of Iran and Afghanistan. At this time Afghanistan does not make full use of its natural gas and its potential for the generation of electricity. The former (which accounts for 11 percent of the country's exports) is all exported to the USSR; in the PIA region, wood is a scarce resource used for heating homes and industries and for cooking. Natural gas or electricity could be substituted for this purpose.

The results of CIT can also be used during the planning phase. For instance, a scenario in which drought was imposed as an uncontrolled event was added to Table 2 with a 0.50 probability of occurrence by the year 1990. After its relations with the other events had been determined, the resulting 26x26 matrix was used as a basis for a single run through 1000 interactions. The drought decreased the final probability of occurrence of the following events by 0.30-0.40:

E_{11}: Increase in life expectancy,
E_{13}: Decrease in infant mortality rate, and
E_{10}: Increase in food production.

The conclusion from this analysis is that agricultural productivity and food-storage capacity must be increased to cope with food shortages. Similar to drought, other unexpected events (war, invasion, etc.) should also be added to test their impacts during the planning phase.

In general, the proposed KRR, its impact-identification process, and the application of CIT to measure the overall developmental effects of the railway were analyzed in a systematic fashion that might serve as a model for similar undertakings.

Other potential events should also be tested to measure their likelihood of occurrence relevant to the construction of KRR. To enhance sound economic development and to maximize the efficiency of investment, all the region's modes of transportation should be used.

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Forecasting Economic and Demographic Change in Slow-Growth Economy

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Application of a regional population and employment forecasting model to a slowly growing metropolitan area, the Kansas City Metropolitan Region, is discussed. The model used integrates an econometric approach to employment forecasting with a cohort-survival approach to population forecasting. The labor-market adjustments required to ensure that the demand for and supply of labor are in equilibrium are based on the proposition that labor supply continually responds to labor demand. The major problem encountered in applying the model to the Kansas City Metropolitan Region was employment forecasts that did not correspond to current trends or theoretical expectations and that arose because of inconsistent modeling of the labor supply-and-demand interactions. Once the model had been respecified, reasonable forecasts were achieved. The implication for other slowly growing areas is that some current methods of modeling metropolitan growth may not adequately capture the nature of a stagnant economy. The magnitude of factors that are relatively uncertain, such as unemployment and labor-force participation rates, becomes critically important in such economies because there are few other sources of change in the supply of labor. The adjustment of such factors must therefore be made explicit in the forecasting process. This is the first part of an overall forecasting effort currently being implemented under several federally sponsored programs by the region's metropolitan planning organization, the Mid-America Regional Council.

One major requirement for planning highway and transit improvements, future economic development needs, and infrastructure additions and for analyzing impacts of air and water quality is information about future population and employment growth and location. These types of analyses are the charge of the metropolitan planning organization of the Kansas City Metropolitan Region (KCMR), the Mid-America Regional Council (MARC). However, in the past MARC has not always been able to construct these analyses by using soundly developed economic and demographic information. The data often did not reflect the most current information and were available for a very limited set of variables. Also, there existed no method by which the effect of currently interesting policies could be systematically examined for their impact on people and jobs. To aid in the provision of better information so that decisions based on MARC's analyses take into account a more realistic idea of future development consequences, MARC decided to implement a set of state-of-the-art computerized forecasting models.

The regional forecasting process engaged by MARC can be divided into four major steps; each step examines the metropolitan region from a slightly different perspective. The first step examines the region's overall potential for economic and population growth. The second step examines the effect of regional growth on small areas within the region.

The third step analyzes the travel demands that result from the forecast activity distribution. Finally, the outputs from the first three steps are combined to assess the impacts of various policy alternatives. The purpose of this paper is to describe the development and results of the first step in the overall forecasting process, the forecasting of population and employment for KCMR as a whole.

