

# Three Keys to the City: Resources, Agglomeration Economies, and Sorting\*

BY GERALD A. CARLINO

**M**etropolitan areas in the U.S. contain almost 80 percent of the nation's population and nearly 85 percent of its jobs. This high degree of spatial concentration of people and jobs leads to congestion costs and higher housing costs. To offset these costs, workers must receive higher wages, and higher wages increase firms' costs. So why do firms continue to produce in cities where the cost of doing business is so high? Economists offer three main explanations. First, cities developed and grew because of some natural advantage, such as a port. Second, as cities grew, the resulting concentration of people and jobs led to efficiency gains and cost savings for firms, creating agglomeration economies. Finally, the presence of a talented and flexible labor force made it feasible for entrepreneurs to start new businesses. This third reason for the growth of cities is called sorting. In this article, Jerry Carlino looks at recent developments in measuring each of the sources of city productivity and discusses the policy implications of this research.

Although metropolitan areas account for only 16 percent of the total land area in the United States, they



**Jerry Carlino** is a senior economic advisor and economist in the Research Department of the Philadelphia Fed. This article is available free of charge at [www.philadelphiafed.org/research-and-data/publications/](http://www.philadelphiafed.org/research-and-data/publications/).

[www.philadelphiafed.org/research-and-data/publications/](http://www.philadelphiafed.org/research-and-data/publications/).

contain almost 80 percent of the nation's population and nearly 85 percent of its jobs. This high degree of spatial concentration of people and jobs leads to congestion costs, such as increased traffic and pollution, and higher housing costs. To offset these congestion costs, workers must receive higher wages, and higher wages increase firms' costs.

\*The views expressed here are those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

So why do firms continue to produce in cities where the cost of doing business is so high? Economists offer three main explanations.<sup>1</sup> The first explanation is that cities developed and grew because of some valuable natural advantage, such as a source of raw materials or a port that allowed businesses to save on transportation costs. For example, because of its access to a deep harbor and because of its central location, Philadelphia was the largest and most important trading and merchant center in North America during the nation's colonial period.

But, as Satyajit Chatterjee points out in an earlier *Business Review* article, a natural advantage, such as a harbor, was not the main reason for Philadelphia's subsequent growth into the fourth largest metropolitan area in the country. As colonial Philadelphia grew, the resulting concentration of people and jobs led to efficiency gains and cost savings for firms, efficiency and savings that arose from being close to suppliers, workers, customers, and even competitors. This second reason for cost savings in cities is referred to as agglomeration economies. Finally, as Joseph Gyourko points out, the early growth of Philadelphia was aided by its large and relatively highly skilled labor force. The presence of a talented and flexible labor force made it feasible for entrepreneurs to start new businesses

<sup>1</sup> The terms city, metropolitan area, and their adjectives are being used to designate a metropolitan statistical area (MSA). In general, MSAs are statistical constructs used to represent integrated labor market areas. They typically are geographic areas combining a large population nucleus with adjacent communities that have a high degree of economic integration with the nucleus.

in Philadelphia. This third reason for the growth of cities is called sorting: A disproportionate share of highly skilled (more productive) workers choose to live in large cities, making big cities more productive than small ones. Other things equal, firms will have little incentive to move if congestion costs are balanced by the benefits of a natural advantage, agglomeration economies, and sorting.

At one time, economists tended to lump together the advantages of sorting and the advantages associated

retain highly skilled people.

In this article I will look at recent developments in measuring each of the sources of city productivity and discuss the policy implications of this research.

### SPATIAL CONCENTRATION OF PEOPLE AND JOBS IN CITIES: ROLE OF NATURAL ADVANTAGE, AGGLOMERATION ECONOMIES, AND SORTING

A location may attract households and firms because of

spatial concentration of manufacturing plants can be accounted for by a location's natural advantages. Given that employment in manufacturing is continually being replaced with jobs in the service sector, the role of natural advantages in accounting for the geographic concentration of industries will continue to be less important than it was even as recently as 50 years ago.

Some economists believe that an increase in the capital stock of the public sector leads to increases in private-sector output and productivity because public infrastructure is an essential input into the production of private output.<sup>2</sup> For example, driver productivity increases when a good highway system allows truck drivers to avoid circuitous back roads and congestion and to bring supplies to a firm and goods to market more quickly. Similarly, well-maintained roads reduce wear and tear on commercial vehicles, lowering private-sector maintenance and replacement of these vehicles. Similar arguments can be made for the public provision of police and fire protection, water supply facilities, airports, and mass transit. An increase in the public capital stock, like an increase in any factor of production, increases private-sector output.

Historically, economists have focused on agglomeration economies to explain the high concentration of people and jobs found in cities, of which there are two broad types:

---

<sup>2</sup>See the article by Randall Eberts and Daniel McMillen for a review of the early empirical evidence on public infrastructure. This evidence indicated a strong response of private-sector output to increases in the capital stock of the public sector. More recent studies have not found such a strong link between the capital stock of the public sector and productivity. For example, looking at the role that public infrastructure plays in a state's economic growth, Andrew Haughwout finds that increases in a state's public capital stock did not dramatically raise a state's economic growth.

## Historically, economists have focused on agglomeration economies to explain the high concentration of people and jobs found in cities, of which there are two broad types: business agglomeration economies and consumer agglomeration economies.

with urban agglomeration economies into a single measure. However, more recently, economists have examined how important each of the three reasons is in accounting for city productivity. Knowledge about the relative importance of each of the reasons is important to policymakers, too. If agglomeration economies kick in once a city reaches a critical size, urban planners might want to pursue policies that help a city reach that size. There is also mounting evidence that agglomeration economies depend on a city's ability to attract and retain high-skill workers. Edward Glaeser and Matthew Resseger find that agglomeration economies are much stronger in cities where workers are relatively highly skilled. Given the evidence that a high concentration of skilled workers enhances city productivity, policymakers may want to consider policies that attract and

the presence of valuable natural resources, such as petroleum, coal, lumber, or minerals, and proximity to a navigable river or a port. Although the availability of resources and other natural advantages varies from place to place, a diversity of resources cannot be the main reason for the existence of cities. According to Edward Glaeser and Janet Kohlhase, "The cost of moving a ton by rail has declined in real terms by more than 90 percent since the late 19th century and the rise in trucking has been even more dramatic." As a result, firms have become increasingly "footloose" with respect to a location's natural advantages, since easy access to rivers, other water systems, and raw materials has become less valuable over time. In studying the spatial concentration in manufacturing in 1987, Glenn Ellison and Edward Glaeser found that only about 20 percent of the

business agglomeration economies and consumer agglomeration economies. Business agglomeration economies can increase the productivity of firms and their workers. More recently, economists have underscored the importance of consumer agglomeration economies, which improve the quality of leisure activities, as a source of the continuing growth of cities. The bulk of the empirical evidence on agglomeration economies has focused on business agglomeration economies (hereafter referred to simply as agglomeration economies unless otherwise noted), so we will start there.

If agglomeration economies are important, they will make workers in large cities more productive compared with workers in small cities and rural areas. Since workers are paid according to their productivity, wages and the demand for labor reflect the advantages of agglomeration economies. Thus, early studies looked at the impact of agglomeration economies on average wages (wages averaged across all workers in a city). Since agglomeration economies are not directly observable, many studies have used some measure of urban size, such as the size of a city's population or its population density (the city's population relative to its land area), as a proxy for agglomeration economies. The idea is that the benefits of agglomeration economies increase with a city's population size or its population density.

Studies from the 1970s and 1980s found that a doubling in city population size could lead to a substantial 8 to 10 percent increase in manufacturing productivity.<sup>3</sup> More recent evidence indicates that the

---

<sup>3</sup>See the article by Randall Eberts and Daniel McMillen for a review of the early empirical evidence on agglomeration economies.

findings from these early studies most likely overstate the actual productivity gains associated with urban size. The contribution of population size to urban productivity may be overstated if the other factors thought to influence urban productivity are not taken into consideration. An important problem with these studies is that they did not control for one aspect of city population: the very real possibility that the more productive places will

## If agglomeration economies are important, they will make workers in large cities more productive compared with workers in small cities and rural areas.

tend to draw people. Are cities large because they are more productive or more productive because of their size? In a 2010 article, Pierre-Philippe Combes and his co-authors refer to this issue of reverse causation as the *endogenous quantity of labor*. This issue was first raised by Ronald Moomaw in his critique of the early literature and first dealt with in a study by Antonio Ciccone and Robert Hall. Ciccone and Hall proposed using population from the distant past (in their case for 1850) instead of using current population to control for reverse causation. The idea is that the population from 1850 is likely to be correlated with the population size of today but not with productivity today. We will have more to say about this source of reverse causation later.

Another concern is that more highly skilled workers may sort themselves into cities because large cities offer greater opportunities for consumption. Rising real incomes mean that quality-of-life issues have become more and more important as

determinants of where people choose to live. For example, growth in real income increases the demand for a greater variety of goods and services (more theaters, varied restaurant cuisine, and professional sports teams). This implies that large cities with more choices will attract high-income households that put a high value on variety. Members of these high-income households also tend to be highly skilled individuals. The concern is

that highly skilled workers tend to earn higher wages, and this could account for some of the positive correlation found between city population size and average wages in cities. In their 2010 article, Pierre-Philippe Combes and his co-authors refer to this sorting of relatively high-skill (highly productive) workers in large cities as the *endogenous quality of labor*.

In sum, there can be two important sources of overestimation of agglomeration economies: More productive places may attract more people, and more productive people may sort themselves into large cities. That is, large cities may draw people, especially highly skilled ones, leading to a potential overestimation of city size's effect on city productivity. It is important for any study of urban agglomeration economies to control for both of these sources of upward bias.<sup>4</sup>

---

<sup>4</sup>See the article by Pierre-Philippe Combes, Gilles Duranton, and Laurent Gobillon for a discussion of a variety of solutions to address the overestimation of agglomeration economies.

## WHAT'S THE EVIDENCE?

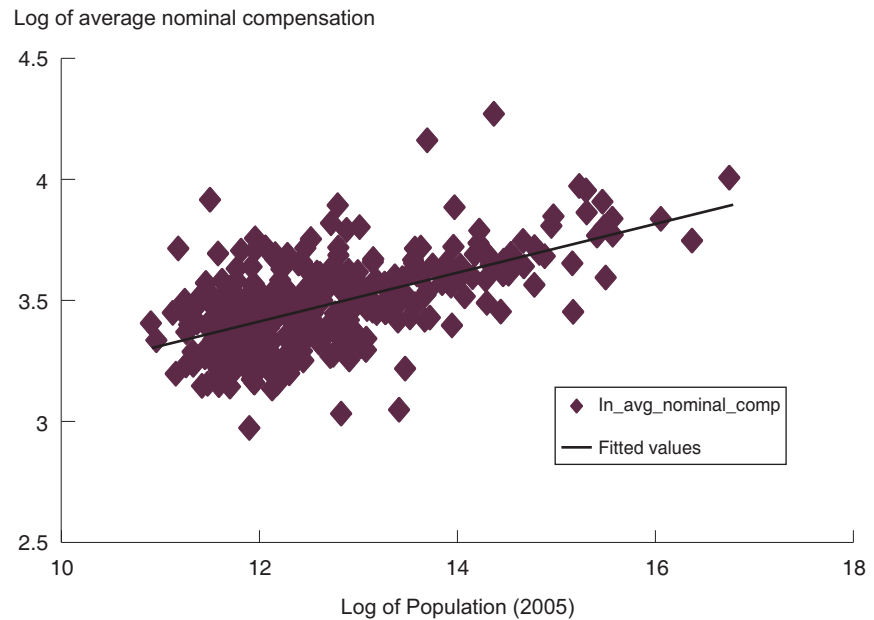
One of the facts that support the existence of urban agglomeration economies is the positive association between average wages in a city and a city's population size. The idea is that if workers are paid according to their productivity (that is, there is perfect competition in local labor markets), wages and the demand for labor reflect the advantages of agglomeration economies. The figure shows that there is indeed a positive correlation between average annual wages (total annual wages relative to the total number of workers) and population in a sample consisting of over 300 metropolitan statistical areas (MSAs) in 2005. Population size alone explains about 16 percent of the variation in average wages across MSAs. The positive correlation depicted graphically in the figure is shown numerically in column 1 of the table, which shows that a doubling of MSA population size is associated with a 6.1 percent increase in average wages.<sup>5</sup> As we will see, this estimate falls to 3.8 percent once we control for both sources of upward bias.<sup>6</sup> As

<sup>5</sup> Average wages could be higher in large cities if large cities tend to have a mix of industries that would pay higher wages even if they were located in medium size and small cities. If so, estimates of agglomeration economies will be overstated if we do not control for differences in industry mix across cities. All regressions reported in the table control for the 1970 employment shares in each of nine broad industries. We used 1970 industry employment shares to mitigate any feedback from average wages in 2005 on current industry employment shares. The industries consist of agriculture; mining; construction; manufacturing; wholesale trade; retail trade; finance, insurance, and real estate; services; and government (transportation is the excluded sector). All of the regressions include controls to indicate an MSA's region. The regions are New England; Mideast; Great Lakes; Plains; Southeast; Southwest; and Rocky Mountain (the Far West is the excluded region).

<sup>6</sup> See Table A in the appendix for a summary of the regression underlying the discussion in the text.

## FIGURE

### Wages Increase with City Size



Average wages are equal to average worker compensation.

I have already indicated, estimates of agglomeration economies will be overstated if people move to high-productivity MSAs (the reverse causation issue). Column 2 of Table 1 shows the results when we use the 1920 level of an MSA's population to identify the effect of population (our proxy of agglomeration economies) on a city's average wages.<sup>7</sup> After controlling for reverse causation, the estimate for the effect of a doubling of city population size on average wages

<sup>7</sup> The reason for using 1920 population is that a city's population today tends to be highly positively correlated with its population from long ago, but the forces giving rise to a city's productivity today are quite different from those of the distant past. For example, in 1920, high productivity in manufacturing would have resulted in the growth of a city and a high level of population. It's highly likely that the level of population in 2005 will be highly correlated with the level of population from 85 years earlier, but it's unlikely that the drivers of productivity in manufacturing matter very much for the services-oriented cities of today.

falls from 6.1 percent to 3.9 percent.

