

THE COLUMBIAN EXCHANGE AND THE REVERSAL OF FORTUNE

Thomas Grennes

It is difficult to think about modern American food without including hamburgers and hotdogs. It is also difficult to think about popular American history without cowboys mounted on horseback tending herds of cattle. However, before the arrival of Columbus in 1492 there were no cattle or pigs in America to provide beef and pork for hamburgers and hotdogs. There was no wheat to make hamburger and hotdog buns. There were no horses for cowboys or Indians to ride. The European settlers brought with them cattle, pigs, horses, wheat, and many other plants and animals that became the foundation for modern food and agriculture in the Western Hemisphere.

It is also difficult to think about modern Mexican food without including rice, tacos filled with meat, refried beans in animal fat, cheese in enchiladas, and sugar, cinnamon, and milk in chocolate. However, Mexico in 1492 had none of these ingredients. The massive transplantation of plants and animals across the Atlantic Ocean in both directions has been called the Columbian Exchange (Crosby 1972). It has been described as the “greatest human intervention in nature since the invention of agriculture (Fernandez-Armesto 2002: 165), and it has had an enormous effect on the Americas and the entire world. The Columbian Exchange altered the kind of food Americans and Mexicans eat, the kind of agricultural products produced in both countries, and the entire pattern of world economic growth.

This article will concentrate on the effects of the Columbian Exchange, but the exchange of plants and animals was part of a broader process of trade, migration, investment, colonization, and exchange of

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Thomas Grennes is Professor of Economics and Professor of Agricultural and Resource Economics at North Carolina State University. He thanks Ronald Grennes for useful comments.

ideas that followed the voyages of discovery by Columbus and others. The same Old World plants and animals were introduced to the two regions that would become the United States and Mexico, but the effects in the two countries were substantially different.¹ The United States was the poorer neighbor in 1492, but it became relatively richer. The purpose of this article is to show how differences in institutional development affected responses to the same opportunities. I shall concentrate on developments in the United States and Mexico, but the Canadian experience was similar to the U.S. response, and the response in the rest of Latin America was similar to the Mexican response (Cole et al. 2005).

What Products Were Exchanged?

Columbus's discovery favored all naval powers located on the Atlantic Coast of Europe, but England took greater advantage of the opportunity than Spain, Portugal, France, and other Atlantic nations. Both New and Old Worlds gained from the Columbian Exchange, but the New World gained more because its plant and animal species had been less diverse. The number of cultivable plants in America doubled or tripled as a result of the Columbian Exchange (Crosby 1972: 107). Europe and the Americas were once connected, but after separation their plants and animals evolved separately. Large animals that once roamed the Americas had become extinct centuries earlier, and by 1492 dogs and llamas were the largest domesticated animals. In addition to cattle, pigs, and wheat, the New World received chickens, sheep, donkeys, rice, oats, barley, rye, onions, garlic, lettuce, cabbage, bananas, and more (Crosby 1972). Before Columbus there was no coffee, cream, or sugar in America. Coffee was transplanted from the Canary Islands to Martinique and later to Latin America.

In addition to bringing new crops and animals, Europeans brought technology that included iron tools and wheels. They also increased agricultural productivity by planting native American crops, such as cotton, tobacco, and potatoes, in more favorable locations in the New World. Potatoes were native to the Andes in South America, but they were slow in moving to North America. The slow movement of potatoes to North America is an example of Diamond's proposition that agricultural innovations move East-West faster than North-South. Potatoes were first moved from South America to England and Ireland

¹For ease of exposition, the terms "United States" and "Mexico" will be used to refer to the geographical territories that later became the United States and Mexico as well as the independent countries themselves.

before being transplanted to New England in 1718 by Scotch-Irish settlers (Crosby 1972: 170).