OVERVIEW OF KCMR ECONOMY

According to the Bureau of Economic Analysis, KCMR has experienced continued growth in employment since the 1950s (1). The current growth rate in employment is approximately 2 percent/year, which is about the same as it has been in the past. However, the rate of employment growth in KCMR has fallen relative to that for the nation since 1950 and is in fact currently below that for the nation for the first time in more than 30 years.

Census Bureau figures for 1950, 1960, and 1970 indicate that the population growth in KCMR has decreased dramatically from 1950 to 1978 (2), and there has been a far more severe decline in KCMR than in the nation as a whole. Indeed, the region's population growth rate is now about half that of the nation (3). Part of the explanation for this lower growth in population is that the labor-force participation rate (LFPR) is higher than average in KCMR, especially the participation rate of women. To meet a growth in employment similar to that of the nation, KCMR has historically required less population to supply the appropriate quantity of labor. Moreover, the region's labor force is highly mobile in response to changes in employment prospects. Census Bureau figures indicate a net outmigration of approximately 30 000 from 1970 to 1978.

Although such mobility has kept the KCMR unemployment rate down (it averages about 1.25 percentage points less than that for the nation during the 1970s, according to figures from the Kansas and Missouri Divisions of Employment Security and Census Bureau statistics for 1979), this also points to a problem. The KCMR economy has not created sufficient jobs to retain all its potential labor force in the region and resources are being lost to other metropolitan areas.

An examination of the industrial structure of employment reveals the nature of the problem. The industries that grew least relative to growth for the nation during the 1970s are mining, manufacturing, transportation, communications and public utilities, and wholesale trade. With the exception of mining (which is of little significance in KCMR), these are industries in which KCMR has traditionally enjoyed a competitive advantage due to its location in the geographic center of the country and at the intersection of two major rivers. Yet they are precisely the industries that are not competing well with those of other regions, and this is reflected in the demand for labor. The other sectors of the economy grew at rates comparable with or exceeding those of the nation. However, they are not industries that take particular advantage of KCMR's locational characteristics. Without strong growth in the industries that can take advantage of its central geographic location, KCMR's ability to attract factors of production from other areas or even maintain its existing factors will continue to represent a major problem.

REGIONAL FORECASTING METHODOLOGY

Major Assumptions

For the regional forecasts, two major assumptions were made concerning the interaction between the economy and the population:

1. Labor supply adjusts to labor demand, and
2. Several different mechanisms exist by which labor supply can adjust to labor demand.

Labor Supply and Labor Demand

Although on a national level labor supply and demand are interdependent, at the metropolitan level it is more appropriate to forecast the labor force as being determined by labor demand. Consider the case in which there is a labor shortfall. At the national level, excess demand for labor results in higher wages and a shift toward capital investment to make existing labor more productive; both of these results contribute to a lessened labor requirement. At the metropolitan level, however, such a restraining mechanism is greatly weakened. A metropolitan area in which job opportunities exceed available labor can draw migrants from areas in which the reverse situation is true. The same dichotomy holds in the case of a labor surplus. At the national level, a surplus of labor tends to lead to the substitution of labor for capital as the price of labor falls. But at the regional level, rather than accept a lower wage or unemployment, a more likely response would be for labor to relocate where there is availability of employment.

The regional forecasting model in this study uses national projections of employment to capture the effects of national trends in labor demand and supply. However, once these effects have been taken into account, the assumption is made that demand-supply forecasts are reconciled through supply-side adjustments.

Adjustment Procedures

Changes in the level of net migration, participation rates, and unemployment are perhaps the most readily perceived long-term consequences of an imbalance in a metropolitan region's labor market. Other possible adjustments that can bring labor supply into balance with labor demand include (a) change in wage rates, (b) more efficient use of relatively scarce resources, (c) development of new technology, (d) shift in the type of occupations held from those no longer required to those in demand, (e) change in the rate of commuting into the region, and (f) change in the number of people who hold more than one job.

