Taxation and the Mobility of Inventors and Scientists

Inventors are a highly mobile group, according to data from the World Intellectual Property Organization. Some of the most successful inventors in U.S. history — Alexander Graham Bell, James L. Kraft, Ralph Baer, and Samar Basu, for example — were immigrants. What determines the migration patterns of inventors? Do tax rates matter? The fear of a "brain drain" — the exodus of inventors and other value-creating individuals in response to progressive tax rates — has led to a vigorous public debate regarding the taxation of high-income households.

Two new NBER studies, one examining movements of inventors internationally, the other looking at similar individuals within the United States, find substantial evidence that tax rates have a significant influence on location decisions. Both studies concentrate on the most successful innovators, and find that the mobility of these individuals is sensitive to tax rates.

In **Taxation and the International Mobility of Inventors** (NBER Working Paper No. 21024), authors Ufuk Akcigit, Salomé Baslandze, and Stefanie Stantcheva study the effects of taxation on the international mobility of inventors. They put particular emphasis on the location decisions of individuals who have the most

> Lower tax rates appear to induce a significant fraction of top inventors to move between countries and scientists to move between states in the U.S.

patents or the most valuable patents. The authors employ panel data on all inventors who received a patent from U.S. or European patent offices to track international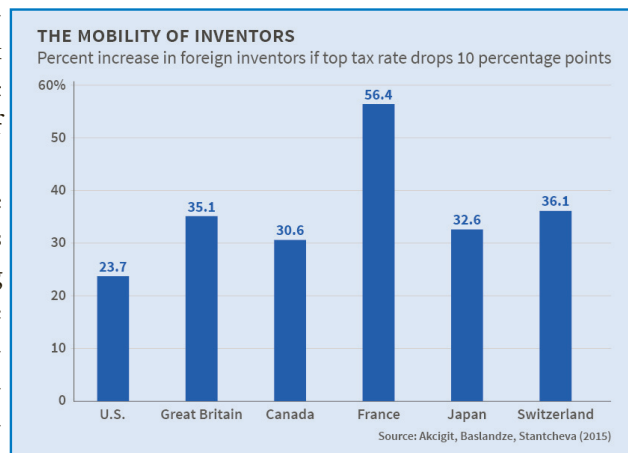 mobility since the 1970s. A very large fraction of worldwide patent filings involve at least one of these two patent offices, so the sample includes most inventors. The authors combine data on where

THE MOBILITY OF INVENTORS
Percent increase in foreign inventors if top tax rate drops 10 percentage points

U.S. 23.7
Great Britain 35.1
Canada 30.6
France 56.4
Japan 32.6
Switzerland 36.1

Source: Akcigit, Baslandze, Stantcheva (2015)

inventors reside, gleaned from the patent filings, with information on the top effective marginal tax rate in each country in each year, to study how taxes affect location choices.

Their results suggest that a 10 percentage-point decrease in a nation's top tax rates is associated with an increase, on average, of about 1 percent in the number of domestic superstar inventors. The effect is more muted for less productive inventors. A decline in the top tax rate is associated with an even larger effect on the number of foreign inventors who reside in a country: averaged across the eight nations studied, a 10 percentage-point drop is associated with a 38 percent increase in this group.

Inventors who have worked for multinational firms appear to be more likely

to respond to tax differentials, possibly because working for a multinational makes a move abroad easier and grants the inventor international exposure. On the other hand, inventors whose companies' research activities are highly concentrated in a given country are less sensitive to tax differentials.

In **The Effect of State Taxes on the Geographical Location of Top Earners: Evidence from Star Scientists** (NBER Working Paper No. 21120), Enrico Moretti and Daniel Wilson study the cross-state location decisions of top scientists in the U.S. Their findings regarding the individual income tax parallel those of the international study, but suggest a greater degree of tax sensitivity. The researchers estimate, for example, that New York State's 2006 reduction of 0.65 percentage points in its top marginal income tax rate was associated with a net increase of 2.1 percent in the number of star scientists in the state. In addition to personal taxes, the authors also study the effect of business taxes, as high business taxes might discourage firms from locating in a state or from growing there. The authors find business taxes, especially the corporate income tax and investment tax credits, have strong effects. When examining the dynamic effects of tax changes, this study finds that the effect on location increases over time, because it takes time for workers and firms to relocate after a tax change. While there are many factors that determine where innovative individuals and innovative companies decide to locate, state taxes play an important role in the U.S.

