

The effect of Hurricane Katrina on employment and unemployment

After BLS and its State partners made critical modifications to estimation procedures, local area data show that Hurricane Katrina depressed employment levels sharply in Louisiana and Mississippi; the initial effect on unemployment, though also strong, was temporary

Sharon P. Brown,
Sandra L. Mason,
and
Richard B. Tiller

The Local Area Unemployment Statistics (LAUS) estimates for the month of September 2005 were among the first subnational data to reflect the impact of Hurricane Katrina, which struck the gulf coast on August 29 with catastrophic effects in parts of Louisiana, Mississippi, and Alabama. Beginning in September and continuing to the present, the Bureau of Labor Statistics (BLS, the Bureau) and its State partners made a number of critical modifications to standard estimating procedures to better reflect the employment and unemployment situation in the affected areas. The Bureau analyzed the subnational Current Population Survey (CPS) estimates and verified that they did not reflect the economic upheaval created by the hurricane and its aftermath. The Bureau also evaluated unemployment insurance statistics and State and area nonfarm employment estimates. To address estimating issues at the State level, models were modified to allow the State-supplied inputs of nonfarm employment and unemployment insurance claimants to have far greater weight in the calculations of estimates. In addition, breaking with longstanding practice, the Bureau introduced special intervention variables into the models in real time in order to immediately reflect the effect of Katrina. Area estimation procedures also were modified. The identification and implementation of revised estimation approaches at the State and area levels and of model interventions necessary each month in Louisiana and Mississippi required innovation and risk taking, as standard methods were adapted in an attempt to fully reflect the impact of Katrina. This article describes the process of determining appropriate actions to take in

the areas affected by the hurricane, the implementation of those actions to date, and the key labor market trends as measured by the LAUS program.

Overview of the LAUS program

The LAUS program produces monthly estimates of the labor force, employment, unemployment, and the unemployment rate for more than 7,200 unique geographic areas through a Federal-State cooperative effort that dates back to 1973, when the Bureau was given responsibility for the program.¹ Labor force estimates are prepared for all Census Regions and Divisions, States, metropolitan areas, metropolitan divisions, “micropolitan”² areas, small labor market areas, counties and county equivalents, cities of 25,000 or more, and all cities and towns in New England.

LAUS estimates are one of the most timely and important subnational economic indicators. Data on Census Regions and Divisions, States, and selected major areas are issued about 2 weeks after the release of the national employment situation estimates. Data on the remaining metropolitan areas are issued 2 weeks after that, and data on all other areas are released about 1 week later. All LAUS data for the month are issued by approximately the next release of the national labor force estimates.

LAUS estimates are key indicators of local economic conditions. In addition to being important for labor market analysis, LAUS data are used by a variety of Federal programs to allocate more than \$45 billion in funds to States and areas, as well as to

Sharon P. Brown is Chief, Division of Local Area Unemployment Statistics; Sandra L. Mason is a supervisory economist in the Division of Research and Methods; and Richard B. Tiller is a mathematical statistician in the Division of CPS and LAUS, all in the Office of Employment and Unemployment Statistics, Bureau of Labor Statistics. E-mail: brown.sharon@bls.gov

determine eligibility for assistance for a number of government programs.

The Bureau is responsible for the concepts, definitions, technical procedures, validation, and publication of the estimates that State agencies prepare under BLS auspices. The estimates are based on statistical models of varying degrees of complexity, with the strongest models for Census Divisions, States, and selected metropolitan areas. The concepts and definitions underlying LAUS estimation come from the CPS, the household survey that is the official measure of the labor force for the Nation. Monthly State LAUS estimates are based on models that are controlled in real time to sum to CPS national monthly labor force estimates through modeled estimates at the Census Division level. Estimates for eight large areas and the rest of their States (including New Orleans through August 2005) are also model based, while LAUS estimates for the remainder of substate labor market areas are based on a less sophisticated method that uses a building-block approach. Below the labor market area level, monthly employment and unemployment estimates are prepared with the use of disaggregation techniques.

Geographic scope of Katrina

Unlike other hurricanes, Katrina covered an unusually large area of the gulf coast, with an especially severe impact on Louisiana and Mississippi. Other affected States—Alabama, Florida, and Texas—did not require special treatment in the development of LAUS estimates.

For LAUS estimation purposes, Louisiana is part of the West South Central Census Division, along with Texas, Oklahoma, and Arkansas. Mississippi is part of the East South Central Division, together with Alabama, Tennessee, and Kentucky.

The Bureau publishes data on the following metropolitan and micropolitan areas in the two most heavily affected States:

- Louisiana:
Metropolitan areas: Baton Rouge, Houma-Bayou Cane-Thibodaux, Lafayette, Lake Charles, and New Orleans-Metairie-Kenner
Micropolitan areas: Abbeville, Bogalusa, Crowley, Hammond, Jennings, Morgan City, New Iberia, and Pierre Part
- Mississippi:
Metropolitan areas: Gulfport-Biloxi, Hattiesburg, Jackson, and Pascagoula
Micropolitan areas: Brookhaven, Columbus, Laurel, McComb, Meridian, Natchez (MS-LA, MS county only), Picayune, Starkville, Vicksburg, and Yazoo City

The impact of Katrina on local labor markets in the two States was quite dramatic in the affected Louisiana parishes and

Mississippi counties in August and September 2005 and May 2006. (See maps 1–6.)

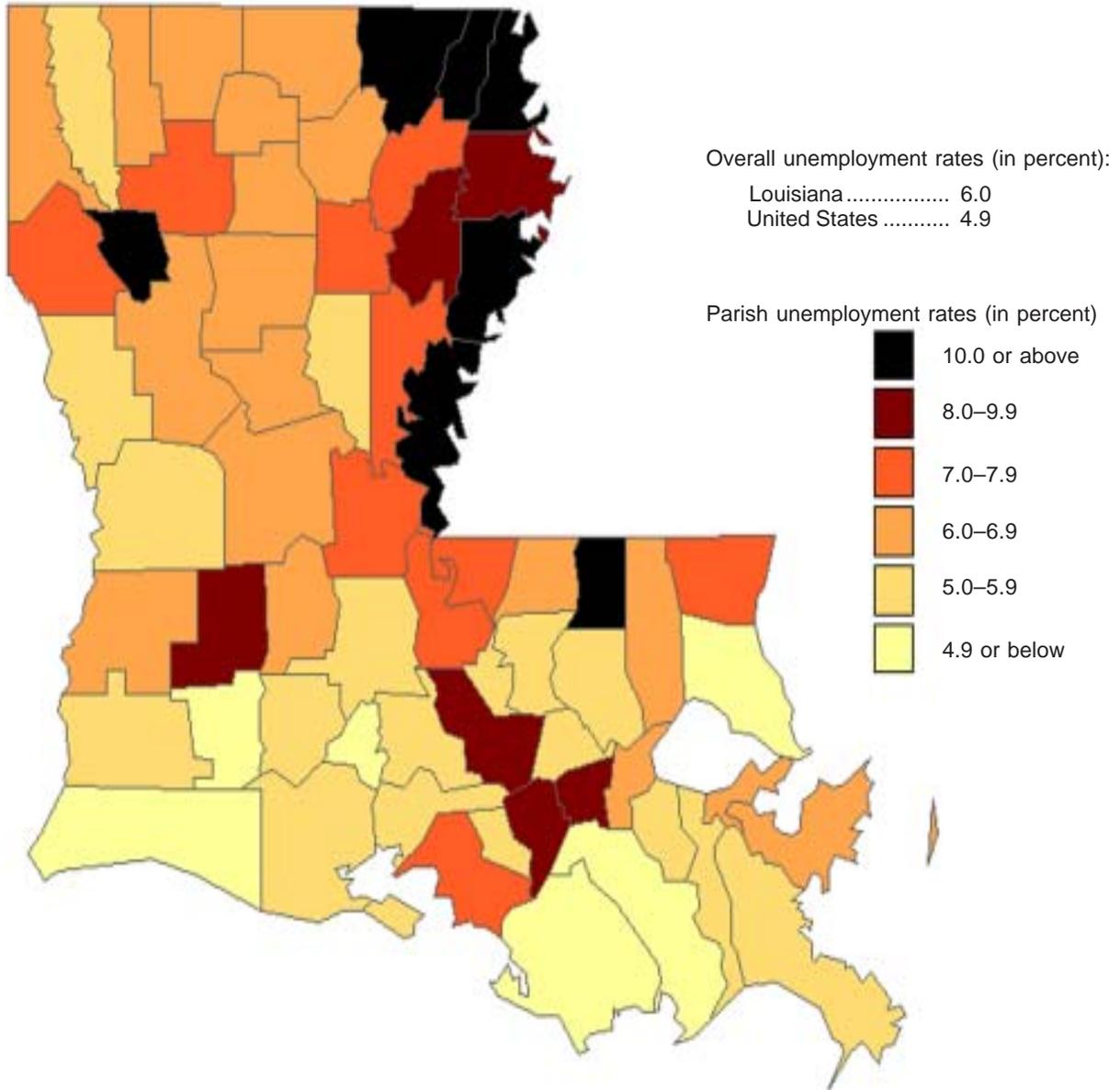
LAUS estimation and Hurricane Katrina

State and area estimates of employment, unemployment, and the unemployment rate are not produced directly from a sample survey; rather, they are developed through models that use information on the labor force from a number of statistical programs. Inputs to LAUS estimation include data from the CPS, the Current Employment Statistics (CES) program, and the State Unemployment Insurance (UI) program, all of which were affected in various ways by Hurricane Katrina. The effect of Katrina on each of these series is examined in this article, as are the changes in methodology required to adequately reflect the impact of the disaster on the labor forces of the affected States.