There is a great deal of uncertainty and little empirical evidence about the relative magnitude of such responses to a given imbalance in the labor market. No model has been developed to satisfactorily predict these types of changes. Yet the relative magnitude of the changes is important because it determines the level of population required for a given employment level.

Model Selection and Original Specification

For the purpose of regional forecasting, the Interactive Population and Employment Forecasting (IPEF) model was selected (4). This model was developed in San Diego and used successfully there and in Dallas-Fort Worth; both of these are rapidly growing regions. Designed to produce medium- to long-range demographic and employment forecasts, the original IPEF model integrates two fundamental forecasting techniques: a cohort-survival method of population forecasting and an econometric approach to employment forecasting. As a result, IPEF is sensitive to the interdependence of demographic and economic forces within a particular region.

In the demographic sector, births are calculated from projections of national age-specific fertility rates (5). Deaths are calculated from national projections of survival rates by age and sex. Aging the previous period's population by five years, adding the births, and subtracting the deaths yields the change in the natural population by age and sex. The final component of population change--net migration--is determined endogenously by the model through the interaction between labor supply and demand.

The region's available labor supply is calculated by multiplying age-specific LFPRs by the natural population by age and sex and summing over all age and sex groups. Through the application of an assumed unemployment rate, a net commuting rate, and a ratio of jobs per employee, this figure is converted to the maximum available supply of labor, which is then compared with the labor demand yielded by the independent employment forecast.

The econometric models used to forecast employment are calibrated on historical data (6,7) to find the past relationship between the dependent and independent variables. The relationship is then applied to exogenous projections of the independent variable to calculate projections of the dependent variable. In the IPEF model, the dependent variable is place-of-work employment for each industrial sector. The independent variable varies as a function of the basic or service characteristics of the industry.

Basic industries are exporting industries, and since they serve national markets, employment in a basic industry at the regional level is assumed to serve exactly the same market as employment in the same industry nationally. National projections of employment are available from the Monthly Labor Review of the Bureau of Labor Statistics. Therefore, each local basic industry is forecast as a function of the performance of the same industry at the national level.

Local-serving industries satisfy local demand for products. Since local demand for goods and services can only be expressed through the expenditure of local income, service industries are forecast as a function of income. However, since income forecasts are not available, a surrogate variable is used--in this case, population.

Once the industrial employment forecasts have been developed, they are summed to produce a total employment figure. This defines the demand for labor. To ensure a balance between the size of the population and labor-force requirements, the labor supply and demand are compared, and the labor supply is adjusted to accommodate labor demand by changing the amount of net migration. Labor-force migrants are then converted to total migrants based on a ratio of total migrants to labor-force migrants derived from national data (8), and they are added to or subtracted from the natural population.

Such changes in the population result in a revised demand for the goods and services of the local-serving sectors, the employment forecast for which must also be adjusted. This changes the total employment and the required level of net migration. Population changes once more, and the process is iterated until an equilibrium is reached. Upon equilibrium, the whole process is repeated for the next five-year forecasting period.

Respecification of Model for Slow-Growth Economy

The original specification of the model produced forecasts that did not correspond to current trends or theoretical expectations, primarily because it did not adequately take note of the characteristics that make a stagnant economy different from one that is rapidly growing. In KCMR, the industries that are growing fastest are the local-serving industries. They also contribute the largest proportion of the total employment. Because rapid economic growth is usually generated from satisfying a national demand, in rapidly growing areas it is usually basic-industry growth that fuels the economy and to which most of the employment is devoted. Since, in the original model specification, the result of labor supply-and-demand interactions is the determination of the local demand variable, population, the significance of the interactions varies directly with the dependence of an economy on local demand for its employment. Consequently, inconsistencies in the modeling of labor supply-and-demand interactions may not be noticed in rapidly growing areas, whereas in an area in which economic growth is slow, such inconsistencies produce serious problems.