Europe also gained from the Columbian Exchange. It is difficult to think of Ireland and Northern Europe today without potatoes, but they were not grown in Europe before Columbus's voyage. There was no tomato sauce in Italy before tomatoes were introduced from America. There was no Swiss or Belgian chocolate before cocoa beans were sent from America.² The Old World also received corn (maize), peanuts, chili peppers, tobacco, and many other plants from America. Corn and manioc from America have become important food crops in Africa.

Not everything about the Columbian Exchange was favorable. Europeans inadvertently carried diseases that had a devastating effect on the native population of America that lacked immunities. The population of Mexico dropped by more than 90 percent in the century after Cortés arrived in 1519 (Coatsworth 2003a:1). It took more than 350 years for the population of Mexico to return to the 1519 level, and this disaster influenced the Mexican response to new opportunities. The Conquistadores also destroyed Aztec institutions and replaced them with Spanish institutions.

When and Where?

New plants and animals were introduced to New Spain a century before they reached the British colonies. On Columbus's second voyage, he transported sugar plants, cattle, pigs, and sheep to the island of Hispaniola (Fernandez-Armesto 2002: 169). Cortés wrote to his King that no ships should be sent from Spain without plants and animals (Simpson 1966: 29). Horses contributed to Cortés's conquest of the Aztecs in 1519, and he immediately moved plants and other animals from Hispaniola to the mainland of Mexico. Potatoes and tobacco were sent from America to England and Ireland before 1600.

Because of the scarcity of domesticated animals in America in 1492, transplanted animals had a greater immediate impact than transplanted crops. In addition to their military value, horses became an important source of animal power and improved transportation. Horses and oxen became an important source of animal power in a land that lacked wheels, as well as large domesticated animals. Without wheels, there were no wagons, waterwheels, or windmills. The importance of introducing animal power to the New World in the

²The word chocolate is derived from a Nahuatl word that means "bitter water."

16th century has been compared with James Watt's introduction of the steam engine in Europe in the 18th century (Crosby 1972: 109), and the concept of horsepower is still used to express the power of automobile engines long after they replaced horses and buggies.

Access to horses enabled cowboys to manage large herds of cattle. Horses also facilitated the movement of cattle to Northern Mexico and the Great Plains of the United States and Canada where grazing conditions were more favorable for large herds. After the development of railroads and refrigeration in the 19th century, long distance trade in beef developed. Cattle became an early source of meat, hides, and tallow in Mexico. Beef from local cattle was plentiful in Mexico City by 1550 (Crosby 1972: 84). Tallow for candles became an important source of light in silver mines that produced Mexico's most important export. New World pigs multiplied rapidly, and they quickly became an important source of meat and lard.

Wheat was transplanted to Mexico immediately to provide Spanish settlers with their traditional bread. New World bread had been made entirely from corn for centuries. The new wheat crop in Mexico was mostly consumed locally, but Mexico became a small exporter by 1535 (Crosby 1972: 69). Much later after the railroads made specialized wheat production profitable on the Great Plains, the United States and Canada became major exporters. Barley, oats, and rye were also transplanted to America. There were no amber waves of grain in America in 1492, but the United States later became the world's largest wheat exporter.

Cotton was native to the New World, and fine quality cotton fabric was produced in Mexico before Columbus arrived. With the introduction of sheep, the colonial government encouraged the development of woolen textile production in Puebla (Bazant 1964). The Spanish also introduced mulberry trees and silk production to Mexico.

Geography and climate had some influence on where crops were grown. Some transplanted crops grew better in the warmer regions of Latin America than in the United States. Sugar quickly became an important New World export that displaced honey as the main sweetener in Europe. Sugar cane was one of the first new products to be produced in Hispaniola, and the first sugar mill appeared on the island in 1516. By the 1530s there were 34 mills on the island, including some owned by Cortés. Warmer climate favored sugar, and Portuguese transplanted sugar cane to Brazil, which eventually became the world's largest producer. Bananas are another warm weather transplant. They were brought from the Canary Islands to Hispaniola in 1516 (Crosby 1972: 68).

