Comparable Wages, Inflation and School Finance Equity

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Abstract: Educational dollars don't go quite as far in some parts of the country as they do in others. Therefore, there is considerable interest in developing a measure of the cost of education that can facilitate cross-state comparisons of school district expenditures and be used to adjust school finance formula.

One attractive mechanism for measuring geographic variations in cost is the Comparable Wage index (CWI). A CWI reflects systematic, regional variations in the salaries of workers who are not educators. Provided that those non-educators are similar to educators in terms of age, educational background and tastes for local amenities, a Comparable Wage index can be used to measure uncontrollable variations in the wages paid to educators.

Together, the 2000 Census and the Occupational Employment Statistics (OES) survey support the construction of just such an index.. The resulting panel of index values measures the wage level for college graduates in all parts of the US for the years 1997 through 2003 and reveals substantial variation in purchasing power both across districts and across time. Interestingly the index suggests that in California, New York, Texas, Virginia, Illinois and New Mexico, the educational dollar can stretch at least 40 percent farther in one part of the state than in another.

Such inequalities in purchasing power undermine the equity and adequacy goals of school finance formulas. If states were successfully directing additional resources to school districts in high cost environments, then measured inequality within states should fall when differences in purchasing power are taken into account. Instead, cost adjustment widens the spending gap in all but a handful of states.

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One attractive mechanism for measuring geographic variations in cost is the Comparable Wage index (CWI). A CWI reflects systematic, regional variations in the salaries of workers who are not educators. Provided that those non-educators are similar to educators in terms of age, educational background and tastes for local amenities, a Comparable Wage index can be used to measure uncontrollable variations in the wages paid to educators. Because education is such a labor-intensive industry, such wage variations represent the lion's share of variations in school purchasing power.[2]

Together, the 2000 Census and the Occupational Employment Statistics (OES) survey support the construction of just such an index. The resulting panel of index values measures the wage level for college graduates in all parts of the United States for the years 1997 through 2003 and reveals substantial variation in purchasing power both across districts and across time. Interestingly the index suggests that in California, New York, Texas, Virginia, Illinois and New Mexico, the educational dollar can stretch at least 40 percent farther in one part of the state than in another.

Such dramatic inequalities in purchasing power undermine the equity and adequacy goals of school finance formulas. If states were successfully directing additional resources to school districts in high cost environments, then measured

[2] Salaries and benefits comprised more than 80 percent of current educational expenditures in the United States in 2002 (U.S. Bureau of the Census, 2004).

inequality within states should fall when differences in purchasing power are taken into account. Instead, cost adjustment widens the spending gap in all but a handful of states.

The Comparable Wage Index

The basic premise of the CWI is that all types of workers demand higher wages in areas with a higher cost of living or a lack of amenities. Therefore, one should be able to measure uncontrollable variations in educator pay by observing systematic variations in the earnings of comparable workers who are not educators.[3] Thus, if Atlanta construction workers are paid 25 percent more than the national average construction wage, Atlanta engineers are paid 25 percent more than the national average engineering wage, Atlanta nurses are paid 25 percent more than the national average nursing wage, and so on, then the CWI predicts that Atlanta teachers should also be paid 25 percent more than the national average teacher wage.

There are a number of advantages to using a CWI to measure uncontrollable differences in the costs of education. The greatest advantage is that the CWI measures costs that are clearly beyond the control of school administrators. Other measures of the cost of education—including Chambers' geographic cost of education index (GCEI)[4] and the various cost-function based indexes[5]—are based on school expenditure data and therefore must rely on statistical technique to ensure that the resulting cost index does not misinterpret high spending districts as high cost districts. Cost indexes that are based on school expenditures data have been criticized as subject to school district manipulation

[3] See for example, Rothstein and Smith, 1997; Guthrie and Rothstein, 1999; Goldhaber, 1999; Alexander et al. 2000; Stoddard 2002 or Taylor et. al 2002.
[4] Chambers 1997, Taylor, Chambers and Robinson, 2004
[5] See, for example, Duncombe, Ruggiero, and Yinger 1996; Imazeki and Rechovsky 1999; and Taylor et al 2003.

(McMahon 1994), biased by the non-competitive nature of the teacher labor markets (Hanushek 1999), and liable to reward school districts for historic inefficiency (Rothstein and Smith 1997). The CWI is immune to such criticisms.

Among the typical strategies for measuring the cost of education, the CWI is most similar to the cost-of-living approach used in Florida, Colorado and Wyoming. Those states gather data about the prices of a “market-basket” of consumer goods and services in each community, much like the Bureau of Labor Statistics gathers information for the Consumer Price Index. While similar in spirit to the market-basket approach, the CWI is much less expensive because it can be generated from existing data. In addition, a market-basket index may overestimate labor cost in areas with both a high cost of goods and services and a lot of amenities that make it a desirable place to work (Rothstein and Smith 1997). A CWI offers a more complete picture of labor cost because it can reflect not only differences in the price of haircuts and houses, but also any influence on wages coming from differences in important community characteristics such as climate, crime rates, or cultural amenities.

Another advantage of the CWI approach is its general applicability. Because it is based on systematic differences in the general wage level, it can also be used to measure labor cost for private schools, job training programs, and post-secondary institutions.

There are also a number of disadvantages to using a CWI to measure variations in school district cost. First, labor cost is only part of the total cost of education. Other prices (such as energy cost) and other district characteristics (such as economies of scale or variations in student need) also influence the cost of education. Any labor cost index such as the CWI or Chambers' Teacher Cost Index represents only one dimension of the complete cost of education.[6]

Second, a CWI is most useful when the non-educator population under analysis is truly comparable to the educator population. If comparability breaks down, then a CWI becomes a poor proxy for the cost of educator labor. For example, if tastes for local amenities differ according to worker types (perhaps college graduates are more susceptible to the lure of city lights than other workers), then it would be important to include only college graduates in an analysis intended to measure the cost of hiring teachers.

Finally, by design, a CWI measures cost in a broad labor market like a metropolitan area. It does not capture variations in cost within a labor market. Therefore, despite the substantial differences between them, an advantaged school district has the same CWI as its disadvantaged cross-town rival.

Estimating a Comparable Wage Index

As a general rule, there are three reasons why wages differ from one person to another. First, differences in worker characteristics will drive differences in wages. All other things being equal, workers with advanced degrees or increased work experience can expect to earn higher wages than other workers. Second, differences in job characteristics will drive differences in wages. Workers will demand a wage premium to accept jobs that are relatively unattractive or dangerous, but may be willing to work at a discount when the job is particularly fulfilling or the working conditions are unusually

[6] For a further discussion of the various strategies for generating a cost of education index, see Monk and Fowler (2001) or Keller and Taylor (2003).

pleasant. Finally, locational characteristics will drive differences in wages. Workers in areas with a low cost of living or an abundance of amenities will be willing to accept a lower nominal wage than otherwise equal workers in a less attractive locale.

By definition, a CWI reflects only the third source of wage variation. Researchers must avoid concluding that the wage level is low in an area simply because most of the workers are young and inexperienced. Similarly, researchers must avoid concluding that the wage level is low in an area simply because there are a disproportionate number of low-wage jobs. Therefore, estimating a CWI requires data not only on earnings and location, but also on worker and job characteristics.

The 2000 Census provides exactly the data needed for a comparable wage analysis. The Individual Public Use Microdata Sample (IPUMS 5-Percent) contains information on the earnings, occupation, place-of-work and demographic characteristics of individual workers throughout the United States. Given the rich set of demographic data on the Census, one can be reasonably confident that a Census-based CWI is not biased by demographic considerations. Furthermore, by restricting the analysis to college graduates, one can generate a wage index for non-educators who are directly comparable to teachers.

Using geographic detail provided on place-of-work, the Census can support Comparable Wage estimates for each school district in the United States. For urban school districts, this would be the CWI for the corresponding metropolitan area. For rural district, this would be the CWI for the corresponding rural region, which generally represents more than a single county. For example, the 22 rural counties in the Texas

Panhandle are clustered together into a single Census place-of-work area and therefore would be assigned the same CWI value.

The primary disadvantage of using Census data to estimate the CWI is the long gap between Censuses. While a baseline estimate of labor cost can be extremely useful, it would be even better to have information about the evolution of relative wages over time.

The Occupational Employment Statistics (OES) program provides information that can be used to extend the baseline CWI in non-Census years. The OES is a Bureau of Labor Statistics (BLS) database which contains average annual earnings by occupation for states and metropolitan areas.