The CPS survey and LAUS estimation. As previously mentioned, the concepts and definitions underlying LAUS data come from the CPS, the household survey that yields the official measures of the labor force for the Nation. Monthly CPS estimates are not used directly in the LAUS program, because State samples are too small to yield reliable estimates. For LAUS estimation of States and eight substate areas (including the New Orleans metropolitan area through August 2005), the monthly CPS estimates are inputs to models. State models are controlled in real time to sum to CPS-based Census Division models that are based solely on current and historical CPS estimates and to sum to national monthly labor force estimates from the CPS. This real-time benchmarking of State estimates to the national estimates of employment and unemployment reduces the number of end-of-year revisions to the series and ensures that national shocks to the economy are reflected in States as they occur. However, the local nature of the shock from Hurricane Katrina, and the decisions made regarding CPS data collection and estimation from September forward affected the relevant State and area CPS estimates.³

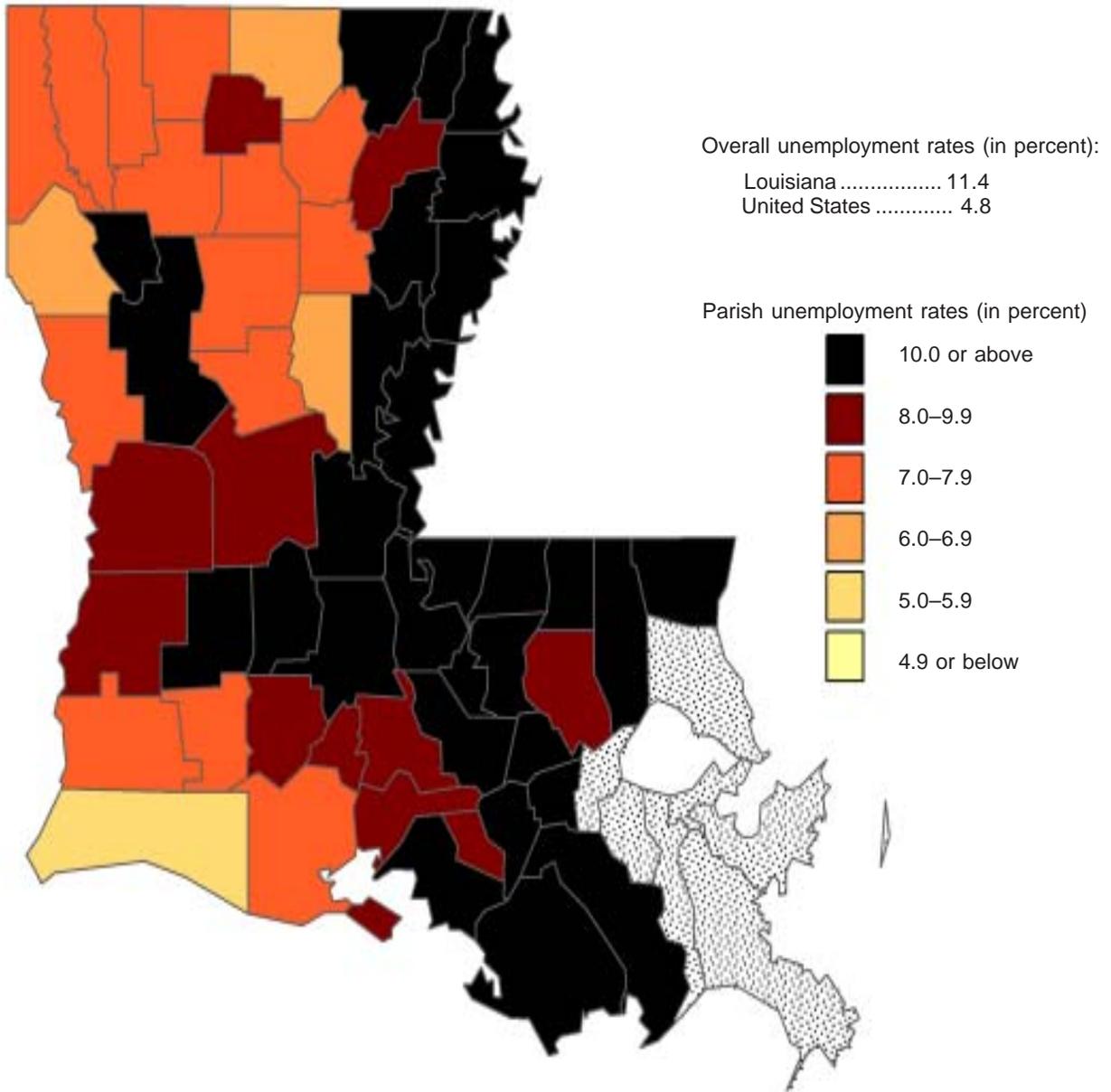
The most significant data limitation had to do with the nature of the CPS, in which households are contacted by interviewers each month during the week that includes the 19th day of the month. Katrina made landfall the last few days of August. In addition, Hurricane Rita came ashore near the Texas-Louisiana border on September 24, during CPS data collection week. Thus, the estimates made from the September sample were the first to reflect the impact of the hurricanes. The magnitude of the destruction caused by Katrina and, to a lesser extent, by Rita severely restricted the ability of CPS interviewers to contact persons in the hurricane-affected States. Every attempt was made to contact households, except for those in Orleans and Jefferson parishes, which were under mandatory evacuation orders. In accordance with standard procedures, the survey was not conducted in temporary shelters, hotels, or motels—structures in which some respondents were staying during the reference

Map 1. Unemployment rates in Louisiana, by parish, August 2005, not seasonally adjusted



SOURCE: Bureau of Labor Statistics, Local Area Unemployment Statistics.

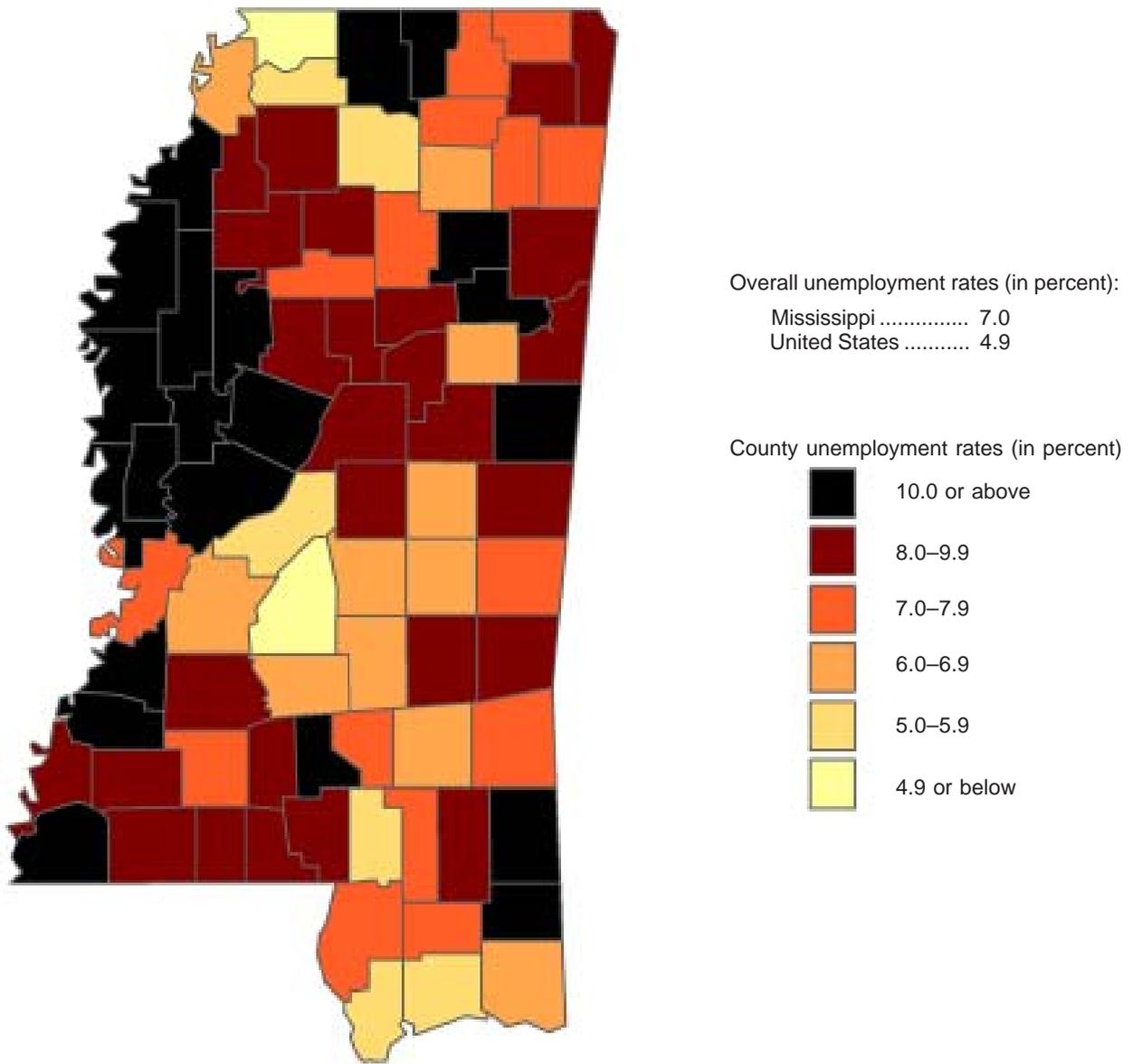
Map 2. Unemployment rates in Louisiana, by parish, September 2005, not seasonally adjusted



NOTE: Dotted area indicates data not available.