If inventors and scientists are important contributors to economic growth in their state or country, then their migration in response to tax progressivity is a potential cost of such a policy. These studies may provide broader insights if the mobility of highly productive inventors sheds light on how taxation affects the location decisions of other educated, talented, high-earning workers.

— Les Picker

China's State Sector: Transformed, but Not So Privatized

The transformation of China's industrial sector that began in the late 1990s was not simply a resource shift from the public to the private sector. It also involved policy changes that transformed the remaining state-owned firms and created new ones, according to **Grasp the Large, Let Go of the Small: The Transformation of the State Sector in China** (NBER Working Paper No. 21006).

This study injects new evidence into a long-running debate over what drove China's decade-long "industrial revolution," when the share of China's industrial output from state-owned firms fell from 50 percent to 30 percent. This dramatic shift has been hailed by some experts as a triumph of the private sector.

Authors Chang-Tai Hsieh and Zheng (Michael) Song find that the reality is not that simple.

In 1999, the Fourth Plenum of the Communist Party's Central Committee announced industrial reforms under the slogan "Grasp the Large, Let Go of the Small." The plan was to merge large state-owned companies into profit-maximizing but still government-controlled industrial conglomerates while privatizing or closing

> Large public companies have been opened to individual investors, but control remains firmly in the hands of the central government.

smaller firms. As it turned out, the state allowed many small state-owned firms to

TRANSFORMATION OF THE STATE SECTOR IN CHINA
Share of state-owned firms registered as private firms

In 2012, more than half the state-owned firms were registered as some form of privately owned firm

Sources: Authors' tabulations of microdata from China's National Bureau of Statistics; state-owned firms as defined by authors

survive, but it closed or privatized many midsize companies, which often had relatively low labor and capital productivity.

This released labor and other resources into the more productive private sector. By analyzing data from China's Annual Survey of Industries on all state-owned and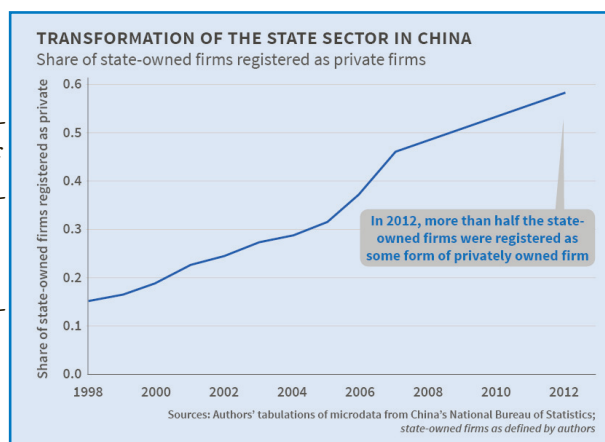 private companies with revenues of more than 5 million RMB ($800,000), the authors calculate that this accounted for 3.2 percent of aggregate growth in the industrial sector during 1998–2007.

A far greater boost — more than 13 percent — came from reform of surviving state-owned companies. Formation of new state-owned companies accounted for another 7 percent of growth.

The changes at Baoshan, a large steel manufacturer in Shanghai, are illustrative. In 2000, the company was "closed" and all its assets transferred to a corporate entity, Baoshan Company Ltd., which became publicly listed on the Shanghai Stock Exchange. Private investors can own the stock, but Baoshan and five other

Chinese steel manufacturers became part of the BaoSteel Group. BaoSteel, which is wholly owned by the Chinese central government, controls 75 percent of Baoshan's shares. Its senior executives are appointed by the Organization Department of the Chinese Communist Party.

Baoshan has flourished under this arrangement. Total sales rose sixfold, from $2.8 billion to $17 billion, between 1998 to 2007. Profits soared more than 20-fold, from $122 million to $2.5 billion. Baoshan is now China's largest steel producer and No. 2 in the world.

Most state-owned companies have made great strides since 1999, with their labor productivity and total factor productivity (TFP) narrowing the gap with privatized companies. The TFP of newly established state-owned companies actually exceeded that of private companies. However, state-owned firms made far less progress in capital productivity. Productivity gaps between the smallest state-owned firms and their private-sector counterparts have widened.