What would happen to our estimate of the city size wage premium after we control for the share of an MSA's population with a college degree? There is a strong positive correlation between the share of the adult population with a college degree and city size.<sup>8</sup> In fact, if a city were to double its share of the adult population (persons 25 years old and over) with a college degree, its average wages would increase almost 63 percent. While it is highly unlikely that most cities would be able to double their college share, a 10 percent increase would still bring nice returns in terms of average wages. For example, in 2000, almost 28 percent of the Philadelphia metropolitan area's population had a college degree. If Philadelphia's college

<sup>8</sup> The simple correlation between the college share and the log of population is 0.71.

## TABLE

### Effect on Average Nominal Wages Resulting from a Doubling of an MSA's Population Size<sup>†</sup>

	(1)	(2)	(3)	(4) <sup>†††</sup>
Population, 2005 <sup>††</sup>	6.1			
Population, 1920 <sup>††</sup>		3.9	3.8	3.6
Controls for the share of 1920 population with a college degree	No	No	Yes	Yes
Controls for natural advantage and infrastructure <sup>†††</sup>	No	No	No	Yes
No. of MSAs	313	309	309	254

<sup>†</sup>Results reported after controlling for the 1970 employment shares in each of nine broad industries and for eight broad regions and for the MSA's region. See the appendix for details.

<sup>††</sup>Indicates variable is in logs.

<sup>†††</sup>A city's distance to commercially navigable rivers in 1890 is used to control for a city's natural advantage. The square miles of interstate highway system planned for in 1947 for a city is used to control for infrastructure in that city.

share increased 5 percent, to just over 29 percent, we estimate that average wages in Philadelphia would increase 3.2 percent. Put differently, relatively small changes in an area's college share can lead to relatively large changes in its average wage.

This positive correlation between a city's average wages and its college share could lead to an overestimation of the city size wage premium if high-ability and highly productive people sort themselves into large cities (the issue of endogenous quality of the population). Including the college share in the analysis is one way to control for the sorting in an MSA's population. Column 3 of the table shows that the estimates of the city size wage premium are only slightly affected after controlling for an area's college shares, falling to 3.8 percent from 3.9. Thus, at least for average city wages, it is more important to control for reverse causation (the migration

of workers into cities) than it is to account for sorting (the self-selection of highly skilled workers into large cities).

As discussed earlier, some economists believe that an increase in the capital stock of the public sector leads to increases in private-sector output and productivity because public infrastructure is an essential input into the production of private output. In addition, some natural advantages (such as access to a port, rivers, or lakes) that gave rise to large cities in the past may still influence productivity (and wages) today. Column 4 of the table shows that the estimate of the city size wage premium falls only slightly (from 3.8 to 3.6) after we control for both an MSA's urban infrastructure and its natural advantages.<sup>9</sup> This finding is consistent with those reported by Andrew Haughwout: Increases in a state's public capital stock did not

dramatically raise state economic growth.

What does our estimate of an urban wage premium of 3.8 percent mean for wages in dollar terms? A typical city in our sample had a population of about 680,000 (about

<sup>9</sup>Recall that estimates of the city size wage premium could be overstated if we fail to control for urban infrastructure. Following the seminal work of Nathaniel Baum-Snow, we take the miles of highways planned for an MSA in the 1947 national interstate highway plan. These planned highway miles are divided by the square miles of an MSA's land area to arrive at the proxy variable used for MSA infrastructure. We used 1947 planned miles of highways, since it's likely that miles of highways today are highly correlated with planned miles, while productivity today is not likely to have caused the planned miles in 1947. We thank Matthew Turner for providing the data for the planned highway miles; see the article by Gilles Duranton and Turner for details. We use an MSA's distance to commercially navigated waterways in 1890 as our proxy for an MSA's natural advantages. We thank Jordan Rappaport for providing these data; see the article by Rappaport and Jeffrey Sachs for details.

the size of Springfield, Massachusetts) in 2005 and an average annual wage of almost \$34,700 in 2005. A doubling in the size of a typical city to a city consisting of almost 1.4 million people (about the size of the Nashville, Tennessee, or the Austin, Texas MSA) would result in an increase in average annual wages of about \$1,320. If the Philadelphia MSA grew to the size of the New York City MSA, the average wage in the Philadelphia MSA is estimated to increase by about \$2,500. If the Allentown MSA grew to the size of the New York City MSA, the average wage in Allentown would increase by just under \$5,500. While it's unlikely that either Philadelphia or Allentown will ever reach the population size of New York City, these examples demonstrate that the urban wage premium can be substantial.

While firms care about what they must pay workers in nominal dollars, workers care about the purchasing power of the wages they receive. Although money wages are higher in New York City than in either Philadelphia or Allentown, the cost of living is much higher in New York City, too. (See *Adjusting Wages for City Cost of Living Differentials*.)

**Moving from Aggregate Data to Micro Data.** In attempting to measure agglomeration economies, we dealt with the sorting issue by controlling for worker characteristics by what we could observe in the aggregate data, namely, the share of a city's adult population with a college degree. But there are plenty of other observable and unobserved worker characteristics that need to be considered in attempting to get the most accurate estimate of agglomeration economies. Some of these characteristics, such as a worker's years of experience and his occupation, can be observed. Yet a number of unobserved worker characteristics, such as motivation,

dedication, and innate abilities, may also influence a worker's wages.<sup>10</sup> The role of agglomeration economies in urban productivity may be overstated if the more experienced workers or those with the most innate ability tend to sort themselves into large cities. Recently, economists have been using large data sets containing highly detailed information on individual workers (micro data) rather than

doubling of urban density is associated with an overall urban wage premium of about 5 percent. When they control for just reverse causation, the urban wage premium falls to 4 percent. If, instead, they control only for sorting, the urban wage premium shrinks from 5 percent to 3.3 percent. That is, sorting matters in that it accounts for about one-third of the overall wage premium. The premium shrinks to 2.7 percent

## While firms care about what they must pay workers in nominal dollars, workers care about the purchasing power of the wages they receive.

aggregate data (summed across all workers in an area) in an attempt to account for the role that observed and unobserved worker traits play in productivity. For example, Edward Glaeser and David Maré report that workers in large U.S. cities have wages that are 33 percent higher than those of workers outside of cities. But they find that the urban wage premium shrinks dramatically once they control for individual worker characteristics.

In an important 2010 study, Pierre-Philippe Combes and his co-authors use French micro data to gather evidence on the relationship between urban density and the urban wage premium.<sup>11</sup> They find that a

after controlling for both sorting and reverse causation in regard to labor.<sup>12</sup> In comparison, using data for U.S. cities, we found a somewhat larger urban premium of 3.8 percent when looking at population size (the table on page 5 or Table A in the appendix) or a premium of 3.3 percent when looking at population density (Table B in the appendix). The smaller premiums found in the study using French data may be largely due to better controls on worker characteristics afforded by the use of worker-level data.<sup>13</sup>

Loosely applying the 2.7 percent urban wage premium to the aggregate data indicates that the premium

<sup>10</sup> Recent work on skills in cities by Marigee Bacolod, Bernardo Blum, and William Strange, among others, acknowledges that skills are multifaceted and, therefore, may not be adequately summarized by using a measure of education, such as a city's college share.

<sup>11</sup> Some economists use population size as a proxy for agglomeration economies, while other economists use population density (population of an MSA divided by the MSA's land area) as a proxy for agglomeration. As the appendix to this article shows, the findings for aggregate average wages are quite similar whether we use population size or population density.

<sup>12</sup> Similar to studies finding an urban wage premium in the neighborhood of 2 percent using French micro data, a study by Giordano Mion and Paolo Naticchioni, using micro data from Italy, finds that a doubling of density increases wages by 1 to 2 percent.

<sup>13</sup> Using panel data for 22 U.S. cities for the period 1985-2006, Morris Davis, Jonas Fisher, and Toni Whited find an urban wage premium of 2 percent. They also find that this urban wage premium raises national long-run consumption growth by 10 percent. Also using data for the U.S., Baum-Snow and Pavan find that agglomeration economies and sorting each account for about one-half of the urban wage premium.

## Adjusting Wages for City Cost of Living Differentials

I

n the text, we looked at the effect agglomeration economies have on average nominal wages because this is the wage that firms care about. Since firms must compete in national and international markets, an area's nominal wage is important for firms' cost of doing business and may influence their decisions about where to locate a plant. From the viewpoint of workers, the possible advantages of working in an area with high nominal wages partly depend on how expensive it is to live there. Other things equal, workers should be indifferent between an area where wages and prices are at the national average and one where both the cost of living and wages are, say, 10 percent above average. In this case, real wages are equal in both areas. Thus, workers will choose a location in response to real wage differentials.

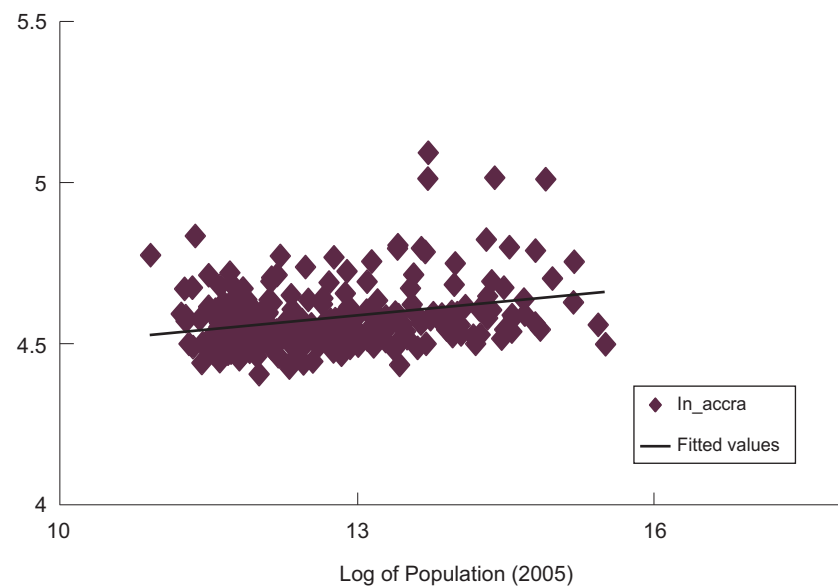
In the figure, we plot the cost of living in an MSA against the MSA's population size. As the figure shows, the cost of living is positively associated with city size.\* Since the cost of living tends to rise with city size, the gap in *net* city size wage premiums (an area's wage premium due to agglomeration economies adjusted for its cost of living) across cities will not be as large as the gross wage premium. Other things equal, we would expect workers to migrate from areas with low real wages to areas with high real wages and that this process would eventually lead to real wages that are largely equalized across cities. In reality, real wages may not be equalized if workers trade off real wages for amenities, accepting lower real wages in high-amenity places and demanding higher real wages in low-amenity locations.

\* Data for the cost of living by MSA are for 2005 and were obtained from the American Chamber of Commerce Research Association (ACCRA). The data show a moderate positive correlation of 0.2884 between the log of the cost of living and the log of MSA population size. The correlation between cost of living and city size falls to 0.2248 once we exclude the four outlier MSAs (Bridgeport-Stamford-Norwalk, CT; Honolulu, HI; San Diego-Carlsbad-San Marcos, CA; and San Jose-Sunnyvale-Santa Clara, CA) shown in the upper-center portion of the figure.

### FIGURE

#### Cost of Living Increases with City Size

Log of Cost of Living in Cities, 2005



between the Philadelphia MSA and the New York City MSA falls from \$2,500 to about \$1,800 in nominal terms. Thus, the most comprehensive studies — those using micro data — find that the urban wage premium exists but it is much smaller than previously thought. The findings in the 2010 article by Combes and co-authors suggest that an important share of the measured agglomeration economies are, in fact, attributable to the sorting of highly skilled workers in denser locations.<sup>14</sup>

### SKILLS AND CITIES

So far, we have summarized studies showing that productivity increases along with the population size or density of an area. We have seen that agglomeration economies are part of the story in any explanation of greater city productivity. We have also seen that there is a strong positive correlation between productivity in cities and the tendency for more skilled workers to locate in large cities. Economists cite several reasons why skilled workers matter so much for urban productivity. The high concentration of people in cities facilitates the exchange of knowledge among people. These exchanges, called knowledge spillovers, are likely to be enhanced in cities with highly skilled workers, who are better able to articulate and communicate

---

<sup>14</sup> Another potential way in which agglomeration economies could be overstated is if only the strongest (most productive) firms survive in large cities. That is, the existence of a large number of firms in large cities gives rise to greater competition among firms and may lead to an exodus of less productive firms. This “selection” of the most productive firms in large cities could result in an overestimation of agglomeration economies if researchers fail to account for this potential source of bias. A 2009 study by Pierre-Philippe Combes and co-authors, using French establishment-level data, finds that this selection bias does not appear to be important in estimating agglomeration economies.

ideas and may be better at adapting to new technologies. In a study of local innovative activity (measured by an MSA’s patents per capita) that I co-authored with Robert Hunt, we found that a skilled work force (measured by the percent of the adult population with a college degree) was by far the most powerful determinant of innovative activity, even after controlling for other R&D inputs and other city characteristics. Specifically,

## Economists cite several reasons why skilled workers matter so much for urban productivity.

we found that a 10 percent increase in the college share is associated with an almost 9 percent increase in patents per capita.