Two examples illustrate the sensitivity of the original model specification to labor-market interactions when applied to a slowly growing economy. First, the iterative process described in the preceding section takes longer to equilibrate labor supply and demand when a relatively large segment of the economy depends on the final level of labor supply than when the major portion depends on exogenously generated demand. Over the period 1970-1975, when, in fact, substantial out-migration occurred, the model continued to iterate in response to the perceived excess supply of labor until it predicted an employment decline from 600 000 to 100 000. Actual employment rose slightly over the period.

Second, the model produced unrealistic employment forecasts in response to assumed changes in such labor-supply variables as LFPR, unemployment, net commuting, and jobs per employee. A reduction in the forecast LFPRs by 1 percent (which allows more people to reside in an area, given an employment level) resulted in a 15 percent increase in the local-serving employment growth forecast for the projected period. However, since the people added are not in the labor force, it is difficult to understand why their inclusion should result in an increased locally generated demand for goods and services.

As may now be obvious, the reason the original model specification did not adequately capture the nature of a stagnant economy is that it did not completely abide by the first major assumption outlined earlier--that labor demand be forecast independently of labor supply. Because local-serving employment, a labor demand variable, was being forecast as a function of population, a labor supply variable, the two were made interdependent, which (as was explained in the earlier section) is an unrealistic model of metropolitan labor-market interactions. Therefore, it was decided to use another variable to forecast local-serving employment. However, as the importance of the labor supply variables to a slowly growing economy became obvious, it was also decided to examine the impact of their adjustment process on final population levels more explicitly. The assessment procedure is described in the next section.

One of the difficulties associated with econometric models is their requirement for estimates of the independent variables to make forecasts of the dependent variable. The independent variable must be forecast either exogenously or by the model itself. Exogenous projections of a local demand variable are, however, extremely difficult to make. The IPEF model also does not produce forecasts of such variables endogenously. Therefore, it was decided to adopt employment in the same industry at the national level as the independent variable in forecasting local-serving employment. This makes the functional form of the local-serving model identical to that of the basic industries, which thereby eliminates any explicit reference to base theory. Implicitly, however, base theory still operates. The new functional specification implies that KCMR's local-serving industries are functions of certain national trends--productivity increases, increased white-collar employment, larger union contract settlements--that affect the amount of local income spent on service-oriented products. No local variable remains, however, to separate KCMR industries from their national counterparts.

The revised IPEF model used in KCMR is therefore somewhat less complicated than the original model. However, it is also more theoretically robust, which allows the effects of factors that would normally be concealed in a high-growth economy to be captured more accurately. The specification of the revised model is shown in Figure 1.