— Laurent Belsie

Using the Shale Revolution to Infer Carbon Abatement Costs

In recent years, policymakers have grappled with a number of ideas on how to reduce carbon pollutants believed to be causing climate change. One of the approaches has been to apply a "carbon price," or "carbon tax," on CO_2 emissions by electricity generators, thereby making it more expensive for power-plant owners to use fossil fuels that emit large amounts of carbon dioxide, particularly coal.

In **Inferring Carbon Abatement Costs in Electricity Markets: A Revealed Preference Approach Using the Shale Revolution** (NBER Working Paper No. 20795), authors Joseph A. Cullen and Erin T. Mansur use data from a number of sources—including actual natural-gas prices since the onset of the historic shale revolution in the U.S.—to show that carbon prices do lead to reductions in CO_2 emissions in the electricity sector, and that this impact is greatest when natural gas prices are low.

Carbon-pricing systems already have been implemented in a number of states around the nation and countries around the world.

The idea behind carbon-pricing programs is this: new carbon costs disproportionately affect the dirtiest generators on the grid, providing incentives to reduce carbon emissions. In the short-term, firms may engage in "fuel switching," or using alternate plants to lower costs, such as switching from coal-fired plants to gas-fired plants, a

move that can reduce carbon emissions by 23 to 42 percent.

> The historic cost advantage of coal-fired electric power plants is reduced by carbon pricing and by use of cleaner-burning abundant natural gas.

Using price, production, consumption, and emission data from the U.S. Environmental Protection Agency, Federal

LOW COST OF GAS REDUCES CO₂ EMISSIONS

(Y-axis: Change in carbon dioxide emissions (%), from -20 to 5)
(X-axis: Natural gas price ($/million BTUs), from 12 to 0)

CARBON PRICE REDUCES CO₂ EMISSIONS

(Y-axis: Carbon price ($/ton), from 0 to 80)
(X-axis: CO₂ emissions abated as a percentage of baseline emissions, from -5 to 15)

Sources: Environmental Protection Agency, Energy Information Administration, Intercontinental Exchange, NBER Working Paper No. 20795; Figure depicts results for the Eastern Interconnection of the U.S. electricity grid

Energy Regulatory Commission, Energy Information Administration, Canada's National Energy Board, and other sources, the authors seek to examine how carbon emissions from the electricity industry reacted to dramatic falls in natural gas prices, such as have occurred since the historic surge in gas production from U.S. shale fields between 2005 and 2012. Since carbon prices and cheap natural gas reduce the historic cost advantage of coal-fired power plants, in a nearly identical manner, largely by making coal more expensive compared with cleaner-burning and increasingly more abundant natural gas, the authors show how emissions would decrease in response to actual carbon prices. The authors aim to base findings on "observable behavior" rather than simulated scenarios.

They estimate that a price of $10 per ton of carbon dioxide would reduce CO_2 emissions by 4 percent. Significantly, a price of $60 per ton of carbon dioxide would be needed to cut emissions by 10 percent, suggesting that it becomes increasingly more expensive to achieve ever-larger target reductions of emissions in the short run.

In addition, the authors show that carbon prices are much more effective at reducing emissions when natural gas prices are
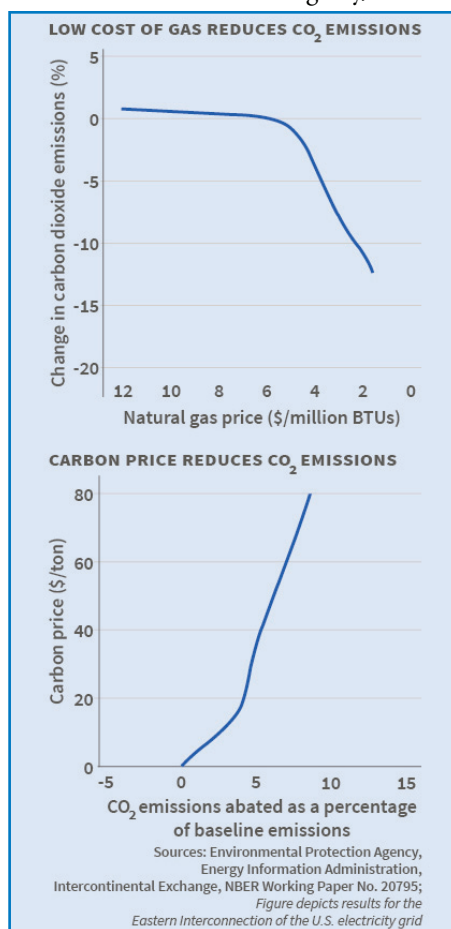
low. If fuel prices evolve according to industry forecasts, the authors predict a 6 percent decrease in CO_2 emissions from a $20 per ton price on carbon, but if gas prices were to return to their typical, pre-shale-gas levels, the same price on carbon would reduce emissions by only one percent.