Each year, the BLS samples and contacts approximately 400,000 civilian, nonfarm establishments for the OES survey.[7] Every firm in the United States with at least 250 employees is included in the sample with near certainty each year. Smaller firms are sampled proportionally. The rate of response to the survey is typically quite high. Nearly 80 percent of the establishments contacted for the May 2003 survey responded. The survey respondents in the 2003 OES data set employed 72 percent of civilian, nonfarm workers in the United States.[8]

Unfortunately, while the OES survey categorizes workers into 770 detailed occupations, it does not provide any demographic information about them.[9] Therefore,

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[7] Details on the OES survey come from "Technical Notes for the May 2003 OES Estimates" on the BLS website http://stats.bls.gov/oes/2003/may/oes_tec.htm.

[8] The OES is constructed as a three-year moving average. Thus, the estimates for 2002 are drawn from surveys in 2000, 2001, and 2002. Because the 2003 survey straddles the shift from the Standard Industrial Classification system (SIC) to the North American Industrial Classification System (NAICS), "May 2003 data were combined with samples from November 2002, 2001, 2000, and a subset of certainty units collected in 1999." ("Technical Notes for the May 2003 OES Estimates").

[9] "Technical Notes for the May 2003 OES Estimates".

the OES would not be an appropriate data set for construction of a baseline CWI. However, the demographic characteristics of states and metropolitan areas should be relatively stable over time. It ought to be possible to use changes in the locational fixed effects from an OES analysis to adjust the Census-based wage differentials. For example, if the OES indicates that wages in Houston increased by 5 percent between 1999 and 2001, then the baseline CWI for Houston can be revised upward by 5 percent to generate an estimate of the Houston CWI in 2001. Such annual estimates can be generated for 1997 forward.

As an alternative to updating with the OES, one could consider extending the CWI with the Current Population Survey (CPS). Because it is a household-based rather than establishment-based survey, the CPS contains demographic information. Thus, a CPS index would be able to control for demographically driven wage shifts that could influence year-to-year changes in an OES index. On the other hand, the CPS provides much less occupational and industrial detail than does the OES, so an OES index is likely to do a better job of controlling for wage shifts driven by changes in the occupational and industrial mix. Most importantly, the OES provides much better geographic coverage than does the CPS. The OES is designed to generate wage estimates for metropolitan areas as well as states. CPS is a "state-based" study that is not designed for analysis of labor market areas within states.[10] Therefore, while either series could be used to extend the CWI for states, only the OES is well suited to extending the CWI for metropolitan areas.

[10] "Technical Paper 63RV: Current Population Survey - Design and Methodology" 2002. US Department of Labor, Bureau of Labor Statistics and US Department of Commerce, Economics and Statistics Administration, US Census Bureau.

One advantage to extending the baseline CWI with the OES is that it generates a very timely index of school district labor cost. The annual OES estimates are generated with only a one-year lag. Thus, researchers can generate a CWI for 2003 in the spring of 2004. In contrast, the most recent data from the Schools and Staffing Survey (the primary data source for Chamber's GCEI) cover the 1999-2000 school year, and the most recent national data on school district expenditures cover the 2001-02 school year.

The Baseline Estimates

Regression analysis of the 2000 Census yields the baseline estimates of the CWI.[11] The dependent variable is the log of annual wage and salary earnings. The independent variables are age, gender, race, educational attainment, amount of time worked, occupation and industry of each individual in the national sample.[12] In addition, the estimation includes an indicator variable for each labor market area.[13]

To ensure that the sample represents non-educators who are directly comparable to teachers, the estimation excludes self-employed workers, workers without a college degree, those who work less than half time or for less than $5,000 per year, and anyone who has a teaching occupation or who is employed in the elementary and secondary education industry. Individuals employed outside of the United States are also excluded.

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[11] Census data for this analysis come from Steven Ruggles and Matthew Sobek et al., Integrated Public Use Microdata Series: Version 3.0, Minneapolis: Historical Census Projects, University of Minnesota, 2003.

[12] This analysis is conceptually very similar to previous work by Dan Goldhaber using data from the Current Population Survey (CPS). However, Goldhaber's analysis was limited to generating state-level wage estimates.

[13] The model also includes random effects for states. Treating state effects as random rather than fixed ensures that the predicted wage is the same in Kansas City, Kansas as it is in Kansas City, Missouri, while allowing for a correlation in the errors among labor markets within any given state.

After these exclusions, the IPUMS 5-percent sample retains 1,053,184 employed, college-educated workers drawn from 460 occupations and 256 industries.

Arguably, some of the 460 occupations included in the analysis are more directly comparable to teaching than others. For example, Allegretto, Corcoran, and Mishel (2004) identify 16 occupations that are particularly similar to teaching based on the skills required to do the job. One might consider restricting the CWI sample to a carefully selected subset of the occupations held by college graduates. However, the CWI reflects only systematic regional differences from the national wage, controlling for worker demographics, industries, and occupations. Because it is based on pay differentials within each occupation, the CWI is not influenced by differences in pay levels from one occupation to another. Therefore, it is not sensitive to differences in job characteristics across occupations. Furthermore, reducing the sample size greatly reduces the precision of any regional wage estimate. Without evidence that differences in job description imply differences in tastes for consumer products and local amenities, there would be little gain to restricting the sample to a subset of occupations. [14]

To ensure that the CWI is useful going forward, the analysis uses the most recent metropolitan area definitions generated by the United States Office of Management and Budget (OMB). The OMB used information on population density and commuting patterns from the 2000 Census to substantially revise its definition of metropolitan areas nationwide. For example, in Texas the OMB reclassified 22 formerly rural counties as urban, separated the Midland-Odessa metropolitan area into two distinct MSAs (Midland and Odessa), and folded the Brazoria and Galveston metropolitan areas into the massive

[14] A similar logic applies to any suggestion that the sample be limited to a subset of industries.

Houston-Baytown-Sugar Land Metropolitan area. Wherever possible, the place-of-work areas on the Census files have been mapped into the new metropolitan area definitions. After updating the place-of-work definitions, there are 803 metropolitan areas or rural place-of-work areas in the 2000 Census.

As Table 1 illustrates, the estimated model conforms to reasonable expectations about labor markets. Wage and salary earnings increase with the amount of time worked, and the age of the worker (a rough proxy for experience). Persons with advanced degrees earn systematically more than persons with a bachelor's degree. Women earn less than men of comparable age and educational attainment, possibly because age is a better indicator of experience for men than for women. Whites earn systematically more than apparently comparable individuals from most other racial groups.

The predicted wage level in each labor market area captures systematic variations in labor earnings while controlling for demographics, industrial and occupational mix, and amount of time worked.[15] The average predicted wage nationwide is $47,835 per year.[16] Dividing each local wage level by this national average yields the CWI. The CWI ranges from 0.70 to 1.24, indicating that the wage level for college graduates is 24 percent above the national average in New York City (the nation's most expensive labor market) and 30 percent below the national average in several rural areas.

The pattern of index values generally corresponds to reasonable expectations. Almost without exception, the labor markets with the lowest CWI are located in rural

[15] Formally, the predicted wage level in each market is the least-squares mean for the market fixed effect. The least-squares mean (or population marginal mean) is defined as the expected value of the mean for each effect (in this context, each market) that you would expect from a balanced design holding all covariates at their mean values and all classification variables (such as occupation or gender) at their population frequencies.

[16] The national average predicted wage is a weighted average of the local area predicted wages.

areas. The labor markets with the highest CWI are generally major urban areas. Wages for college graduates are more than 15 percent above the national average in New York City, San Jose, San Francisco and Bridgeport, Connecticut (Figure 1).

The CWI reveals significant variation in wages not only between urban and rural America, but also among America's largest cities. (See figure 2.) The cost of hiring college graduates is higher in New York City than in any other U.S. labor market except San Jose, California. Wages in New York City are almost 13 percent higher than wages in Dallas, which in turn are nearly 15 percent higher than wages in Phoenix. College graduates in Phoenix earn 4 percent less than the national average.

The state wage level is a weighted average of the local wages within its borders. As figure 3 shows, state-by-state comparisons also reveal substantial variation in comparable wage levels. On average, the wage and salary of a typical college graduate is 54 percent higher in New Jersey (the state with the highest estimated wage level) than in Montana (the state with the lowest estimated wage level).[17] As one might expect, the CWI is highest in the populous Mid-Atlantic States, and lowest in the Great Plains. Because the states with the highest CWI are also among the most populous, most states have a CWI below 1.00.