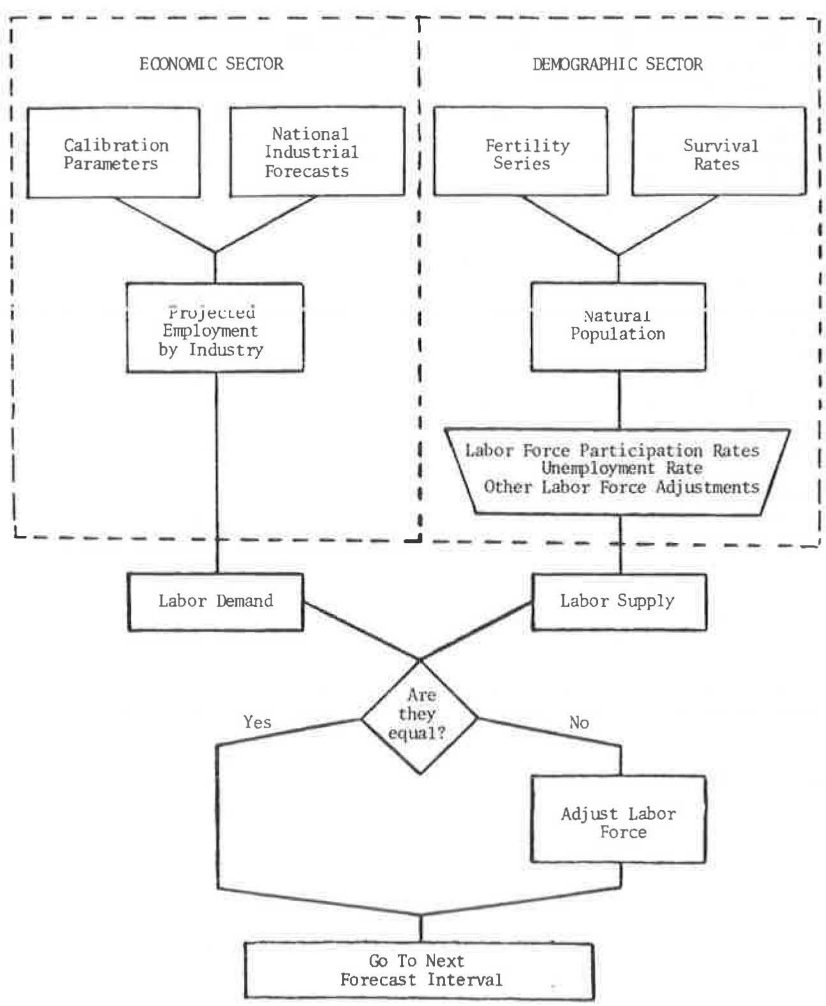
Labor-Market Adjustment Procedures

The initial estimates of labor demand and labor supply are independent of one another, and although historically they represent independent estimates of the same identity, in making forecasts there is an expectation that they will not balance. The reconciliation of the initial supply-demand forecasts is achieved through the labor-market adjustment process, to which we now turn.

As explained earlier, there are several mechanisms by which labor supply can adjust to labor demand. They include changes in net migration, rate of unemployment, LFPRs, net commuting, occupational shifts, technology, productivity, average number of jobs held per employee, and wages. For the purpose of this study, only changes in net migration, rate of unemployment, and LFPRs have been considered. Together they represent the most significant supply-side adjustments to the forecast supply-demand imbalances. In the case of KCMR, the other factors are considered to be relatively unimportant (net commuting rate and ratio of jobs per employee), too difficult to forecast (changes in technology and wage rates), or deficient in data (productivity and occupational shifts). Except for productivity changes embodied in the national employment forecasts, these are all held constant over the projection period.

The limits to changes in LFPR and unemployment rate were defined based on their maximum historical variation relative to the values recorded for the nation as a whole. Net migration was then assumed to compensate for any remaining difference between labor supply and demand. The extent to which LFPRs and unemployment rates will adjust within these historical limits, however, is uncertain. For each projected labor-market situation there exists a range of possible responses in both of these labor-supply factors. In the absence of any data, an ad

Figure 1. Regional economic and demographic forecasting procedure.



hoc procedure was developed to estimate the probable range of adjustment.

First, the labor-supply adjustments are classified as compatible or incompatible with the direction of the labor-market imbalance. This determines in which direction LFPRs and unemployment rates have the most scope for adjustment. For example, in the case of a labor surplus, compatible adjustments in the labor-supply factors are an increase in the unemployment rate and a decrease in LFPR. Changes in the opposite directions are classified as incompatible and are assumed to be smaller in absolute value than are compatible changes, all else being equal.

Second, the magnitude of the imbalance is classified as small, moderate, moderately large, or large. Given that LFPRs and the unemployment rates can adjust more in one direction (are compatible) than in another (are incompatible), the relative size of the imbalance affects how far in each direction the labor-supply factors can adjust. That is, a large imbalance creates the most pressure for adjustments in the compatible direction, whereas a small imbalance creates the least. Conversely, a small imbalance provides the greatest opportunity for adjustment in the incompatible direction, whereas large imbalances provide the smallest. Based on this discussion, the probable range of supply-side adjustments that occurs for different supply-demand imbalances was estimated. These values are shown in Table 1.

