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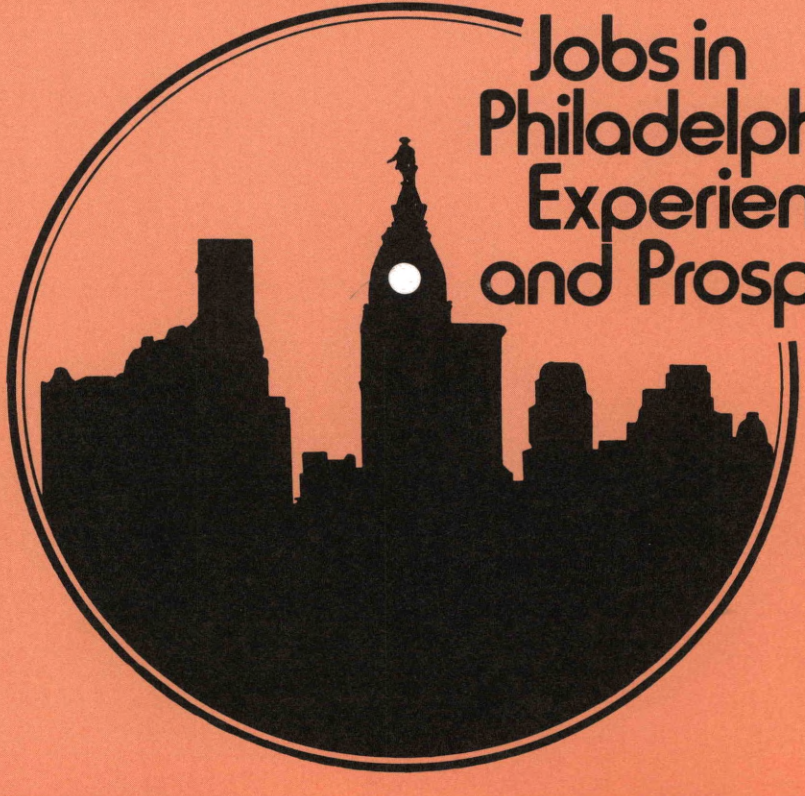
business review

Jobs in Philadelphia: Experience and Prospects



1975

ABOUT THIS ISSUE . . .

The Department of Research of this Bank has undertaken an analysis of the employment experience and prospects in Philadelphia. The findings of the first part of the study—a general overview—are reported in this issue. In the second phase of the study an empirical analysis will be made in an attempt to identify the specific characteristics of communities (tax rates and public services, for example) which relate to employment location.

Several major conclusions are reached in the first part reported here: (1) there has been only a small job loss in the city of Philadelphia during the last quarter century, and no clear evidence of a long-term job loss in the Delaware Valley as a whole; (2) a major shift in activity from manufacturing to nonmanufacturing has taken place in the city, and there has been a similar, though less pronounced, shift in the region; (3) the projection for 1980 indicates employment gains both for the city and the region.

Basic economic forces—national demand, input prices, transportation costs, technology—underlie these trends. If business firms are to remain competitive and profitable they must respond to these forces, and there is probably not much a city can do to alter them fundamentally. Many of the problems (such as concentrations of low-income residents and abandoned buildings) that arise from these trends can probably be ameliorated, however, by appropriate public policy.

This study reflects the continuing interest of the Federal Reserve Bank of Philadelphia in the economic vitality of the region—an interest which is, perhaps, more urgently needed than ever as urban economies come under intense scrutiny.

David P. Eastburn, President
Federal Reserve Bank of Philadelphia

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Jobs in Philadelphia: Experience and Prospects*

Visions of businessmen and residents packing up and fleeing the troubled city haunt officials and concerned citizens of most major urban areas more than ever. Many commentators in the public eye are quick to cite the latest closing of a major plant or the deterioration of a once healthy neighborhood as an ill omen for the city. How accurate are these views? This report looks at where jobs have been and where they are going for Philadelphia and the region.

The problems of most older urban areas are many and complex. A number of these areas have clearly passed their peak of prestige and economic power. Yet, despite vacant plants and abandoned neighborhoods, the news is not all bad. While Philadelphia has clearly been losing manufacturing jobs and upper income residents, nonmanufacturing jobs have shown a more promising trend, and the total population, while dipping in recent years, has remained stable over a long stretch of time. Meanwhile, employment in the Philadelphia region as a whole, while also dipping in recent years, shows a long-term trend of increases. Both the city and suburbs face problems associated with a changing mix of economic activity. However, these problems, when taken as a whole, may not be as serious as might appear at first glance. Indeed, while projections for the future indicate a continuing change in the mix of industries, the general outlook is not at all discouraging.

WHAT HAS BEEN HAPPENING TO JOBS IN THE DELAWARE VALLEY?

The dip in employment over the past few years has focused considerable public attention on future prospects for the city of Philadelphia and the region.[1] While the recent

*The research for this project was conducted by David Fellner, Timothy H. Hannan, Mary M. Hinz, Robert E. Hopkins, Nonna A. Noto, and Anthony M. Rufolo.