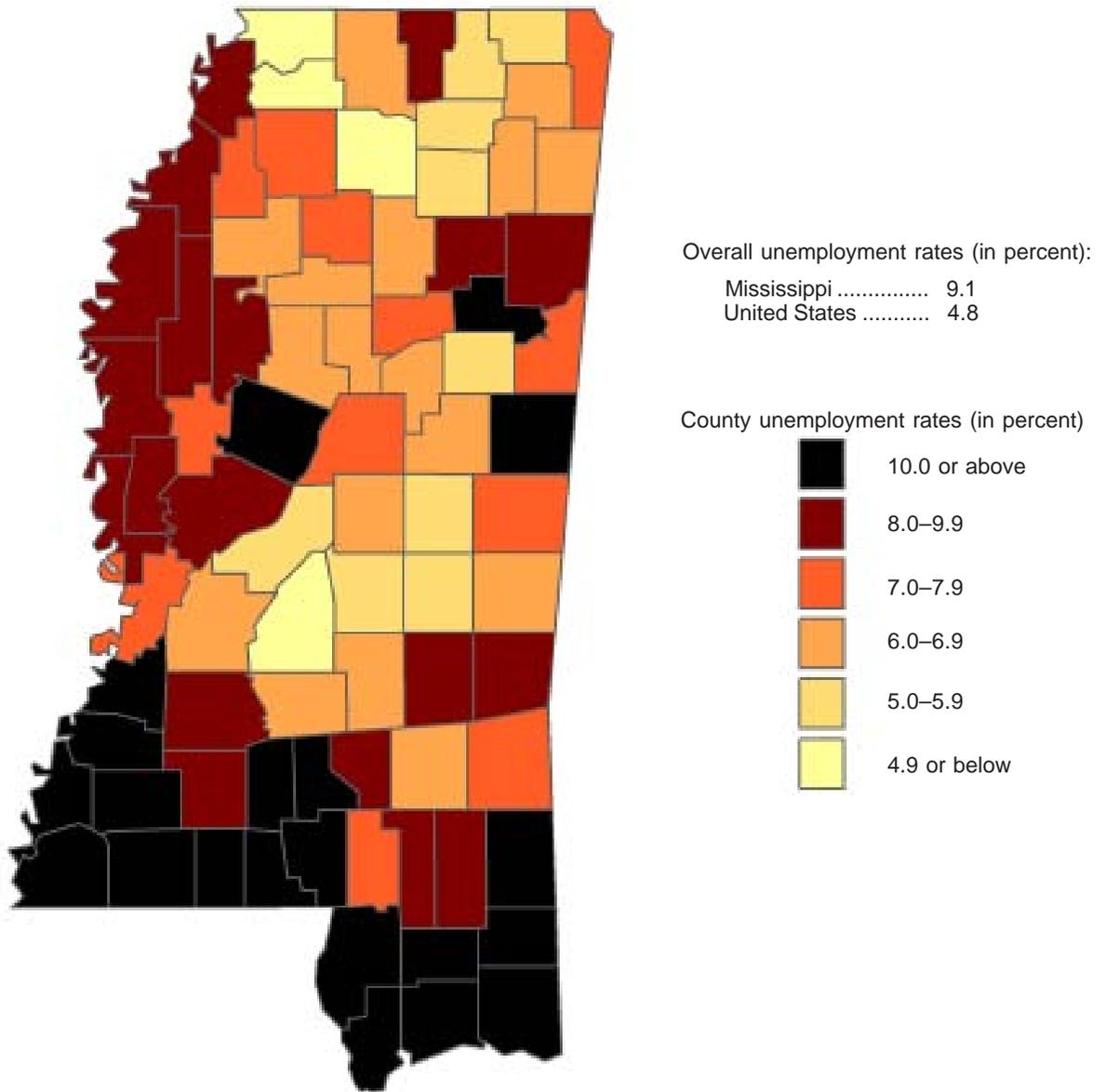
SOURCE: Bureau of Labor Statistics, Local Area Unemployment Statistics.

Map 3. Unemployment rates in Mississippi, by county, August 2005, not seasonally adjusted



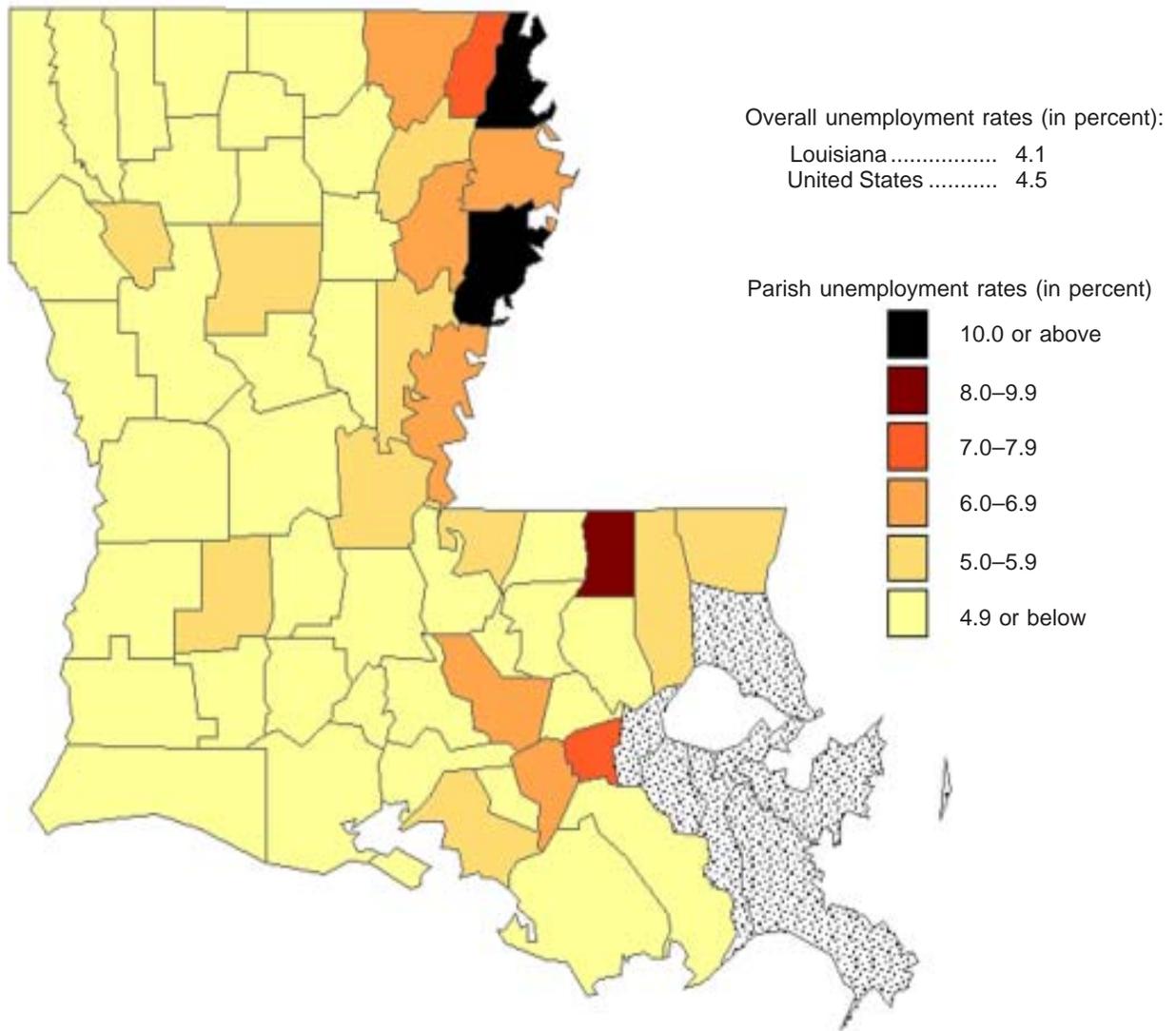
SOURCE: Bureau of Labor Statistics, Local Area Unemployment Statistics.

Map 4. Unemployment rates in Mississippi, by county, September 2005, not seasonally adjusted