Because the labor-supply factors have a range of possible values for each labor-market situation, the population required to provide the labor force will also have a range of possible values. For example, a labor surplus met by an increase in the unemployment rate or a decrease in LFPR would result in a larger population than if the surplus were to be met by net out-migration. Similarly, a labor deficit met through lower unemployment or higher LFPR would result in a lower population than one met through net in-migration. Table 2 summarizes the interaction between these labor-supply adjustments and the population. The result is that there exists a range of population forecasts for any given employment forecast due to the uncertainty in the response of labor supply to changing labor demand.

The methodology adopted in applying these labor-supply adjustments to create a range of populations at each forecast employment level is as follows. The unemployment rate and LFPRs are first set to their long-run historical average and the model is run for one forecasting interval. The direction and magnitude of the labor-market imbalances can then be observed and classified as shown in Table 1. To generate the high end of the population range for a given employment forecast, the unemployment rate is set at its maximum allowable value, and LFPRs are set at their minimum allowable values. To generate the low end of the population range for the same employment forecast, the unemployment rate is set at the lowest value allowed and LFPRs are set at their highest allowable values.

The new unemployment rate and LFPRs are then input and the model is rerun under each case (i.e., upper and lower population), this time for one additional forecasting period. The projected labor-market situation in this new forecasting interval is then examined and the market adjustments are again introduced so as to produce an upper and lower population range for the given employment forecast. This process is repeated for each forecasting period. Once historical limits are reached, however, the economy is assumed to possess no further scope for adjustment and the labor supply variables are fixed at their historical maximum and minimum values.

Results

Table 3 presents the equations and relevant statistics achieved from the calibration of the respecified IPEF model. The model was calibrated on a 1962-1977 time series of employment by industry from the Bureau of Labor Statistics. All regressions are significant at the 0.95 level. Although more-complicated equations were tested, the simple linear form provided the best-fitting relationships.

The total-employment forecasts for 1970, 1975, 1980, 1985, 1990, 1995, and 2000 are, respectively, 613 004, 659 644, 748 610, 821 290, 872 405, 910 014, and 938 241. The resulting probable population forecasts are presented in Table 4. Also presented are changes in the labor-supply factors required to create the range of populations forecast.

CONCLUSIONS

Implications for KCMR Economy

The essential conclusions to emerge from the study

Table 1. Adjustment probabilities in labor-supply variables for different labor-market imbalances.

			Supply-Side Adjustment (%)			
			Magnitude of Imbalance			
Direction	Classification	Labor-Force Supply Factor	Small (<5000)	Moderate (5000-15 000)	Moderately Large (15 000-20 000)	Large (>20 000)
Surplus	Compatible	LFPR	-1.5	-2.0	-3.0	-4.0
		Unemployment rate	+1.0	+1.5	+2.0	+2.5
	Incompatible	LFPR	+1.0	+0.5	+0.5	+0.0
		Unemployment rate	-0.5	-0.5	-0.0	-0.0
Deficit	Compatible	LFPR	+1.5	+2.0	+3.0	+4.0
		Unemployment rate	-1.0	-1.5	-2.0	-2.5
	Incompatible	LFPR	-1.0	-0.5	-0.5	-0.0
		Unemployment rate	+0.5	+0.5	+0.0	+0.0

Table 2. Interaction between labor-supply adjustments and population.

Direction	Classification	Labor-Supply Adjustment	Population
Surplus	Compatible	Unemployment increase; LFPR decrease	High
Surplus	Incompatible	Unemployment decrease; LFPR increase	Low
Deficit	Compatible	Unemployment decrease; LFPR increase	Low
Deficit	Incompatible	Unemployment increase; LFPR decrease	High

Table 3. Calibration equations and relevant statistics.