A city may be highly innovative, but it may have trouble surviving if the benefits of this innovation largely accrue to other regions. As technology changes, cities need to adapt by reinventing themselves. Having a highly skilled labor force may be a crucial ingredient in the reinvention process. Edward Glaeser and Albert Saiz point out that skilled workers may adjust more rapidly to negative economic shocks and educated workers may find it much easier to adapt their activities to changing economic incentives presented by emerging technologies. In fact, Glaeser and Saiz argue that generating new technologies locally is not as important as having the ability to adapt to them. In a 2009 study, Jeffrey Lin provides evidence that the spatial concentration of skilled workers increases the rate of adaptation to new technologies.

In another study, Joseph Gyourko points out how Philadelphia has successfully reinvented itself several times. Until the mid-19th century,

Philadelphia was the largest and most important trading and merchant center in North America. However, in the early 19th century, New York overtook Philadelphia as the leading center, but Philadelphia successfully reinvented itself and became a major center of highly skilled manufacturing activity. Up until the mid-19th century, Philadelphia was also able to benefit from its central location among North American cities. But the rise

of rail transportation in the mid-19th century threatened Philadelphia’s survival by drastically reducing the cost of shipping goods and the price of traded goods, allowing other cities to compete with Philadelphia.

However, Philadelphia figured out how to turn this potential liability into an asset and reinvented itself by exploiting the city’s proximity to the coal fields of northeastern Pennsylvania. The rise in coal as an energy source not only increased the volume of shipping through Philadelphia (as witnessed by the development of the Philadelphia and Reading Railroad), but it also facilitated the transition to steam-powered machinery, a move that reinforced the city’s position as an important manufacturing center.

The reinvention of Pittsburgh is a more contemporary example. As President Obama noted on September 8, 2009, Pittsburgh has “transformed itself from the city of steel to a center for high-tech innovation — including green technology, education and training, and research and development.” Pittsburgh was chosen to host the G-20 Summit in 2009 both



in recognition of and to highlight this transformation.

The evidence suggests that a city's prosperity and growth depends crucially on its ability to attract and retain highly skilled workers. Recently, economists have started to more closely examine the role of consumer agglomeration economies in the growth and development of cities. Jesse Shapiro has shown that the amenities that cities offer are especially attractive to high-skill workers, who, as we have already discussed, can stimulate employment and population growth.

In a study I conducted with Albert Saiz, we used the number of leisure tourist visits to cities as a proxy for the amenities offered in these cities. The idea is that leisure visitors are attracted by an area's special traits, such as proximity to the ocean, scenic views, historic districts, architectural beauty, and cultural and recreational opportunities. But these are some of the very characteristics that attract households to cities when they choose these places as their permanent homes. We found that the decadal population growth rate for the typical city during the 1990s would be 2.2 percentage points higher and its decadal job growth would be 2.6 percentage points higher in a city with twice the level of leisure tourists as another city. While


more evidence is needed, my research with Saiz suggests that consumer agglomeration economies can be a future source of growth for cities.

## CONCLUSION

Progress has been made in obtaining better estimates of both business and consumer agglomeration economies. Currently, the best evidence suggests that a doubling of city size increases productivity between about 3 to 4 percent. Still, the limitations of the data preclude us from speculating on the exact channels that explain business agglomeration economies. For example, we do not know the extent to which agglomeration economies arise from the sharing of specialized inputs by many firms in a common city.

Another possibility is that cities facilitate learning, since the exchange of ideas among individuals is enhanced in dense locations. Yet another possibility is that cities allow for better matches among workers and firms and better matching improves overall city productivity. Recent studies have identified the importance of some of these mechanisms. For example, in a *Business Review* article, Jeffrey Lin describes his paper with Hoyt Bleakley in which they evaluate one potential mechanism: better matching between job seekers and firms in dense

MSAs. Still, no study that I'm aware of considers the relative importance of the various mechanisms. It is difficult to formulate specific policy recommendations without precise estimates of the *relative* importance of these various channels for agglomeration economies.

It is natural for local policymakers to think about the benefits of agglomeration economies for their own cities. But if city A increases its population size at the expense of other cities, any gains from agglomeration economies in city A might be offset by reductions in agglomeration economies in other cities. This suggests that agglomeration economies can have different policy implications for national as opposed to local policymakers. As Edward Glaeser points out, "The existence of agglomeration economies does not itself give guidance about optimal regional policy." It is difficult to formulate a national regional policy based on estimates of how agglomeration economies affect cities on average. Policymakers would need good estimates of how agglomeration economies affect different cities. Precise estimates of agglomeration economies for specific cities are an important next step for future research and for policy design. 

## REFERENCES

- Bacolod, Marigee, Bernardo S. Blum, and William C. Strange. "Elements of Skill: Traits, Intelligences, Education, and Agglomeration," *Journal of Regional Science*, 50 (2010), pp. 245-80.
- Baum-Snow, Nathaniel. "Did Highways Cause Suburbanization?" *Quarterly Journal of Economics*, 122 (2007), pp. 775-805.
- Baum-Snow, Nathaniel, and Ronni Pavan. "Understanding the City Size Wage Gap," unpublished manuscript, Brown University (February 2010)
- Bleakley, Hoyt, and Jeffrey Lin. "Thick-Market Effects and Churning in the Labor Market: Evidence from U.S. Cities," Federal Reserve Bank of Philadelphia Working Paper 07-23 (2007).
- Carlino, Gerald A., and Robert Hunt. "What Explains the Quantity and Quality of Local Inventive Activity?" in G. Burtless and J. Pack, eds., *Brookings-Wharton Papers on Urban Affairs*. Washington: Brookings Institution Press (2009), pp. 65-109.
- Carlino, Gerald A., and Albert Saiz. "City Beautiful," Federal Reserve Bank of Philadelphia, Working Paper 08-22 (September 2008).
- Chatterjee, Satyajit. "Agglomeration Economies: The Spark That Ignites a City?" Federal Reserve Bank of Philadelphia *Business Review* (Fourth Quarter 2003).
- Ciccone, Antonio, and Robert E. Hall. "Productivity and the Density of Economic Activity," *American Economic Review*, 86 (1996), pp. 54-70.
- Combes, Pierre-Philippe, Gilles Duranton, Laurent Gobillon. "The Identification of Agglomeration Economies," unpublished manuscript (April 2010).
- Combes, Pierre-Philippe, Gilles Duranton, Laurent Gobillon, and Sebastien Roux. "Estimating Agglomeration Economies with History, Geology, and Worker Effects," in Edward L. Glaeser, ed., *Agglomeration Economies*. Chicago: University of Chicago Press, 2010.
- Combes, Pierre-Philippe, Gilles Duranton, Laurent Gobillon, and Sebastien Roux. "The Productivity Advantages of Large Cities: Distinguishing Agglomeration from Firm Selection," unpublished manuscript (February 2009).
- Davis, Morris, Jonas Fisher, and Toni Whited. "Macroeconomic Implications of Agglomeration," unpublished manuscript, University of Wisconsin (December 2009).
- Duranton, Gilles, and Matthew A. Turner. "Urban Growth and Transportation," unpublished manuscript, University of Toronto (November 2008).
- Eberts, Randall W., and Daniel P. McMillen. "Agglomeration Economies and Urban Public Infrastructure," in P. Cheshire and E. Mills, eds., *Handbook of Regional and Urban Economics, Volume 3: Applied Urban Economics*. New York: Elsevier Sciences, 1999.
- Ellison, Glenn, and Edward L. Glaeser. "Geographic Concentration of Industry: Does Natural Advantage Explain Agglomeration?" *American Economic Association Papers and Proceedings Review*, 89 (1999), pp. 311-16.
- Glaeser, Edward L. "Introduction," in Edward L. Glaeser, ed., *Agglomeration Economies*. Chicago: University of Chicago Press, 2010.
- Glaeser, Edward L., and Matthew Resseger. "The Complementarity Between Cities and Skills," *Journal of Regional Science*, 50 (2010), pp. 221-224.
- Glaeser, Edward L., and Janet E. Kohlhase. "Cities, Regions and the Decline of Transport Costs," *Papers of the Regional Science Association*, 83 (2004), pp. 197-228.
- Glaeser, Edward L., and Albert Saiz. "The Rise of the Skilled City," in W. Gale and J. Pack, eds., *Brookings-Wharton Papers on Urban Affairs*. Washington: Brookings Institution Press (2004), pp. 47-94.
- Glaeser, Edward L., and D.C. Maré. "Cities and Skill," *Journal Labor Economics*, 19 (2001), pp. 316-42.
- Gyourko, Joseph, "Looking Back to Look Forward: Learning from Philadelphia's 350 Years of Urban Development," in G. Burtless and J. Pack, eds., *Brookings-Wharton Papers on Urban Affairs*. Washington: Brookings Institution Press (2005), pp. 1-58.
- Haughwout, Andrew. "The Paradox of Infrastructure Investment," *Brookings Review*, 18:3 (Summer 2000).
- Lin, Jeffrey. "Urban Productivity from Job Search and Matching," Federal Reserve Bank of Philadelphia *Business Review* (First Quarter 2011).
- Lin, Jeffrey. "Technological Adaptation, Cities, and New Work," Federal Reserve Bank of Philadelphia Working Paper 09-17 (2009).
- Mion, Giordano, and Paolo Naticchioni. "The Spatial Sorting and Matching of Skills and Firms," *Canadian Journal of Economics*, 42 (2009) pp. 28-55.
- Moomaw, Ronald L. "Productivity and City Size: A Critique of the Evidence," *Quarterly Journal of Economics* 96 (1981), pp. 675-88.
- Puga, Diego. "The Magnitude and Causes of Agglomeration Economies," *Journal of Regional Science*, 50 (2010), pp. 203-19.
- Rappaport, Jordan, and Jeffrey Sachs. "The United States as a Coastal Nation," *Journal of Economic Dynamics and Control*, 8 (2005), pp. 5-46.
- Shapiro, Jesse M. "Smart Cities: Quality of Life, Productivity, and the Growth Effects of Human Capital," *Review of Economics and Statistics*, 88 (2006), pp. 324-35.

## APPENDIX

# A

s pointed out in the main text, agglomeration economies increase worker productivity, and in competitive labor markets, this increased productivity will show up in the wages workers are paid. Thus, it has become customary for economists to estimate a wage equation of the following type:

$$\ln(\text{Average Total Wages}_i) = C + \alpha \ln(\text{MSA Pop}_i) + \beta(\text{controls}_i)$$

where estimates of  $\alpha$  are the parameters of interest and the controls (such as city's college share and its mix of industries) differ in different studies. The findings reported in this study are based on the estimation of the following wage equation:

$$\ln(\text{Average Total Wages}_i) = C + \alpha \ln(\text{MSA Pop}_i) + \beta(\text{College Educated}_i) + \delta_j \sum_{j=1}^8 (\text{Industry Mix}_{j,i}) + \phi_k \sum_{k=1}^7 (\text{Region}_{k,i}) + \varphi \ln(\text{Planned Highway Miles}_i) + \gamma \ln(\text{Navigable Rivers}_i)$$

where

Average Total Wages<sub>*i*</sub> = Total wages and salaries divided by total number of workers for 2005 in MSA *i*

MSA Pop<sub>*i*</sub> = Two alternative measures are used:

in Model 1: MSA Pop<sub>*i*</sub> = the level of population in MSA *i* (either for 2005 or for 1920);

in Model 2: MSA Pop<sub>*i*</sub> = population density = population in MSA *i* divided by square miles of land area in MSA *i* (either for 2005 or for 1920).

Percent College Educated = Percent of 1920 population with at least a college degree in MSA *i*

Industry Mix<sub>*i*</sub> = 1970 employment shares in each of nine broad industries in MSA *i*

Region<sub>*i*</sub> = A dummy variable indicating each MSA's region

Planned Highways Miles = 1947 planned miles of interstate highways for MSA *i* relative to square miles of land area in MSA *i*

Navigable Rivers<sub>*i*</sub> = Distance from navigable rivers in 1890 for MSA *i*

The dependent variable refers to average annual total private-sector wages divided by the number of private-sector workers in an MSA in 2005. The dependent variable is a proxy for MSA productivity. In general, deeply lagged values of the independent variables are used in this article. This reduces the simultaneity and reduces concerns about direction-of-causation issues, since 2005 values of the dependent variable are not likely to affect deeply lagged values of the independent ones. Two population measures are used as proxy variables for agglomeration economies. In Model 1, population size is used because sometimes researchers use MSA population size as a proxy for agglomeration economies. Alternatively, in Model 2, we use population density as the proxy variable because more recent studies have chosen density measures over measures of size. For comparative purposes, 2005 values for population size/density are used and reported. Since 2005 values are likely to be endogenous, we will use MSA population size and MSA population density in 1920, since this reduces the simultaneity and reduces concerns about direction-of-causation issues.

The industry mix variables consist of the 1970 employment shares in each of nine broad industries: agriculture; mining; construction; manufacturing; wholesale trade; retail trade; finance, insurance, and real estate; services; and

## APPENDIX *(continued)*

government (transportation is the excluded sector). The region variables consist of a set of dummy variables to account for the MSA's region. The regions are New England; Mideast; Great Lakes; Plains; Southeast; Southwest; and Rocky Mountain (the Far West is the excluded region). We use planned highway miles as a proxy for urban infrastructure. Specifically, we use the miles of highways planned for an MSA in the 1947 national interstate highway plan. These planned highway miles are divided by the square miles of an MSA's land area to arrive at the proxy variable used for MSA infrastructure. Finally, we use an MSA's distance to commercially navigated waterways in 1890 as our proxy for an MSA's natural advantages.

The models were estimated using ordinary least squares (OLS) methods with White robust standard errors to take heteroskedasticity into account.\* The results of the regression using population size are presented in Table A and a portion of the results are given in the table in the text. All of the variables in the model have the expected sign, and the coefficients on the variables for population size and college share are highly significant. Since the estimated coefficients can be interpreted as percentage changes, column 1 of Table A shows that a doubling of an MSA's population size is associated with a 6.1 percent increase in average wages. As indicated, our estimate of agglomeration economies can suffer from reverse causation bias. Therefore, column 2 of Table A shows the results when we use the 1920 level of an MSA's population to identify the effect of population on a city's average wages. After controlling for reverse causation, the estimate for the effect of a doubling of city population size on average wages falls from 6.1 percent to 3.9 percent.