New plants and animals were used first by Spanish settlers, but eventually indigenous farmers adopted them as well. The speed of adoption was increased by the massive decline in the native population. Some marginal traditional cropland was converted to pasture, and large land grants to colonists speeded the adoption of European technology. Food preparation also changed, as natives introduced animal fat into their cooking. The resulting fusion food was also different from European food that relied on olive oil or butter for cooking oil.³

Conditions in England and Spain in 1492

Before the Industrial Revolution, there had been no persistent economic growth anywhere in the world. Economic stagnation was the norm. Differences in incomes per capita and life expectancy between England and Spain and between Europe and America were small (Maddison 2001). The Columbian Exchange began earlier in Spanish America than in British America, but eventually all of America had access to the same new plants and animals brought across the Atlantic. It is now clear that British colonies took greater advantage of new opportunities than did Spanish colonies. The different response can be partly attributable to institutional differences in England and Spain at the time of Columbus.

England had already restricted the power of the King and provided for protection of property rights and contracts that were important to entrepreneurs (Acemoglu and Robinson 2006). The Spain of Ferdinand and Isabella was more medieval and absolutist. Spanish institutions restricted competition in economics, politics, and religion more than England. Spain had just ejected Moors from the country, and Jews, Muslims, and dissident Christians were subjected to the Inquisition. Those Jews and Muslims who did convert to Christianity continued to face suspicion of disloyalty. Some productive Sephardic Jews, such as the family of David Ricardo, left for the Netherlands and England where they contributed to the development of the Industrial Revolution. The Inquisition was transplanted to Mexico

³The Columbian Exchange had a permanent effect on Mexican cuisine. “Indeed, most of the dishes so closely associated with Mexican cuisine—carnitas, tortas, tacos, and tamales—are prepared with animal fats, cheeses, onions, garlic, and bread, all of which were introduced by Europeans” (Super and Vargas 2000: 7). A modern Mexican chef, Ileana de la Vega, has been criticized by traditionalists for omitting lard from the “Mexican food” served at her prominent Oaxacan restaurant. However, lard has been “Mexican” only since the Columbian Exchange (Black 2002).

where it functioned as a blunt instrument for protecting certain kinds of monopoly rights in religion, education, and other activities.

Conditions in America in 1492

Greater relative scarcity of domesticated animals was a major difference between American and European agriculture in 1492. Fossil remains of many large mammals (mammoths, horses, etc.) have been found in America, but they all became extinct centuries before 1492. Among the survivors, there were fewer mammals capable of becoming domesticated than in Europe. There were no large draft animals comparable to European horses and oxen. Dogs in North America and llamas in South America were the largest domesticated animals. Indigenous agriculture lacked animal power and a ready source of meat and dairy products. The absence of sheep delayed the development of woolen textiles until the Spanish arrived. Failure to interact closely with domesticated animals prevented Indians from developing immunities that Europeans derived from closer contacts with animals (Diamond 2005). This failure made natives vulnerable to the arrival of smallpox and other European diseases that devastated the population after 1492.

Specific plants were domesticated in various locations in the Americas, but domestication started later than in Mesopotamia and it spread more slowly. Domestication of corn in Mexico (around 5000 B.C.) and potatoes in Peru was the basis of advanced civilizations in those areas, but diffusion of the agricultural technology was slow. Potato production remained in the Andes for a long time, and it reached England before it was transplanted to the United States. Agriculture based on corn, squash, and beans was sufficiently productive to support large cities and high population density in Central Mexico. Wild turkey, deer and dog meat supplemented diets. Cacao beans were processed to produce a chocolate beverage that was sweetened with honey. Productive agriculture and an effective trading network were essential for the prosperity of the large city of Tenochtitlan. Extensive irrigation and the use of raised fields or *chinampas* (Coatsworth 2003b: 3) in the lakes around the city increased agricultural productivity. Cotton was native to the Americas and conquistadors were impressed by the high quality cotton fabric when they arrived.