Not only are there substantial differences in wage levels across the country, there are also substantial differences within a single state. The difference in CWIs within the state of California is as great as the difference between New Jersey and Montana. In New York, Texas, Virginia, Illinois and New Mexico, the educational dollar can stretch

[17] Such a range is not unexpected. When Goldhaber estimated a comparable wage index for the states using CPS data from 1994, he found a 52 percent range between the highest cost state and the lowest cost state.

at least 40 percent farther in one part of the state than in another. With the exception of Rhode Island and Washington DC, all states face at least a 7 percent internal differential.

The substantial differences in hiring cost revealed by the CWI suggest that it is very important to take purchasing power into consideration when making financial comparisons across school districts. For example, consider beginning teacher salaries. In 1999-2000, only five states had higher average salaries for beginning teachers than did New Jersey. However, New Jersey also had the highest wages for college graduates, on average. Adjusted for geographic variations in hiring costs, beginning teacher wages in New Jersey were not the 6^{th} highest in the nation, but instead the 7^{th} lowest—just behind Mississippi (Table 2).

One potential criticism of the CWI is that it reflects wage and salary earnings rather than total compensation. (The IPUMS-5 Percent provides no information on employee benefits.) To the extent that benefits differ systematically across industries or occupations, they will be captured by regression fixed effects and have no impact on the CWI. However, systematic differences in benefits across states—as might arise because workers desire to take more of their compensation in the form of benefits in states with income tax than in states without income tax—will be indistinguishable from cost-of-living differentials.

It is difficult to gauge the magnitude of potential bias from excluding benefits because few researchers have published work on the geographic variation in employee benefits. However, two recent reports using the 2004 Current Population Survey (CPS) indicate that there is considerable geographic variation in employer-provided benefits. Copeland (2004) finds that the share of full-time, full-year workers participating in an employer-provided retirement plan ranged from 46.7 percent in Florida to 67 percent in North Dakota. Gould (2004) finds that that the share of at-least-part-time, private-sector workers covered by employer-provided health insurance ranged from 43.7 percent in New Mexico to 69.6 percent in Hawaii. The pension participation rates and the CWI are not correlated (the Pearson correlation is 0.0498), but there is a statistically significant relationship between health insurance coverage rates and the CWI (the Pearson correlation is 0.3837). States with higher CWIs also had higher shares of the working population covered by employer-provided health insurance.

Because neither fringe-benefits report adjusts the estimated benefit rates to reflect differences in the demographic, occupational, and industrial composition of the states, or restricts the analysis to college-educated workers (who are likely to have higher and more uniform participation rates than other workers), neither benefit rate is directly comparable to the CWI. Furthermore, the health benefits estimate makes no distinction between part-time and full-time workers. Therefore, the apparent correlation between health insurance coverage rates and the CWI could be spurious. However, if high-wage states are also generally high-benefit states, the CWI would understate the geographic differential in the cost of hiring teachers. As such, the CWI is a conservative estimate of geographic differences in the cost of education.

Extending the Baseline

While the baseline CWI makes it possible to compare district purchasing power across space, the OES makes it possible to extend the CWI across time.

The first step in extending the CWI is generating OES-based estimates of the annual wage level in each labor market. The OES provides estimates of average annual earnings and employment by occupation for states and metropolitan areas each year from 1997 through 2003. Because metropolitan areas span state lines, combining the state and metropolitan data into a single model would be inappropriate. Therefore, the wage levels for states and metropolitan areas are estimated separately. To allow for both occupation-specific and location-specific shifts in wage levels over time, each year is also analyzed separately. Table 3 presents descriptive statistics for the fourteen OES regression models.

In each year, the wage level is the predicted wage from an annual regression of the average wages (in logs) on fixed effects for occupation and location (either state or MSA) weighted by total employment in the occupation/location cell.[18] The wage level is the predicted wage in each location assuming that each occupation's share of total employment is proportional to its share of total employment among college graduates in the Census database. Thus, occupations that are held only rarely by college graduates are given little weight in the construction of the OES wage levels while occupations that employ college graduates intensively are given a greater weight.[19] Because the distribution of employment across occupations mirrors the Census, changes in the OES

[18] As with the Census analysis, elementary and secondary education occupations have been excluded from the estimation database.

[19] The OES does not use consistent coding for occupations in all years between 1997 and 2003, and in no year is the OES coding completely consistent with the 2000 Census. Therefore, OES occupations were matched to their Census equivalents using a crosswalk provided by the National Crosswalk Service Center. Occupations that could not be matched to the Census files for college graduates or that are present in only some of the OES years are included in the estimation, but assigned a zero weight in the construction of the wage predictions. Thus, while there are between 451 and 533 occupations included in the OES regressions each year, the predicted wage level is based on the 304 of them that can be matched to the Census occupation codes and are observed in at least one state and metropolitan area each year.

wage estimates over time reflect systematic changes in average wages across occupations and not changes in the occupational mix.

The Census asked respondents to report their wages in 1999. Therefore the OES wage estimates for 1999 form the basis for comparison of changes in local wage levels. If the OES estimated wage level for Dallas in 2000 is 2 percent higher than the OES estimated wage level for Dallas in 1999, then the Extended Comparable Wage Index (ECWI) for Dallas in 2000 is 2 percent higher than the CWI baseline. Similarly, if the average OES wage for Texas increases by 10 percent between 1999 and 2002, then the ECWI for the state of Texas in 2002 is 10 percent higher than the baseline CWI for Texas.

For rural areas and many smaller metropolitan areas, there is no direct estimate of the change in wage levels. If state average wages are up 10 percent and the average wages in all metropolitan areas within the state are up 10 percent, it is clear that rural wages must also be up 10 percent. When the metropolitan areas and the state as a whole are growing at different rates, then the rural area growth rate is imputed as the growth rate such that an employment-weighted average of the rural and metropolitan growth rates equals the state average growth rate.[20]

All states and local labor market areas show considerable increase in labor cost between 1997 and 2003. State wage levels increased between 18 and 33 percent over the

[20] The employment weights come from the total employment records from the 2000 Census. The employment weights reflect workers with all levels of educational attainment because the OES data reflect workers of all levels of educational attainment. Note that when metropolitan areas spill over state boundaries, it is not necessarily true that the state's growth rate is a weighted average of the growth rate of its metropolitan areas and its rural places of work. Therefore, this imputation strategy is only an approximation in states that share a metropolitan area with another state.

six year period. State wage growth was highest in Colorado and Vermont, and lowest in Alaska and Montana.

Wage levels increased by at least 14 percent in all local labor markets and by more than 35 percent in a dozen markets, predominantly on the West Coast. The wage level grew by 38 percent in San Jose, leading it to overtake New York City as the highest paid market in the United States for college graduates. Among the 10 largest local labor markets, wage growth was fastest in Riverside-San Bernardino and slowest in Phoenix.

The geographic pattern of wages was largely unaffected by the growth differentials, however. Figure 4 plots the ECWI for the 10 largest local labor markets while figure 5 plots the ECWI for the 10 largest states. As the charts illustrate, the pattern of relative wages is dominated by the common trend and the baseline differentials. Among the 803 metropolitan areas and Census places of work, the correlation between the ECWI for 1997 and the ECWI for 2003 is .96.

The ECWI and Inflation

Interestingly, the ECWI paints a very different picture of education sector inflation than does the Consumer Price Index (CPI). The CPI indicates that the general price level rose 15 percent between 1997 and 2003. On average, the ECWI rose 27 percent over the same period.[21] The ECWI rose more rapidly than the US CPI in all states and all but a handful of local labor markets.

The Bureau of Labor Statistics publishes CPI estimates for major metropolitan areas in addition to the national estimates (figure 6). The Pearson correlation between the

[21] The annual estimate for the CPI-U was taken from the BLS website (www.bls.gov). The national average ECWI is a weighted average of the state ECWIs where each state is weighted by its share of the IPUMS sample used in the estimation of the CWI.

local CPI inflation rates and the changes in the corresponding ECWIs is .7025. However, the ECWI rose more rapidly than the local CPI in all markets for which the BLS reports a local CPI .

The ECWI is much more consistent with the BLS's Employment Cost Index (ECI) than it is with the CPI. Like the ECWI, the ECI measures changes in labor costs rather than consumer prices. The ECI indicates that the wages and salaries of blue-collar workers rose 21 percent between 1997 and 2003, while the wages and salaries of white collar workers rose 24 percent.[22] In both cases, the ECI indicates that total compensation (which includes an estimate of employer-provided benefits) rose faster than wages and salaries.[23]

The ECWI measures changes in a major component of the purchasing power of school districts while the CPI measures changes in the purchasing power of consumers. Arguably, the ECWI is a better indicator of education sector inflation than is the CPI. To the extent that labor costs have been rising faster than the costs of energy, technology and other school supplies, the ECWI will tend to overstate education sector inflation. However, since payroll costs comprise more than 80 percent of current educational expenditures, the overstatement should be modest.