Next, we add the 1920 college share variable to the regression to control for a sorting bias. Column 3 of Table A shows that the estimates of the city size wage premium are only slightly affected after controlling for college shares, falling to 3.8 percent from 3.9 percent. Finally, column 4 of Table A shows that the estimate of the city size wage premium falls only slightly (from 3.8 percent to 3.6 percent) after controlling for both an MSA's infrastructure and its natural advantage.

Table B summarizes the findings for the regression results when we use population density measures instead of population size measures. The results for density presented in Table B are quite similar to the results reported in Table A for size. At least for the aggregate data we considered, it makes little difference for the estimates of the urban wage premium whether size measures or density measures are used to proxy for agglomeration economies.

---

\* Alternatively, we used a two-stage least squares (2SLS) procedure to estimate the parameters of the model. The 2SLS procedure confirmed that 1920 values for population size and population density are strong instruments for 2005 values of these variables. The findings from the 2SLS regressions are mostly similar to those based on the OLS method described in the text, and Hausman tests do not identify any systematic differences between the OLS and 2SLS coefficients in these regressions. We therefore present the results from the OLS regressions.

## APPENDIX (continued)

**Table A. Effect on Average Nominal Wages Resulting from a Doubling of an MSA's Population Size<sup>†</sup>**

	(1)	(2)	(3)	(4)
Population, 2005 <sup>†</sup>	<b>6.1*</b>			
Population, 1920 <sup>††</sup>		<b>3.9*</b>	<b>3.8*</b>	<b>3.6*</b>
Share of 1920 Population with a College Degree			<b>62.8*</b>	<b>65.9*</b>
1947 Planned Highway Miles <sup>††</sup>				1.1
Distance from Navigable Rivers in 1890 <sup>††</sup>				-0.004
No. of MSAs	313	309	309	254
<i>R</i> <sup>2</sup>	0.6630	0.6207	0.6448	0.6567

**Table B. Effect on Average Nominal Wages Resulting from a Doubling of an MSA's Density<sup>†</sup>**

	(1)	(2)	(3)	(4)
Population Density, 2005 <sup>†</sup>	<b>7.1*</b>			
Population Density, 1920 <sup>††</sup>		<b>3.4*</b>	<b>3.3*</b>	<b>3.6*</b>
Share of 1920 Population with a College Degree			<b>61.4*</b>	<b>66.8*</b>
1947 Planned Highway Miles <sup>††</sup>				0.6
Distance from Navigable Rivers in 1890 <sup>††</sup>				-0.004
No. of MSAs	313	309	309	254
<i>R</i> <sup>2</sup>	0.6541	0.6060	0.6291	0.6430

\*Indicates statistically significant from zero at the 1 percent level.

<sup>†</sup>Results reported after controlling for the 1970 employment shares in each of nine broad industries and for the MSA's region.

<sup>††</sup>Indicates variable is in logs.

# The Effectiveness of Government Spending in Deep Recessions: A New Keynesian Perspective\*

BY KEITH KUESTER

**A**s the recent recession unfolded, policymakers in the U.S. and abroad employed both monetary and fiscal stabilization tools to help mitigate the downturn. One of the tools that can be used by fiscal policymakers is to actively purchase more goods and services: the idea being that the government's demand can offset the weak demand by households and firms. For such a policy to be effective, one needs to know the extent to which government spending can stimulate the economy. One of the models frequently used by economists who study business cycles suggests that the answer depends very much on the extent to which monetary policy can be employed to stabilize the economy. In this article, Keith Kuester reviews the literature on the effectiveness of government spending during severe recessions.

The U.S. economy is emerging from the deepest recession since the Great Depression. From late 2007 to the trough in the second quarter of 2009, output fell by more than 5 percent. At its peak, the unemployment rate had more than doubled from pre-recession levels. Many other economies witnessed similar declines.



**Keith Kuester** is a senior economist in the Research Department of the Philadelphia Fed. This article is available free of charge at [www.philadelphiafed.org/research-and-data/publications/](http://www.philadelphiafed.org/research-and-data/publications/).

As the recession unfolded, policymakers in the U.S. and abroad employed both monetary and fiscal stabilization tools to help mitigate the downturn. One of the tools used by fiscal policymakers was to actively purchase more goods and services, the idea being that the government's demand can offset

<sup>1</sup> Fiscal stimulus packages, such as the American Recovery and Reinvestment Act of 2009, very broadly consist of one or both of two categories: outright purchases of goods or services by the government (government spending henceforth) and changes in transfers or taxes. This article is concerned with government spending.

\*The views expressed here are those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

the weak demand by households and firms.<sup>1</sup> For such a policy to be effective, one needs to know the extent to which government spending can stimulate the economy, especially when the economy is in a severe recession.

One of the models frequently used by economists who study business cycles suggests that the answer depends very much on the extent to which monetary policy can be employed to stabilize the economy. "Conventional" monetary policymaking typically operates by targeting a certain level for an overnight interest rate. In the United States, for example, the Federal Reserve targets the federal funds rate. Monetary policy can reduce this interest rate in a recession to help stimulate private demand. The figure on the next page shows the level of the effective federal funds rate for more than half a century. Grey areas mark periods of recession. As can be seen, in the last recession, the Federal Reserve cut the federal funds rate essentially to a level of zero.

At that point, lowering the federal funds rate further is no longer feasible

<sup>2</sup> When interest rates are at zero, central banks can still try to influence aggregate demand using "unconventional" monetary policy tools. In exceptional circumstances, such interventions can be warranted. Central banks can, for example, engage in purchases of financial assets to try to reduce interest rates in certain sectors. For example, during the recent recession, the Fed purchased mortgage-backed securities issued by the federal housing agencies. Fed Chairman Ben Bernanke, in a speech, called this "credit easing." Central banks can also increase the quantity of money and thereby try to influence aggregate demand, a strategy known as "quantitative easing." Chairman Bernanke's speech discusses the set of tools available to the Federal Reserve beyond conventional interest rate policy. The *Business Review* article by Michael Dotsey assesses some of the alternative policy tools in greater depth.

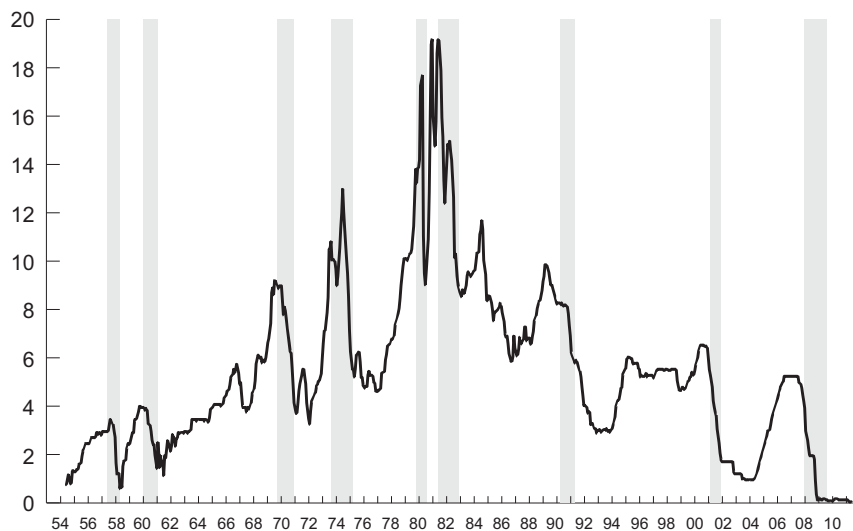
because the nominal interest rate cannot fall below zero.<sup>2</sup> The zero lower bound on nominal interest rates occurs because cash yields a zero interest rate. Consider, for example, interest rates on loans. Imagine that you borrow a dollar today. You can store it as cash. If the interest rate is negative, you pay back less than you borrowed, and you do not need all of the cash you received initially in order to repay the loan. As a result, you would have made money from nothing. At the same time, the lender would take a sure loss. Therefore, no lender would offer loans with a negative interest rate. Similarly, interest rates on deposits cannot fall below zero either. You would be better off keeping your cash rather than depositing the money into a savings account that pays a negative interest rate. For these reasons, nominal interest rates cannot fall below zero.<sup>3</sup>

As the figure shows, in December 2008 the federal funds rate reached this level (of very close to zero) for the first time in the postwar period. The lack of historical evidence with overnight interest rates at zero suggests that previous experience may be only a limited guide to the effectiveness of government spending when monetary policy is constrained by the lower bound on interest rates. In order to ascertain the efficacy of government spending in the latest recession, researchers have therefore relied on theoretical arguments.

<sup>3</sup> Clearly, the cash would need to be stored and could be stolen or destroyed, a fact that the argument above ignores. People may be willing to pay a fee to avoid the risk and the storage cost. Interest rates on some accounts could therefore fall somewhat below zero to the extent that this fee is reflected in the interest rate. What matters for the logic that follows is that there is a lower bound for interest rates, the existence of which places constraints on what monetary policy can do to stabilize economic fluctuations. Of lesser importance is whether the bound is exactly at zero, as assumed in the exposition that follows, or slightly below zero.

## FIGURE

### Effective Federal Funds Rate (monthly average of daily data)



Effective federal funds rate, percent annualized. Grey areas mark official recession dates as determined by the National Bureau of Economic Research.  
Source: Haver.

The literature reviewed in this article assumes that only conventional monetary policy is used. It argues that in a situation in which monetary policy is constrained by the lower bound on interest rates, government spending may be more effective than it usually is. This reasoning is based on the class of so-called New Keynesian models that have become one of the benchmark models for economists who study business cycle fluctuations. See, for instance, the article by Richard Clarida, Jordi Galí, and Mark Gertler for an introduction to this class of models.<sup>4</sup>

#### THE NEW KEYNESIAN MODEL

In their simplest form, New Keynesian models describe three economic relationships. The first relationship says how firms and households

<sup>4</sup> The article by Michael Woodford and the one by Lawrence Christiano, Martin Eichenbaum, and Sergio Rebelo present a more technical overview of the arguments in this article.

adjust their demand for goods and services in response to changes in the real rate of interest. The real interest rate is the nominal interest rate minus the expected rate of inflation. Basically, the higher the real interest rate, the more goods consumers can buy in the future by forgoing a purchase today. Higher real interest rates therefore induce households to consume less and save more. Higher real interest rates also mean that firms must earn a higher rate of return on a project in order for the project to be cost-effective. A higher real interest rate therefore means less investment, too. In sum, a higher real interest rate means that private demand — the sum of consumption by households and of investment by firms — is lower.

The second relationship in the New Keynesian model concerns the link between inflation and how much firms produce. This relationship is central to the model and has been

given the name the New Keynesian Phillips curve. This Phillips curve is derived from a structural model of firms' price-setting behavior that has two key elements. First, firms have some pricing power. They can choose to sell more of their product by setting a lower price, or they can choose to sell somewhat less but at a higher price. Second, firms adjust their prices in response to events that have an impact on the economy, but the price adjustment is sluggish. That is, not all firms immediately adjust their prices to the full extent. These two features of the model allow monetary policy to affect output in the short run.<sup>5</sup>

According to the New Keynesian Phillips curve, if firms face lower demand for their goods or services, they will be inclined to reduce their prices to some extent, since they face lower costs of production. The costs tend to be lower, for example, since less demand means less revenue, which can allow firms to negotiate lower wages with their workers. Also, if firms expect future demand to be weaker or future inflation to be lower, they will be inclined to reduce their current prices in order not to get too far out of line with their competitors' prices and the price level in general. As a result, according to the model, inflation falls when aggregate demand (and thus aggregate output) falls.

The third and final relationship in the model describes how monetary policy is conducted. To conduct monetary policy, central banks generally vary a short-term interest rate in response to economic conditions. Indeed, the literature that this article discusses assumes that monetary

<sup>5</sup> Keith Sill's *Business Review* article describes this relationship in much more detail. It also explores the extent to which the resulting price-setting relationship can be used to infer the degree of inflationary pressure in an economy.

policy is carried out by using only the conventional monetary policy means of setting the overnight interest rate. This process usually involves lowering short-term interest rates when economic growth is weak or when inflation or expected inflation is below some desired level. Conversely,

**Another property of well-designed monetary policy is that if inflationary pressures increase, central banks will raise the nominal interest rate by more than the amount by which expectations of inflation increase.**

it involves raising short-term interest rates when economic growth is strong or when inflationary pressures build up. It has been theoretically shown in a wide class of economic models that low and stable inflation allows the economy to employ resources more efficiently, which, in turn, is conducive to moderate long-term interest rates and maximum employment.<sup>6</sup> Such behavior therefore describes good conduct of monetary policy in this model environment.

Another property of well-designed monetary policy is that if inflationary pressures increase, central banks will raise the nominal interest rate by more than the amount by which expectations of inflation increase.<sup>7</sup> This behavior implies that the real rate rises when inflationary pressures increase. Such an increase of the real interest

<sup>6</sup> The goals of monetary policy are spelled out in the Federal Reserve Act, which specifies that the Board of Governors and the Federal Open Market Committee should seek "to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates."

<sup>7</sup> See, for example, the discussion in the paper by Clarida, Galí, and Gertler.

rate reduces aggregate demand, as discussed above. This, in turn, brings down inflation through the New Keynesian Phillips curve relationship. Conversely, typically, the central bank reduces nominal rates by enough to make sure that the real interest rate falls when inflation falls below the

desired level (or if economic activity is depressed). Thus, in general, the deeper a recession, the lower the real interest rate.