Productive agriculture was an essential component of the division of labor that supported the highly urbanized population of pre-Columbian Mexico. Tenochtitlan (on the site of modern Mexico City) was one of the largest cities in the world when Cortés arrived in 1519

(Thomas 1993). With an estimated population of about 250,000, Tenochtitlan was larger than the biggest European cities at the time: Naples (150,000), Venice (100,000), Rome (55,000), Paris (100,000), and London (40,000). Granada, the largest city in Spain, had a population of 70,000 (Maddison 2001: 54). Tenochtitlan was built on an island in a lake, and extensive use of causeways and canals to facilitate transportation led Spaniards to compare it with Venice. Dikes were used for flood control and aqueducts carried water long distances. Remnants of Aztec viaducts are still visible in parts of Mexico City today. Other large cities (Teotihuacan, Monte Alban, and various Mayan cities) had been constructed centuries earlier and left impressive pyramids, but they were mysteriously abandoned.

If greater urbanization can be taken to imply higher income, Mexico and the Inca civilization in the Andes were more prosperous in 1492 than the territory that became the United States and Canada. Construction of large pre-Columbian cities and pyramids was accomplished without the use of the wheel (used only in toys) or the power of large draft animals. Worker productivity was enhanced by specialization and extensive trade. Merchants in Tenochtitlan carried out local and long distance trade that supported a large marketplace. Tlatelolco, the marketplace within Tenochtitlan, was larger than any markets the Spanish had seen, including Rome and Constantinople (Thomas 1993). In addition to the main marketplace, there were also specialized markets for building materials, clothing, jewelry, and dogs. A distinct class of merchants (pochtecas) based in Tenochtitlan engaged in long distance trade with Mayan cities, but trade was limited by the capacity of the Aztecs to provide security for merchants against hostile forces. Trade was also limited by the lack of wheeled carts (first built by the forces of Cortés) and animal power. Legal institutions of Tenochtitlan facilitated trade by protecting property rights of merchants and enforcing contracts. Rules were enforced against fraudulent trade and trade in stolen goods, and judges were employed to resolve commercial disputes.

Aztec institutions produced an efficient agriculture and prosperous cities that contrasted with their neighbors to the north. The area that became the United States was less urban, less densely populated, and had lower income per capita in 1492 than Mexico and Peru. Mexico continued to have a higher income per capita than the United States as late as 1700 (Coatsworth 2005: 129). However, by 1820 Mexico's income per capita had dropped to only 62 percent of the U.S. level. Acemoglu, Johnson, and Robinson (2002) have described this relationship as a "reversal of fortune." The region that was poorer became richer, and Mexican relative income per capita has remained lower

from 1820 to the present. Agriculture was practiced in the United States in 1492, but hunting and gathering were more common than south of the Rio Grande River. Population density was lower and there were fewer cities. The United States was not an untouched wilderness as described by the “pristine myth” (Mann 2005b). Plains Indians made systematic use of fire to expand the size of the prairie. A larger prairie supported a larger population of buffalo, elk, and deer, and improved opportunities for hunter gatherers. However, the range and productivity of hunters were limited by the absence of horses.

The Aztecs that ruled Mexico when Cortés arrived had a centralized government that imposed tributes and heavy taxes on their subjects. Taxpayers were required to deliver goods in kind and also provide labor services for the state. Human sacrifices required by the Aztecs also had to be provided by subjects. Specialized production and voluntary trade contributed to wealth creation, but rival tribes conquered by the Aztecs resented heavy taxation. Cortés was able to use this resentment to form alliances with rival tribes that helped him to defeat the Aztecs. Also the tradition of forced labor among the Indians in Mexico may have made it easier for the Spanish to impose forced labor (*encomienda* and debt peonage) after the conquest. According to Simpson (1966), Spanish colonial rule was harsh, but going from harsh Aztec rule to harsh Spanish rule was not “like going from heaven to hell.”

How Did British and Spanish Colonial Policies Differ?