[1]The region in this study refers to the Standard Metropolitan Statistical Area (SMSA) comprising Philadelphia, Bucks, Chester, Delaware, Montgomery, Burlington, Camden, and Gloucester counties. The city refers to Philadelphia county.

dip in employment levels is a serious problem, it probably is not the best measure for gauging future trends. The city and region have experienced such dips in the past and probably will do so in the future as national recessions and short-term business fluctuations work their way through the economy.[2] A better gauge and the one used here is an analysis of long-term job trends accompanied by an examination of the basic economic forces that foster such trends. Taking the long view, what has happened to employment? Available evidence indicates that there has been some job loss for the city but little if any for the region.[3] Even for Philadelphia, the net decline has been relatively small. However, there has been a significant *shift in the type of activity*. Moreover, this shift seems to have been more pronounced for the city than the suburbs.

[2]The decline of the last few years is not unprecedented in the city's history. It is not yet clear whether this is a new trend, but the evidence argues against such a strong conclusion. A partial explanation of the drop in employment during the past year was the national economic recession that induced many employers in the local area to trim payrolls.

[3]Job loss in this study refers to *actual decline* in employment rather than the popular notion of "relative decline." "Relative decline" falls short of the mark as a good working definition of employment change because it can actually occur under three totally different circumstances: when a city grows more slowly than its surrounding region, when it does not grow (or declines) and the surrounding region grows, or when the city declines even faster than the surrounding region. Clearly, it is possible for an urban area to grow at a phenomenal rate and still register a "relative decline" if its surroundings are mushrooming even faster. Thus, the popular concept of employment change can be misleading. Because many problems associated with employment or population loss for a city relate more closely to absolute declines than to relative ones, reliance on "relative decline" can cause alarm where none may be called for.

TABLE 1

EMPLOYMENT GROWTH IN THE PHILADELPHIA REGION WAS LESS THAN EMPLOYMENT GROWTH NATIONALLY

	1960–72	1972–75
Percent Change in National Employment†	24%	−0.6%*
Percent Change in Regional Employment††	18	−0.6**

*1975 national employment figure was obtained by averaging BLS employment data relating to the first ten months of the year.

**1975 regional employment figure was obtained from the November 11, 1975, forecast of the Economics Research Unit of the University of Pennsylvania.

SOURCES: †U. S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings*, 22, 4 (October 1975) Table A-1 (Household Data).

††Philadelphia Region Econometric Model Databank (February 21, 1975), Economics Research Unit of the University of Pennsylvania.

(For a full discussion of data sources, see Technical Supplement A.)

The Region Has Shown Relative but Not Absolute Decline. As can be seen in Table 1, employment growth in the region did not keep pace with the nation. While employment in the nation grew approximately 24 percent between 1960 and 1972, regional employment increased only 18 percent. In fact, during the last three years regional employment has declined slightly, undoubtedly reflecting the effects of the current recession.

A commonly given reason for the region's inability to keep pace is its poor "mix" of industries. However, available data do not support that view. Industries that dominate the area are generally those that have grown more rapidly nationwide. The 11 major manufacturing industries and the six nonmanufacturing divisions in the Philadelphia region together exhibited a 21 percent rate of growth in employment from 1960 to 1972. However, if each industry had grown at its national rate, total employment would have grown 34 percent. This indicates that if the national trend is an appropriate yardstick, the industries located in Philadelphia should have grown rapidly, but they clearly have not. Generally, this lower rate of regional employment growth indicates that certain factors, such as the already dense development of the region, are on balance retarding regional employment growth. Nevertheless, the area has experienced positive growth, despite this relative decline.

Looking at employment on a more detailed level, it is evident that there has been some shift in the mix of jobs in the region. Consistent with national trends, the importance of nonmanufacturing employment in the regional economy has increased considerably. From 1951 to 1972 total manufacturing employment declined slightly (Chart 1) while nonmanufacturing soared by about 50 percent to one and a half million (Chart 2). Within the manufacturing sector, some of the larger industries, such as textiles and apparel, declined while others, such as

CHART 1

MANUFACTURING EMPLOYMENT HAS BEEN DECLINING IN THE CITY BUT RISING IN THE SUBURBS, LEAVING THE REGIONAL TOTAL RELATIVELY STABLE.

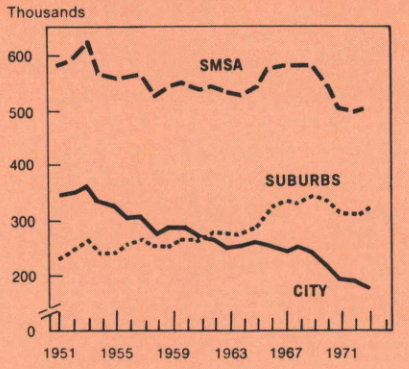
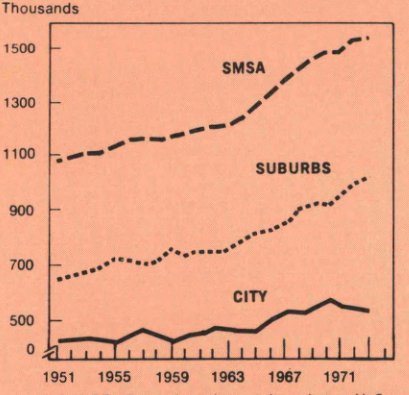


CHART 2

NONMANUFACTURING EMPLOYMENT HAS BEEN GROWING SLOWLY IN THE CITY AND RAPIDLY IN THE SUBURBS.