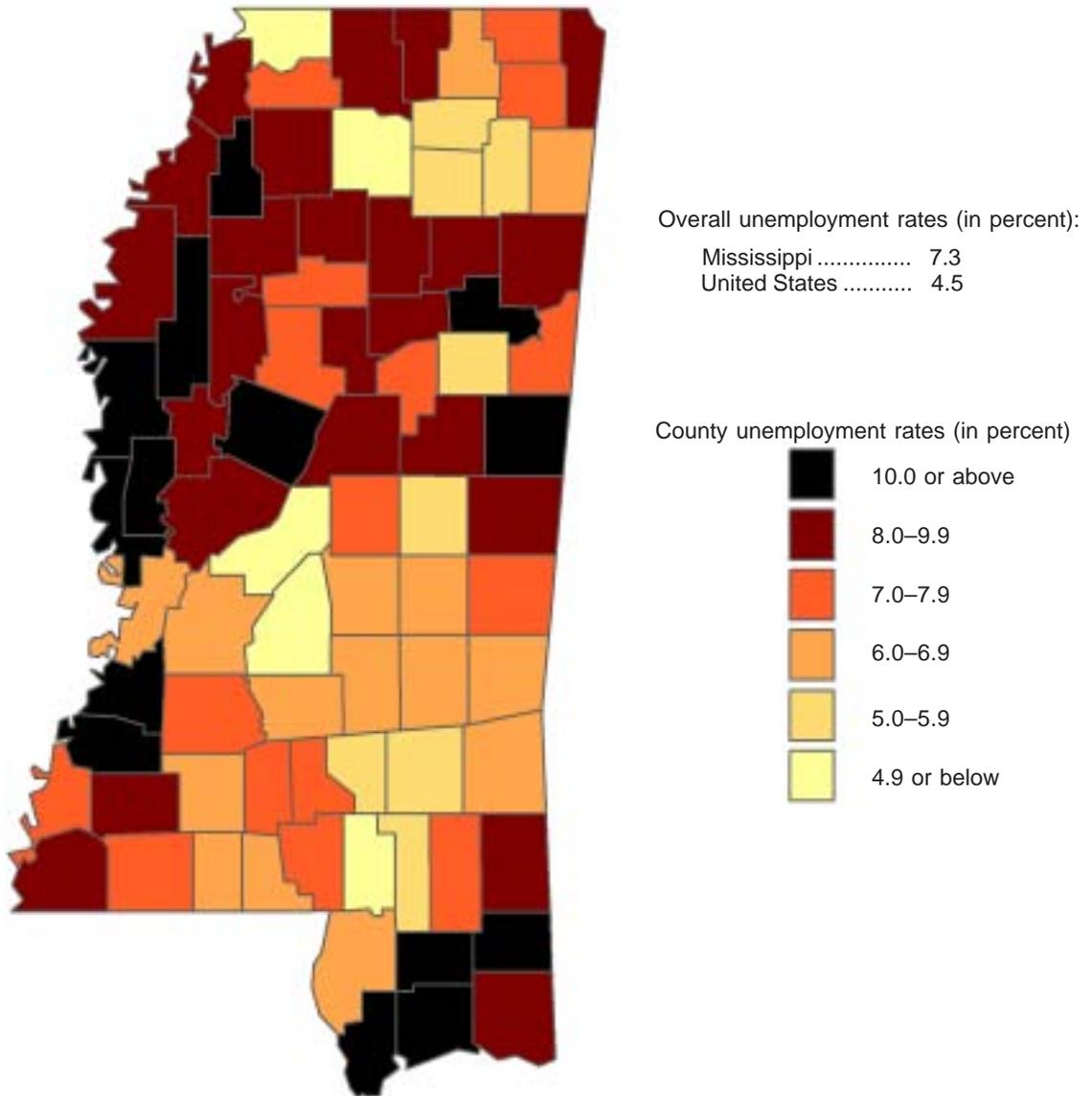
SOURCE: Bureau of Labor Statistics, Local Area Unemployment Statistics.

Map 5. Unemployment rates in Louisiana, by parish, April 2006, not seasonally adjusted



NOTE: Dotted area indicates data not available.
SOURCE: Bureau of Labor Statistics, Local Area Unemployment Statistics.

Map 6. Unemployment rates in Mississippi, by county, April 2006, not seasonally adjusted



SOURCE: Bureau of Labor Statistics, Local Area Unemployment Statistics.

week. Despite the effort, there was an unusually large drop in the number of households interviewed from August to September in Louisiana and Mississippi, as shown in the following tabulation:

State	<i>Number of households interviewed in—</i>		<i>Percent change</i>
	<i>August</i>	<i>September</i>	
Louisiana	580	381	-34
Mississippi	570	504	-12

This inability to maintain the sample introduces not only variability due to a reduced sample size, but also bias in the remaining sample, and it is the latter effect that is of most concern: the labor force behavior of persons displaced from areas affected by the hurricanes was unlikely to be well represented by the sample in the rest of the State.

In October, Census Bureau interviewers attempted to collect data in all areas affected by the hurricane. As in the previous month, nonresponse was higher than normal in both Louisiana and Mississippi, because housing units in the sample were destroyed or because people had not yet returned to their homes. Again, in accordance with standard procedures, the survey was not conducted in temporary shelters, hotels, or motels.

Many residents of Louisiana and Mississippi relocated or were evacuated in the days and weeks following Katrina. Official estimates of the population shifts associated with the evacuations and relocations were not available in the weeks immediately following the storm. Therefore, in September, the Census Bureau was not able to incorporate the results of population shifts due to the disaster. Explicit adjustment of the LAUS State estimates aimed at reducing population estimates and, in turn, labor force estimates in the directly affected States and at increasing estimates in States such as Texas, Arkansas, and Georgia, to which many evacuees relocated, also was not possible at that time.

In an effort to develop official statistics on the movement of population, the Census Bureau obtained the National Change of Address File (NCOA) from the U.S. Postal Service in late September. This file includes the current (at the time) contact addresses for individuals and families who lived within one of the 21 areas designated by the Federal Emergency Management Administration as affected by the hurricane and who notified the Postal Service of their change of address after the onset of Katrina.

The Census Bureau felt that the NCOA file was a good official source of information for population shifts, even though it likely included only a portion of residents who had changed their State of address. From October onward, using the NCOA tabulations, the Census Bureau was able to provide modified population data that accounted for some of the movement of individuals as a result of the hurricane. The LAUS program incorporated these modified population data into the model estimates for all States.

The population control for Louisiana was adjusted downward by 6.3 percent, and that for Mississippi was adjusted downward by 0.7 percent. The Texas control was adjusted upward by 0.64 percent, while the controls for Georgia and Alabama each rose 0.31 percent. (There was little or no impact on the remaining States.) It is important to note that, whereas these adjustments had a proportionate impact on levels of employment and unemployment, they had no effect on the unemployment rate.

Although the Census Bureau undertook extraordinary efforts to collect data in the months following Katrina, the usual monthly CPS estimates for the Katrina-affected Census Divisions and States were not as affected by the disaster as were other important economic series—in particular, the nonfarm wage and salary estimate and the count of unemployment insurance (UI) claimants. The sample in the affected States captured few Katrina victims. Standard estimation procedures were followed for those contacted, thus biasing the results.

Nonfarm wage and salary employment inputs to LAUS. The nonagricultural wage and salary estimates from the CES program are used as basic employment inputs for several LAUS estimating procedures—most notably, as variables for the State employment models. CES data also are used in adjusting place of employment to place of residence and as current inputs to labor market area employment, where available. Although the CES input typically is not a major contributor to the LAUS State model employment series, CES metropolitan area estimates are important in those areas.

For the September 2005 CES estimates, the Bureau and its State partners made several adjustments to the usual estimation procedures. These adjustments, which were designed to help the estimates reflect the employment situation more accurately for September, can be summarized as follows:

- Imputation procedures for survey nonrespondents were modified in the most heavily affected disaster areas in order to recognize the likelihood of temporary or permanent business deaths.
- Sample weights were adjusted as needed for sample units in the more broadly defined disaster area to compensate for lower-than-average survey response rates.
- The business net birth-death model used for adjusting sample-based employment estimates was left unchanged for national estimates, aside from its use in reporting an employment of zero from affected businesses, but was modified for States and metropolitan areas in recognition that the statistical relationship between business births and deaths may have changed in the disaster areas.⁴

The net result of the changes made to CES estimating procedures resulted in lower employment estimates for Louisiana than were

seen in the CPS employment estimates, but surprisingly, for Mississippi, the impact on CES employment estimates was relatively small and of much shorter duration than it was on CPS employment estimates.

UI statistics and LAUS estimation. The Federal-State UI program provides unemployment benefits to eligible workers who are unemployed through no fault of their own and who meet other eligibility requirements of State law. UI payments are intended to provide temporary financial assistance to unemployed workers. Each State administers a separate program within guidelines established by Federal law. The State law under which UI claims are established determines a worker's eligibility for insurance, benefit amounts, and the duration of benefits.

Statistics from the UI systems are the only current measure of substate unemployment available at the county and city levels and thus are important inputs into subnational labor force estimation. As an administrative statistic, the UI data reflect not only the economic fluctuations related to layoffs, but also noneconomic elements of the State's UI law and of the State's administrative practices. Each State has its own set of laws defining both the individual's eligibility for UI, based on requirements on earnings and length of work, and his or her qualification for benefits, based on the nature of the job loss and continuing efforts to actively seek work. The State laws have coalesced to a significant extent, but still, an insured unemployed worker in one State may not qualify for benefits in another State, and differing levels of earnings may be "forgiven." States also have the ability to affect the administration of the UI system. Historically, this aspect was reflected in such decisions as how often the individual had to report to the UI office and which local office was visited. Over the years, the impact of administrative factors such as frequency of reporting and place of filing has diminished as more and more workers file claims over the Internet or by telephone.

Because of these issues, rather than resorting to the raw administrative UI data, the Bureau requires that States both produce special tabulations of UI data that bring the statistics closer to CPS concepts and use these data in LAUS estimation. Each month, unduplicated counts of individuals certifying their unemployment for the week that includes the 12th of the month (the CPS reference week) are developed by keying on the Social Security number of the claimants and the ending date of the week of certification. Claimants are identified by place of residence (State, county, and city) rather than place of filing. In accordance with the CPS employment classification, claimants with *any* earnings due to employment in the week of certification are treated as employed and are removed from UI inputs to the LAUS program.

At the State level, the UI claims count typically is not a major contributor to the LAUS unemployment estimate, for the simple reason that, for the Nation as a whole, the ratio of UI claims to

total unemployment is about 34 percent. At the substate level, however, UI data are important to the unemployment estimates, because the data are current and pertain to the place of residence of the individual and because no other direct estimates of unemployment are available. For labor market areas, the LAUS program uses UI data on the basis of the State and county or parish of residence, while county, parish, and city claims counts are used to disaggregate labor market areas to smaller geographic units.

When Katrina hit the gulf coast, States processed claims for UI filed by affected individuals in accordance with procedures established in cooperation with the Federal Department of Labor. In the 5-week period following Katrina, Louisiana processed 224,200 new unemployment insurance claims under the State UI program, compared with 193,000 initial claims for all of 2004. (The State also provided disaster unemployment benefits to Katrina-affected individuals who were not otherwise eligible for regular UI benefits. Such individuals are not considered as being in the labor market and thus are not included in LAUS estimates.)

