessary to establish a statistical base for monitoring scientific and technological activities. This task was

assigned to CONACYT, and in 1991 it began developing science and technology indicators on an annual basis. According to CONACYT, in 1994 48 percent of Mexico's scientists and engineers were working in public institutions of higher education and only 1.6 percent in private education. In addition, almost 95 percent of the scientific articles published each year were by Mexican scholars in public universities. Most of the research projects conducted dealt mainly with the social sciences and humanities, followed by mathematics and the sciences (OECD, 1997).

In 1996, CONACYT implemented a new structure based on a methodology proposed in the Frascati Manual of the Organization for Economic Cooperation and Development (OECD). Its R&D activities were organized into three basic categories: research and experimental development scientific and technical education and training; and scientific and technological services (OECD, 1997). Both the private and public research sectors receive support from CONACYT, with institutions of higher education in institutions receiving the largest proportion of funds. In 1996, research expenditures were distributed as follows: public education 67 percent, energy 16 percent, agriculture, livestock, and rural development 8 percent, health and social security 3 percent, and the remaining 6 percent went to other sectors (CONACYT, 1996).

To better understand the support of the Mexican government for R&D and the amount of effort that will be required to compete successfully in the global economy, a comparison between the support of research by Mexico and its two NAFTA trading partners, Canada and the United States, is presented in Table 9.3. As indicated, in 1992 the United States expended $626, Canada $296, and Mexico $12 per capita for research and development activities. An examination of other measures such as the total expenses in R&D as a percentage of the gross national product indicate the wide disparity between the countries in terms of support of R&D efforts. These comparisons indicate the Mexico's vulnerability in terms of the amount of research support necessary to facilitate an expanding economy, particularly one requiring high levels of technology.

All three sectors—academia, industry, and government—believed that earlier policies had failed. In addition, Mexico is one of the few OECD member countries whose main source of financing research and development is the government (66.2%) followed by business and private institutions (17.6%), and individuals and international governments (16.2 %). In most of the OECD countries, unlike Mexico, the private sector provides the majority of R&D financing, so there would have to be an enormous increase in funding support from all sectors to begin to approach the level of research commitment of neighboring countries.

Technology transfer, the process of moving research and innovations to commercialization and exchanges of technologies between nations, is also an

Table 9.3. Selected research and development (R&D) comparison among NAFTA partners

	United States (1992)	Canada (1991)	Mexico (1991)
Total expenses in R&D (in millions of dollars)	157	8	1
Total expenses in R&D as % gross national product (GNP)	2.7	1.4	0.4
Percentage of total of expenses in R&D assigned to universities	18	25	31
Population (in millions)	250	27	86
GNP per capita (in thousands of dollars)	21.8	20.5	2.5
Expenses in R&D per capita (in dollars)	626	296	12

Source: Bruner (1994).

important way to expand Mexico's R&D base. Technology transfer and R&D are forms of knowledge diffusion, as well as producers of knowledge. Castaños (1991) indicated that technology transfer was a hotly debated issue in Mexico during the 1980s and 1990s, and has been a topic of growing interest since the 1982 debt crisis through the more recent NAFTA signing. While universities, the private sector, and the government all went on record to officially support knowledge transfer from academic institutions to industries, there were also many people within universities who were reluctant to support this activity. During this debate, the past practice of being overly reliant on imported knowledge was noted by several institutions as a major drawback that had negatively affected Mexico's ability to compete in a high tech environment. It was felt that Mexico's industries were too often based on technologies that were either obsolete or did not fit Mexico's needs. This was mostly the result of a large gap between research and industrial applications. Although foreign investment is a way to obtain new technologies, there is also an increased reliance on professionally trained immigrants from highly developed countries, thus mitigating its beneficial impact. An effective link between Mexican higher education and industry was not developed, thereby prohibiting technology production and transfer, both of which are essential to Mexico's development. Mexican efforts at the production of knowledge must be a high priority in the 21st century, and the results of these efforts must be disseminated to business and industry.

THE CONTEMPORARY ROLE OF HIGHER EDUCATION IN SUPPORTING MEXICO'S TRANSFORMATION TO THE 21ST CENTURY

One of the key elements in Mexico's efforts to achieve sustainable growth will be the development of new methods for the *diffusion of knowledge*, geared toward the creation of human resources with the necessary skills to meet its more technologically advanced economic needs. Since 1992, higher education has been an important consideration in the formation of plans for the country's economic development. Two major goals for higher education institutions are to provide trained professionals for business and industry and to enhance social mobility. In 1993 there were four major characteristics identified in the development of the Mexican economy in respect to human resources (Lorey, 1993):

1. Limited employment opportunities for professionals resulted from the highly protective nature of Mexican industry from both domestic and international competition. Without modern equipment and investment for R&D, there is little opportunity to expand production.
2. The Mexican economy was overly dependent upon the importation of capital goods and technology for industrial expansion, which reduced the need for native professionals.
3. Much of the increase in employment occurred in industries that had limited needs for the skills of highly trained professionals.
4. The government, particularly after the late 1950s, became an employer of last resort, absorbing many professionals not needed by the private sector.