SOURCE: Data for the region from U. S. Department of Labor, Bureau of Labor Statistics, "Employment and Earnings, States and Areas, 1939-72," Bulletin 1370-10, and Commonwealth of Pennsylvania, Department of Labor and Industry, Bureau of Employment Security, "Total Civilian Work Force, Unemployment & Employment By Industry: Annual Average, 1964-1973, Philadelphia Labor Market Area" (June 1974); data for the city from Philadelphia Region Econometric Model Databank (February 21, 1975), Economics Research Unit of the University of Pennsylvania; data for the suburbs are the difference between the regional and city series.

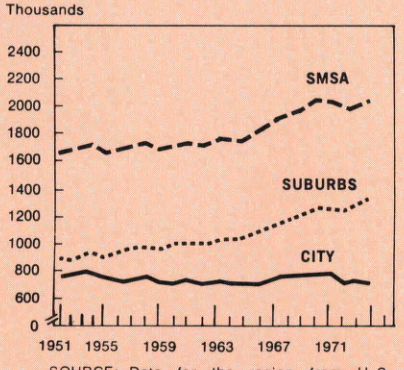
chemical products and nonelectrical machinery, grew. (See Technical Supplement B.)

The City—a Changing Mix. Manufacturing employment in the city plunged from a peak of 357,000 in 1953 to 189,000 in 1972, but employment gains in nonmanufacturing soared, largely filling the gap (see Charts 1, 2, and 3). Thus, the changing mix of jobs appears to have been much more significant than the absolute decline in the number of jobs. As in many other large urban areas, that changing mix has increased the dominance of the nonmanufacturing sector.

Manufacturing Employment: The Big Loser. In manufacturing employment definite trends between the city and suburbs emerge over the past three decades. City employment was greater than suburban employment at the beginning of the postwar period, but in later years plummeted while suburban employment rose sharply. By 1961 manufacturing employment in the suburbs exceeded city manufacturing employment. This crossing pattern frequently appears in individual industries. (See Technical Supplement B.) Despite these shifts and the concentration of growth in suburban counties, Philadelphia maintained far more manufacturing employment than any one of the suburban counties.

CHART 3

AS A RESULT, TOTAL EMPLOYMENT HAS STAYED FAIRLY STABLE IN THE CITY, BUT HAS INCREASED SHARPLY IN THE SUBURBS.



SOURCE: Data for the region from U. S. Department of Labor, Bureau of Labor Statistics, "Employment and Earnings, States and Areas, 1939-72," Bulletin 1370-10, and Commonwealth of Pennsylvania, Department of Labor and Industry, Bureau of Employment Security, "Total Civilian Work Force, Unemployment & Employment By Industry: Annual Average, 1964-1973, Philadelphia Labor Market Area" (June 1974); data for the city from Philadelphia Region Econometric Model Databank (February 21, 1975), Economics Research Unit of the University of Pennsylvania; data for the suburbs are the difference between the regional and city series.

Who are the major Philadelphia employers in manufacturing now and what has happened to them?[4] The *apparel industry* remains the largest single industry, although it experienced a decline in employment of one-third between 1959 and 1972. Its largest subindustry, by far, is mens', youths', and boys' suits, coats, and overcoats, employing nearly half the 29,000 workers in the industry. In Philadelphia, apparel firms are generally in the medium-size range, with half of the establishments employing between 20 and 250. The second largest manufacturing industry, *printing and publishing*, experienced one of the smallest declines in employment over the same period. Approximately one-third of the workers are involved with newspapers, and another third with commercial printing. Establishments tend to be heavily concentrated in the city of Philadelphia and of small size—two-thirds of all establishments have fewer than 20 employees. Producers of sausages and prepared meats, fluid milk, and bakery products account for about half of all employees in the *food products* industry. Although employment in the industry has declined in recent years, it remains as one of

[4]Commonwealth of Pennsylvania, Department of Commerce, Pennsylvania Industrial Census Series, No. M-5-72, *Philadelphia County;* U.S. Department of Commerce, Bureau of the Census, *County Business Patterns, 1972,* Pennsylvania CBP-72-40; Kenneth McLennan and Paul Seidenstat, *New Business and Urban Employment Opportunities* (Lexington, Mass.: Lexington Books, D.C. Heath and Company, 1972); Arthur D. Little, Inc., *The Usefulness of Philadelphia's Industrial Plant: An Approach to Industrial Renewal,* Summary of a Report to the Philadelphia City Planning Commission, January 1960.

the largest. Establishments are distributed relatively evenly throughout the city. *Electrical machinery,* another major manufacturing industry in Philadelphia, has a majority of its establishments located in upper North Philadelphia. Establishments tend to be large—nearly 7 percent employ more than 500 workers. Producers of switchgear and switchboard apparatus, and residential electrical lighting fixtures account for two out of three industry workers. *Fabricated metals* was the only major manufacturing industry in Philadelphia in which the level of employment was about the same in 1959 and 1972. Automotive stampings is the largest subgroup, dominated by one firm employing nearly 5,000 workers. Firms in the other subgroups (iron and steel forgings and sheet metal work, for example) tend to be smaller in size with 90 percent of the establishments employing fewer than 100 workers. Plants have tended to locate in the northern and northeastern parts of the city, near highway and rail facilities.