In some cases, the authors conclude, policymakers might get more bang for the buck by imposing "relatively modest" carbon prices, such as a $20 per ton price that could reduce emissions by 6 percent almost immediately. Additional reductions of emissions could come in the long run as consumers facing higher electricity prices could adjust consumption and firms could opt to build new, cleaner generation facilities.

"Understanding how a carbon price will affect polluting firms in the short run is an important step in demonstrating the effectiveness of such an instrument for use in the long run," the authors conclude. "On a longer time horizon, even greater emissions reductions could be expected as new generation could be built and consumers could adjust to new equilibrium electricity prices."

—Jay Fitzgerald

Individual Discount Rates and Energy-Efficient Purchasing

When shopping for appliances, consumers often must decide between the standard model and an energy-efficient model. The latter is typically more expensive but promises reduced operating costs for the lifetime of the appliance. The trade-off is between spending less now (with the standard model) and spending less later (with the energy-efficient model). Consumers' decisions depend crucially on their "discount rates"—the rates at which they discount future benefits when comparing them with present benefits.

In **Individual Time Preferences and Energy Efficiency** (NBER Working Paper No. 20969), Richard G. Newell and Juha V. Siikamäki measure these discount rates and explore how they affect U.S. homeowners' decisions related to energy efficiency.

Economists often measure the discount rate by asking "Would you rather have $1,000 today or $X in one year?" When the difference is relatively small, for example when X = $1,001, virtually everyone takes the $1,000 now. But what if X is larger? At some value, unless the decision-maker is presently experiencing a financial emergency, the survey respondent will opt for $X in a year rather than $1,000 today.

Using survey data on 1,200 U.S. homeowners, Newell and Siikamäki find substantial variation in the value of X that leads different consumers to choose the future payoff.
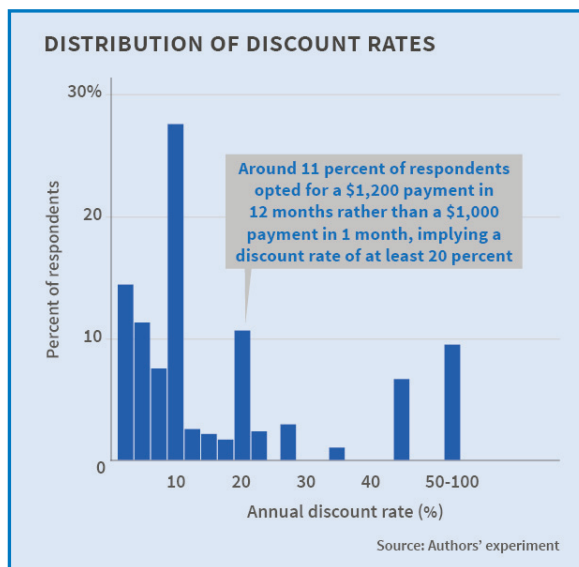
> Lower discount rates, signifying greater patience, are associated with increased willingness to pay for energy efficiency.

Some are very patient and take the delayed benefit at low values like $1,020. Others are very impatient, requiring thousands of dollars to accept a one-year delay. About half of the sample chose the delayed payment when X was equal to $1,124. This implies that roughly half of the sample has a discount rate of 11 percent or lower. In general, respondents tended to have greater discount rates if they had less education, low income, low credit scores, and large households.

Having calculated individual-specific discount rates, Newell and Siikamäki then explore the relationship between patience and willingness to pay for energy efficiency. They find that lower discount rates, signifying greater patience, are associated with increased willingness to pay for energy efficiency. This holds even after statistically controlling for a range of potentially confounding factors, including age, education, ethnicity, gender, employment status, number of children, income, and geographic region.