Spanish conquistadores destroyed Tenochtitlan and its physical infrastructure. They destroyed temples, filled in lakes surrounding the city, and abandoned aqueducts. They dismantled Aztec institutions of governance and commerce and replaced them with institutions of Spanish mercantilism. The forced substitution of Spanish institutions was made easier by the drastic reduction in the native population.

The British also imposed some mercantilistic restrictions that contributed to the Revolutionary War, but Spanish policies were more restrictive. In colonial Mexico there was no growth in per capita income over the century 1700–1800. Spanish policies were more conducive to plunder rather than voluntary trade and wealth creation. Silver became the main export from colonial Mexico. (Engerman, Haber, and Sokoloff 2000). Early Spanish policy required that all trade with New Spain must pass through the city of Seville. Rewarding

allies with monopoly privileges was a common practice, and the Mexico City merchant guild was given a monopoly over all foreign trade until 1778 (Coatsworth 2003). Colonial policy restricted production in Mexico of goods, such as olives and wine, that might compete with production in Spain. The large decline in the native population was not offset by large numbers of immigrants. Spanish colonies attracted fewer immigrants than British colonies. Total immigration was smaller, and Spanish immigration peaked earlier.

Immigration restrictions discouraged the development of an efficient market for labor. Spanish policy restricted occupational mobility of labor. Craft guilds restricted entry and blocked advancement of indigenous workers to the highest levels of guilds. Education was restricted, literacy rates were lower than in British colonies, and a large part of the work force did not participate in the dynamic sector of the economy.

Differences in land policies were one reason the United States attracted more immigrants than Mexico. It was easier for a poor immigrant to become a landowner in the United States, and full property rights (alienability) were established rather early. Owners could use, rent, sell, and bequeath land. Ownership rights meant land could be used as collateral in loans, and this contributed to the development of loan markets. Spanish policy was more feudal by requiring workers to remain on land and provide labor services in-kind. The early *encomienda* gave landowners claims on their workers' services. Those claims were not tradable, and they encouraged landowners to overwork workers. Later debt peonage also tied workers to the land. Farmer/entrepreneurs who actively seek higher-valued uses of land are an important source of economic growth (Schultz 1980), but Spanish colonial policies did not encourage entrepreneurship.

Spanish economic policies were not conducive to economic growth in Mexico, other Spanish colonies in America, or in Spain itself. Spanish policies were more effective at plunder than wealth creation. After 1820, Spanish income per capita fell relative to England and the United States for the next 150 years (Maddison 2001).

United States after Independence

By the time of independence for both countries, fortunes had reversed, and the United States was more prosperous than Mexico. However, Mexico's relative decline continued long after independence from Spain, and by 2000 Mexican per capita income was only 26 percent of U.S. income (Coatsworth 2003a). The income difference has not diminished since the implementation of NAFTA in

1994, and the persistent large gap in income and earnings has resulted in massive migration from rural Mexico to the United States in recent years. Developments in institutions after independence magnified the decline that began under colonialism. Latin American countries in general have followed the same pattern of decline in income relative to the United States after independence (Duarte and Restuccia 2006), which has led some observers to refer to an “Iberian Curse.”

Wheat and livestock that were part of the Columbian Exchange made major contributions to U.S. agricultural development. More generally, the rise of U.S. agriculture contributed to a new pattern of international specialization that led to the Industrial Revolution that began in England (Pomeranz 2000). Wheat that was introduced to Mexico made its way north to the Great Plains of the United States and Canada. As a result of favorable immigration and land policies and transport innovations (railroad and shipping), the United States became the world’s largest wheat exporter and retained that rank for a century. Corn production also moved north, and it became feed for the growing livestock industry in the United States. Yellow corn is exported to Mexico today.

Animals that were part of the Columbian Exchange were introduced to the United States later than in Mexico, but they added more to agricultural productivity in the United States. Horses contributed to both production and transportation until they were replaced by tractors and trucks in the 20th century. Cattle, pigs, and chickens from the Old World quickly became the major sources of meat in the United States. Private property rights over cattle had to be established to avoid the “tragedy of commons” problem experienced by bison (Anderson and Hill 2004). Abundant land and feed grains stimulated the industry, and innovations in transportation and refrigeration brought about regional specialization.