Nonmanufacturing Employment: A Bright Spot. Even in 1959, Philadelphia had more employment in nonmanufacturing than in the manufacturing sector. But since then, employment in the nonmanufacturing sector has become even more dominant (Chart 2). Indeed, by 1972 almost three out of every four city jobs were in nonmanufacturing. Not to be overlooked, too, is the change in the mix of industries within this increasingly important sector.

Services is the largest employer in the nonmanufacturing sector, and it has experienced the largest growth between 1959 and 1972 of any industry in Philadelphia. (This was true nationally as well.) Medicine and education are the major services, with hospitals and colleges accounting for 31 percent of total employment in the sector. Much of the industry is comprised of small establishments with 56 percent employing fewer than four persons. *Wholesale and retail trade* employs almost as many as the services industry. Wholesale trade, employing about a third of the sector, is composed of small establishments (79 percent employ fewer than 20 persons); employment has declined nearly 14 percent between 1959 and 1972. The largest wholesale employment is in machinery equipment and supplies, accounting for about a fifth; groceries and electrical goods together account for another fifth. Establishments in retail trade are even smaller than in wholesale. The exception to this is five department stores, each with more than 500 employees. Restaurants and bars are a major source of retail employment. *Government* is a major employer—60 percent are state and local employees, 40 percent are Federal. Federal employment has fallen since the late 1960s so the stable level of employment is attributable to the growth of state and local governments. The *finance-insurance-real estate sector* has been a strong growth industry, with employment increasing a third between 1959 and 1972. Banking and insurance carriers account for 63 percent of the sector's workers. The industry includes a large number of small establishments (53 percent employ one to three workers), with 80 percent of the employees working at Center City locations. Employment in *transportation and public utilities* barely increased between 1959 and 1972. About half of those employed work in communications, trucking, and warehousing establishments. Large companies characterize this sector—over 14 percent of the establishments employ more than 50 persons. *Contract construction* employment in Philadelphia declined 6 percent between 1959 and 1972. Two-thirds of this sector's employment is composed of special trade contractors—plumbing, painting, and roofing are examples. Employment tends to be distributed according to construction sites.

In short, Philadelphia experienced significant shifts in employment patterns among its major industries, but not much overall change in total employment. These shifts occurred both between the manufacturing and nonmanufacturing sectors as well as within each of these sectors. (See Technical Supplement B.)

WHAT ARE THE FACTORS BEHIND THESE EMPLOYMENT TRENDS?

To get a grip on why both the city and the region have experienced changes in employment mix and the number of workers on the job it is necessary to dig into some basic economics. The amount of employment, as well as the kind of employment, that exists in Philadelphia or the region depends on the decisions of firms to come here and to remain here.[5] A prime consideration for firms that choose either the city or the region as a place to do business is the impact of these locations on their bottom line.

Choosing the Philadelphia Region. Most firms don't just accidentally land in the Philadelphia area. Their managements make conscious decisions about what constitutes the best location. The profit motive is a key factor in shaping managements' decisions. Profits are vital, and because profit opportunities differ from region to region the drive for profit explains a great deal about why some firms choose one region over another.

The profits obtainable in each region depend upon the firm's production requirements and the price of its inputs and its outputs, and these can vary from region to region.[6] Production needs are particularly important in distinguishing the locational orientation of some industries from those of other industries. Take, for example, the production needs of a textile firm and an aluminum-processing company. A textile firm depends heavily on labor. So, in considering a location or move, it would gravitate toward a region with abundant low-cost labor. Many regions of the Southeast have a decided edge over those in the Northeast in this regard. An aluminum-processing company depends heavily on energy. So, in considering a location or move, it would tend toward a region with abundant low-cost energy. Here, the Pacific Northwest has a decided advantage over many other regions in the country.

Clearly, changes in the determinants of profit over time can alter the most desirable location for a firm or industry. A good example is the migration of the textile industry out of the Philadelphia region—a move that many ascribe to the increasing cost of labor in Philadelphia relative to that found in the Southeast.

No wonder, then, that the history of Philadelphia and its surroundings is one of constant change! Because of differences in markets and in types and quantities of inputs used, different industries show different location "orientation." (Although some of the most significant changes in employment have occurred in nonprofit areas such as government, this does not alter the fact that economic forces play a major role in most areas of the economy.) These are, in turn, important in explaining changes over time. Nonmanufacturing industries, such as finance, insurance and real estate, for example, sell a large part of their services to customers located in the region. For this reason, changes in the level of output or employment of such industries varies closely with local personal income and population. For the Philadelphia region, it has been estimated that increases in total personal income are associated with gains in the dollar value of the combined output of the finance, insurance and real estate industries.[7] How-

[5]Changes in the level of employment do not result solely from the physical movement of firms. The amount and type of employment can also be altered as a result of births of new firms, deaths of old firms, and expansions or contractions of established firms. Decisions to make these types of changes are subject to the same forces as are decisions to completely relocate, and they often account for the lion's share of the ups and downs in local employment.