These characteristics of Mexico's economy with respect to human resources began to change after the NAFTA regulations were implemented. While Mexican industry is not as highly protective as before, it stills depends on the importation of capital goods and technology, despite its own increased expenditures on R&D activities. Privatization, particularly since the early 1990s, has created higher expectations in terms of employee skills and knowledge.

In the 1960s, universities expanded their efforts to include students from lower socioeconomic backgrounds. These efforts often resulted in higher enrollments of students from lower socioeconomic backgrounds, but also increased dropout rates prior to graduation. Public universities increasingly took on the task of promoting upward social mobility by providing higher education programs students from low-income families, while private universities focused on middle class students seeking professional degrees.[3]

The continued emphasis of public higher education to providing upward social mobility is deeply rooted in the history of Mexican higher education.

Having the major benefits of higher education affect all strata of Mexican society is necessary if the country is to realize the potential benefits of all its human assets in fostering economic development. This task falls largely to Mexico's public higher education institutions. Private universities have only a small percentage of lower income students, and these institutions have historically demonstrated higher levels of program quality than public universities, although not in the area of research. While some public institutions were improving the quality of their programs, their efforts generally lagged behind private institutions. Public universities had difficulty competing and began to produce a larger number of "egresados," individuals who had finished undergraduate coursework but not their final requirement such as an undergraduate thesis, final examination, or public service activity. During the latter decades of the 20th century, the demand for high-quality graduates has been greater than the public universities could meet; therefore, private institutions have expanded and grown rapidly in order to meet these emerging needs.

Changing economic demands traditionally have had a profound effect upon Mexican universities, both public and private. A system of public and private universities has been in continual development since the 1940s, and each has contributed to different aspects of Mexico's trained workforce. Yet the disconnection between historical economic development and social mobility has been a persistent problem. On one hand, as Lorey (1993) notes, this is reflected in the number of professional university graduates seeking employment, and in their ability to find suitable employment. However, many in the business world feel that the curriculum and training received by students in the areas of business administration, communications, finance, and accounting were inferior compared with universities in the United States, Europe, and South American countries such as Argentina, Chile, and Peru (Puglisi, 1995). Also, Governor Canales (1998) of Nuevo León, Mexico, noted that the problem in Mexico is not the lack of jobs, but the adequate training and education of the graduates.

The issue of social mobility and economic development is also underscored in a study conducted by Psacharopoulos (1985) in which he compiled different sets of estimates for a diverse sample of countries concerning the contribution of education to economic growth. He concluded that in the case of Mexico between the 1950s and 1970s, education explains only 0.8 percent of the economic growth, while the average found was 8.8 percent of the entire sample (with Argentina at 16.5 percent, Brazil 3.3 percent, Canada 25 percent, and United States 15 percent). This finding is disturbing not only because Mexico was well below the average, but also because in that period Mexico, with its GDP growth rate averaging 6 percent per year, had experienced tremendous enrollment growth at its universities. Nevertheless, in that same period income distribution among all economic strata did not change, nor did the Gini coefficient, indicating a near absence of social mobility.[4]

Londoño and Székely (1997) showed that sustained growth over time reduces overall income disparity and facilitates the creation of new jobs and mobility opportunities. They found that increased investment in capital formation of between four and five points of GDP has been associated with a one-point decline in the Gini coefficient, and a one year increase in average education is associated with a reduction of the Gini coefficient of over two points. Consequently, Mexico not only needs to increase investments in capital and open markets, but also needs to increase its population's access to higher education.

A Mexican worker who does not have twelve years of schooling does not have the necessary knowledge and skills to contribute to Mexico's economic growth. Whereas the average U.S. and Canadian worker has 12.6 and 11.7 years of schooling respectively, the average Mexican worker has only 6.4 years (Puglisi, 1995). This lower level of general education also reduces the size of the pool from which students can be drawn to attend institutions of higher education and thereby to contribute to the country's transformation.

It is very important that a country fully develop its human resource assets if it is to attain world-class status. Therefore it is imperative that Mexico increase the number of students from all socioeconomic groups, as well as improve the quality of the education provided. While this is a necessary condition for world class status, it is not sufficient. Mexico must also open its commercial ties with other world markets, thereby creating an internal demand for personnel with appropriate training and educational backgrounds.