However, remember that nominal interest rates cannot fall below zero. Regardless of how low inflation may be expected to go or how severe a recession is, the central bank cannot reduce the nominal interest rate any further than to a level of zero. Importantly, once that bound on the interest rate is reached, the more depressed economic activity is, and thus the lower inflation is, according to the model, the *higher* is the real rate of interest. Note that this is the opposite of the relationship between inflation and the real interest rate that applies in "normal times." The reason is that monetary policy is constrained when the lower bound on the nominal interest rate is reached and cannot follow its usual stabilization practice. In such a circumstance, when the nominal interest rate is zero, the real interest rate is just the negative of the expected inflation rate. Lower inflation expectations then mean a higher real rate of interest.

These observations allow us to characterize how private demand is



related to inflation. It turns out that demand is negatively related to inflation in normal times but positively related if monetary policy is constrained by the zero lower bound. The explanation for this is as follows: In “normal times,” when inflation falls below a level that monetary policymakers deem consistent with price stability, monetary policy lowers the nominal interest rate by enough, so that the real interest rate falls. In response to this, households save less and demand more consumption goods. Firms invest more. In “normal times,” therefore, because monetary policymakers want to ensure stable inflation, private demand tends to rise when inflation falls and tends to fall when inflation rises.

If the zero lower bound is binding, in contrast, monetary policy cannot ensure that this is the case. The relationship between inflation and private demand — according to the model — is reversed! In this circumstance, lower inflation implies a higher (rather than a lower) real interest rate, since conventional monetary policy cannot react by lowering the nominal interest rate. As a result, lower inflation implies *less* aggregate demand for goods and services.

This puts us in a position to discuss the effect of government spending in the model and to see why that effect can crucially depend on whether monetary policy is constrained.

### GOVERNMENT SPENDING RAISES INFLATION IN THE NEW KEYNESIAN MODEL

The Phillips curve relationship is important for the logic that follows because it means that government spending in the model is inflationary. The reason is as follows. Higher government spending means that the government buys more goods and services from firms. Just as with higher private demand, the additional demand gener-

ated by the government means that firms have to produce more. Workers work longer hours, and firms use their capacity more intensively. As a result, wages and production costs increase, and firms raise their prices. Therefore inflation increases. This is so regardless of whether monetary policy is constrained by the zero lower bound on interest rates. What differs in the two regimes is how the real interest rate and private demand react to this increase in government spending.

In “normal times,” if inflation rises, the central bank increases the nominal interest rate such that the real interest rate rises. As a result, households save more and consume less. Firms invest less. In short, private demand falls if government spending rises. Therefore, economic activity rises by less than the amount by which government spending has increased: Government spending has crowded out private demand because of higher real interest rates. The model therefore suggests that, normally, output rises by less than one dollar if government spending rises by a dollar. The technical term for this is that the “government spending multiplier” is less than one.<sup>8</sup>

### THE GOVERNMENT SPENDING MULTIPLIER AT THE LOWER BOUND

Suppose now that a negative shock leads to a very strong reduction in private demand. Examples for such shocks are manifold. For instance, a collapse in asset prices could make households feel less wealthy, or financial turbulence could increase credit spreads and risk premiums. Or households’ or firms’ confidence

---

<sup>8</sup> For a review regarding the existing empirical evidence on the effectiveness of government spending for “normal times,” see the paper by Robert Hall.

in future economic prospects may be diminished for other reasons. As private demand crumbles, and inflationary pressures succumb, the central bank reduces the nominal interest rate to counteract the recessionary impulse.

If the recessionary impulse is exceptionally deep, the central bank would want to reduce the nominal interest rate to less than zero. But it cannot do so: The lower bound on nominal interest rates becomes binding. As a result, unless the central bank now resorts to nonconventional monetary policy means, which this article does not take into account, the real rate of interest is higher than what the central bank would like to achieve, and aggregate demand is lower than desired.

Let us look at the effect of government spending under such circumstances. Higher government spending means more demand and thus higher inflation. Since the zero lower bound is binding, the higher inflation rate induced by the increase in government spending means that the real rate of interest will be *lower* than it would have been without the increase in government spending. This is so because at the zero lower bound, the real rate of interest is just the negative of the rate of inflation. Note that a lower real interest rate is precisely what monetary policy would have liked to achieve but could not by using only conventional monetary policy means.<sup>9</sup> The central bank thus does not raise the nominal interest rate in response to an increase in government spending.

---

<sup>9</sup> This, of course, raises the question of why central banks would want to confine themselves to using only conventional interest rate policy in the first place. Footnote 2 presents a brief discussion of nonconventional policy and provides references for further reading.

The lower real interest rate means that private consumption and investment increase. In the model, government spending, through the lower real interest rate, thus crowds in private consumption and investment when the zero lower bound is binding. In sum, not only does government spending rise, but so does private demand. Aggregate demand and output thus rise by more than the amount of government spending. This is at the core of why government spending multipliers may be bigger than one and therefore bigger than usual if the zero lower bound is binding.

## REFINEMENTS AND CAVEATS

The above analysis has ignored the fact that both households and firms base their decisions not only on the current economic environment but also on their expectations about the future. The anticipation effects of fiscal policy are important in the model environment. For example, in order to affect private demand today, government spending need not occur immediately; a credible announcement of *future* spending can suffice. The reason is that a future increase in spending increases demand in that period and will therefore increase inflation in that period. This affects the real interest rate in the future and thus also the long-term real interest rate that households and firms face today. This means that government plans for future spending can affect saving and investment decisions today. Broadly speaking, announcing future government spending “crowds in” private demand today if the zero lower bound is expected to still be binding at the time of the higher spending and crowds it out otherwise. As Robert Hall, for example, emphasizes, these anticipation effects — at the zero lower bound — can lead to a stronger (cumulative)

response of output for a given dollar amount of the increase in government spending, suggesting that the credible commitment to future government spending alone can — via the effect on the long-run real interest rate — help stabilize current output. However, if the zero lower bound is not expected

## The anticipation effects of fiscal policy are important in the model environment.

to be binding at the time of future spending, the long-term real interest rate rises, and such an announcement crowds out private demand today. This would be the case, for example, when the increase in government spending is persistent.

The above reasoning helps to explain some of the quantitative differences in the effectiveness of government spending that different studies find in a zero lower bound environment. Much of it hinges on the different timing of the increase in government spending. For example, Christiano, Eichenbaum and Rebelo find multipliers that are much bigger than one. In a similar model environment, the study by John Cogan, Tobias Cwik, John Taylor, and Volker Wieland reports multipliers of “just above” 1 percent for the first quarter of spending. Their estimates of the multipliers fall quickly to levels well below one in subsequent quarters of fiscal stimulus through government spending.

The difference between these two findings can be explained by the differences in the assumptions about the spending plans. Christiano and his co-authors assume that the government spending program ends once monetary policy ceases to be constrained by the

zero lower bound. In contrast, Cogan and his co-authors look at spending programs that last well beyond that point. As a result, in their simulations, there are many periods in which government spending increases the real interest rate and thus crowds out private demand, both at the time of spending and in the initial periods in which the zero lower bound is still binding.

For similar reasons, Christopher Erceg and Jesper Lindé emphasize that the size of the government spending packages matters for their cost-effectiveness. In the New Keynesian model environment, the bigger the government spending package, the earlier the zero lower bound may cease to bind. This means that government spending thereafter will — again — crowd out private demand. As a result, Erceg and Lindé stress that the first dollar of government spending in a zero lower bound situation increases output by more than the second dollar and so forth.

This suggests that if the New Keynesian model is a good guide for policy, fiscal stimulus may be most effective if it is well targeted in the sense that it is contingent on the disruption in the economy still being present and the zero lower bound still being binding.<sup>10</sup> In line with this, several papers argue that the deeper the economy is into a recession and the longer the recession is anticipated to last, the more effective will be fiscal stimulus through an increase in government spending.<sup>11</sup>

More recently, fiscal consolidation has received growing interest. Turning

---

<sup>10</sup> That the benefit of fiscal stimulus depends on how persistent the economic disruption will be implies that it may be difficult for policymakers to ascertain the appropriate timing and amount of fiscal stimulus.

<sup>11</sup> See, for instance, the paper by Michael Woodford.

the above arguments upside down, my paper with Giancarlo Corsetti, André Meier, and Gernot Mueller argues that a credible upfront commitment to cut government spending in some *future* period, when the economy has already left the zero lower bound, can stimulate demand while the zero lower bound is still binding. The reason is that cuts in government spending reduce inflation. If well timed, they can thus reduce long-term interest rates. Such a commitment provides further stimulus to an economy that is still caught in the zero lower bound (that is, in times of a deep recession), and it helps to finance fiscal deficits. My co-authors and I stress that the timing of such spending reversals matters, however. If the consolidation comes too soon, we argue, the associated deflationary tendencies occur while the lower bound on interest rates is still binding, putting upward pressure on real interest rates and reducing the government spending multiplier.

All this said, the above analysis simplifies matters in a number of dimensions. Therefore, some caveats seem in order. First, the economic effects of government spending depend on the entire path of government spending, not just current spending.


Second, the implications for tax rates have not been fully explored. If future declines in government spending do not offset all of the increase in government spending in earlier periods, tax rates must eventually increase to balance the government's budget. Taxes, however, distort the economy. Increased taxes on labor income, for example, would tend to reduce the supply of labor. To the extent that these taxes are expected to be higher after the zero lower bound ceases to bind, future productive capacity will be reduced. In addition, inflationary pressures increase in the future. Both effects induce households to consume less initially, which weakens the effectiveness of the initial fiscal stimulus.<sup>12</sup> Third, the arguments are largely based on theory and model relationships that have been deduced for "normal times." Given that the zero lower bound very rarely binds, empirical evidence on government spending multipliers in such a situation is scarce. This means that, in practice, macroeconomists remain quite uncertain about the precise quantitative effects of temporary in-

---

<sup>12</sup> The paper by Erceg and Lindé shows some simulations; the paper by Gauti Eggertsson discusses tax policy at the zero lower bound.

creases in government spending when monetary policy is constrained by the zero lower bound. This is an exciting avenue for future research.

## CONCLUSIONS

This article has assessed the effect of temporary increases in government spending on economic activity through the lens of a benchmark New Keynesian model. Several caveats notwithstanding, the literature finds that when monetary policy is constrained by the zero lower bound on interest rates, such fiscal stimulus may be more effective than in weaker recessions. The literature also highlights that such a policy must be carefully designed to have the desired effect: Fiscal stimulus is most effective if it is contingent on the disruption to the economy still being present and the zero lower bound still being binding. That said, none of the studies claim that higher government spending is a panacea for tackling the causes of why the economy ended up in a deep recession in the first place. In addition, the precise magnitude of the impact of government spending on the economy remains uncertain. 

## REFERENCES

Bernanke, Ben S. "The Crisis and the Policy Response," speech at the Stamp Lecture, London School of Economics, London, England, January 13, 2009; available at <http://federalreserve.gov/newsevents/speech/bernanke20090113a.htm>.

Christiano, Lawrence J., Martin Eichenbaum, and Sergio Rebelo. "When Is the Government Spending Multiplier Large?" NBER Working Paper 15394 (October 2009).

Clarida, Richard, Jordi Galí, and Mark Gertler. "The Science of Monetary Policy: A New Keynesian Perspective," *Journal of Economic Literature*, 37 (December 1999), pp. 1661-1707.

Cogan, John F., Tobias Cwik, John B. Taylor, and Volker Wieland. "New Keynesian Versus Old Keynesian Government Spending Multipliers," *Journal of Economic Dynamics and Control*, 34:3 (March 2010), pp. 281-95.

Corsetti, Giancarlo, Keith Kuester, André Meier, and Gernot Mueller. "Debt Consolidation and Fiscal Stabilization of Deep Recessions," *American Economic Review Papers and Proceedings*, 100 (2010), pp. 41-45.

Dotsey, Michael. "Monetary Policy in a Liquidity Trap," *Federal Reserve Bank of Philadelphia Business Review* (Second Quarter 2010).

Eggertsson, Gauti B. "What Fiscal Policy Is Effective at Zero Interest Rates?," in Daron Acemoglu and Michael Woodford, eds., *NBER Macroeconomics Annual 2010*, Volume 25. Chicago: University of Chicago Press, May 2011, pp. 59-112.

Erceg, Christopher J., and Jesper Lindé. "Is There a Fiscal Free Lunch in a Liquidity Trap?" CEPR Discussion Paper 7624 (January 2010).

Hall, Robert E. "By How Much Does GDP Rise if the Government Buys More Output?" *Brookings Papers on Economic Activity* (Fall 2009), pp. 183-231.

Sill, Keith. "Inflation Dynamics and the New Keynesian Phillips Curve," *Federal Reserve Bank of Philadelphia Business Review* (Fourth Quarter 2010).

Woodford, Michael. "Simple Analytics of the Government Expenditure Multiplier," *American Economic Journal: Macroeconomics*, 3:1 (January 2011) pp. 1-35.

# What's It Worth?

## Property Taxes and Assessment Practices\*

BY TIMOTHY SCHILLER

**R**esidential property taxes are both a major source of local government financing and a significant cost of owning a home. Tax limitation measures and relatively moderate gains in house prices during most of the 1990s tended to keep property taxes from rising rapidly in those years. But from the late 1990s to the mid-2000s, house prices once again rose sharply. Property taxes followed a similar path, bringing them to greater public attention once again. Now that house prices appear to have shifted to a level or downward trend in most parts of the country, there seems to be increasing concern that real estate valuations for property taxes are not promptly reflecting declining values. In this article, Tim Schiller focuses on how tax authorities measure value and calculate tax liabilities, the shortcomings of some of these processes, and the remedies that have been, or can be, implemented to make real estate assessment more accurate and equitable.