To meet the challenge that the increased, and rising, claims load put on State staff, Louisiana partnered with several States, chiefly Texas, California, Montana, and Georgia, to help input claims from Louisiana evacuees. The State also set up a call center to take claims from customers, collected claims at job centers throughout the State, and visited shelters to assist with claims filed by evacuees. Louisiana also encouraged evacuees to file claims over the Internet and issued instructions for individuals to access the Louisiana Web site. The State indicated that benefits would be paid by direct deposit or by debit cards through automated teller machines and not with paper checks sent through the mail.

Identifying claimants' residences is important for both UI and LAUS purposes and is part of the UI benefit application process. UI staffs need to know where claimants reside in order not only to pay benefits, but also to deliver appropriate employment and training services. LAUS estimates relate to total resident unemployment, so counting claimants where they reside is a key feature of estimation. Louisiana evacuees filing claims in other States identified themselves as Louisiana residents if they continued to consider themselves as living in Louisiana, but temporarily domiciled elsewhere, and were treated as such by the UI system and in LAUS estimation. Evacuees who considered themselves residents of the State in which they relocated and who indicated as much on their UI benefit application were counted as unemployed in that State.

When Katrina hit in September, Louisiana waived a number of key rules that normally apply for seeking and receiving UI benefits. Because many individuals did not have complete documentation to prove where and how long they worked, the State waived eligibility requirements for individuals who submitted initial claims for benefits. Owing to communications issues after the hurricane, the State waived the Federal requirement that

Who are the Louisiana unemployment insurance claimants?

A look at the demographic composition of Louisiana and New Orleans unemployment insurance claimants before and after Katrina

In August 2005, there were 31,797 continued claimants for unemployment insurance (UI) in Louisiana. (The claims of these persons are specifically extracted and processed for LAUS requirements: they relate to individuals who have claimed unemployment in the CPS reference week—the week including August 12—and have no earnings associated with employment.) Twenty-eight percent, or 9,011, of the total claimants were residents of the New Orleans metropolitan area.

Just over half of the statewide claimants for the month were black, and half were women. Sixteen-to-nineteen-year-old claimants were less than 1 percent of the State total, while 20-to-44-year-old claimants were three-fifths of the total, and claimants 45 and older made up nearly two-fifths.

The demographic picture of claimants in New Orleans in August was similar to the statewide distribution. Slightly less than three-fifths were black (57 percent) and just over one-half were female (53 percent). Less than one percent were 16 to 19 years old, three-fifths were 20 to 44 years, and two-fifths were 45 years and older.

After Katrina hit the gulf coast at the end of August, claimant counts rose dramatically. September claims more than tripled in Louisiana, to 147,126, while New Orleans claims increased to 58,275, more than 5 times their August level.

Women and young claimants posted the most dramatic increases in September. Statewide, the number of women claimants quadrupled, and the women's share of total claimants rose to 56 percent. In New Orleans, the number of women claimants rose fivefold, and their share of the total claimant pool increased to 58 percent. Young claimants (16-to-19-year-olds) in Louisiana totaled 2,639 in September, up from 170 in August.

The ethnic composition of claimants shifted in September, becoming less black. Blacks made up 42 percent of statewide claimants in September, compared with 51 percent in August. In New Orleans, the change was more dramatic: the proportion of black claimants fell to 29 percent in September, from 57 percent in August.

Claims levels continued to rise in Louisiana in October (by 8 percent) and November (by 2 percent). The September pattern of black and women claimants persisted through November.

Claims levels fell dramatically in December as the State reinstated requirements for claimants to report their unemployment weekly and to verify that they were actively searching for work. Statewide claims fell 57 percent, to 70,103 from the 162,112 posted in November, while New Orleans levels dropped to 25,027 from 61,538.

The number of black claimants decreased by almost half in December, and the black proportion of total claimants was again 50 percent, the August proportion. Women claimants fell by slightly more than half, but women were three-fifths of total claimants, still above their August share. Claimant levels in each of the three age categories dropped substantially, but the proportions of claimants by age remained stable: 1 percent for 16-to-19-year-olds, nearly three-fifths for 20-to-44-year-olds, and two-fifths for those aged 45 years and older.

April 2006 claimant levels were substantially below those posted in December and also were below August levels, both statewide and in New Orleans. The demographic profile in April returned to the pre-Katrina August picture, with blacks and women each slightly more than half of the total claimants.

NOTE: Tabulations of demographic characteristics of UI claimants are from the BLS Program to Measure Insured Unemployment Statistics (PROMIS), designed to facilitate State production of appropriate UI inputs for the LAUS and Mass Layoff Statistics programs. State claimant files are formatted according to established BLS specifications for each program. The claimant data discussed in this box relate to unduplicated counts of individuals who certified that they were unemployed in the week including the 12th of each month (the CPS reference week) and who have no earnings from employment in that week. This article represents the first time that the Bureau is using the PROMIS system to issue tabulations of demographic characteristics of UI claimants. Special thanks are extended to Jamie Cross Kennedy of the BLS Dallas-Kansas City regional office, who provided the PROMIS databases to national office staff, and to Brad Jensen, economist in the Office of Employment and Unemployment Statistics, who developed the tabulations.

claimants contact the State Department of Labor weekly to report that they looked for work and that they were available for work. The State felt that it was important to get benefits to displaced workers as quickly as possible. As a result of the waiver, claims counts rose dramatically in September, October, and November. On November 27, Louisiana reimposed the requirement that claimants call weekly to certify that they continue to look for work and that they are available for work. Thereupon, the December claims count for Louisiana fell dramatically, but not to pre-Katrina levels, and it has remained at that slightly elevated level to date.

The administrative actions of temporarily waiving and subsequently restoring contact and reporting provisions by Louisiana had a major impact on not only the UI claims data, but also the decisions taken to adjust the State's LAUS unemployment estimate. Although the number of claims also rose in Mississippi, there did not appear to be any clear administrative impact on the series.

The box on page 33 presents a profile of the Louisiana UI claimants.

Adapting State labor force estimates to reflect Hurricane Katrina. To produce monthly employment and unemployment estimates for all 50 States and the District of Columbia, time-series models are applied to CPS estimates. Time-series models provide a way of reducing variability in the direct survey estimates related to small sample sizes. Each State has two separate models, one for unemployment and the other for employment. Each model uses an auxiliary series along with the CPS in a bivariate framework to estimate the underlying trend. For unemployment, CPS unemployment and UI claims are used, while for employment, CPS and CES employment are used. In this bivariate framework, the model of the CPS trend depends not only on the past history of the CPS series, but also on correlations of the CPS with the past history of the auxiliary series.

The importance of the non-CPS variable in explaining the trend in the CPS depends on the strength of the correlation between the two series, which, in the case of Louisiana and Mississippi, the two States most affected by Katrina, is relatively low for both employment and unemployment. As a result, the historical trend and seasonal pattern in the CPS are given by far the most weight in the estimation of total unemployment and employment. This strong reliance on CPS data raised special problems in estimation because, as mentioned earlier, the CPS sample-based estimate did not reflect the impact of Katrina on the labor force.

Although the use of models produces estimators with much smaller variances than those of the direct survey estimates, models can break down. The most dramatic type of breakdown occurs when an unexpected external shock that occurs in real time results in a large shift in the level of the series. Because this shift is unrelated to the historical past, the model will be slow to adapt to the new level. Even when a large shift is detected, prior information about its cause is rarely available, and it is difficult to

determine the appropriate action to take until additional data become available.

In order to provide protection against nationwide shocks to the economy, the LAUS State model estimates are constrained through real-time benchmarking, so that the sum of the monthly State model estimates equals the monthly national CPS values, which are far more reliable than any State estimate. Thus, if there is a nationwide shock that affects most States, the benchmarked estimators will reflect this change much faster than the model-dependent estimators.

Benchmarking actually takes place in two stages. First, States are grouped into nine Census Divisions, and the aggregate CPS Division employment and unemployment series are modeled and then constrained to add up to the monthly national CPS estimates. These adjusted Division model estimates serve as benchmarks for constraining the State estimates within each of the Divisions to sum to their respective adjusted Division estimates. In this way, all of the State model estimates sum to the national CPS estimates and therefore will immediately reflect national disturbances.

Katrina challenged the LAUS State model-based methodology in a number of respects. First, the CPS inputs—the core of the estimation—did not reflect the labor market impact of Katrina. Second, real-time benchmarking did not afford protection to the LAUS estimates for Louisiana and Mississippi, because Katrina was a local shock and not a national one. Third, with the CPS not reflecting the effect of Katrina, reliance was shifted to the auxiliary variables to provide information on the appropriate interventions. Last, decisions had to be made each month as to the nature of the actions to be taken.

Adapting to local shocks. While real-time benchmarking builds protection against national shocks into the LAUS estimation system, no such protection is afforded for shocks confined to a small number of States with little, if any, impact on the national economy. Information about local shocks is confined to each of those States' sample data, for which sampling variability is very high. Therefore, adapting to local shocks is much more difficult than adapting to national shocks. Special intervention is required to modify the models so that they can adapt immediately to the shock. Hurricane Katrina is an example of a local shock affecting only a few States.

Shocks can affect a time series in many different ways, changing its level, either abruptly or after some delay, changing the growth rate of the series, or leading to other, more complicated response patterns. Specifying a model to address a shock assumes that a lot is known about the shock, such as when the disturbance first occurred, how long it will last, and how the magnitude of the effect varies over time. When this information is known, the model used is referred to as an "intervention" model.

A common form of intervention is referred to as a *level shift*—an abrupt shift in the level of a series at consecutive points in

time, with the shift assumed to be fixed over time. If the shift is not permanent, it is referred to as a *temporary level shift*. If the shift is for one period only and is followed by an immediate return to the normal level of the series, the shift is referred to as an *additive outlier*. The important issues having to do with the intervention relate to its duration and the pattern of recovery of the labor force to the initial damage from the hurricane.