Using the ECWI instead of the CPI to adjust for changes in school district purchasing power yields a very different perspective on the time path of real educational expenditures (figure 7). The National Center for Education Statistics—which uses the CPI to adjust for inflation—reports that real per-pupil current expenditures on primary and secondary education rose steadily between 1997 and 2001 (National Center for

[22] The ECIs for civilian workers were taken from the BLS website (www.bls.gov).
[23] Between 1997 and 2003, total compensation rose 23 percent for civilian blue collar workers and 25 percent for civilian white collar workers.

Education Statistics, forthcoming, table 171). Using the national average ECWI as the deflator indicates that real per-pupil expenditures were stable during the late 1990s, and rose only modestly between 2000 and 2001. Furthermore, despite official NCES figures indicating that all states experienced real per-pupil expenditure growth between 1997 and 2001, the ECWI-adjusted figures indicate that eight states saw real declines in spending.[24]

Implications for School Finance Equity

Equalizing access to educational resources is a common goal of school finance formulas. In order to accomplish this goal, states must provide more funding to school districts in high cost environments than they provide to school districts in relatively low cost environments. Thus, in states with large internal differences in the cost of education, an equal distribution of resources will imply a very unequal distribution of expenditures. Similarly, an equal distribution of expenditures can imply a very unequal distribution of resources.

There are a number of tools that can be used to examine the distribution of educational expenditures. Murray, Evans and Schwab (1998) use four: the Gini coeffient, the Theil index, the ratio of spending at the 95th percentile to spending at the 5th percentile, and the coefficient of variation.[25] Using the ECWI to adjust school district expenditures for geographic variations in purchasing power greatly alters the values of all four of these indicators.

The NCES' Local Education Agency Finance Survey (a.k.a. F-33) provides data on current expenditures for elementary and secondary education. The most recent data

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[24] The eight states are Florida, Nevada, Washington, Alaska, Wisconsin, Connecticut, Nebraska, and Pennsylvania.

[25] For more on these measures, see Murray, Evans and Schwab (1998).

(which is preliminary) covers the 2001-2002 school year. Table 5 presents the four measures of distributional inequality for the 2001-2002 school year and for the 1996-97 school year (the earliest period that can be matched to the ECWI).[26]

As table 5 illustrates, adjusting for geographic variations in cost reduces the measured inequality of the US school finance system. All of the indicators of inequality fall when differences in school district purchasing power are taken into account. For example, cost adjustment lowers the Gini coefficient for current expenditures per pupil in 2001-02 from 12.98 to 11.83.[27]

One of the most intriguing aspects of table 5 is the decomposition of the Theil index into within-state and between-state effects. Both Corcoran et al. (2004) and Murray, Evans and Schwab (1998) conclude that differences across states are a more important component of measured inequality than are differences in expenditures within states.[28] Indeed, absent cost adjustments, less than one third of expenditures inequality is attributable to within-state variations. However, after cost adjustments, nearly half of the total inequality comes from within-state variations.

Within-state variations explain a greater share of total inequality after cost adjustments for two reasons. First, cost adjustments reduce the measured inequality

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[26] Only districts that serve both elementary and secondary school students are included (i.e. districts with an NCES school level code of '03'). All districts that reported zero current expenditure on elementary and secondary education were excluded. All descriptive statistics are weighted by the number of students in fall enrollment in each district. Hawaii and Washington DC are also excluded because they are served by a single school district.

[27] For notational convenience, the Gini coefficient is multiplied by 100. The Theil index and its components are multiplied by 1000.

[28] Both Corcoran et al. (2004) and Murray Evans and Schwab (1998) exclude Montana and Vermont from their analyses on the grounds that those states have virtually no unified school districts. In 1996-97 and 2001-02, those states each have more unified school districts than Delaware, Maryland, Nevada or Rhode Island. Therefore they are not excluded from this analysis. Alaska is also included here where it is not in the other two cited works. The analysis does not change if Alaska, Montana and Vermont are excluded.

between states. The Theil index of between-state inequality falls 43 percent from 20.90 to 11.90 in 2001-02. Second, cost adjustments increase the measured inequality within states. The Theil index of within-state inequality rises 28 percent from 9.07 to 11.57 in 2001-02.

The Theil index of within-state inequality is a weighted average of the Theil indexes for the individual states. It is higher with cost adjustments than it is without cost adjustments because the individual state-level Theil indexes are generally higher with cost adjustments than they are without (figure 8). In all but eight states, adjusting for purchasing power differentials increases measured inequality.[29] In six states (Florida, Iowa, Kansas, Nebraska, Texas and West Virginia) the Theil index more than doubles when expenditures are adjusted for purchasing power.

One clear implication of this analysis is that states are more successful at equalizing nominal school district expenditures than they are at equalizing real school district expenditures. However, state policymakers frequently have objectives beyond simply equalizing access to resources. In particular, states may be making deliberate efforts to direct compensatory resources toward small districts or districts with a disproportionately high share of low income students. If small districts that are receiving additional resources are more likely to be located in low-wage markets, then cost-adjustment could raise measured inequality in the state, even if the state were perfectly equalizing purchasing power for districts of comparable size. Similarly, if low-wage areas have more low-income students, then cost adjustment could raise measured

[29] Cost adjustments using the ECWI can have no impact on measured equality in Rhode Island because all of the state's school districts fall within a single labor market.

inequality, even if the state were perfectly equalizing purchasing power for districts with comparable demographics.

If the higher inequality of real expenditures reflected state efforts to compensate for differences school district size or student poverty, then cost-adjustment should not lead to an increase in measured inequality among districts of comparable size or demographics. However, that is not the case. As table 5 illustrates, even among comparable districts, cost adjustment raises measured inequality.

The first set of estimates compares the Theil index of within-state inequality for school districts within certain size categories. In all cases, measured inequality within states is higher after cost adjustment. For example, consider the 1,875 school districts with between 500 and 1000 pupils. The Theil index of within-state inequality is 9.83 for nominal expenditures, but 14.25 for cost-adjusted expenditures. Furthermore, the sharp increase in the Thiel index is driven by widespread increases in measured inequality. There are four times as many states where measured inequality rises with cost adjustment as there are states where inequality falls.

As an alternative to dividing the nation's school districts into size categories, one could divide each state into quintile groups and ask whether states equalize access to resources among the smallest (or largest) twenty percent of school districts within the state. As the second set of figures in table 5 illustrates, cost adjustment increases measured inequality in all size quintiles. Among the smallest school districts in each state, or among the largest school districts in each state, there is greater equality of expenditures than there is equality of resources.

The third set of estimates in table 5 compares the Theil index of within-state inequality for school districts with comparable shares of students receiving free or reduced-price lunches, a common proxy for student socioeconomic status.[30] In all but one case, measured inequality within states is higher after cost adjustment. Only in the case of districts with less than 15 percent low-income students is real spending more equal than nominal spending.

Arguably, the distribution of school districts with less than 15 percent low-income students is geographically skewed. Five states—Arkansas, Florida, Louisiana, Mississippi and West Virginia—do not have a single district with so few low-income students, while Connecticut and Massachusetts have at least two-thirds of their districts in this category. As an alternative, one could divide each state into quintile groups and ask whether states equalize access to resources among the school districts with largest shares of low-income students within the state. As the last set of figures in table 5 illustrates, cost adjustment increases measured inequality in all income quintiles. Among the school districts with the least-advantaged students in each state, or among the school districts with the most-advantaged students in each state, there is greater equality of expenditures than there is equality of resources.

Clearly, cost adjustment greatly alters our perspective on school finance equity. Differences in spending across states are much smaller after cost differentials are taken into account. On the other hand, differences in spending within states are much larger

[30] Data on the shares of students receiving free or reduced price lunch come from the NCES' Common Core of Data. Arizona and Tennessee have no students in this category for all school districts for all years from 2000-01 to 2002-03 (an implausibility indicating missing data) and are therefore excluded from the analysis of student poverty. Two other states—Connecticut and Wyoming—have zero students in this category for all school districts in 2001-02, but have non-zero values in both the previous and subsequent school years. The 2001-02 shares of free or reduced lunch students for each district in Connecticut and Wyoming is taken to be the arithmetic average of the district's share in 2000-01 and 2002-03.

than they first appear. Furthermore, there is no evidence that the within-state inequalities in spending revealed by cost adjustment arise from deliberate efforts to direct additional resources to districts that are too small to take advantage of economies of scale or to districts that serve particularly needy students. One cannot help but disagree with Murray, Evans and Schwab's conclusion that most of the school finance inequality is between states and "thus school-reform litigation is able to attack only a small part of inequality" (Murray, Evans and Schwab 1998, p 808).