Equation	Statistic F-Value	Adjusted R^2	Durbin-Watson
Agriculture = -1454 + 2.41 * U.S. agriculture	329.5	0.96	0.98
Mining = 1109 - 0.66 * U.S. mining	5.1	0.21	2.50
Construction = 14 912 + 2.92 * U.S. construction	11.9	0.42	1.47
Declining manufacturing = 3254 + 751.55 * LDECLMANU	127.0	0.93	N/A
Stable manufacturing = -17 154 + 8.00 * U.S. stable manufacturing	42.9	0.74	1.13
Transportation = -2998 + 15.05 * U.S. transportation	94.7	0.86	2.09
Communications and public utilities = 2289 + 6.15 * U.S. communications and public utilities	106.01	0.88	0.73
Wholesale trade = 7525 + 8.85 * U.S. wholesale trade	1153.3	0.99	1.19
Retail trade = 12 737 + 6.65 * U.S. retail	1978.3	0.99	1.23
Finance, insurance, and real estate = 7824 + 7.02 * U.S. finance, insurance, and real estate	698.2	0.98	0.63
Services = 11 921 + 8.377 * U.S. services	1035.5	0.99	0.59
State and local government = -3784 + 5.63 * U.S. state and local government	2797.6	0.99	1.31
Federal government = -15 264 + 15.36 * U.S. federal government	125.5	0.89	1.45
Military = 15 100 in 1975 = 9410 for every period thereafter	N/A	N/A	N/A

Notes: LDECLMANU = lagged KCMR declining manufacturing employment.
N/A = not applicable.
Coefficients for U.S. industries are in thousands.

Table 4. Probable range of population and labor-force responses to forecast level of employment.

Year	Population	Labor Force	Net Migration	KLFPR[a]	Unemployment Rate
High Forecast					
1970	1 327 266	594 275	-	-	-
1975	1 398 012	650 793	23 975	0.980	0.054
1980	1 462 517	738 566	21 232	0.970	0.054
1985	1 544 757	803 477	20 921	0.965	0.046
1990	1 632 864	851 697	28 100	0.960	0.044
1995	1 717 033	888 413	30 232	0.960	0.044
2000	1 768 577	915 971	5 471	0.960	0.044
Low Forecast					
1970	1 327 266	594 275	-	-	-
1975	1 351 032	641 303	-23 005	1.005	0.040
1980	1 366 032	720 292	-23 495	1.020	0.030
1985	1 430 476	790 224	12 695	1.030	0.030
1990	1 507 219	839 405	25 146	1.030	0.030
1995	1 587 063	875 591	32 832	1.030	0.030
2000	1 636 634	902 751	9 306	1.030	0.030

[a]KLFPR = multiplier to increase or reduce all KCMR LFPRs by a fixed percentage.

are as follows. First, the pattern of employment growth that has been prevalent in KCMR through the 1970s is expected to continue to be the dominant factor through the forecasting period. This indicates that industries that use the locational advantages of KCMR (manufacturing, transportation, and wholesale trade) will continue to grow much more slowly than industries that serve primarily local demand. This understandably mirrors the prospects for the nation, since the national projections are the input data used to provide KCMR employment forecasts. Yet it also indicates that no major industry makes effective use of the characteristics for which KCMR has a comparative advantage. Otherwise, the region would be better able to dissociate itself from the overall national trends.

Second, unlike the pattern in the 1970s, the relatively slow employment growth in the sectors that require a KCMR-type location will not lead to a loss of population. Even the low-population forecasts indicate a net in-migration requirement to match the demand for labor by the year 1985. Once the post-World War II population growth has been absorbed into the labor force, the natural growth in labor supply is likely to slow down considerably. But since this slowdown in labor supply is a national phenomenon, it raises the question of where the necessary migrant labor is likely to come from. Finally, labor-supply adjustments prove very important to an area that is experiencing slow economic growth, since they determine the level of population consistent with the forecast employment. In KCMR, future population growth could vary by as much as plus or minus 18 percent, depending on the precise response of the labor force to employment opportunities.