Residential property taxes are both a major source of local government financing and a significant cost of owning a home. Homeowners view rising house prices favorably, but rising



When he wrote this article, **Tim Schiller** was a senior economic analyst in the Research Department of the Philadelphia Fed. This article is available free of

charge at [www.philadelphiafed.org/research-and-data/publications/](http://www.philadelphiafed.org/research-and-data/publications/).

property taxes, which are based on house values, are not regarded in the same light. When house prices move up rapidly, public concern about the resulting upward pressure on property taxes increases. Periods of rapid increases in house prices occurred in the late 1970s and middle 1980s, and state and local property taxes increased in those same years. (See Figures 1 and 2.) The rising real estate property tax burdens during that time led many

\*The views expressed here are those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

states to adopt measures limiting their growth. An early and widely copied measure was California's Proposition 13, enacted in 1978 and amended in 1986 to be even more favorable to homeowners. Proposition 13 limited annual increases in assessed value to the annual change in the consumer price index or 2 percent, whichever was lower. Proposition 13 also required houses to be reassessed at market value when they were sold.

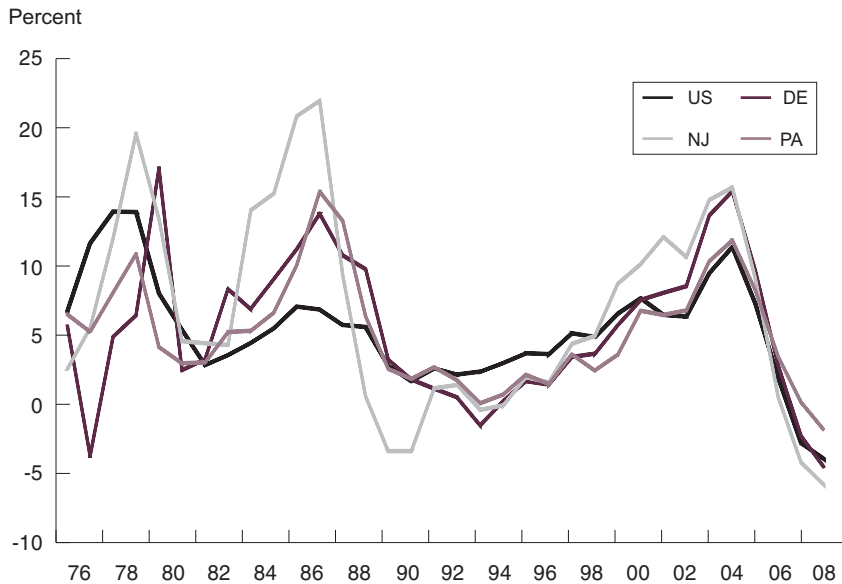
Tax limitation measures and relatively moderate gains in house prices during most of the 1990s tended to keep property taxes from rising rapidly in those years. But from the late 1990s to the mid-2000s, house prices once again rose sharply. Property taxes followed a similar path, bringing them to greater public attention once again, and by 2007, limits on residential property tax assessments were in place in 20 states.<sup>1</sup> Now that house prices appear to have shifted to a level or downward trend in most parts of the country, there seems to be increasing concern that real estate valuations for property taxes are not promptly reflecting declining values.<sup>2</sup> And

<sup>1</sup> See the report by Mark Haveman and Terri Sexton.

<sup>2</sup> Analysis of property tax collections and house-price appreciation between 1980 and 2008 indicates that collections increased less rapidly than house prices during this period, in part perhaps because of the limits on increased assessments. Collections increased about 4 percent for each 10 percent increase in house prices for the nation as a whole. However, it appears that tax collections increased more for a given amount of house-price appreciation in areas where appreciation was slower and that tax collections have fallen by less than the 4 versus 10 percent ratio as house prices have declined in recent years. See the article by Byron Lutz.

**FIGURE 1**

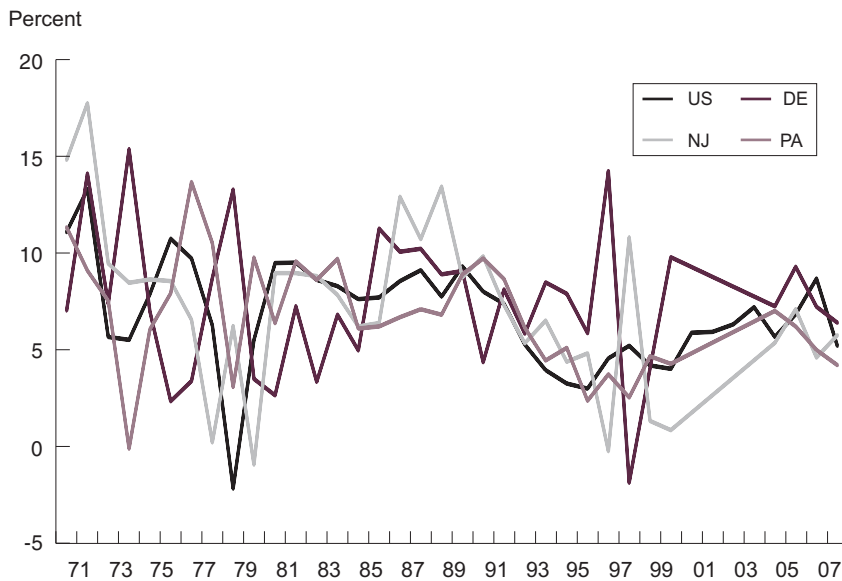
**House Price Annual Change**



Source: Federal Housing Finance Agency

**FIGURE 2**

**Annual Change in Property Tax Collections**



Source: U.S. Census Bureau

whether house prices are rising, falling, or flat, there are public complaints that property tax burdens have been inequitable across property owners, with similar houses subject to unequal taxes.

Taxes on real property, such as houses, are *ad valorem* taxes; they are based on the monetary value of the property. Consequently, a fundamental issue in the subject of real estate taxation is the valuation, or appraisal, of properties, which is part of the overall real estate tax assessment procedure. The accuracy of valuations at the time they are made, changes in valuation over time, and the equity of valuations among properties are the major points of concern. With rapid fluctuations in residential property values over the past 10 years or so — first rising, then falling — valuation has come under increasing attention. This attention is especially justified during periods of rapid change in house prices and fluctuations in the pace of house sales, both of which make accurate appraisals more difficult.<sup>3</sup>

This article takes a look at real estate tax assessment practices that are common among local government jurisdictions in the U.S. — counties, municipalities, school districts, and special-purpose districts — which obtain most of their revenue from property taxes. The focus is on how tax authorities measure value and calculate tax liabilities, the shortcomings of some of these processes, and the remedies that have been, or can be, implemented to make real estate assessment more accurate and equitable.

**FUNDAMENTALS OF ASSESSMENT**

Valuation of properties is a critical part of property tax assessment.

<sup>3</sup>See the article by Leonard Nakamura.

Assessment is the process by which a taxing authority identifies taxable properties, determines who is responsible for paying taxes on them, assigns values to them for taxation, and calculates the tax liability of the property. These last two steps — valuation and computation of tax liability — are frequently conflated in the public discourse on the subject of property taxes, but it is important to view them separately when analyzing the process of property taxation.<sup>4</sup>

In most states, the responsibility for property tax assessment resides with the county government. Among the three Third District states, this is the case in Pennsylvania and Delaware. In a few states, both county and municipal governments have assessment authority. This is the case in New Jersey, the other Third District state. In most states, a statewide agency has authority to set assessment standards, assist local assessors, and monitor local assessment processes. However, in a few states that have small numbers of local assessment jurisdictions, there are no state-level supervisory agencies. In the Third District, Delaware has no state-level supervision; assessment is conducted by each of the state's three counties. In Pennsylvania, the state supervisory agency is the State Tax Equalization Board, and in New Jersey it's the Division of Taxation.<sup>5</sup>

The assessment basis for real estate tax, required by most states' laws, is an estimate of a property's value. There are three approaches to this estimation: market value, rental value, and replacement value. The

<sup>4</sup>See the book by Richard Almy, Alan Dornfest, and Daphne Kenyon.

<sup>5</sup>Equalization is a process to ensure that all properties are assessed at the same percent of value. It is discussed in more detail later in this article.

market value method (also known as the sales comparison and capital value methods) determines the value of the property on the basis of the price at which it could be sold in the open market in an arm's length transaction (a sale between unrelated parties in which there is no discounting or inflating of value intended to favor the seller or buyer). The rental value (also known as the income method) analyzes the income stream or rent

tax rate. The most common form of varying tax rates is the classification of property types into groups, usually according to the function the property serves, with different rates for each group. For example, assigning properties to such classifications as residential, commercial, industrial, or agricultural — with different tax rates for each class — is common. Other classifications include historic sites and raw land.

## The tax liability of a property is determined by applying the tax rate applicable to that property to the value of that property.

produced by the property to estimate the amount that might be invested in the property in order to obtain the projected income. The replacement or construction cost method estimates the cost of constructing the building to be valued using current costs for similar materials and design features, with an adjustment to account for physical depreciation of the building being valued. Market value is generally used for owner-occupied residential properties for which recent sale prices of a sufficient number of similar properties are available. The rental value approach is, of course, most often used for properties that are commonly rented, such as apartment buildings and commercial buildings. The replacement cost method is usually used for new construction, for which there are few comparable properties to make a sales comparison approach feasible.

The tax liability of a property is determined by applying the tax rate applicable to that property to the value of that property. Most taxing jurisdictions have more than one

Finally, some uses of property qualify for total or partial exemption from property taxes. In many, if not most, jurisdictions in the United States, the following types or uses of property are exempt: charitable, educational, and religious organizations; governments; and hospitals. Exemptions can also apply to property owners. Common, usually partial, exemptions of this type are for homeowners in general (known as homestead exemptions) or for homeowners meeting certain criteria of age, income, or disability. Taxing jurisdictions use other means to reduce effective property taxes, such as rebates and property tax credits against state income taxes. These are common across the country, including in the three Third District states. (Property tax reductions are discussed in more detail below.)

### THE VALUATION PROCESS

The structure of the assessment process and the tax rates and classifications used by a taxing jurisdiction set the framework in which proper-

ties are valued and their tax liability is determined. These broad features apply in general to all properties, and they are altered only occasionally. Valuation, on the other hand, applies to each individual property, and assigned valuations can be changed with more frequency than the features of the overall property tax system. Thus, valuation is of more immediate concern to individual property owners, and the details of the valuation process are of vital interest to most.

The valuation process has several sequential steps. It begins with identifying properties and describing their features, including aspects of the property that might add to or detract from their value, such as ancillary rights and easements. Information about the property is analyzed in order to account for all of the features that affect its value, such as size, age, and location. The market value of these features is estimated for the market in which the property is located. After these preliminary steps, one or a combination of the valuation methods described earlier is used to compute the property's assessed value. Property owners may appeal the assessed value and, if successful, have the property's assessed value changed (lowered). The burden of proof is on the property owner to show that the assessed value is too high. Common bases for appeals are that the assessment used erroneous data about the property or that the assessed value is greater than that of comparable properties by more than the legally allowed variance (commonly 15 percent). After the assessment is finalized the tax rate applicable to the class of property (see below) is applied, taking exemptions into account, to compute the tax liability.

Residential properties are not typically valued individually on a case-by-case basis. Instead, appraisers use large data sets of residential property

information to calculate typical values for similar properties, and they may apply adjustment factors for some variations in features from one property to another. This process is known generically as mass appraisal, and when done with computerized systems, the entire process is referred to as computer-assisted mass appraisal (CAMA). The

be estimated for the properties in the group, such as location, size of lot, and the number of bathrooms, garages, and stories, and so forth. Actual sales price data are obtained for properties in the group of properties subject to mass appraisal. The software then estimates how much each feature contributed to the value of each sold property: so

**Residential properties are not typically valued individually on a case-by-case basis. Instead, appraisers use large data sets of residential property information to calculate typical values for similar properties, and they may apply adjustment factors for some variations in features from one property to another.**

use of statistical techniques in this process has increased as computerization of assessment procedures has advanced, and now many jurisdictions, including some within the Third District, use such a technique. Mass appraisal systems are used because they are economically efficient and because they are a means of valuing properties on a consistent, equitable basis.

Under a mass appraisal system, the actual sales price of any given property is not the basis of its value for property tax assessment. Instead, a group of similar properties is evaluated as of a common date using common data elements and a standard — usually statistical — method. Properties included in the group should be those located in the same market area, that is, properties that might be considered by a potential buyer looking to purchase a property in a given geographic area. The data elements used are those features for which market values can

much for each bath, so much for each quarter acre of lot size, and so forth. Then these valuations are applied to all of the houses in the neighborhood. Because location is an important factor in determining a property's market value, the geographic neighborhood should be compact enough to reflect similar values. Some jurisdictions have legal requirements that land and structures on a property be valued separately. This can be done either by an independent estimate of the land value or by using computerized statistical models that include techniques for separating land and structure values.

#### **ACCURACY AND EQUITY IN APPRAISALS**

As noted at the beginning of this article, equity in property appraisals is a perennial concern for property owners, assessors, and the supervisory agencies charged with review of assessment practices and enforcement



of laws regarding property taxation. Equity is the assurance that similar properties are similarly appraised. An essential prerequisite for this is full and accurate data on properties with respect to those features that affect a property's value. An initial step in ensuring overall accuracy in the assessment process is to make certain that each property to be assessed is accurately described in both the data entered in the mass appraisal system as well as the jurisdiction's property tax records. (These records — called a cadastre — include the location, description, and ownership of the property.)

Assessors or trained data collectors compile these data by physically inspecting properties. The inspection focuses on measurable features such as land area, square footage of the structure, number of garage spaces, and so forth, including factors that affect the market value of properties in the locations covered (e.g., riparian rights of riverfront properties, views in scenic areas, and so forth). In addition to objective and measurable features, qualitative features related to such things as materials used in construction and condition of the structure need to be taken into account. These subjective evaluations should be made by experienced appraisers with the requisite knowledge.