[6]There are, of course, a number of considerations that complicate this basic framework substantially. Uncertainty and lack of information limit the degree to which firms can choose the most profitable location. More important, the existence of moving and other types of costs means that in the short run, many firms will prefer to remain in their existing location rather than move to those which would be preferable from the standpoint of an initial location decision.

[7]A number of these relationships have been studied

ever, many of the region's manufacturing industries, such as textiles, chemicals, and transportation equipment, sell their products in a national market. Thus regional output and employment in these industries are strongly related to the level of national demand[8] and are influenced also by the cost of inputs in one region as opposed to another.[9] Moreover, if transportation costs for the finished product are high, firms in some of these industries may relocate in regions where demand for the product is large and growing. Both the Southeast and West represent growing markets for many products.

These different location "orientations," based on the decisions of profit-motivated firms facing changing economic conditions, result in the changing mix of regional employment. Therefore, it is not surprising that while some industries have lost employment in the region, others have experienced employment gains.

The City or the Suburbs. Once a firm has decided to do business in the Philadelphia region, will it choose the city or the suburbs? Firms move into and out of the Quaker City (or expand or contract in the city) for reasons similar to those that influence regional decisions. Indeed the general framework that explains the choice between regions can also explain the "city-suburban" decision so important to those concerned with the health of the city. Just as technology, the price of inputs, and the price of outputs can influence a firm's decision to do business in the Philadelphia region, so also do they help determine whether the firm will choose to locate in the suburbs or the city.

The Attraction of the City. City locations have a number of aspects that make them more attractive and profitable for a wide range of firms. A city address usually means lower transportation costs and denser business activity.

A Philadelphia location has two types of transportation attractions. First, extensive street and railway systems web the city and fan out into the region. This can spell a significant cost reduction for firms that depend heavily on the local transportation network to obtain their inputs and sell their outputs. For example, metropolitan dailies must gather their information and sell their products in the entire region. For such an enterprise, a central location in Philadelphia involves the lowest transportation cost. Evidence of this is the fact that the major Philadelphia newspapers are located in the city. Many other types of firms seek a city location for the same reason. Indeed one of the primary reasons for the existence of large cities is the substantial savings in transportation costs that central locations can bring. If it were costless to move people, goods, and information, then there would be no need to have concentration of employment. Clearly there is a cost, and this cost plays an important role in determining whether a firm will locate in the city or in the suburbs.

The second type of transportation attraction is a city's access to national and international markets. Philadelphia's port and waterways have served as textbook examples of this for several centuries and continue to do so today. The concentration of refineries along the Delaware River in Philadelphia was certainly influenced by the access to foreign and domestic oil provided by such sites. This relatively low cost access to both national and interna-

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with statistical tests during the construction of the Philadelphia Region Econometric Model of the Wharton School of Finance. See Norman J. Glickman with Kenneth Ballard, "The Philadelphia Region Econometric Model IV," Economics Research Unit of the University of Pennsylvania, 1973, mimeo.

[8]Ibid.

[9]Some regions have lower cost resources, others have low-cost labor; and items such as these can be the deciding factor for many industries. But the availability of amenities such as sunshine and soft pretzels can also be important to other industries. Thus, while some industries are tied to particular regions, the net level of employment may be influenced by many noneconomic factors. For a discussion of such factors see Elizabeth P. Deutermann, "Headquarters Have Human Problems," *Business Review* of the Federal Reserve Bank of Philadelphia, February 1970, pp. 3–22.

tional markets provides an important focal point for some of the region's economic activity.

Low transportation costs, however, are not the only advantage the city has to offer. Equally important to firms considering a city location is the economic density of the area, which tends to attract even more economic activity. In such an area a new firm is most likely to find a variety of skilled labor and other firms ready to supply specialized inputs, such as the services of firms supplying messengers and temporary office help. This concentration of demand in turn makes central Philadelphia a prime location for firms which supply specialized inputs and require a dense market for profitable operation. Furthermore, a central location can reduce the problems of communication among principals of firms. Banking and financial institutions probably find these considerations important. In fact, many Philadelphia banks and financial institutions have located their main offices in Center City.[10] Another advantage is improved marketing that results if an industry's customers can be brought to a central location where they can compare products of many different firms. This appears to be the reason for the concentration of particular types of retail stores in certain parts of the city. Jewelers' Row along Sansom Steet is a prime example.

Philadelphia's commercial printing industry, which is highly concentrated in Center City, is an example of an industry which has traditionally been attracted to the city for all of these reasons. Portions of the commercial printing industry may be oriented toward the central city area because (a) it offers specialized services and probably requires a carefully timed production schedule involving simultaneous or consecutive work in physically separated establishments; (b) frequent and extensive interplay between customer and printer is apparently necessary; and (c) reliable delivery and the ability to meet short-term deadlines seem to be important. Also, in cases where time is of great importance, the site selection of these printing firms could be influenced by the lower cost of transportation and communication networks found in downtown areas. Thus, for many firms such as those in certain areas of the commercial printing industry, a central location may be the most appropriate choice.