Conclusions

Together, the Census and the OES support a viable Comparable Wage Index. The resulting panel of index values measures the wage level for college graduates in all parts of the US for the years 1997 through 2003.

The ECWI confirms that educated workers command substantially different wages in different parts of the country. All other things being equal, in 2003 an employer in San Jose could expect to pay 21 percent more than an employer in Los Angeles to hire a comparable individual. An employer in Dallas could expect to pay 3 percent more than an employer in Houston and 27 percent more than an employer in El Paso, Texas. The average college graduate in New Jersey could expect to earn 53 percent more than the average college graduate in Montana.

Furthermore, ECWI indicates that the price of labor has been rising rapidly. Since 1997, wage levels have increased between 3.5 and 4.5 percent per year in most states. All states and local labor markets have seen average wage increase of more than 2 percent per year over the past six years. Some local markets have seen average annual increases of more than 5 percent per year.

Because school districts must compete for workers in all of these labor markets, they must pay teacher wages that are comparable to those outside of the teaching profession. Large geographic differences in the price of labor imply equally large differences in the purchasing power of school districts. Meanwhile, rapid growth in labor costs can imply substantial erosion in school district purchasing power over time.

The inequalities in purchasing power revealed by the ECWI undermine the equity and adequacy goals of school finance formulas. If states were successfully directing additional resources to school districts in high cost environments, then measured inequality within states should fall when differences in purchasing power are taken into account. Instead, as a general rule, purchasing power is less equitably distributed than expenditures.

Clearly, the differences in labor cost measured by the ECWI are both substantial and relevant for educational policymaking and analysis. The estimated wage differences are highly persistent, implying that it would be appropriate to make adjustments for them not only when analyzing school finances, but also when constructing school finance formula. Furthermore, unlike other measures of the cost of education, the ECWI reflects variations in labor cost that are undeniably outside of school district control. The ECWI should become part of the toolkit for policy and analysis in education finance.

Table 1:
Coefficient Estimates From the Census Model of Comparable Wages

Dependent Variable
Annual wage and salary income in 1999 (log)

Explanatory Variables	Estimate	Standard Error	t-Value	p-Value
Usual Hours Worked per Week (log)	0.7249	0.0028	256.21	0.0000
Weeks Worked Last Year (log)	1.0225	0.0058	175.84	0.0000
Age	0.0685	0.0003	220.1	0.0000
Age, squared	-0.0007	0.0000	-186.94	0.0000
White	0.0000			
Black/Negro	-0.0879	0.0022	-40.23	0.0000
American Indian	-0.1095	0.0085	-12.94	0.0000
Chinese	-0.1176	0.0037	-31.36	0.0000
Japanese	-0.0029	0.0068	-0.42	0.6648
Other Asian or Pacific Islander	-0.1094	0.0026	-42.78	0.0000
Other race, nec	-0.1643	0.0045	-36.1	0.0000
Two or more major races	-0.1216	0.0042	-29.07	0.0000
Male	0.0000			
Female	-0.1703	0.0012	-142.61	0.0000
Professional degree	0.0000			
Bachelors degree	-0.0781	0.0028	-28.4	0.0000
Masters degree	-0.0007	0.0029	-0.24	0.8024
Doctorate degree	0.1163	0.0037	31.62	0.0000

Note: The model also includes 460 occupational fixed effects, 256 industry fixed effects and 805 labor market fixed effects. There are 1,053,184 observations and the log likelihood is 1616468.

Table 2: Adjusting Teacher Salaries with the Comparable Wage Index

	Minimum teacher salary 1999-2000	Cost-adjusted Minimum Salary	CWI
United States	$27,989	$27,989	1.000
Alaska	$33,676	$34,401	0.979
Alabama	$29,790	$33,602	0.887
Oregon	$29,733	$31,504	0.944
Pennsylvania	$30,185	$31,126	0.970
Vermont	$25,791	$31,000	0.832
Delaware	$30,945	$30,873	1.002
Georgia	$30,402	$30,644	0.992
Hawaii	$29,204	$30,160	0.968
Iowa	$25,275	$30,152	0.838
Wyoming	$24,168	$30,067	0.804
Indiana	$26,553	$29,673	0.895
Kansas	$25,252	$29,526	0.855
California	$32,190	$29,480	1.092
Illinois	$30,151	$29,255	1.031
North Carolina	$27,968	$29,241	0.956
Tennessee	$27,228	$29,003	0.939
Missouri	$25,977	$28,898	0.899
Nevada	$28,734	$28,871	0.995
Massachusetts	$30,330	$28,708	1.057
Michigan	$28,545	$28,703	0.994
Louisiana	$25,738	$28,613	0.900
New Mexico	$25,042	$28,559	0.877
New York	$31,910	$28,440	1.122
Connecticut	$30,466	$28,206	1.080
Oklahoma	$24,025	$28,073	0.856
West Virginia	$23,829	$28,056	0.849
South Dakota	$21,889	$28,039	0.781
Montana	$20,969	$28,037	0.748
Texas	$28,400	$27,964	1.016
Maine	$22,942	$27,915	0.822
Arizona	$25,613	$27,761	0.923
Nebraska	$22,923	$27,643	0.829
Rhode Island	$27,286	$27,607	0.988
Florida	$25,132	$27,592	0.911
Kentucky	$24,753	$27,559	0.898
South Carolina	$25,215	$27,436	0.919
Maryland	$28,612	$27,394	1.044

Table 2: Adjusting Teacher Salaries with the Comparable Wage Index

	Minimum teacher salary 1999-2000	Cost-adjusted Minimum Salary	CWI
New Hampshire	$24,650	$27,169	0.907
Wisconsin	$25,344	$26,994	0.939
Arkansas	$22,599	$26,962	0.838
District of Columbia	$30,850	$26,722	1.154
Colorado	$24,875	$26,609	0.935
Minnesota	$25,666	$26,556	0.966
Mississippi	$23,040	$26,539	0.868
New Jersey	$30,480	$26,440	1.153
Washington	$26,514	$26,139	1.014
North Dakota	$20,422	$25,984	0.786
Virginia	$26,783	$25,929	1.033
Utah	$23,273	$24,977	0.932
Idaho	$20,915	$24,891	0.840
Ohio	$23,597	$24,523	0.962

Note: States sorted by cost-adjusted minimum salary.
Source: *Digest of Education Statistics 2001* and author's calculations.

Table 3: Descriptive Statistics for OES Models

	Year						
	2003	2002	2001	2000	1999	1998	1997
Metropolitan Area Analysis							
Number of Occupations	462	462	463	462	451	527	525
Number of Labor Markets	307	307	307	307	307	304	304
Number of Observations	94,779	96,200	96,306	91,203	65,383	98,467	87,705
R-Square	0.942	0.943	0.935	0.931	0.937	0.943	0.940
State Analysis							
Number of Occupations	466	467	467	466	464	533	533
Number of Labor Markets	51	51	51	51	51	51	51
Number of Observations	30,790	28,151	28,645	28,092	24,187	30,790	28,978
R-Square	0.956	0.951	0.946	0.944	0.946	0.956	0.953

Table 4: The Impact of Cost Adjustment on Measured Inequality

	2002		1997	
	Current Expenditures per Pupil	Cost-Adjusted Expenditures per Pupil	Current Expenditures per Pupil	Cost-Adjusted Expenditures per Pupil
95/5 Ratio	2.13	1.95	2.06	2.00
CV	16.35	14.22	16.15	14.21
Gini Coefficient	12.98	11.83	13.02	12.01
Theil Index	29.97	23.48	29.72	23.90
Within-state	9.07	11.59	9.49	11.59
Between-state	20.90	11.90	20.23	12.32

Note: The expenditures data come from the NCES F-33 files for elementary and secondary school districts (NCES school code ‘03') with positive per-pupil current expenditures. Because they lack intra-state variation, Hawaii and Washington DC are excluded. All descriptive statistics are weighted by the number of students in fall enrollment in each district.