The authors gather evidence on the link between discount rates and demand for energy-efficient products in four different ways, all of which use the same survey of 1,200 U.S. homeowners. First, they ask survey respondents to choose between water heaters that vary in terms of price and energy efficiency. From these hypothetical choices, the authors calculate exactly how much respondents are willing to pay for energy efficiency. Second, the authors directly ask survey respondents how much they would be willing to pay for a $10 reduction in annual operating cost of their water heater. In both of these cases, the authors demonstrate a robust relation-

DISTRIBUTION OF DISCOUNT RATES

Around 11 percent of respondents opted for a $1,200 payment in 12 months rather than a $1,000 payment in 1 month, implying a discount rate of at least 20 percent

Percent of respondents

Annual discount rate (%)

Source: Authors' experiment

ship between measured discount rates and willingness to pay for energy efficiency. Third, the authors ask survey respondents how long it should take for annual operating cost savings to offset or pay back the price markup of an energy-efficient appliance. Consistent with their other results, homeowners whose discount rates are lower have longer payback horizons as well. Fourth, the authors examine the relationship between discount rates and purchases of energy-efficient appliances, as reflected in the recent receipt of an energy-efficiency tax credit. As expected, those whose discount rates are lower are more likely to have sought an energy-efficiency tax credit.

— Andrew Whitten

The Welfare Effects of Coordinated High School Assignments

In 2003, about 90,000 incoming high school students in New York City applied for admission to roughly 600 programs of study, offered by some 300 schools. For the first time, the process was mediated through a centralized, coordinated matching algorithm. In **The Welfare Effects of Coordinated Assignment: Evidence from the NYC HS Match** (NBER Working Paper No. 21046), Atila Abdulkadiroğlu, Nikhil Agarwal, and Parag A. Pathak find that the centralized matching process substantially improved outcomes, measured using several standard metrics, relative to the previous method of school assignment.

In earlier years, incoming high school students in NYC were matched to programs of study by a complex, uncoordinated procedure. Students ranked their top five programs, and schools observed where students had ranked them. The schools then independently decided which students would be offered admission. There were three rounds of rankings and admissions offers, but this procedure only matched 63 percent of students to schools. The remaining students were administratively assigned to the nearest school to their homes. Many students found the outcomes unsatisfactory, and 8.5 percent of students left the New York school district after receiving their school assignment. Further, some schools advertised they were only interested in students who ranked them first, encouraging some students to strategically misrepresent their preferences.

For school year 2003–04, this matching process was substantially altered. Students were asked to rank their top 12 programs, and schools coordinated with one another in making offers of admission.

THE BENEFIT OF COORDINATED SCHOOL ASSIGNMENT

Students who were offered positions on their preference list
Students who were administratively assigned to another school

Uncoordinated system: 37%, 63%
Coordinated system: 11%, 89%

Source: New York City Department of Education

This process was based on a matching algorithm designed by mathematicians David Gale and Lloyd Shapley, winner of the 2012 Nobel Prize in Economics. Unlike the previous matching mechanism, the Gale-Shapley algorithm encourages students to report their preferences truthfully. Further, it matches as many students as possible and creates stable matches. Though students are not guaranteed their top choices, there are never any vacancies at a school that any student ranked higher than the one to which he or she was assigned. The algorithm was used for two rounds of assignments; those students who did not match in either round were assigned administratively.
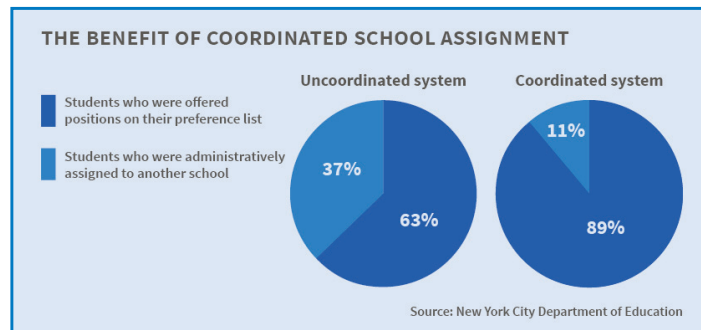
The new algorithm performed better than the old, uncoordinated mechanism by reducing exits from the schools and the number of students administratively assigned. With the new algorithm, only 6.4 percent of students left the district after receiving a school assignment. Moreover, despite having fewer rounds of matching, the new mechanism ended up matching 89 percent of students before resorting to administrative assignment. The authors also develop a statistical model that predicts how much a given student will like a given school based on both student and school characteristics. It suggests that the matching algorithm significantly improved overall welfare, with the largest gains for those students no longer matched via administrative assignment to the nearest school. Because fewer students were in this category, the new algorithm sent the average student to a school 20 percent (0.7 miles) farther from his or her home. Nonetheless, the authors estimate that the improved school match more than compensated for the extra distance.