Because of these attractive characteristics of central locations, the city can be viewed as a magnet for certain types of economic activity. Each firm faces a tradeoff of the benefits of proximity to Center City and the resulting costs, such as the higher rents that typically prevail close to Center City. Those gaining the greatest advantage from locating near Center City, such as firm headquarters and certain office functions, bid highest for the land. Thus, the rent and location patterns are then determined by the interaction of transportation costs and the demand for land. And changes in any of these factors could lead to changes in density, rent, and business mix for the city. (See Box 1.)

The Attraction of the Suburbs. Of course, not all of the region's business activity occurs within the city limits of Philadelphia, and the reasons are not hard to find: lower rents and a growing population in the suburbs. Rents are generally lower in the suburbs for properties of identical quality. This makes suburban locations more attractive to firms that require a lot of space. The increasing popularity of the single-story production process, with its large space requirements, has made the suburbs increasingly attractive to some manufacturing firms.

Suburban population and income growth also have had an important impact on employment location. Some firms now find certain types of high-skilled labor more readily available in the suburbs than in the city. Moreover, as firms found their customers

[10]Because of Pennsylvania's contiguous county banking law for banks, many Philadelphia banks have designated their "home office" outside Philadelphia County so as to have wider branching options. Yet their main offices remain in city locations.

BOX 1

LOCATION DECISIONS: AN ECONOMIC PERSPECTIVE

Further amplification on the factors attracting firms to the city or the suburbs can be found by looking at two models economists have developed to explain location decisions.

Cost Minimization. Emphasizing transactions in the central business district (CBD) is generally accepted as the most useful method for analyzing cities. It is usually assumed that the firm purchases its inputs and sells its products in the CBD. A firm can minimize its transportation costs by locating in or near the center; however, competition to get these sites will lead to a rise in land rent. The amount each firm will bid for land depends on the transportation costs for its inputs and outputs and its use of land. Because transportation costs increase with distance, firms bid less for locations further out. This leads to declining rents as distance from the CBD increases. Thus rent interacting with transportation costs determines the best location for each firm.

Any business which does not have a strong attraction to the city's center will find that the lower costs of outlying locations offset the higher transportation costs. For example, firms requiring larger amounts of land may find that the lower costs of outlying areas more than offset higher transportation costs.*

While this model of firm location offers many insights into the structure of the regional economy, the model is much more applicable to some firms than to others. An important alternative model looks at firms whose customers are dispersed rather than in one central location.

Market Area Competition.** The key difference between this and the previous model is the assumption that customers are spread out. They must either travel to the firm or have the firm send the output to them in order to complete a transaction. Thus, a firm essentially charges each customer a different price, which is equal to the cost of the output plus the transportation cost. Generally, the transportation costs of inputs are assumed to be small compared to the cost of output transportation.

Each customer is assumed to purchase from the firm offering him the lowest total price, and the quantity of output purchased by the customer may depend on its price at delivery. Since firms closer to a customer tend to have a price advantage, there is a tendency for firms to spread out to increase the number of customers they serve and avoid competition.

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*For a good exposition of the theory, see Martin Beckman, *Location Theory* (New York: Random House, 1968).

**Robert D. Dean, William H. Leahy, and David L. McKee, *Spatial Economic Theory* (New York: The Free Press, 1970), pp. 155–200.

spreading over the region they often found it profitable to expand into the suburbs. This has been particularly true of numerous retail outlets selling frequently purchased items such as food and clothing. The outcome of this process is that while the suburbs accounted for only 44 percent of retail employment in 1959, their share swelled to 58 percent in 1972. Thus, a growing suburban population along with low rents has boosted suburban employment levels by attracting industry.

However, the factors attracting firms to the suburbs do not appear to be as important for nonmanufacturing as they are for manufacturing employment. As historical trends indicate, Philadelphia has actually gained in nonmanufacturing employment over the long run, and a number of factors may account for this. First, the mere growth of the region is likely to create greater specialization within it, and Philadelphia clearly has an advantage in nonmanufacturing. A second factor is the increased importance of nonmanufacturing in the national economy. This may be partially responsible for the relative shift to nonmanufacturing in the Philadelphia region, and the effect should be most evident in the central city.

In sum, the drive for profit means that the characteristics of industries will affect which firms will locate in the city and which will locate in the suburbs. The notion that industry characteristics are an important determinant of where firms locate in the Philadelphia region has been examined using some standard statistical techniques. (See Technical Supplements C and D for details about the techniques and results.) While the tests are only suggestive, they do support the notion that input requirements and related industry characteristics strongly influence the city-suburb choice. For example, firms using a lot of labor relative to their output tended toward Philadelphia locations. Thus, it appears that much of the shift from manufacturing to nonmanufacturing employment can be traced to industry characteristics. And attempts to reverse such a shift will face the pressure of a substantial economic trend.