Data collection should be an ongoing process and subject to quality control procedures and feedback from property owners. Typical quality control edits will produce alerts for missing or inconsistent data. Periodic review of recorded data against actual properties will help ensure that the data being used for tax assessment are accurate and current. However, frequent on-site inspections are costly for assessment agencies and inconvenient for property owners, so less intrusive means can be used for updating data, for example, street-view and aerial

photography. In addition, assessment agencies can receive copies of building permits to inform them of additions and improvements that will prompt reappraisals. For both initial appraisals and reappraisals, property owners should receive reports with all of the relevant appraisal data and be given an opportunity to verify or correct each data element.<sup>6</sup>

## Frequent on-site inspections are costly for assessment agencies and inconvenient for property owners, so less intrusive means can be used for updating data, for example, street-view and aerial photography.

A property's appraised value is determined by its actual features and by the market value of those features. So, in addition to the need for accuracy with respect to the physical description of the property (including location features), there is a need for accuracy in determining market value. As noted earlier, the market value approach is the common method of valuing property for taxation in the United States, and this is usually done by using a sales comparison approach, that is, basing the estimated value of a property on actual sale prices of similar properties. However, care must be used in selecting the actual sale prices used, because not all sales are transacted at true market values. In fact, both economic and legal definitions of true market value govern the values that can be used for the sales comparison approach. Basically, both definitions emphasize

<sup>6</sup>See the standard on mass appraisal issued by the International Association of Assessing Officers.

that only those prices that represent fair sale prices should be used. Fair sale prices are those that obtain in transactions in an open market, between a willing buyer and seller — both acting prudently and knowledgeably — without undue stimulus and with the price unaffected by special financing or sales concessions.<sup>7</sup> Furthermore, only prices representing so-called “arm's length”

transactions should be used, that is, transactions between unrelated parties in which neither is altering the price to benefit the other.

Despite the emphasis on sale prices in the market value approach, the recent sale price of a property should not be used as a basis for reassessing it. This practice — known as “sales chasing” — can result in unrepresentative and inequitable appraised values because some properties (the recently sold ones) are reappraised, while others (properties not sold) are not. Furthermore, because at nearly all points in time most properties in an area have not been recently sold and therefore do not have a recent sale price, sales chasing gives undue weight to the sale prices of a few (recently sold) properties in the determination of the typical or representative value of similar properties. The resulting lack of uniformity

<sup>7</sup>See the sales validation guidelines in the standard on ratio studies issued by the International Association of Assessing Officers.

in valuation will reduce the validity of mass appraisal methods.

Besides the question of the correct transaction to use in the market value approach, there is also the question of the correct selection of properties to use for comparison. In addition to using properties with similar physical features, the properties used for comparison should be in the same geographic or market area, should be of similar age or condition, and should in nearly all respects be considered as reasonable alternatives for a prospective purchaser.

Market values change over time. Indeed, it is during periods of rapidly changing market values that homeowners and other property owners are most likely to question the accuracy of their properties' appraisals. Thus, just as frequent appraisals help ensure accuracy with respect to the data pertaining to the appraised properties, they also help ensure that market values are current. In fact, the International Association of Assessing Officers recommends annual assessments when the market value or sales comparison approach is used, and most states require taxing jurisdictions to conduct reassessments on a regular schedule, ranging from annually to at least once every two to five years. However, the practice of reassessing properties whenever they are sold — which is the practice in California and in some jurisdictions in other states — is detrimental to equity, especially when overall market prices are changing rapidly, because it results in similar properties being appraised at different values solely on the basis of whether they have been recently sold. (In fact, such a practice is equivalent to sales chasing if it produces assessments at or near the sales price of the individual property rather than the average assessed value of similar properties.) Instead, short-

term general price trends affecting a group of properties subject to mass appraisal can be used to obtain rough estimates of current values for an annual assessment update, although for longer periods of time or during periods of rapid or volatile price changes, it is preferable to conduct complete reassessments, including physical reviews of properties, every four to six years.

The basic means of evaluating the

whether statutory requirements for appraisal values are being met, and to determine time trends in market values. As part of a general revaluation of properties, a ratio study is used to review current appraisals, establish preliminary values of new appraisals, and evaluate final appraisals in conjunction with the appeals process for new appraisals.

Because the purpose of the ratio study is to evaluate the validity of the

**Because the purpose of the ratio study is to evaluate the validity of the appraisal process, the sample of properties used should be representative of the total group of properties covered by that appraisal process, and it is important that the sale prices used be true fair market prices.**

accuracy and equity of appraisals is the ratio study, which is in common use throughout the United States. As the name implies, a ratio study measures the ratio of appraised or assessed values to an independent measure of market values, usually represented by sale prices, ideally sales that have occurred in a recent, short period of time. Like mass appraisal, a ratio study is based on a sample of properties in a group for which actual sale prices can be obtained. Also as in mass appraisal, properties sampled in a ratio study can be stratified. Stratification can be by type of property, geographic area, and so forth. The purpose of stratification is to identify and ultimately correct lack of uniformity in appraisal-to-market value ratios that might be found across different strata of properties. Ratio studies are conducted to evaluate the mass appraisal method used in the assessment process, to determine

appraisal process, the sample of properties used should be representative of the total group of properties covered by that appraisal process, and it is important that the sale prices used be true fair market prices. Furthermore, the properties used should be reviewed to make sure that sales chasing has not occurred. This is because sales chasing will result in a spurious accuracy of appraised value — close to actual sale prices — that is not truly indicative of the accuracy of the appraisal process itself.

The ratio study answers two primary questions: 1) How close to 1.00 (when the appraised value equals the full market value) is the average ratio of the properties under review? 2) How much variation is there in the ratio from property to property?

The first question addresses the accuracy of appraisal values in general. If the ratio is 1.00 or close to 1.00,

appraisals are generally accurately measuring market value, although they might not be equally accurate for each individual property. It is also important to determine the average ratio in those jurisdictions in which there are legal requirements that the average ratio be 1.00 or some other legally specified value (less than 1.00).

The second question, about variation, addresses equity. Two kinds of equity need to be considered. One, called horizontal equity, is measured simply by how much variation there is in the ratio from property to property, with greater variation indicating greater horizontal inequity. The other kind of equity, called vertical equity, is a measure of possible systematic differences in the appraisal-to-market value ratio between high-value and low-value properties. Greater ratios for low-value properties are regressive, and greater values for high-value properties are progressive. Ideally, there should be neither progressivity nor regressivity in the ratio because the purpose of appraisals is to establish market value only, not to indirectly apply differing tax liabilities.

In many states, legal requirements address acceptable measures of the ratio with respect to both its level and its variation. In practice, actual assessed values may or may not be equal to 100 percent of full market value. In many states, laws or court rulings permit a lower ratio, usually known as the common level ratio, which can vary from one taxing jurisdiction to another. However, within a taxing jurisdiction, little or no variation in the ratio from property to property is permitted within each property classification. Supervisory agencies enforce this requirement in a process known as equalization (more specifically referred to as direct equalization), and reference to deviations from the common level ratio can be used in the assessment ap-

peal process for individual properties. As noted earlier, enforcement is one of the responsibilities of the State Tax Equalization Board in Pennsylvania and the Division of Taxation in New Jersey. Delaware does not have direct equalization.

Besides its use in determining assessed values for tax purposes, the common level ratio is used in determining the distribution of state government financial assistance to local school districts in many states, including the three Third District states. This process is often referred to as indirect equalization because it does not affect assessed values of individual properties, and it is usually done by the agencies responsible for direct equalization (where this occurs). Property values are critical to public school financing because local property taxes are a primary source of this financing. When states provide subsidies to local school districts, they provide more funds to those districts that have less taxable property, measured by total property value. The state cannot simply use the values determined by local assessors because localities can have different assessment ratios. Therefore, the state must make adjustments to assessed values in order to measure each district's total taxable value. This is done by using the common level ratio to determine the total value of properties in each district, regardless of the ratio used for local tax purposes, and then using this total value to compute the amount of state aid to which each district is entitled.

### ASSESSMENTS AND TAX LIMITATION

To calculate the tax liability of a property once its assessed value is determined, the tax rate for the class of property to which it belongs is multiplied by the assessed value. The tax rate is usually expressed in units called

mills, which represent one-thousandth of a dollar, so that a millage rate of 1 would mean \$1 of tax for each \$1,000 of assessed value. As noted at the beginning of this article, public concern about the burden of property taxes has grown, and this concern has engendered more critical interest in assessments. However, it is the combination of the tax rate and the assessed value that determines the tax bill, and attempting to accommodate all concerns about the property tax burden by means of the assessment can be ineffective and even counterproductive.

Property tax limitation through limits on assessed values originated in California with the passage of Proposition 13 in 1978. Besides limiting the property tax rate, Proposition 13 limited increases in assessed value to the change in the consumer price index or 2 percent a year, whichever is lower. By 2006, at least 20 states had statewide or local limits of some sort on the rate at which assessed values could increase each year, most often setting a fixed percentage or an upper limit at the rate of change in the consumer price index. None of the three Third District states has such limits. In states with limits, residential properties are covered, and in some states, other types of properties have limits as well. Most states with limits have exceptions for acquisitions, resetting assessed value to reflect market value when a property is sold.

A limit on the amount by which assessed value can be increased might have appeal as a way to set a limit on the amount by which the tax burden can increase, but an assessment limitation has ramifications that can seriously reduce or negate its usefulness in mitigating tax increases.<sup>8</sup> The most obvious drawback is that if the total tax levy is fixed or rising, any adjustment

<sup>8</sup>See the article by Richard Dye and Daniel McMillen.

that reduces the tax liability of some properties by lowering their assessed value below what it would have been in the absence of a limit must be offset by increasing the tax liability of other properties that do not get reductions in assessed values below what they would have been in the absence of a limit. Not obvious is the fact that the tax burden can be shifted among properties even when they are all covered by the assessment limitation. This can occur when properties appreciate at different rates while the total tax levy to which the properties are collectively subject remains unchanged or increases. Properties that appreciate furthest above the assessment limit will have their proportion of the total tax levy reduced below what it would have been in the absence of the limit, and properties that appreciate less far above the limit will have their proportion of the total tax levy increased above what it would have been without the limit. This result has in fact occurred in several states and other taxing jurisdictions. Consequently, some properties that were intended to benefit by the limit do not, in fact, get the benefit. This reduces the usefulness of assessment limits as a deliberate policy tool to provide property tax relief. However, there are other means of doing so that enable the taxing authority to direct benefits more precisely to intended beneficiaries.

#### OTHER FORMS OF TAX RELIEF

Several alternatives to assessment limits can restrict property tax burdens — which is the goal of assessment limits — without unintended consequences. Like all forms of tax relief, alternatives to assessment limits shift the tax burden from favored groups to others. However, these other means of relief do not operate through fortuitous changes in property values, as assessment limits do; instead, they can be

directed to specific types of property or property owners.<sup>9</sup>

Property classification is a method by which many jurisdictions place different tax burdens on different types of properties, with the intent of placing lighter tax burdens on some types of property relative to others. In this method, properties are placed in different categories depending on

**In the Third District, classification is not widely used among taxing jurisdictions, although favorable treatment of agricultural land is common.**

their use. Generally, jurisdictions that use property classification distinguish between residential and commercial uses of property, and some jurisdictions have other classes, such as agricultural or charitable uses. With property classification, taxes imposed on properties in different categories are varied through the application of varied assessment ratios (ratio of assessed value to market value) or varied tax rates. Most jurisdictions that use classification favor residential and other types of properties with lower assessment ratios or tax rates and apply higher assessment ratios or tax rates to commercial properties. In the Third District, classification is not widely used among taxing jurisdictions, although favorable treatment of agricultural land is common. A drawback to property classification is that tax burdens will be disproportional to value; thus, the goal of tax equity is subordinated to the goal of tax limitation. Furthermore,

<sup>9</sup> See report by Terri Sexton and the article by Joan Youngman.

higher taxes on some uses of property are a disincentive to those uses, whether intended to be so or not.

Tax revenue limits are another alternative to assessment limits as a means of constraining increases in property taxes. Several states, including some with assessment limits, also have revenue limits. In the Third District, all three states have revenue

limits. (Pennsylvania also has tax rate limits, as do many other states.) Tax revenue limits set maximum amounts by which the total property tax levy in a jurisdiction can be increased. Revenue limits by themselves affect only the total tax collection, not the tax burden on individual properties. This is especially the case when property values are changing over time. For example, if increases in value are not equal across all properties, those properties that appreciate more rapidly will be subject to a greater proportion of the total tax levy. Thus, just as in the case of property classification, tax equity is not addressed by revenue limits. To limit tax burdens on individual properties, tax revenue limits need to be supplemented by limits on individual tax liabilities.

Another means of providing property tax relief is the use of full or partial exemptions from property tax liability. Full exemptions are granted primarily for property owned by federal, state, and local governments, and by educational, charitable, and religious institutions. An exemption

for owner-occupied housing, known as the homestead exemption, is usually a partial exemption. Homestead exemptions are one of the oldest and most common ways in which taxing jurisdictions limit the property tax burden on owner-occupied housing. They are available in nearly every state, including the Third District states. In some jurisdictions, the exemptions are available to all homeowners; in others, they are available only to certain people, such as veterans, senior citizens, or the disabled. The exemption is commonly applied by reducing the assessed value of the owner-occupied property by either a fixed percentage or a fixed dollar amount. A percentage exemption will limit increases in tax liability as assessed values increase — a major concern that motivates efforts to limit assessments — but a dollar-amount exemption will not limit tax increases unless it is raised in line with any rise in assessed values.

Rebates of property taxes and credits of property taxes against other taxes for homeowners are forms of relief that are similar to exemptions. In some jurisdictions, these various forms of relief apply to property types other than homesteads. In the Third District, these forms of relief are available to most homeowners, and they are also provided in different amounts for the elderly and disabled. Some form of property tax relief is also provided in the Third District states (and others) for some types of property other than homesteads, such as agricultural land.