— Andrew Whitten

A student-matching algorithm derived from economic theory performed better, across a variety of metrics, than the uncoordinated procedure previously used in New York City.

The Origins of Latin American Inequality

Income and wealth disparities in Latin America are higher than in Asia and in most industrial nations, a condition that many economists attribute to factors developed during the region's history of Portuguese and Spanish rule.
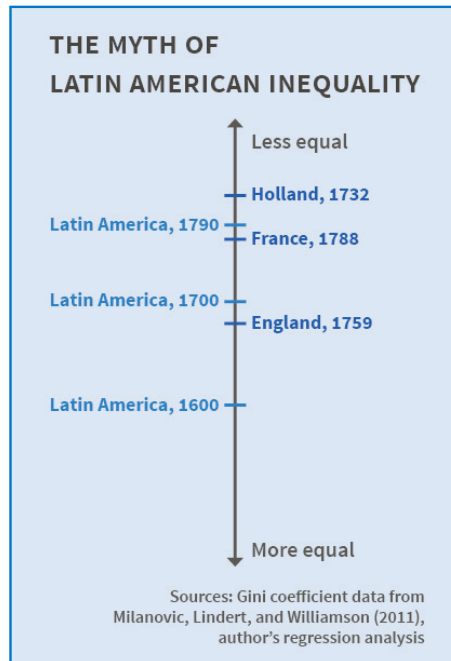
In **Latin American Inequality: Colonial Origins, Commodity Booms, Or A Missed 20th Century Leveling?** (NBER Working Paper No. 20915), Jeffrey Williamson takes issue with what he calls "this pessimistic belief in historic persistence." He finds that only within the past century has inequality in Latin America stood out, even though many analysts mistakenly assume this has been the case for much longer. Prior to the last century, the region had the same, or a lower, level of inequality than that existing in Asia, Western Europe, and the U.S.

The study draws on Williamson's previous work with Branko Milanovic and Peter Lindert, which constructed an "ancient inequality database" drawn from economic and demographic information ranging over two millennia. The data were collected from 29 places, including four in Latin America. This database makes it possible to estimate Gini coefficients, which measure inequality on a 0 to 1 scale with 0 representing perfect equality and 1 all of society's income accruing to the highest-income individual.

Pre-colonial Latin America "had mod-est levels of inequality much like all the other poor pre-industrial societies in our sample which had escaped being colonized," Williamson writes. In the immediate wake

Inequality in Latin America is relatively high now, but historically it has been no higher than in the United States and Western Europe.

of colonization, the Gini coefficient rose from 0.23 to 0.35, but it then leveled off. European diseases initially ravaged the native population, reducing the labor force, but in

THE MYTH OF
LATIN AMERICAN INEQUALITY

Less equal

Holland, 1732
Latin America, 1790 — France, 1788
Latin America, 1700 — England, 1759
Latin America, 1600

More equal

Sources: Gini coefficient data from Milanovic, Lindert, and Williamson (2011), author's regression analysis

later decades of the colonial era, as the population recovered and was supplemented by slaves from Africa, inequality rebounded.

The estimates suggest a peak Gini coefficient of 0.58 around 1790. Inequality then declined as the Latin American economies were crippled by their wars for indepen-dence and the political instability that followed. Williamson finds that pre-industrial inequality was lower in Latin America (pre-1870) than in pre-industrial northwest Europe (pre-1800) and in the early industrial United States (1860).

By 1870, inequality in Latin America was no higher than in the United States and Western Europe.

After 1870, however, Latin America saw a rapid increase in inequality as commodity exports boomed, benefiting the elite who owned much of the region's cropland and minerals. "Latin America had joined the rich country inequality club by World War I," but "it certainly had not yet become the world's most unequal region," Williamson writes.

What sets Latin America apart is that economic inequality continued to rise from the 1920s to 1970s while it declined sharply in much of the rest of the world, including the U.S. Why that was the case, Williamson writes, deserves as much attention, or more, than its colonial heritage.

—Steve Maas