While this need to develop a high quality workforce is viewed as a major priority by many, there is much dissatisfaction with the training graduates receive. As Castaños (1997) has indicated, many individuals who participated in his study believed that the role of universities was to provide quality educational programming, thereby developing the highly trained resources necessary for business and industry. One participant stated, "I have been here now for twenty-three years and the quality of chemical engineering graduates keeps getting worse year after year. We hire whatever we can but we have to re-train the kids. If we screen the applicants using reasonable selection criteria, none of them would make it. Higher education is a mess and the graduates lack the proper outlook" (Castaños, 1997, p. 369).

It is currently not clear whether there exists an acceptable understanding by the government, the private sector, and universities as to appropriate policies and priorities for the universities. However, there are many existing examples of cooperation between these three sectors such as the American Chamber/Mexico (AMCHAM). AMCHAM's education task force was formed in 1994 to define a role for AMCHAM in education and to recommend an action plan to its Board of Directors and includes nine of the country's industrial leaders. AMCHAM diagnosed the causes of conflict and dysfunction between the needs of industry and the graduates of the Mexican

education system. They also identified strategies for change which could address those differences and develop a workable plan of action (Adelman, 1995).

Nevertheless, there still does not appear to be a coordinated policy as to how the public universities in particular will be involved in direct support of economic development. Recently, the public universities have come under criticism for not providing high quality, professional graduates. There has been concern about the ability of the public universities to be at the forefront of advancing Mexico's technological base to support economic development. Expanding Mexico's technological resources will require state-of-the-art laboratories and increased governmental funding for research. Incentives will have to be developed to actively foster appropriate change in public institutions. Private universities currently seem to enjoy a more positive public perception in terms of their ability to produce quality technical professional graduates. The expectations that public universities must have a duality of missions—quality professional training as well as the promotion of social mobility—while not necessarily in conflict, can potentially reduce a university's ability to achieve either successfully. Public institutions must have a clear understanding of their missions and the types of programs they will implement to accomplish these equally important missions. This will require a closer alignment of government, business, and university interest and programs.

Currently, public universities offer educational opportunities to the largest segment of the college-age population and are attempting to develop quality research programs. Yet, they are not adequately funded and are having extreme difficulties with these two missions. Either expanded funding must be made available from the government, or students must be given greater responsibility for funding their own education through family contributions or loans. Funding at the current levels is simply inadequate, and this problem of inadequate resources will become more pressing as a larger number of students obtain high school diplomas and attempt to enter universities. This may require a reexamination of the policy of free tuition for all.

It is instructive to note that private higher education has been able to grow and prosper over the last several decades, relying almost exclusively on tuition as well as private gifts. This may be partially due to the operation of these institutions in a more businesslike manner, and to their willingness to respond and adjust to changing external requirements imposed by the economy and society in general. It is important for universities, both public and private, to continuously evaluate their current array of programs and the changing human resource needs of society. Further, since there is a growing reluctance on the part of government to continue to be the "employer of last resort" of all college graduates and to reduce the size of government in general, many students need to seriously examine their educational programs if

they are to obtain suitable employment. The needs of Mexico's emerging market economy require new academic programs as well as the termination of some existing programs. Universities, if they are to survive and prosper, will have to continue their efforts to develop linkages with business and industry. It will be through such changes that universities can become an important element in Mexico's sustainable economic development.

CONCLUSION

Mexico has taken many steps to improve and expand economically, socially, politically, and technologically. The question remains as to whether the political will of the country's leadership is to continue and to accelerate this change process. At the very least, this will require a reasonably stable political and social environment. The need for political stability and openness is clearly reflected in the negative consequences of the turmoil that has struck the economies of other emerging markets, particularly in Asia. The disruptions caused by political and social instability can quickly decimate any economic gains that have been attained. Successful market-driven economics require the development and implementation of democratic practices. Political stability can only be achieved through the reduction of government corruption at all levels, by increasing upward social mobility, and a more equitable distribution of wealth, thereby reducing the Gini coefficient through accessibility to education. As Mexico continues its development it will confront some major challenges. The country's wide rich/poor stratification is a problem that could severely hinder future economic development and political stability. The extent to which social unrest can be alleviated will depend on Mexico's ability to integrate all marginalized people into an expanding economy and political system. Although there has been some reduction in the degree of social stratification, there is still a very wide gap between the haves and the have nots in terms of economic well being. Increased accessibility to higher education will be one of the keys to enhancing social mobility and reducing this potentially dangerous gap.

Mexico's economic success will also depend on the country's efforts to continue its privatization of state-owned businesses, and to open its markets to an expanding number of international trading partners. Expansion of trade and domestic production can provide the country with the economic capacity needed to develop an appropriate infrastructure in terms of highways, water management and air pollution to more fully meet the needs of its people.