When any kind of property tax relief is based on the individual property-owner's income, it is known as a circuit breaker. Circuit breakers are available in over half the states, although they may be officially known by some other name, typically as a rebate or credit. In most states that have circuit-breaker programs, the state government provides revenue to the local jurisdic-

tions to replace funds not collected from property owners receiving the tax relief. With circuit breakers the amount of property tax relief is related to income in one of three ways: 1) single threshold; 2) multiple thresholds; or 3) sliding scale. With a single threshold, the maximum amount of property tax is limited to a fixed percentage of income for all property

## Deferral programs are available in taxing jurisdictions in around half of the states, including Pennsylvania and Delaware in the Third District.

owners. With multiple thresholds, the percentage limit rises with income. This feature imparts some progressivity to the property tax, increasing it as a percentage of income as income rises. With a sliding scale, a range of income brackets is established, and all property owners whose income falls within a certain bracket receive the same percentage reduction in property taxes, with the percentage of reduction being greater for lower-income brackets and less for higher-income brackets. Thus, sliding scale circuit breakers are also progressive. In some states, progressivity is introduced by limiting the amount of tax relief provided by circuit breakers to houses below an assessed value limit.

In the Third District, circuit breakers are available in Pennsylvania and New Jersey. Pennsylvania's program, a property tax rebate program, is available only to the elderly; it is a sliding scale program with four

brackets and an income ceiling for eligibility. New Jersey's program, a homestead credit/rebate program, is not restricted by age, although it does provide more relief to the elderly. It is a sliding scale program with three brackets for homeowners 65 years and older and two brackets for those under 65. It also has an income ceiling. Both the Pennsylvania and New Jersey programs are available to renters as well as homeowners in recognition that part of their rent covers property tax. In both states, the amount of tax relief available under the renters' program is less than the amount available under the homeowners' program.


Another sort of property tax relief is provided by tax deferral, which allows property owners to delay paying property taxes until their property is sold or their estate is settled. These are often restricted to elderly, disabled, or low-income property owners. Deferral programs are available in taxing jurisdictions in around half of the states, including Pennsylvania and Delaware in the Third District.

### SUMMARY

Rising property tax burdens in the latter half of the last century brought greater public attention to the issue of residential property assessment. Limits on increases in assessed value became a major part of efforts to limit increases in homeowners' property tax bills. As of 2006, statewide or local limits on increases in assessed value of residential property were in effect in 20 states. However, assessment limits, by themselves, cannot limit tax bills unless tax rates are also limited. In fact, unless the total tax burden is restricted, assessment limits without tax rate limits can result in increased tax bills for some homeowners and reduce equity across properties. This has been the experience in several states and tax jurisdictions in the wake of

assessment limits as total tax burdens have shifted more toward slowly appreciating properties than rapidly appreciating properties. There are remedies for many of the problems associated with rising assessments and property

taxes. Principal remedies are revenue limits, exemptions, rebates, and deferrals. These measures can limit increases in the property tax burden in ways that do not have the unintended consequences of assessment limits ap-

plied without such measures. However, ultimately, limits on property taxes can be secured only by substituting other sources of revenue or by limiting spending by the taxing jurisdictions that rely on property taxes. 

## REFERENCES

Almy, Richard, Alan Dornfest, and Daphne Kenyon. *Fundamentals of Tax Policy*. Kansas City, MO: International Association of Assessing Officers, 2008.

Dye, Richard F., and Daniel P. McMillen. "Surprise: An Unintended Consequence of Assessment Limitations," *Land Lines* (July 2007), pp. 8-13.

Haveman, Mark, and Terri A. Sexton. "Property Tax Assessment Limits: Lessons from Thirty Years of Experience," *Policy Focus Report*, Lincoln Institute of Land Policy (2008).

International Association of Assessing Officers. *Standard on Mass Appraisal of Real Property*. Kansas City, MO, IAAO, 2008.

International Association of Assessing Officers. *Standard on Ratio Studies*. Kansas City, MO, IAAO, 2007.

Lutz, Byron F. "The Connection Between House Price Appreciation and Property Tax Revenues," *National Tax Journal* (September 2008), pp. 555-72.

Nakamura, Leonard. "How Much Is That Home Really Worth? Appraisal Bias and House-Price Uncertainty," Federal Reserve Bank of Philadelphia *Business Review* (First Quarter 2010), pp. 11-22.

Sexton, Terri A. "Property Tax Systems in the United States: The Tax Base, Exemptions, Incentives, and Relief," Center for State and Local Taxes, University of California, Davis (2003).

Youngman, Joan M. "The Variety of Property Tax Limits: Goals, Consequences, and Alternatives," *State Tax Notes* (November 19, 2007), pp. 541-57.



You can find more Research Rap abstracts on our website at: [www.philadelphiafed.org/research-and-data/publications/research-rap/](http://www.philadelphiafed.org/research-and-data/publications/research-rap/). Or view our working papers at: [www.philadelphiafed.org/research-and-data/publications/](http://www.philadelphiafed.org/research-and-data/publications/).

## EXPLORING LIMITED ATTENTION AND CHECKING OVERDRAFTS

The authors explore dynamics of limited attention in the \$35 billion market for checking overdrafts, using survey content as shocks to the salience of overdraft fees. Conditional on selection into surveys, individuals who face overdraft-related questions are less likely to incur a fee in the survey month. Taking multiple overdraft surveys builds a “stock” of attention that reduces overdrafts for up to two years. The effects are significant among consumers with lower education and financial literacy. Consumers avoid overdrafts not by increasing balances but by making fewer debit transactions and cancelling automatic recurring withdrawals. The results raise new questions about consumer financial protection policy.

*Working Paper 11-17, “Limited and Varying Consumer Attention: Evidence from Shocks to the Salience of Bank Overdraft Fees,” Victor Stango, University of California, Davis, and Jonathan Zinman, Dartmouth College, and Visiting Scholar, Federal Reserve Bank of Philadelphia*

## ENTREPRENEURS AND AGGREGATE AND IDIOSYNCRATIC RISK IN THE PRESENCE OF BORROWING CONSTRAINTS

This paper studies the quantitative properties of a general equilibrium model where a continuum of heterogeneous entrepreneurs are subject to aggregate as well as idiosyncratic risks in the presence

of a borrowing constraint. The calibrated model matches the highly skewed wealth and income distributions of entrepreneurs. The authors provide an accurate solution to the model despite the significant nonlinearities that are absent in the economy with uninsurable labor income risk. The model is capable of generating the average private equity premium of roughly 3 percent and a low risk-free rate. The model also produces procyclicality of the risk-free rate and countercyclicality of the average private equity premium. The countercyclicality of the average equity premium is largely driven by tightening (loosening) of financing constraints during recessions (booms).

*Working Paper 11-18, “Private Equity Premium in a General Equilibrium Model of Uninsurable Investment Risk,” Francisco Covas, Board of Governors of the Federal Reserve System, and Shigeru Fujita, Federal Reserve Bank of Philadelphia*

## IMPACT OF REDUCING TARIFFS ON WELFARE, TRADE, AND THE ORGANIZATION OF PRODUCTION

The authors study the effects of tariffs in a dynamic variation of the Melitz (2003) model, a monopolistically competitive model with heterogeneity in productivity across establishments and fixed costs of exporting. With fixed costs of starting to export that are on average 3.7 times as large as the costs incurred to continue as an exporter, the model can match both the size distribution of exporters and annual transition in and

out of exporting among U.S. manufacturing establishments. The authors find that the tariff equivalent of these fixed costs is nearly 30 percentage points. They use the calibrated model to estimate the effect of reducing tariffs on welfare, trade, and export participation. The authors find sizeable gains to moving to free trade equivalent to 1.03 percent of steady-state consumption. Considering the transition dynamics following the cut in tariffs, they find that the model predicts economic activity overshoots its steady state, with the peak in output coming 10 years after the trade reform. Because of this overshooting, steady-state changes in consumption understate the welfare gain to trade reform. The authors also find that simpler trade models that abstract from these export dynamics provide a poor approximation of the aggregate responses from their more general model.

*Working Paper 11-19, "Establishment Heterogeneity, Exporter Dynamics, and the Effects of Trade Liberalization," George Alessandria, Federal Reserve Bank of Philadelphia, and Horag Choi, Monash University*

## **CONSTRUCTING ERROR BANDS FOR IMPULSE RESPONSES IN VARs**

There is a fast growing literature that partially identifies structural vector autoregressions (SVARs) by imposing sign restrictions on the responses of a subset of the endogenous variables to a particular structural shock (sign-restricted SVARs). To date, the methods that have been used are only justified from a Bayesian perspective. This paper develops methods of constructing error bands for impulse response functions of sign-restricted SVARs that are valid from a frequentist perspective. The authors also provide a comparison of frequentist and Bayesian error bands in the context of an empirical application — the former can be twice as wide as the latter.

*Working Paper 11-20, "Inference for VARs Identified with Sign Restrictions," Hyungsik Roger Moon, University of Southern California; Frank Schorfheide, University of Pennsylvania, and Visiting Scholar, Federal Reserve Bank of Philadelphia; Eleonora Granziera, Bank of Canada; and Mihye Lee, University of Southern California*

## **POLITICAL FRICTIONS AND THE CONSUMPTION VOLATILITY PUZZLE**

Standard real business cycle theory predicts that consumption should be smoother than output, as ob-

served in developed countries. In emerging economies, however, consumption is more volatile than income. In this paper the authors provide a novel explanation of this phenomenon, the "consumption volatility puzzle," based on political frictions. They develop a dynamic stochastic political economy model where parties that disagree on the size of government (right-wing and left-wing) alternate in power and face aggregate uncertainty. While productivity shocks affect only consumption through responses to output, political shocks (switches in political ideology) change the composition between private and public consumption for a given output size via changes in the level of taxes. Since emerging economies are characterized by less stable governments and more polarized societies, the effects of political shocks are more pronounced. For a reasonable set of parameters the authors confirm the empirical relationship between political polarization and the ratio of consumption volatility to output volatility across countries.

*Working Paper 11-21, "Partisan Cycles and the Consumption Volatility Puzzle," Marina Azzimonti, Federal Reserve Bank of Philadelphia, and Matthew Talbert, University of Texas, Austin*

## **INVESTIGATING THE TRUST PREFERRED SECURITIES CDO MARKET**

This paper investigates the development, issuance, structuring, and expected performance of the trust preferred securities collateralized debt obligation (TruPS CDO) market. Developed as a way to provide capital markets access to smaller banks, thrifts, insurance companies, and real estate investment trusts (REITs) by pooling the issuance of TruPS into marketable CDOs, the market grew to \$60 billion of issuance from its inception in 2000 through its abrupt halt in 2007. As evidenced by rating agency downgrades, current performance, and estimates from the authors' own model, TruPS CDOs are likely to perform poorly. Using data and valuation software from the leading provider of such information, they estimate that large numbers of the subordinated bonds and some senior bonds will be either fully or partially written down, even if no further defaults occur going forward. The primary reason for these losses is that the underlying collateral of TruPS CDOs is small, unrated banks whose primary asset is commercial real estate (CRE). During their years of greatest issuance from 2003 to 2007, the booming real estate market and record low number of bank failures



masked the underlying risks that are now manifest. Another reason for the poor performance of bank TruPS CDOs is that smaller banks became a primary investor in the mezzanine tranches of bank TruPS CDOs, something that is also complicating regulators' resolutions of failed banks. To understand how this came about, the authors explore in detail the symbiotic relationship between dealers and rating agencies and how they modeled and sold TruPS CDOs. In their concluding comments, the authors provide several lessons learned for policymakers, regulators, and market participants.

*Working Paper 11-22, "The Trust Preferred CDO Market: From Start to (Expected) Finish," Larry Cordell, Michael Hopkins, and Yilin Huang, Federal Reserve Bank of Philadelphia*

### **EFFECTS OF ASYMMETRIES IN RE-ELECTION PROBABILITIES ON PUBLIC POLICY AND THE ECONOMY**

This paper studies the effects of asymmetries in re-election probabilities across parties on public policy and their subsequent propagation to the economy. The struggle between opposing groups — that disagree on the composition of public consumption — results in governments being endogenously short-sighted: Systematic under investment in infrastructure and over-spending on public goods arise, as resources are more valuable when in power. Because the party enjoying an electoral advantage is relatively less short-sighted, it devotes a larger proportion of government revenues to productive public investment. Political turnover, together with asymmetric policy choices, induces economic fluctuations in an otherwise deterministic environment.

The author characterizes the long-run distribution of capital and shows that output increases on average with political advantage, despite the fact that the size of the government expands as a percentage of GDP. Volatility, on the other hand, is non-monotonic in political power and is an additional source of inefficiency.

*Working Paper 11-23, "The Dynamics of Public Investment Under Persistent Electoral Advantage," Marina Azzimonti, Federal Reserve Bank of Philadelphia*

### **CORE INFLATION MEASURES AS PREDICTORS OF TOTAL INFLATION**

Policymakers tend to focus on core inflation measures because they are thought to be better predictors of total inflation over time horizons of import to policymakers. The authors find little support for this assumption. While some measures of core inflation are less volatile than total inflation, core inflation is not necessarily the best predictor of total inflation. The relative forecasting performance of models using core inflation and those using only total inflation depends on the inflation measure and time horizon of the forecast. Unlike previous studies, the authors provide a measure of the statistical significance of the difference in forecast errors.

*Working Paper 11-24, "Core Measures of Inflation as Predictors of Total Inflation," Theodore M. Crone, Swarthmore College; N. Neil K. Khettry, Murray, Devine & Company; Loretta J. Mester, Federal Reserve Bank of Philadelphia, and the Wharton School, University of Pennsylvania; and Jason A. Novak, Federal Reserve Bank of Philadelphia*