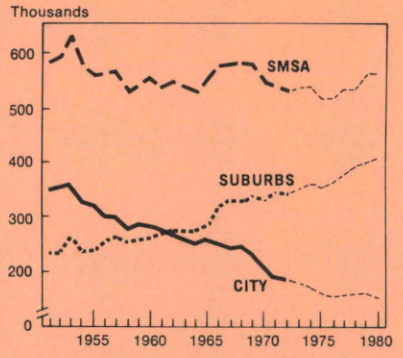
FUTURE TRENDS IN THE CITY AND REGION

What then does the future offer for employment in the Philadelphia area? The basic economic forces which shaped the employment picture in Philadelphia during the 1960s and early 1970s will likely be at work for the rest of the decade and longer. The profit motive will continue to be important, and that means that the cost and availability of inputs like labor, energy, and space, as well as the ability to deliver a competitively viable product to customers, will continue to be uppermost in the minds of business decision-makers. When combined with national economic trends, these regional forces form the basis for future jobs in Philadelphia.

A good glimpse of the way these forces can be expected to push the local economy in the future can be obtained from a large-scale econometric model designed to forecast economic trends in the Philadelphia region. Constructed at the Wharton School of Finance and Commerce of the University of Pennsylvania, the Philadelphia Region Econometric Model provides a framework for looking at the economic forces expected to influence employment in each of several major industries in the Philadelphia area. In general, the model translates projections of national economic variables, such as gross national product and the national output by industry, into economic forecasts for Philadelphia and its suburbs. The result is a set of forecasts on employment and output by industry in the region, total employment, personal income, and tax receipts—to mention just a few of the pieces of economic information relevant to the city and region provided by the model. (See Technical Supplement E for a more detailed discussion.) Because the model provides the best way available to look at the future systematically, it is useful to examine its projections on employment in the region and

CHART 4

PROJECTIONS SHOW MANUFACTURING EMPLOYMENT CONTINUING TO DECLINE IN THE CITY WHILE RISING IN THE SUBURBS.



SOURCE: Actual data for 1951-72, Philadelphia Region Econometric Model Databank (February 21, 1975), Economics Research Unit of the University of Pennsylvania. The series for 1965-72 differ from the more recent BLS estimates shown on Charts 1, 2, and 3, but this probably would not alter the trend in the forecasts. Projected data for 1973-80, *Philadelphia Econometric Model Project, February 21, 1975, Post-Meeting Control Solution*, Economics Research Unit of the University of Pennsylvania, distributed by Wharton EFA, Inc., Philadelphia, Pa.
For greater detail, see Technical Supplement E.

city for the period 1975 to 1980.[11]

Consistent with national forecasts, moderate increases in regional employment in manufacturing and nonmanufacturing are projected. (See Charts 4, 5, and 6.) Regional manufacturing employment is expected to rise by almost 9 percent between 1975 and 1980, while nonmanufacturing is projected to rise by nearly 10 percent during the same

[11]Although several criticisms have been leveled against this and similar models (see Technical Supplement E) the seriousness of the criticisms should not be overemphasized. The Philadelphia Region Econometric Model has had a rather good "track record" in forecasting trends in regional employment and other regional economic variables. However, one point is worth emphasizing. The skill mix of the labor force does not affect the number and type of jobs in the model. Therefore, the implications of this are not addressed.

CHART 5

PROJECTIONS SHOW NONMANUFACTURING EMPLOYMENT CONTINUING TO GROW SLOWLY IN THE CITY AND RAPIDLY IN THE SUBURBS.

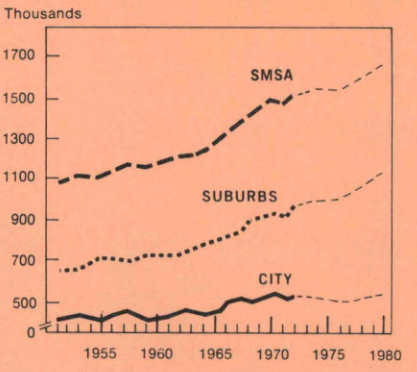
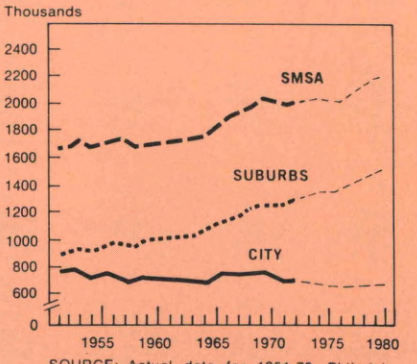


CHART 6

AS A RESULT, TOTAL EMPLOYMENT IS PROJECTED TO REMAIN FAIRLY STABLE IN THE CITY BUT INCREASE IN THE SUBURBS.