Growth in U.S. agriculture has been stimulated by innovations within agriculture and from other sectors of the economy. Openness to international and domestic competition has brought new ideas to agriculture. Railroads, tractors, refrigeration, electricity, trucks, chemical fertilizers, futures markets and other innovations were initiated outside agriculture. Protection of property rights and enforcement of contracts are important for these innovations. Land was very important in traditional agriculture, and allocating land to private owners with full property rights increased productivity. Modern agriculture has become knowledge based, and research and development (public and private) has been a major source of productivity growth. Adoption of new techniques requires that farmers learn about

innovations, face incentives to innovate, and have access to credit to implement new technology. Education and developed financial markets are important for agricultural entrepreneurs.

The development of markets allowed labor, land, and other factors to move in and out of agriculture in response to new opportunities. As a result of productivity increases, millions of people have migrated out of U.S. agriculture in the 20th century while production continues to increase. Less than 2 percent of the current U.S. work force in agriculture produces enough food and fiber for the entire population. As knowledge and machinery have been substituted for labor, the size of the average farm has increased.

The United States inherited some institutions from England that were favorable to a market economy. However, U.S. institutions improved on the ones they inherited. The Industrial Revolution began in England, and in 1870 British income per capita was still 31 percent above U.S. income per capita. By 1913 British income had fallen 7 percent below U.S. income, and it remains below the U.S. figure today (Maddison 2001:185).

The United States became a major exporter of corn and wheat and the world's largest exporter of agricultural products. Corn is used today in ways that could not have been anticipated by the Mexicans who domesticated the plant centuries ago. Corn grown in the United States today is used heavily as feed grain for the cattle, pigs, and poultry whose ancestors came to America as part of the Columbian Exchange. It is also used as high fructose corn syrup that substitutes for the sugar brought by Cortés. Corn-based ethanol is a recent substitute for gasoline that fuels vehicles that replaced animals brought by Cortés.

Mexico after Independence

Spanish colonial policies produced economic stagnation in Mexico. Aztec institutions were destroyed and replaced by Spanish colonial institutions. Massive death from diseases inhibited colonial economic growth and the adverse effects of population decline extended to independent Mexico. It took more than 350 years for the population of Mexico to return to its 1519 level (Coatsworth 2005). Mexican institutions had to adapt not only to new crops and animals but also to a dramatically smaller population. When the Spanish arrived, income per capita in Mexico was higher than in the United States, and in 1700 Mexican income remained higher (Coatsworth 2005: 129).

However, faster growth in the United States and stagnation in Mexico resulted in Mexican income per capita falling to 62 percent of the U.S. level by the time of independence in 1820 (Coatsworth 2005: 129). Wars for independence (including the loss of territory following the Mexican-American War) resulted in Mexican income per capita falling to 28 percent of the U.S. level in 1870. Mexican relative income rose briefly in 1900 to 33 percent of U.S. income per capita and to 34 percent in 1980, but fell to 26 percent in 2005—close to what it was in 1870. The economic advantage that Mexico had in 1491 shows no signs of returning.

Although Spanish colonial policies did not promote economic growth in Mexico, not all Mexican problems can be blamed on the “Iberian Curse.” Policies of independent Mexican governments since 1860 have also contributed to slow growth in Mexico and a further decline in income per capita relative to the United States. Mexican governments have continued mercantilist policies that restrict domestic and international competition and reduce productivity growth. Restrictions on the use of land and labor have prevented the development of efficient markets for these essential factors of production. Policies that favor elite groups have persisted in spite of changes in the form of government (Acemoglu, Johnson, and Robinson 2002). Policies that block innovations protect incomes of established elites but lower national income. Mexican independence has not increased affluence relative to the United States.