One major unknown confronting Mexico's future development will be the condition of the global economy. Without a relatively stable world economy, it will be difficult for Mexico to continue the development of its own economy. The economic problems that were experienced in 1997 in Thailand, Japan, Malaysia, and Russia had major implications for Mexico. Although it

has become a major trading partner with Canada and the United States, it will still need to establish additional trading relationships if it is to sustain its own development. If global economic conditions worsen it can be anticipated that Canada and the United States may also suffer a general economic decline, thus reducing their imports from Mexico. It is therefore important that Mexico continues to explore economic ties with other countries, particularly Central and South American countries and the European Union. Interdependence is indeed a double-edged sword.

Although the three trading partners have made a good start in the implementation of NAFTA, there are many steps yet to be taken by Mexico, including a more uniform treatment of patents, copyrights, privatization, and the stabilization of its currency. While most observers recognize that this will not be a smooth and straightforward task, and that there will be setbacks, it nonetheless is now a major opportunity for Mexico to develop and grow over the next few decades.

All three sectors—higher education, business, and government—believe that previous policies had failed to develop an effective link between higher education and the private sector, thereby limiting technology production and transfer, both of which are essential to economic growth. Developing links with industry and supporting economic growth will also require an attitudinal shift on the part of the current administration and faculty of public and private institutions. There will have to be a close monitoring of graduates to ensure that the quality of students being trained is of the highest order and that their skills are relevant to their future areas of employment. While universities have begun to develop research facilities, increased investments in R&D must be made if Mexico is to be a more equal partner with Canada and the United States in terms of technology exchange and development. Collaboration and partnerships may provide the most viable available strategy in developing the technological base required by Mexico's economy. Government, business and industry, and universities must recognize the symbiotic relationship that exists between them and they must begin to identify strategies that will develop the country's ability to become a major player in the global economy. One of the opportunities that needs to be explored is the establishment of partnerships between Mexican universities and universities in other countries such as the United States and Canada. Collaboration programs between the NAFTA countries can be of major assistance in "jump starting" Mexico's technological development.

While education can be a driver for social mobility, and economic growth, Mexico's past performance of higher education in transmitting knowledge has been poor, failing to meet economic needs and often creating a misfit between industry, business, and graduates. While there is as yet no clearly designed plan to coordinate the efforts of government and the private sector, there is increasing communication. Industry and business have began

to retrain higher education graduates and are collaborating more closely with higher education institutes in an effort to define future needs.

Higher education's activities in the transmission of knowledge have to be extended in quantity and quality through coordination and consultation with business and industry to match effectively the supply and demand of human resources. In this way, the diffusion of knowledge can be effective in contributing to the nation's wealth. The transfer of technology will assist in the diffusion and transmission of knowledge, contributing to the promotion of economic growth. Mexico's political leadership has demonstrated a high level of commitment through the policies of CONACYT to increase the production of knowledge, yet it still needs to invest more in higher education in order to generate more opportunities for economically relevant R&D.

Mexico has taken a series of initial steps to improve its education system and help develop and expand its economy. It has begun to successfully achieve sustained economic growth based on its internal capacity and utilization of its human resources. To continue this development it will require the necessary political will to reform economic policies, create a more open political system, and promote social stability. Higher education will play a critical role in this process.

NOTES

1. On March 6, 1929, the Revolutionary National Party was founded, which became in 1938 the Party of the Mexican Revolution. In 1946 they adopted the name Institutional Revolutionary Party (PRI).
2. Mexico is the only nondeveloped country belonging to the OECD.
3. Certificates of study and recognition are provided for programs that have a short period of study and low or no tuition fees.
4. The Gini coefficient is an inequality indicator. It is a measure of dispersion within a group of values, calculated as the average difference between every pair of values divided by two times the average of the sample. The larger the coefficient, the higher the degree of dispersion.

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CONTRIBUTORS

Bob Donnorummo is a senior research associate and associate director of the Center for Russian and East European Studies, Institute for International Studies, University of Pittsburgh. His recent publications have focused on the political and economic changes in eastern Europe and the former Soviet Union.

James E. Mauch is a professor of administrative and policy studies at the University of Pittsburgh, an associate faculty member at the Center for Latin American Studies, senior associate at the Institute for International Studies in Education; and an associate faculty member at the Center for Russian and East European Studies at the University of Pittsburgh.

Matthew S. McMullen is a visiting faculty member at the Institute for International Studies and a research associate at the Center for Russian and East European Studies at the University of Pittsburgh.

Jiri Prucha is director of the International Center for Distance Education at the Center for Higher Education Studies in Prague.

Wieslaw Oleksy is the director of postgraduate programs at the Department of American Studies and the Mass Media Institute of International Studies at the University of Lodz, Poland. He is also an associate professor of English-Polish linguistics and American studies at the University of Lodz.

Hsiou-Hsia Tai is an associate professor of education at National Chiao-Tung University, Taiwan. Her research focus is on higher education expansion, policy, and university industry relations.