Evaluation of Results

The forecasts presented in this paper are probably representative of the upper end of possible economic/demographic outcomes for KCMR. This conclusion results from the combination of three factors. First, the net in-migration required to balance the labor supply and demand may not be achievable. Because the growth in regional employment arises primarily from the sectors that serve local demand rather than those that use KCMR's locational characteristics, the economy's abilities to attract certain types of labor are not being fully exploited. In the face of expected slow growth in the nation's labor supply, it is unclear why KCMR should be able to compete for scarce labor more effectively than other areas.

Second, the national employment forecasts on which the regional forecasts are based are likely to be high. Currently we see signs that a massive infusion of capital will be necessary to reduce the requirement for two components of the production process that are experiencing rapid cost increases--labor and energy. If this trend continues, the labor requirement to achieve the level of output embodied in the current national economic forecasts will be considerably less.

Finally, it is possible that the estimated relationship between KCMR and U.S. industries is too high. It was noted earlier that the KCMR total-employment growth rate dropped below that of the nation for the first time during the 1970s, which indicates a decreasing relationship over time. Since the linear calibration equations include information from periods that experienced faster growth than current periods, the relationship may be overestimated.

In conclusion, the model used to make projections of population and employment for KCMR as a whole required much modification before it could be applied to a slowly growing economy. This was primarily due to inconsistent modeling of the labor supply-and-demand interactions. The result of the respecification was to produce a less complicated but theoretically more robust model that explicitly recognized the importance of labor-supply adjustments. Yet because certain current and future trends are not adequately reflected in the forecasting process, the forecasts must be interpreted as representing the upper end of possible economic and demographic expectations for KCMR. (Further information concerning the forecasts can be obtained from the Mid-America Regional Council.)

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Evaluation of Two Residential Models for Land Use Allocation

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The current thrust in transportation planning is to make greater use of manual and partly computerized techniques for providing quick-response travel estimation. In this context, land use models, which fuel the typical transportation models, are needed for small and medium-sized cities that operate on a small budget. The results of the evaluation of two operational residential land-use-allocation techniques most suitable for use in small and medium-sized cities are recorded. In an ex post facto test, both techniques were applied in a common setting and the U-statistic was used as a measure of performance. The results were excellent.

The transportation-planning process formalized in the early 1960s became increasingly diversified in the 1970s. This change also affected models for land use allocation, which fuel the typical four-step sequential transportation models. Recently, special attention has been focused on the planning processes for small and medium-sized communities. This paper records the results of an evaluation of two operational techniques for forecasting residential land use most suitable for use in small and medium-sized cities. The first technique tested is the Chicago Area Transportation Study (CATS) method or the Density-Saturation Gradient (DSG) method, which is a simplification of the CATS method (1). The second technique tested is a method of land use forecasting in which the concepts of holding capacity, logistic curves, rates of land consumption, and residential development factors are used. This model will be referred to as the HCLC method in this paper. The method has recently been documented (2).

The testing and evaluation of these two models were performed by applying them in a common setting. The research was not prompted by the desire to proclaim a winner from among the models tested. These two operational residential-forecasting methods were applied to the city of Toledo, Ohio, which was chosen primarily because it was felt that Toledo's size (1974 population, 332 240) was representative of the city for which forecasting techniques of this kind would be most appropriate. Toledo was also chosen because of my knowledge of the city and its environs. This acquaintance with the area is almost a prerequisite for applying the manual techniques of land use forecasting described. Another reason for choosing Toledo was that a rather extensive information file on a small-area basis is available for two time periods--1965 and 1974. Thus, the two techniques were used to forecast land use for 1974 given the 1965 base.

METHODOLOGICAL PROBLEMS

The two traditional manual-forecasting techniques described here are theoretically simple and operationally straightforward. At the same time, it must be said that, although the allocation process in such models is based on acceptable planning standards, it is also dependent on professional judgment, which can at times be subjective, even though such judgments are buttressed by principles and techniques of planning.

DATA SOURCES

The data for testing these two techniques of land