Table 5: The Impact of Cost Adjustment by Size and Socioeconomic Status, 2001-02		
	Theil Index of Within-State Inequality	
	Current Expenditures per Pupil	**Cost-Adjusted Expenditures per Pupil**
Between 100 and 500 pupils	21.32	24.53
Between 500 and 1000 pupils	9.83	14.25
Between 1000 and 2000 pupils	9.58	11.45
More than 2000 pupils	7.90	9.27
State Size Quintile 1	16.02	18.32
State Size Quintile 2	8.98	11.24
State Size Quintile 3	8.36	10.73
State Size Quintile 4	8.42	9.59
State Size Quintile 5	7.01	8.17
Less than 15 percent low-income students	11.71	9.78
Between 15 and 30 percent low-income students	6.77	8.27
Between 30 and 45 percent low-income students	6.19	8.50
More than 45 percent low-income students	5.83	9.05
State Student Income Quintile 1	8.40	9.02
State Student Income Quintile 1	6.94	8.82
State Student Income Quintile 3	6.85	7.58
State Student Income Quintile 4	6.73	9.15
State Student Income Quintile 5	6.24	9.33

Note: The expenditures data cover elementary and secondary school districts (NCES school code '03') with positive per-pupil current expenditures in the NCES F-33 files for 2001-02. Because they lack intra-state variation, Hawaii and Washington DC are excluded. All descriptive statistics are weighted by the number of students in fall enrollment in each district. Each quintile contains one fifth of the school districts in each state, but not necessarily one fifth of the students.

Figure 1

Labor Markets with the Highest CWI
(and two standard error confidence bands)

Figure 2
The CWI in the Most Populous Labor Markets
(and two standard error confidence bands)

Figure 3
The CWI for the States
(and two standard error confidence bands)

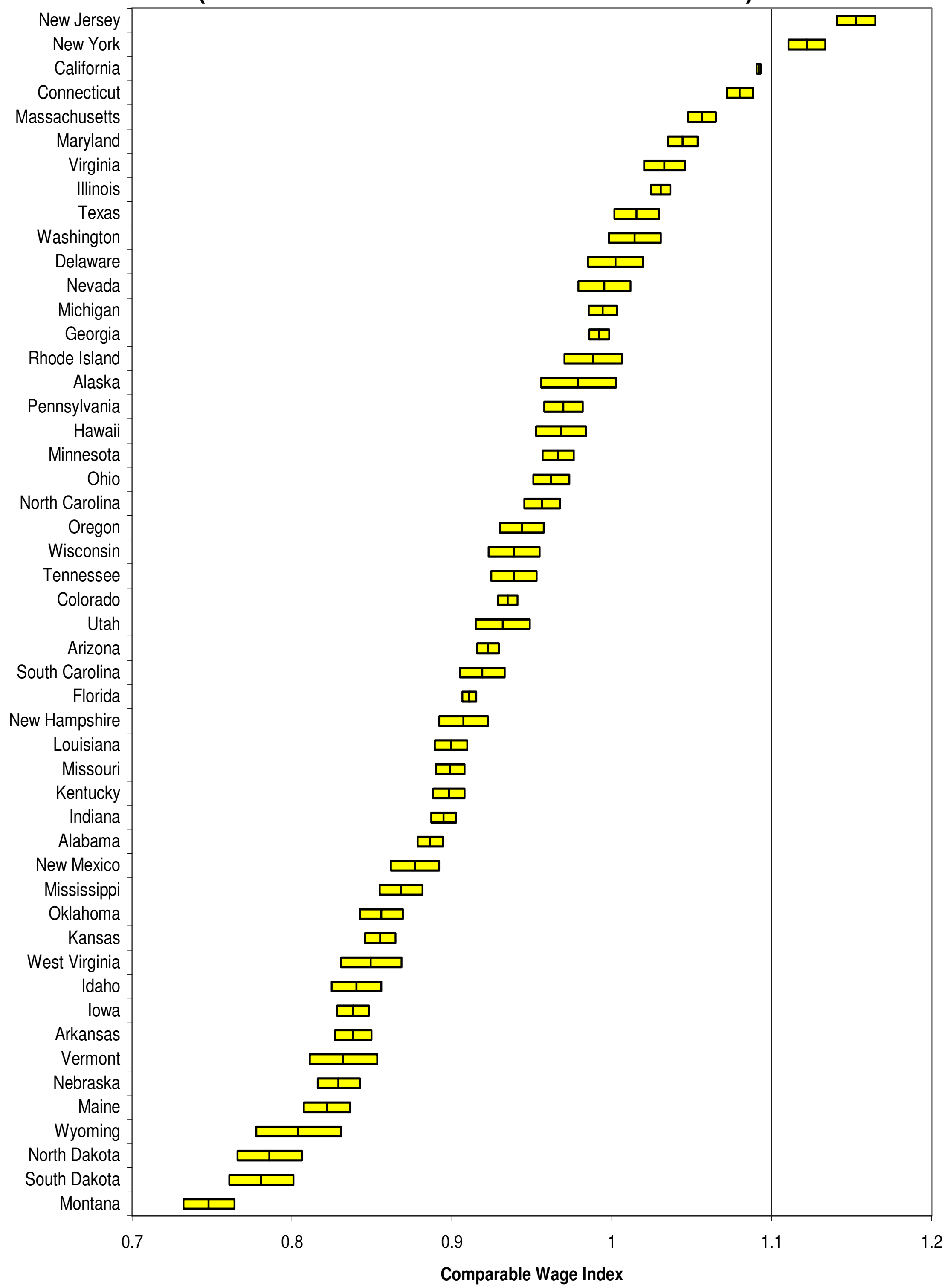
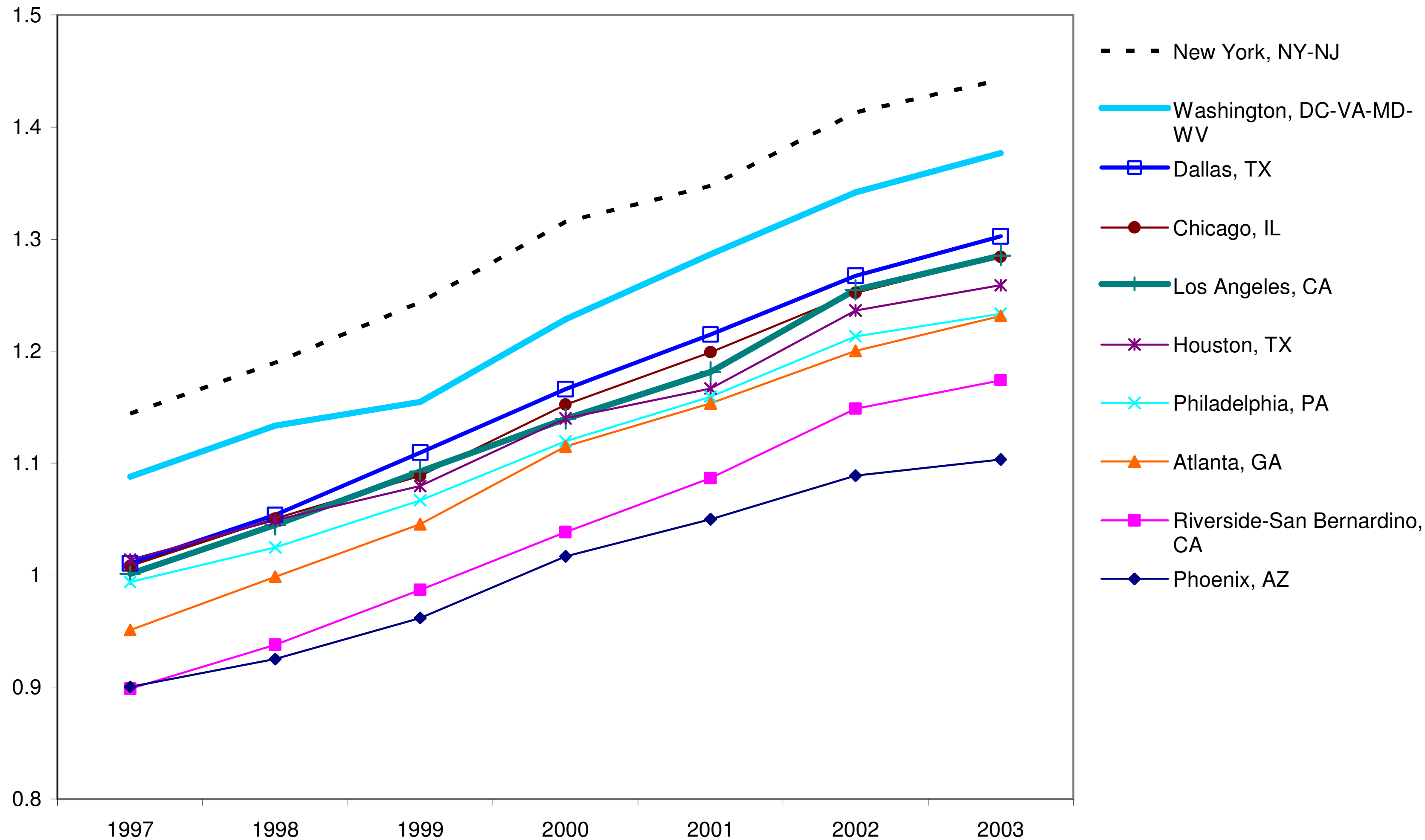