Adjusting a model to respond immediately to an intervention effect is equivalent to augmenting the model with a 0/1 regression variable (dummy), where 1's denote the times at which the intervention is present and 0's the times at which it is absent. The regression coefficient for this variable is a measure of the effect of the intervention.

In practice, interventions are rare in LAUS models. Outliers may occur that require adjustment because they do not conform to the behavior expected by the model, but, unlike the situation with interventions, there is no prior information about their occurrence and there may be no identifiable events to explain them. Heavy reliance is placed on statistical testing to identify outliers, given that visual inspection is often unreliable. Ignoring these observations is not feasible if they seriously distort diagnostic tests and weaken the model's fit. The most effective treatment of an outlier is when there is a large number of months of data before and after the occurrence of the outlier; such data aid in determining the appropriate intervention. Although monitoring for outliers is ongoing, attempting to correct for outliers in real time is not possible, and, in practice, at least 1 year of data following the occurrence of the outlier is required for adjustment.

Modeling the reaction to Katrina at the State and Division levels. A "wait and see" approach to modeling the effect of Katrina was not an option. Because the hurricane's destructive power had such an immediately large impact on the labor force in the affected States, timely corrective action for the Louisiana and Mississippi models was required. Katrina appeared to be a classic intervention, because it was an identifiable exogenous disturbance with a known date of occurrence. However, there were some unusual limitations in data, and the path of the recovery in the labor force was not known.

As discussed earlier in relation to the CPS, the estimates for the Nation and for Louisiana and Mississippi did not appear to reflect the effect of Katrina between August and September. In fact, Louisiana's unemployment estimate from the CPS dropped by a nonsignificant 4,000 in September. Mississippi's employment fell by 40,000, which also was not statistically significant.

In contrast, the CES and UI statistics clearly showed hurricane-related effects. (See table 1.) Louisiana UI claims, as specially processed for LAUS, reached a high of 147,000 in September, 5 times the August level of 32,000. The previous high for the series, which begins in 1976, was 82,000, in March 1983. The Louisiana CES payroll employment estimates fell by an unprecedented 11

Table 1. Effects of Katrina on UI claims and CES payroll employment, September 2005–June 2006

Month and year	Louisiana		Mississippi	
	UI claims	Change in CES employment	UI Claims	Change in CES employment
September 2005 ..	117,682	-225,600	49,630	-20,320
October 2005	130,639	-225,600	35,406	-10,963
November 2005	129,839	-225,600	32,384	0
December 2005	36,493	-225,600	16,730	0
January 2006	23,315	-206,604	9,172	0
February 2006	0	-200,152	5,484	0
March 2006	0	-201,867	0	0
April 2006	0	-217,095	0	0
May 2006	0	-217,095	0	0
June 2006	0	-221,494	0	0

percent. The previous largest monthly decline was 3 percent, in January 1977. Mississippi's UI claims also showed a dramatic September increase, to 66,000, 3.5 times the August level. The previous high of 45,555 occurred in February 1983. Surprisingly, CES payroll employment in Mississippi showed only a modest decline—a relative decrease of 1.5 percent.

To address the problem of estimating an effect that is largely unobserved in the CPS sample with a model that puts relatively little weight on the auxiliary variables—which, for the most part, were strongly affected by Katrina—those variables and their models were used to estimate the effect of Katrina. This was done by adding intervention variables to the models for the auxiliary variables, imputing the effects of those variables to the CPS sample data, and then producing estimates of total employment and unemployment from the CPS models fitted to the corrected sample data. Such an approach effectively puts much more weight on the auxiliary variables than is normally allowed by the structure of the bivariate model.

Two critical assumptions were required: that the UI and CES estimates fully reflect the effect of Katrina and that the CPS undercoverage bias is proportional to that effect in the auxiliary variables. Thus, on a monthly basis, as the CPS and CES estimates and the UI data were provided to the Bureau, the following steps were taken to adjust the State labor force estimates developed by the LAUS model: (1) the Katrina effect was estimated in the UI and CES models; (2) the respective effect was then imputed to the CPS proportionally at the State level and to the Division; (3) next, the CPS models were estimated with the appropriate intervention; and (4) finally, the State model estimates were benchmarked to the adjusted Division controls and to the adjusted national levels.

Step 1 was a learning process that required respecification of some of the auxiliary models as new data became available and previous interventions had to be reestimated. For example, the Louisiana UI model was initially specified as a fixed level shift in September, and this specification was carried forward in October

on the assumption that claims would remain at that level. Instead, claims increased more in October, necessitating a respecification of the September intervention as an additive outlier, with October as a fixed level shift. The situation became further complicated by the significant drop in UI claims in December as the administrative easing of filing requirements was lifted.

In addition, the LAUS State operating system was not designed to accommodate real-time interventions, so special fixes had to be made to the core software each month to reflect the peculiarities of the Katrina effect. The timing each month is very tight. Regular processing occurs in about a 4-day period. Evaluating State inputs, determining the appropriate model intervention, and then respecifying the State models was accommodated in this tight timeframe.

Charts 1 through 4 show employment and unemployment estimates for Louisiana and Mississippi from January 2006 through June 2006. For the unemployment estimates, the UI claims series is provided, as are the CPS series before and after adjustment and the modeled estimates benchmarked to the Division. These charts clearly display the nature of the two States' adjustment to Katrina over the period.

Adjustments to CPS unemployment and employment to reflect hurricane effects in Louisiana and Mississippi also were added to their respective Census Division totals and to the national totals, in order to have consistent controls for benchmarking. The national CPS estimates released in official BLS publications do not include these special adjustments, because they had a marginal effect on the Nation as a whole.

The modifications for Louisiana were incorporated into the West South Central Division, and interventions were made. These effects were constrained to equal those in the Louisiana models, in order to prevent adverse spillover effects in the other States that also are benchmarked to the Division estimates. The Mississippi modifications were reflected in the estimates for the East South Central Division, but interventions were not needed in these models.

Table 2 shows the estimated Katrina effect on the labor force for Louisiana and Mississippi. For example, in September the unemployment rate for Louisiana was increased by 6.4 percentage points and employment was reduced by 232,000. The resultant estimates for Louisiana and Mississippi from August 2005 to June 2006 are given in table 3, which reflects the Katrina effect presented in table 2.

With the Katrina effect incorporated into the model, the Louisiana unemployment rate doubled from about 6 percent to 12 percent in September. In December, it fell back to 6 percent, although the number of unemployed for the month remained slightly above the prehurricane level. (See table 3.) By January 2006, the Katrina effect had disappeared.

The estimated loss in Louisiana employment was about 232,000 from September onward, 11 percent below the number of persons employed in August. The failure of the employed to

recover to previous levels differs sharply from the recovery in the number of unemployed. This difference, a reflection of the contrasting behavior of payroll employment and UI claims, reinforces the impression that the drop in claims, as well as the unusual increase in September, was in part reflecting changes in administrative rules to help provide relief to hurricane victims.

In Mississippi, the initial response to Katrina was a rise in unemployment by about 30,000 and in the unemployment rate by almost 3 percentage points. The normal September decline in the rate was reversed with a net increase from 7.4 percent to 9.4 percent. The Katrina effect resulted in a persistent drop in employment of about 58,000 persons lasting since September 2005. This behavior contrasts with the quick recovery in the CES payroll employment.

In sum, the initial effect on unemployment was very strong, but temporary, in both States. Employment, however, continues to be depressed. This is so in Mississippi even though CES employment returned to prehurricane levels 2 months after Katrina hit the State.

Adapting substate labor force estimates to Hurricane Katrina. A complex methodology is used to develop labor force estimates for labor market areas and their components. This methodology also had to be adjusted to reflect the impact of Katrina. After evaluation of the September data, it was determined that the adjustments were confined to selected areas in Louisiana.

A number of improvements to the program, both in methodology and procedures, were introduced into LAUS estimation beginning with January 2005. Two such improvements were extending model-based estimation to six metropolitan areas, including the New Orleans metropolitan area, and improving the method of adjusting place of employment to place of residence. The modeling method in use for the New Orleans metropolitan area up to August 2005 is similar to the Division models in that the models take only the CPS values into consideration in developing labor force estimates.

Because of the devastating damage done to New Orleans by Katrina, two parishes—Jefferson and Orleans—were under mandatory evacuation orders, and CPS data collection was not possible in those parishes in September. In response, model-based estimation for New Orleans ceased with August estimation, and the area reverted to the estimation methodology used for most of the labor market areas in the Nation and for New Orleans prior to January 2005. The latter methodology utilizes a building-block approach to estimation and incorporates data from the CES and UI programs. This estimation methodology continues to be used to develop labor force estimates for the New Orleans metropolitan area.