The distribution of income in Mexico has been and remains extremely unequal by international standards. A common interpretation is that this inequality reflects protection of elite privileges and unequal economic opportunity. Elites have successfully resisted challenges to their authority. Acemoglu and Robinson (2006) have observed a “coexistence of frequent changes in political institutions with the persistence in certain (important) economic institutions.” Access to education and voting rights have been limited (Engerman, Haber, and Sokoloff 2000). Mexico had regular democratic elections for most of the 20th century, but one political party, the Institutional Revolutionary Party (PRI), retained power for 71 consecutive years, 1929–2000. Resentment against entrenched elites has led to occasional support for populist policies. Episodes of populism have generated cycles that include excess spending, high inflation, currency depreciation, and financial crises. In spite of promises to help poor workers, real wages were lower at the end of a typical cycle than at the beginning (*The Economist* 2006). The 1994 Mexican peso crisis resulted in the most severe drop in real wages since the Great Depression.

Strong support for Andrés Manuel López Obrador in the 2006 presidential election demonstrates the continuing appeal of populism. Pre-occupation with redistributing income of a given size has led to populist policies that have been inimical to economic growth.

Free trade can be one of the most effective anti-monopoly policies, but Mexican governments have consistently shielded its firms and workers from international competition (Cole et al. 2005). From independence in 1820 until 1982, Mexico has been mostly a closed economy (except for the Porfiriato Period, 1876–1911). Following an economic crisis in 1982 Mexico finally joined the General Agreement of Tariffs and Trade (precursor to the World Trade Organization). It was one of the last, large, noncommunist countries to agree to reduce its trade barriers. Mexicans invented corn centuries ago, but corn producers have been shielded from modern innovations. As a result there was great resistance in Mexico to liberalizing corn trade in NAFTA, and some tariffs on corn and beans were retained for 14 years (until 2008) after the introduction of NAFTA (Zahniser and Coyle 2004).

Mexican governments have continued some of the same mercantilist policies they inherited from Spain. The government sector has been large and heavy-handed. The allocation of capital to business firms has frequently been influenced more by political connections than economic efficiency. Banks have moved back and forth between government monopoly and the private sector. Monopoly state-owned enterprises have been common, including PEMEX in energy. Private oil companies were nationalized in 1939, and the constitution bans private ownership of energy reserves. PEMEX continues to stifle innovation in oil exploration, production, and refining. Privatization of state-owned enterprises that has resulted in competition has led to substantial gains in efficiency (LaPorta and Lopez-de-Silanes 1999). In other cases, public monopolies have merely been transformed into private monopolies. The privatized telephone company, TELMEX, continues to be shielded from competition, and its owner, Carlos Slim, has become the richest man in Mexico (O'Grady 2006). For many years, a state enterprise, CONASUPO, played a major role in production, marketing, and pricing of food. The adverse effects of barriers to domestic competition have been magnified by barriers to foreign competition.

Intrusive regulation has reduced economic freedom by limiting entry into businesses and occupations. The Heritage Foundation/Wall Street Journal 2007 Index of Economic Freedom (Kane, Holmes, and O'Grady 2007) ranks Mexico 49th out of 157 countries, well below the

United States (4th), Canada (10th), and Chile (11th).⁴ Bureaucratic control and a high level of government corruption have made Mexico a difficult place to do business. According to the World Bank's 2007 Ease of Doing Business Index, Mexico ranks 43rd out of 175 countries, far below the United States (3rd) and Canada (4th), and slightly below Namibia (World Bank 2006).

From pre-Columbian times to today there have been strains of individualism and entrepreneurship in Mexico, but autocratic forces have consistently stifled innovation (Vargas Llosa 2004). Examples of early successful entrepreneurship are domestication of corn, development of productivity-enhancing *chinampas*, the merchants of Tlatelolco before the arrival of Cortés, and the tradition of skillful peasant craftsmen. More recent examples are the successful cement producer Cemex and Mexican migrant workers that send billions of dollars of remittances back to Mexico each year.