Figure 4: The ECWI for the 10 Largest Metropolitan Divisions



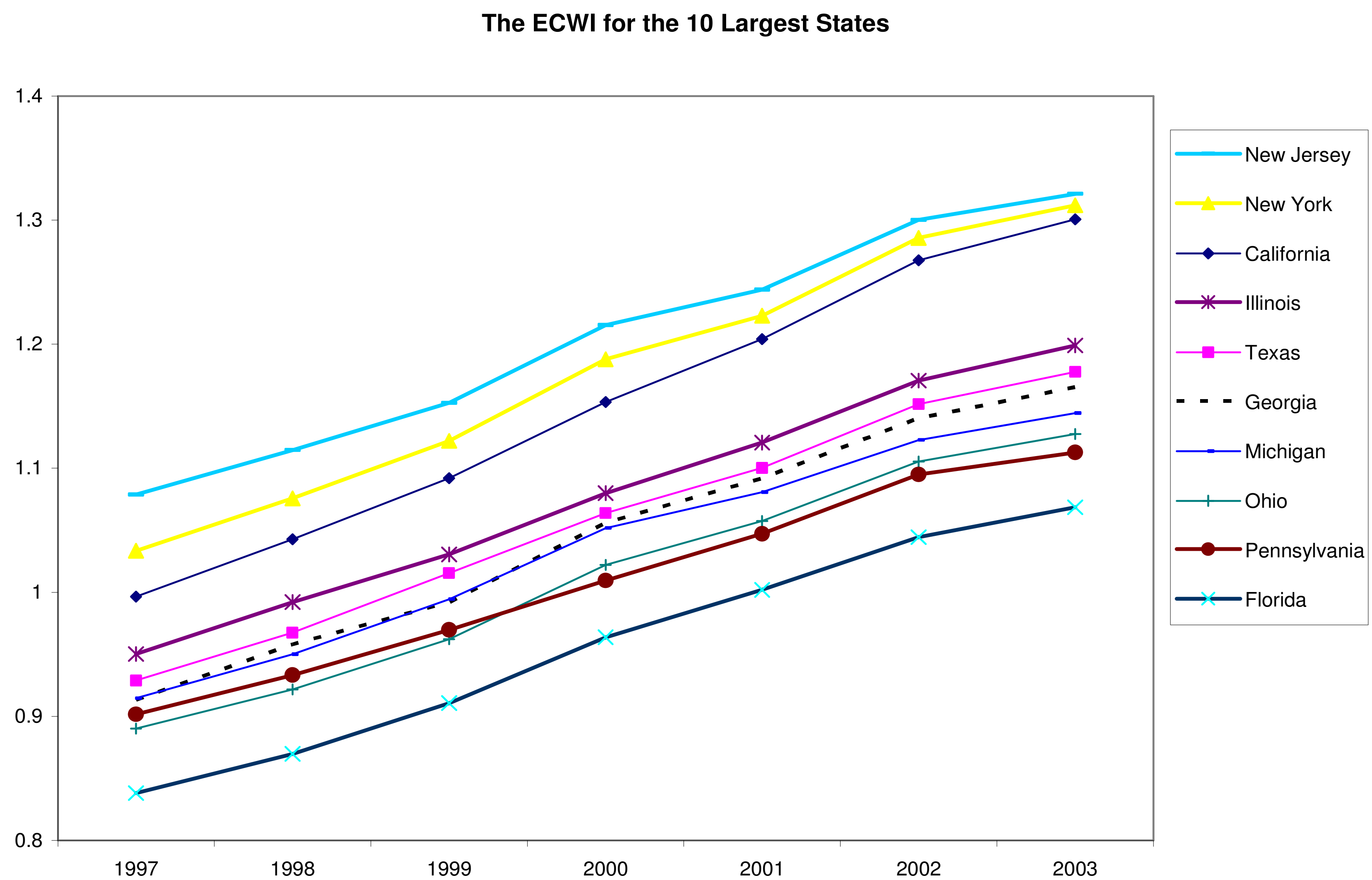

The ECWI for the 10 Largest States
1.4
1.3
1.2
1.1
1
0.9
0.8
1997
1998
1999
2000
2001
2002
2003
New Jersey
New York
California
Illinois
Texas
Georgia
Michigan
Ohio
Pennsylvania
Florida

Figure 6: Two Measures of the Local Change in the Cost of Education from 1997 to 2003