In the LAUS methodology, estimates of nonagricultural wage and salary workers from either the CES survey or the Quarterly Census of Employment and Wages (QCEW) are adjusted to

Chart 1. Louisiana unemployment, January 2005–June 2006

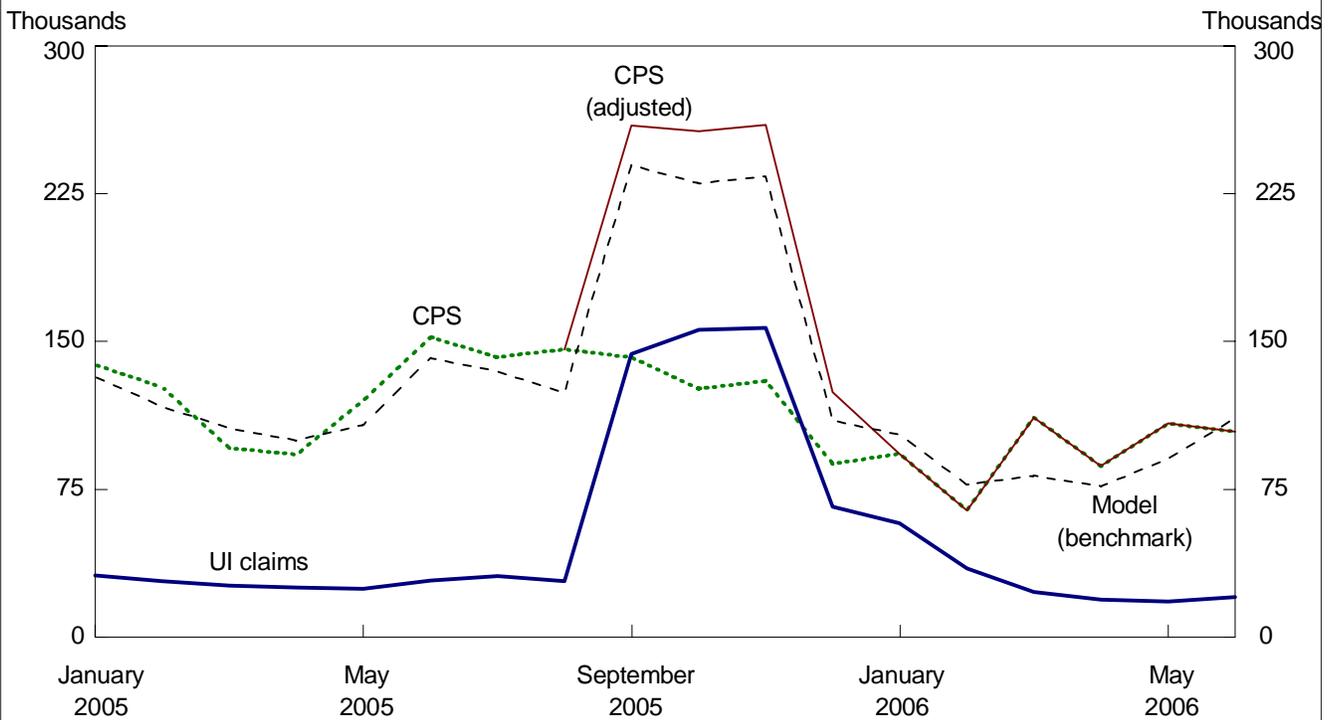


Chart 2. Louisiana employment, January 2005–June 2006

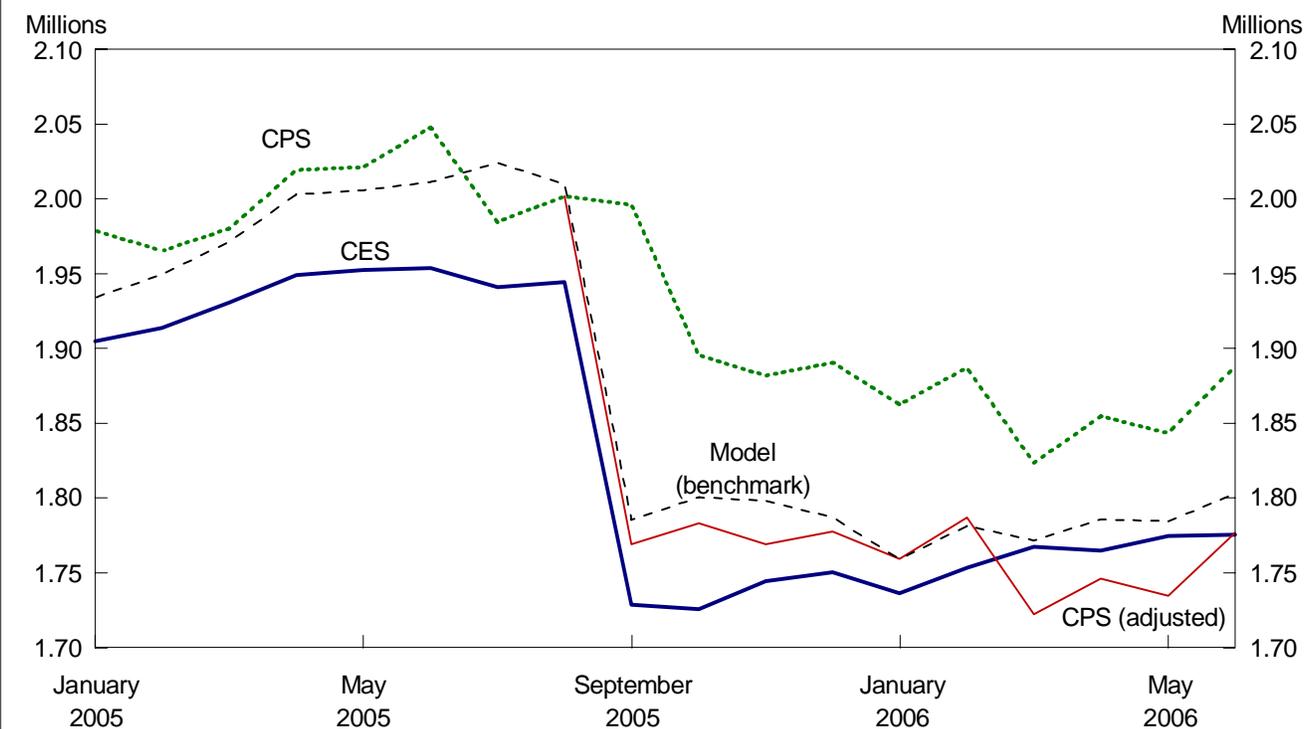


Chart 3. Mississippi unemployment estimates, January 2005–June 2006

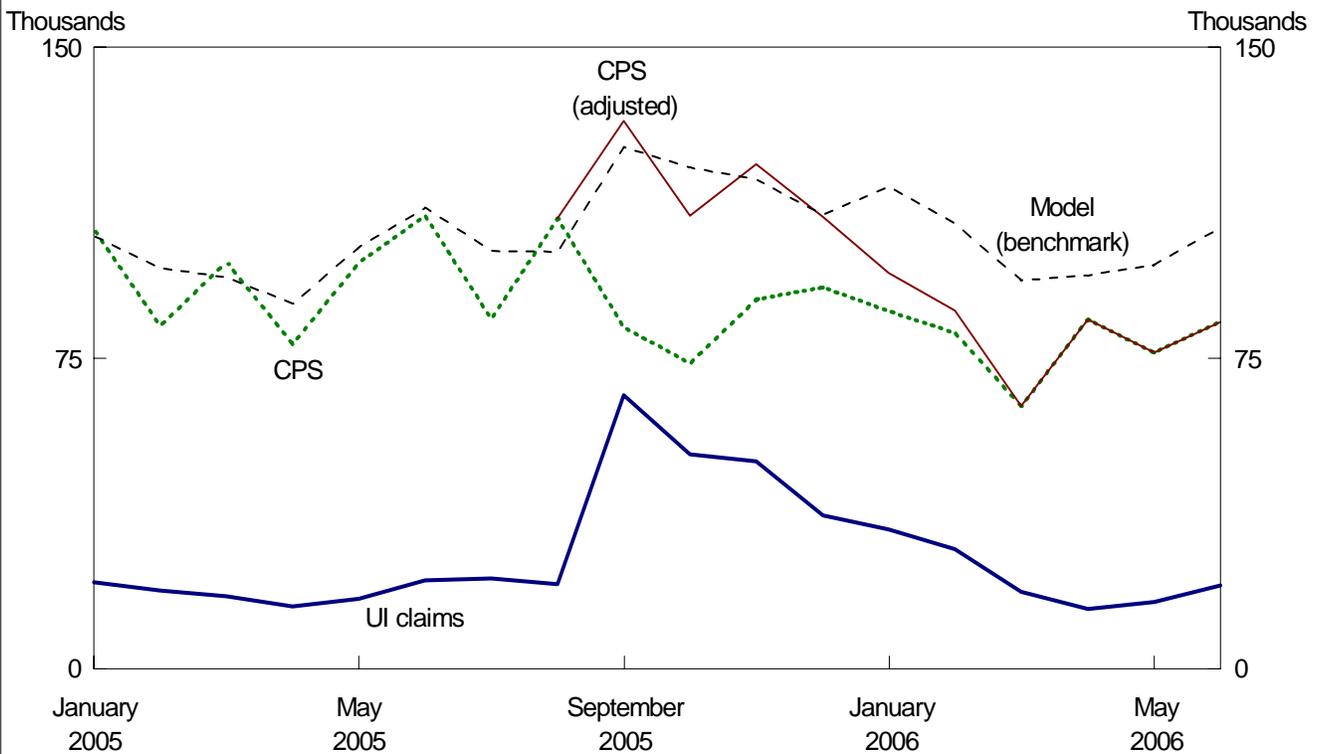


Chart 4. Mississippi employment estimates, January 2005–June 2006

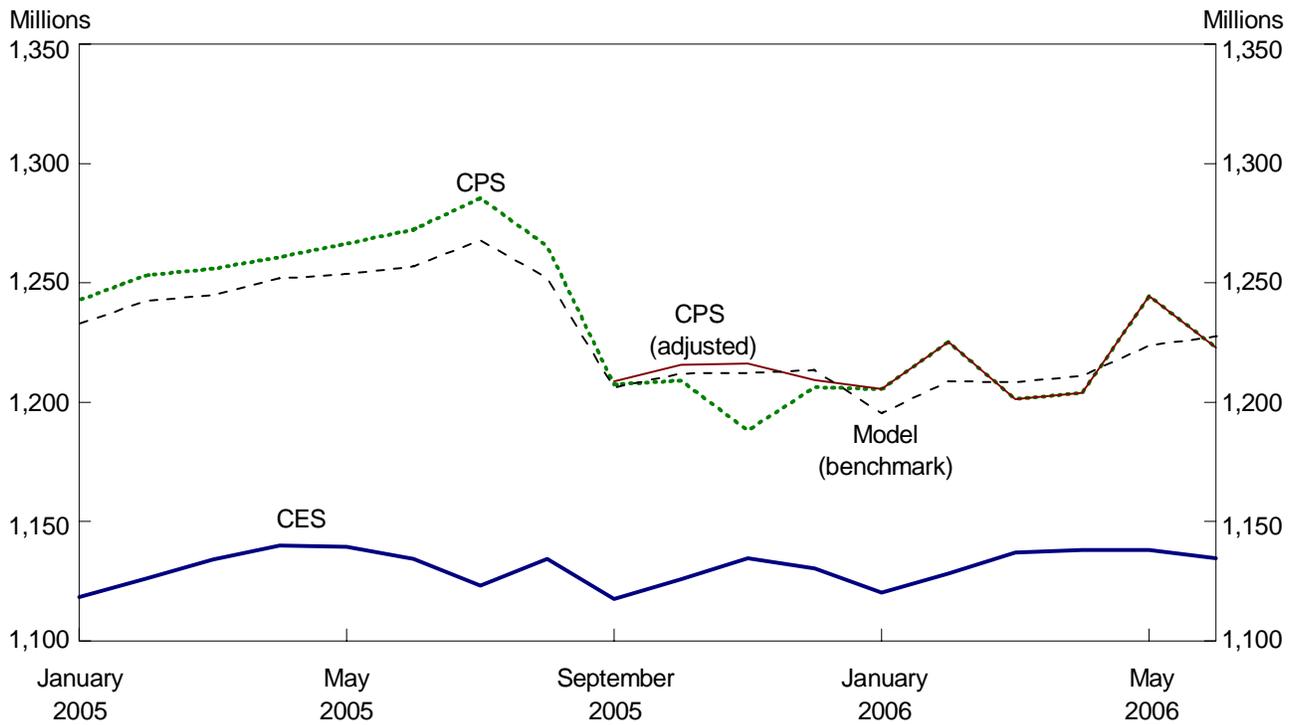


Table 2. Effects of Katrina on the labor force, September 2005–June 2006

Month and year	Louisiana				Mississippi			
	Change in unemployment rate	Change in unemployment	Change in employment	Change in labor force	Change in unemployment rate	Change in unemployment	Change in employment	Change in labor force
September 2005	6.36	122,896	-232,027	-109,131	2.86	36,635	-58,137	-21,502
October 2005	6.20	120,161	-232,485	-112,325	2.16	26,542	-58,183	-31,641
November 2005	6.32	122,747	-231,997	-109,250	2.07	25,247	-58,040	-32,793
December 200569	1,250	-232,363	-231,113	1.23	13,143	-58,042	-44,899
January 2006	0	0	-232,253	-232,253	.86	7,124	-57,986	-50,863
February 2006	0	0	-232,340	-232,340	.65	4,279	-57,970	-53,691
March 2006	0	0	-232,239	-232,239	0	0	-58,053	-58,053
April 2006	0	0	-232,147	-232,147	0	0	-58,000	-58,000
May 2006	0	0	-232,106	-232,106	0	0	-58,002	-58,002
June 2006	0	0	-232,055	-232,055	0	0	-58,021	-58,021

Table 3. Effects of Katrina on total unemployment and employment, September 2005–June 2006

Month and year	Louisiana				Mississippi			
	Unemployment rate	Unemployment	Employment	Labor force	Unemployment rate	Unemployment	Employment	Labor force
August 2005	5.8	123,996	2,010,170	2,134,166	7.4	100,611	1,252,027	1,352,638
September 2005	11.8	239,469	1,785,458	2,024,927	9.4	125,856	1,206,092	1,331,948
October 2005	11.3	230,284	1,800,566	2,030,850	9.1	120,961	1,212,044	1,333,005
November 2005	11.5	233,786	1,798,263	2,032,049	8.9	118,020	1,212,267	1,330,287
December 2005	5.8	109,857	1,787,137	1,896,994	8.3	109,289	1,214,347	1,323,636
January 2006	5.5	102,723	1,759,230	1,861,953	9.1	120,051	1,195,409	1,315,460
February 2006	4.2	77,592	1,781,372	1,858,964	8.6	113,600	1,208,849	1,322,449
March 2006	4.4	81,880	1,771,828	1,853,708	8.0	104,698	1,208,433	1,313,131
April 2006	4.1	76,683	1,785,879	1,862,562	7.3	94,931	1,211,088	1,306,019
May 2006	4.8	90,481	1,784,516	1,874,997	7.4	97,443	1,223,777	1,321,220
June 2006	5.8	110,923	1,802,977	1,913,900	8.0	106,443	1,227,600	1,334,043

reflect the household concept of the CPS. The method employed to adjust the payroll estimates, referred to as the *dynamic residency adjustment*, uses commuting patterns, both into and out of metropolitan areas, to adjust the nonfarm estimates, on the basis of information from the 2000 census. New Orleans was a model-based area, so no additional adjustment for residency was required for the official estimate. However, abandoning model estimation for New Orleans required a consideration of the appropriate method of residency adjustment procedure, especially because the commuting patterns described in the 2000 census were no longer appropriate. Therefore, rather than the dynamic approach (which reflects commuting that no longer exists), a single adjustment ratio that does *not* rely on commuting patterns was put into use. In consultation with the States of Louisiana, Alabama, and Mississippi, the LAUS program reviewed the adjustment ratios for the other labor market areas in the region affected by

Katrina to determine whether further modifications were warranted. Even though it was likely that additional commuting patterns were interrupted by the storm, data to support making a change to the residency adjustment mechanism did not exist.

Also as part of regular data development, monthly labor force estimates are prepared for individual parishes, including the seven parishes of the New Orleans metropolitan area. Beginning with September 2005, the Bureau ceased developing monthly estimates for each parish in New Orleans. Parish estimates are developed from the metropolitan area estimate by means of disaggregation techniques that employ (1) current UI claims data by parish of residence, (2) 2000 census data on population by age and on employment, and (3) intercensal population estimates. Although Louisiana has UI claims data by residence for the parishes that New Orleans comprises, the Census Bureau has not developed official statistics on the population of New Or-

leans, and 2000 census data and relationships clearly have changed.

Communicating with States and the public