Before 1492 Mexicans were the main innovators in corn production. Since then Spanish and Mexican policies have consistently discouraged innovation related to corn. Policies have been designed to keep workers on the land growing corn in traditional ways. Mexican producers find it increasingly difficult to compete with growers using more modern techniques. Most Mexican corn growers today do not plant improved varieties or irrigate their crops. In 2004 only 36 percent of corn growers used tractors. Land redistribution policies have kept the average farm too small to be efficient. The most productive farms are large, irrigated, and located in Northern Mexico (Zahniser and Coyle 2004: 5).

Institutions such as the Spanish *encomienda* and debt peonage were designed to tie workers to the land. The establishment of full property rights in land was slow in coming to Mexico. *Ejidors* or communal land gave peasants the right to use land, but it did not give individual titles that allow the owner to sell, rent, or bequeath land. Inability to use land as collateral for loans can inhibit growth of agricultural credit (Johnson 2001). Limitations on the ability to transfer land interfere with the development of optimum-sized farms and a true land market.

Mexican policies have also blocked entry into skill acquisition by farmers. Rural education has been poor and literacy has lagged behind other countries. Skill acquisition in Mexico has been described as a de facto caste system (Thomas 1993). Modern agriculture has

⁴In the *Economic Freedom of the World 2006 Annual Report*, the Fraser Institute ranked Mexico 60th out of 130 countries in terms of economic freedom in 2004. There is a two-year lag in reporting. See Gwartney and Lawson (2006: 13).

become knowledge intensive and education is important to make decisions about optimum farm size, adoption of new technology, and purchases of seed, equipment, water, and other inputs to modern agriculture. Access to credit is also essential to purchase modern inputs.

Mexicans domesticated corn, and the Columbian Exchange brought pigs and chickens to Mexico. Mexico has now become an importer of yellow corn used as a feed grain in its growing pork and poultry industries (Zahniser and Coyle 2004). Whether Mexico will also become an importer of white corn, used in tortillas, is currently a politically sensitive subject. Years of government policies that blocked innovations have reduced productivity growth and made traditional Mexican corn growers less competitive. Recently corn grown in the United States has moved south to Mexico and Mexican workers have moved north to the United States.

In 1492 income per capita was higher in Mexico than in the United States, and it remained higher for more than 200 years. Today U.S. income per capita is one of the highest in the world, and Mexican income per capita is only about 25 percent of the U.S. level. Part of the difference occurred during the colonial period, and can be attributed to Spanish policy. However, most of it occurred since independence and must be attributed to differences in the development of U.S. and Mexican policies and institutions. Mexico has achieved moderate economic growth, and its income per capita today is higher than the world average and higher than the average for Latin America. However, it has not yet taken full advantage of the Columbian Exchange.

Conclusion

The Columbian Exchange has dramatically changed the kinds of foods eaten in the United States and Mexico. New ingredients such as beef, pork, chicken, bread, dairy products, rice, animal fat, sugar, and spices improved nutrition and added to food diversity. New ingredients were blended with old ones (corn, beans, tomatoes, chocolate) to produce new combinations and a new fusion food. Old World meat and cheese were combined with New World corn tortillas. Old World animal fat was combined with New World beans. Old World sugar, milk, and cinnamon were combined with New World cacao beans to produce hot chocolate.

The response to the Columbian Exchange in agricultural production and general economic growth has been remarkably different in the United States and Mexico. Spanish colonists destroyed Aztec institutions and replaced them with Spanish mercantilism that was

less conducive to economic growth than British colonial institutions. After independence U.S. and Mexican institutions diverged and the patterns of economic growth also diverged. U.S. institutions evolved in a way that was more favorable for economic growth. Continents that had been separated before the voyage of Columbus were reunited through trade and migration. The transplantation of plants and animals across the Atlantic raised incomes in both the United States and Mexico, but it raised them more in the United States. It resulted in a “reversal of fortune” in which the relatively poorer region of the Americas in 1492 became relatively richer. Geography did not change, but institutions did.

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