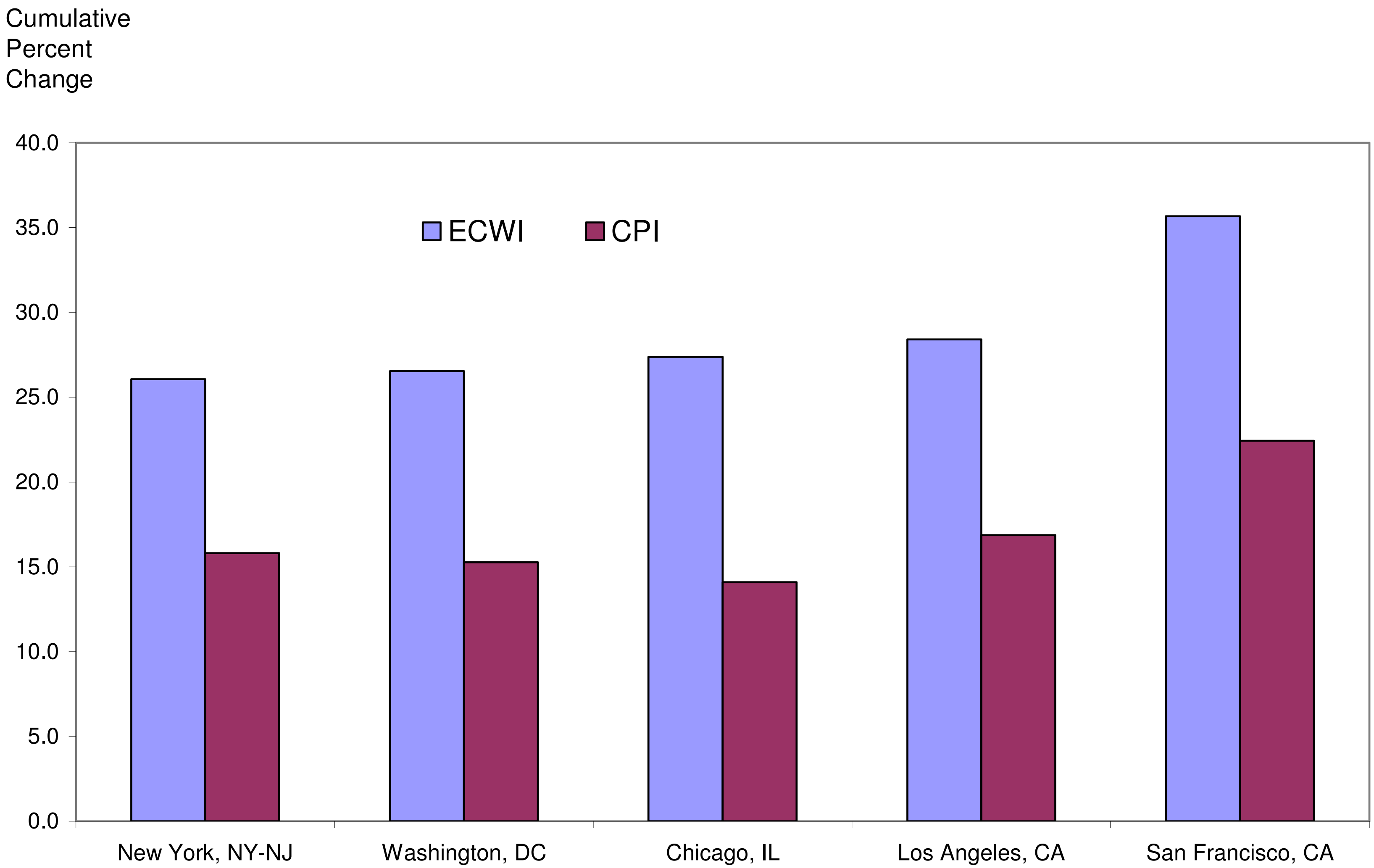
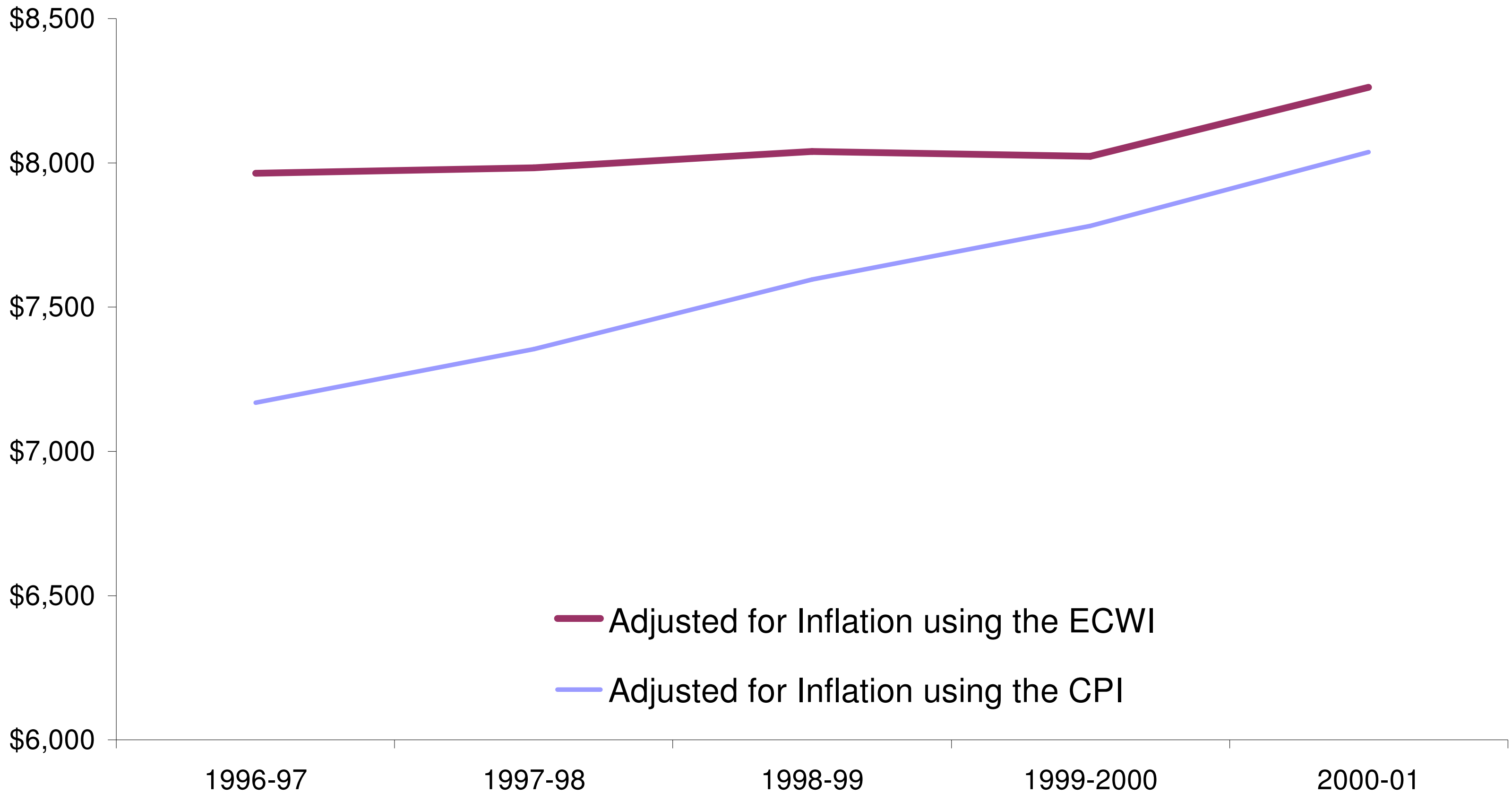
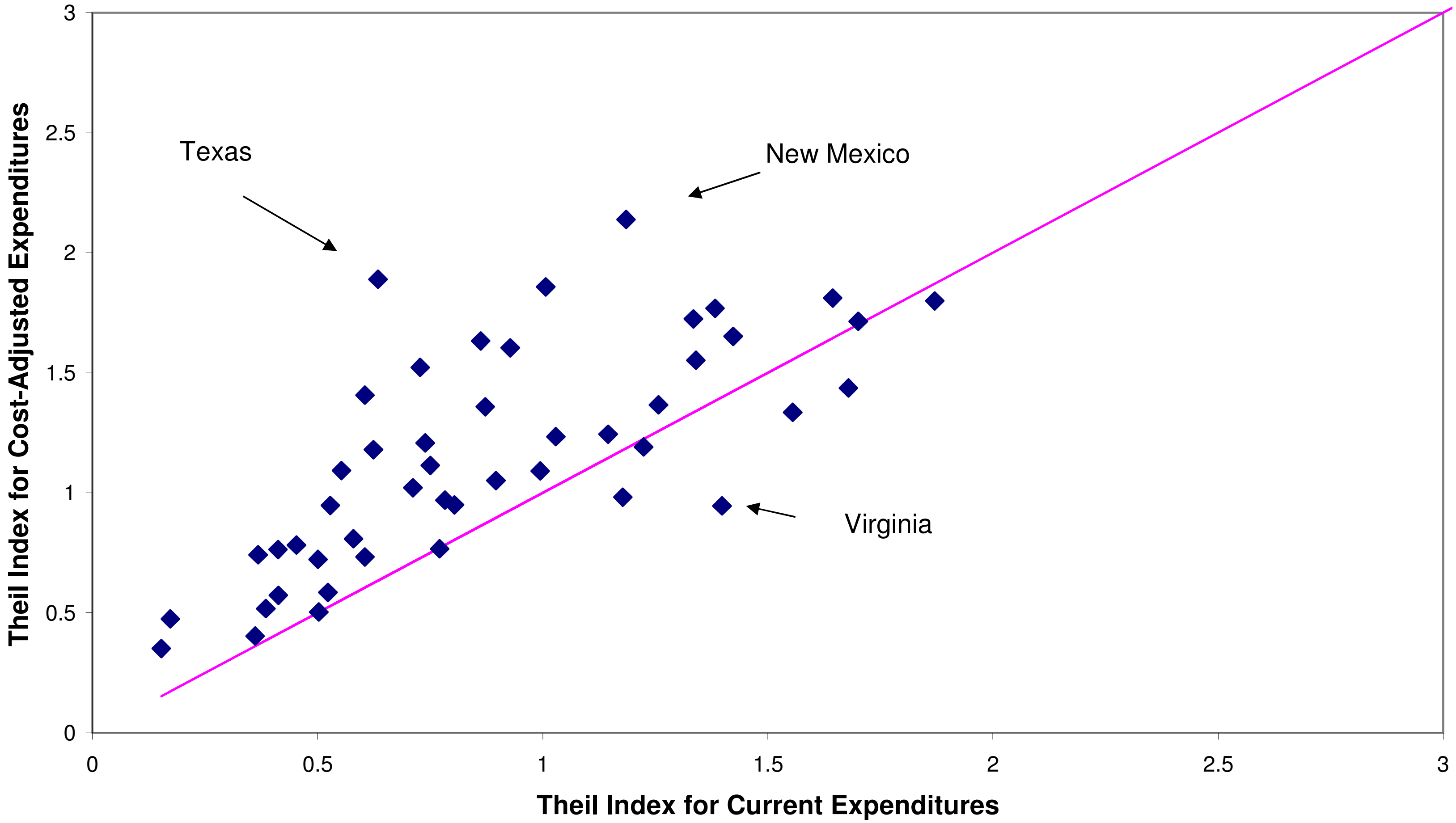


Figure 7
Two Perspectives on Real Expenditures per Pupil in the United States



Note: Current expenditures per pupil in average daily attendance in US public elementary and secondary schools in 2001-2002 dollars.

Figure 8
Cost Adjustment Increases Measured Inequality in Most States



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