The unprecedented nature of Hurricane Katrina and its impact on program operation and estimation resulted in heightened communication with Louisiana and Mississippi staff and with BLS regional staff working on the LAUS program. Obtaining and understanding the State-developed UI and CES inputs, and discussing the interventions planned for the model and their impact on State and Division estimates, required monthly conference calls with State and regional staff. Often, calls were conducted with State and regional staff in all of the States of the East South Central and West South Central Divisions.

During this time, the Bureau made every effort to accommodate States' requests for assistance in understanding the intervention process and its impact on their estimates. State efforts to provide input data to the Bureau ahead of schedule allowed BLS staff to develop and implement the model interventions with no significant impact on preannounced release schedules.

The Bureau took pains to keep users informed of the actions taken to ensure that the impact of Katrina was reflected in the labor force statistics for all States. From the outset, information about modifications being made to BLS programs, background information for the affected region, and frequently asked questions were placed on the BLS Web site.

LAUS PROGRAM ESTIMATION IS COMPLEX AND INTERDEPENDENT: each month, State labor force estimates are developed and controlled to Division estimates, which in turn are controlled to national estimates of employment and

unemployment. The complexity of this approach and its real-time benchmarking to monthly national labor force estimates was stretched in responding to the effects of Hurricane Katrina.

Unusual circumstances limited the effect of Katrina on the CPS. Acknowledging the fact that Katrina effects were not evident in the State CPS estimates, but appeared in the State CES and UI series, the LAUS program shifted the basic relationship of the State models to place more weight than normal on these supporting variables. While that did give a depiction of the impact of Katrina on employment and unemployment that followed those other series, in Louisiana the UI claims series was greatly affected by administrative decisions made by the State regarding the payment of unemployment insurance. On the employment side, some employers continued to issue checks to employees who might have been receiving UI benefits. Despite the unusual circumstances, the UI and CES series were the best indicators of the effect of Katrina at the time. Major modifications to models for Louisiana and Mississippi were necessary to reflect the effect of the hurricane on each State's labor force. The modifications were carried up to the Division models.

Identifying outliers in the data in real time and taking the appropriate action is extremely difficult. Is the outlier a 1-month phenomenon, or does it represent the start of a level shift in the series? Will the series remain at the new level for some time, or will it return to the old level after a certain duration? Because of the nature of Hurricane Katrina, the longstanding LAUS policy of not intervening in model estimation during the course of the current year was ignored, and intervention occurred in real time. The form of the outlier was determined initially by 1 month's data, and the form changed as more information was obtained with the passage of ensuing months. The entire course of events resulted in significant revisions to previous estimates. □

Notes

ACKNOWLEDGMENTS: The authors thank Lisa Williamson for the development of maps of Louisiana and Mississippi, and Jennifer Oh for the preparation of the tables and charts, used in this article.

¹ For a detailed discussion of the LAUS program, including its methodology, visit the program on the Internet at <http://www.bls.gov/lau/home.htm>. For a description of the modeling methodology, see Richard Tiller, "Model-based labor force estimates for sub-national areas with large survey errors" (Bureau of Labor Statistics, March 2006), on the Internet at <http://www.bls.gov/ore/pdf/st060010.pdf>.

² According to the website <http://geography.about.com/cs/largecities/a/metromicro.htm>, a Micropolitan Statistical Area has at least one urban cluster of at least 10,000, but less than 50,000, population.

³ For a complete discussion of the impact of Katrina on the CPS, see Sharon P. Brown and Patrick Carey, "Conducting the Mass Layoff Statistics program: response and findings," this issue, pages 70–75.

⁴ For a complete discussion of the impact of Katrina on the CES program, see "Hurricane Katrina's effects on industry employment and wages," this issue, pages 22–39.