SOURCE: Actual data for 1951-72, Philadelphia Region Econometric Model Databank (February 21, 1975), Economics Research Unit of the University of Pennsylvania. The series for 1965-72 differ from the more recent BLS estimates shown on Charts 1, 2, and 3, but this probably would not alter the trend in the forecasts. Projected data for 1973-80, *Philadelphia Econometric Model Project, February 21, 1975, Post-Meeting Control Solution*, Economics Research Unit of the University of Pennsylvania, distributed by Wharton EFA, Inc., Philadelphia, Pa.
For greater detail, see Technical Supplement E.

period. Thus, as in the past, nonmanufacturing employment is expected to experience a faster rate of growth in the region. Breaking down the manufacturing and nonmanufacturing sectors into their component industries, past trends are generally projected to continue. In terms of employment growth, the food and apparel industries are expected to remain among the weakest in the manufacturing sector, while the transportation equipment industry is projected to rank as one of the strongest. In the generally faster-growing nonmanufacturing sector, employment growth in both government and services is expected to be relatively rapid.

With respect to the city, the economic forces that played a substantial role in employment trends during the 1960s and early '70s are likely to prevail on into the '80s. Unfortunately no projections are available for the city by industry. However, the projections for manufacturing and nonmanufacturing show that past trends are likely to continue here also (see Charts 4, 5, and 6), because changes in technology and national trends will continue to favor nonmanufacturing in Philadelphia. This does not signal a long-run absolute decline in employment for the city. The recent dip in total employment appears to be more closely related to the current recession than to any long-term trend. For Philadelphia, employment in manufacturing is projected to decline by 4.5 percent, but that in nonmanufacturing is expected to increase by 3.8 percent. Because there is already more nonmanufacturing employment in the city, total city employment is projected to increase by almost 2 percent.

In summary, for the region as a whole, more of the same is in the cards—a moderate rate of growth in employment for the region, with nonmanufacturing employment showing the strongest gain. Very little change in total employment is expected for Philadelphia, but a continued shift from manufacturing to nonmanufacturing is likely. This loss of manufacturing employment has often been very visible. The closing or moving of a large firm attracts a lot of attention. However, most people do not reflect on the reasons for such movement, and any job loss is considered automatically to be bad for the city. In fact, increases in nonmanufacturing employment are at least partially offsetting decreases in manufacturing employment. Hence, looking at the total picture provides much less reason for gloom.

BEYOND JOBS

The outlook for jobs clearly has implications that go far beyond the number of people employed in particular industries. What happens to employment in terms of size, mix, and location can influence the economic vitality of an area, income mix of the population and the whole social fabric of a community. Shifts in population can lead to changes in the location of jobs. Moreover, the creation of new employment opportunities can attract population to another locale. The impact of these changes in employment and population can have a number of ramifications for everyone living in large urban clusters.

The ever-present threat of an exodus of jobs and population can effectively limit the choices of city managers in levying taxes and providing services. High taxes are not necessarily a cause of employment and population shifts because they can support a high level of services. However, burdensome taxes that are not matched by a high level of services can induce residents and firms to flee. Such a situation can occur when local governments attempt to redistribute income by taxing one segment of the local population to help another, causing the more heavily taxed to leave.

This affects the fiscal health of many cities. Big cities are generally home to large numbers of lower-income families requiring relatively more services, such as compensatory education (see Tables 2 and 3), but having less ability to pay for such services—an element of New York City's current

TABLE 2

A MUCH HIGHER PROPORTION OF THE POPULATION IS POOR AND UNEDUCATED IN THE CITIES THAN IN THEIR SUBURBS

	Welfare Dependency		Schooling	
	Percent of Population Receiving Public Assistance,* 1972		Percent of Persons 25 and Over With Less Than 5 Years Of School Completed 1970	
City/SMSA	City	Suburbs	City	Suburbs
Baltimore	15.0%	1.7%	8.1%	3.4%
Boston	14.5**	3.9**	5.6	3.0
Chicago	9.3**	1.5**	6.7	2.5
Detroit	9.4**	2.8**	7.2	3.0
New York	12.6	6.7	7.6	3.2
Philadelphia	14.1	5.2	6.7	3.1
Pittsburgh	6.3**	4.5**	5.3	4.0
Washington	12.3	1.6	5.3	2.0

*"Public Assistance" is the sum of Old Age Assistance (OAA) and Aid to Families with Dependent Children (AFDC).

**Welfare data were available only by counties, which for four of the areas are not coterminous with central city boundaries. Figures for the county containing the central city of the region have been used as the central city estimate. In the cases of Baltimore city, New York (Bronx, Brooklyn, New York, Queens, and Richmond counties), Philadelphia, and the District of Columbia, county and city boundaries are coterminous. Figures for Suffolk County were used for Boston, Cook County for Chicago, Wayne County for Detroit, and Allegheny County for Pittsburgh. The welfare dependency figures are likely to be understated for these four cities. Cook, Wayne, and Allegheny counties, in particular, include substantial areas outside the central city limits which are likely to have lower welfare dependency rates than the central city. The suburban welfare figure is composed of the numbers for all other counties in the SMSA other than the one(s) containing the central city.

SOURCE: U. S. Department of Commerce, Bureau of the Census, *County and City Data Book, 1972;* U. S. Department of Commerce, Bureau of the Census, *Current Population Reports,* Series P-25, No. 537, "Estimates of the Population of Metropolitan Areas, 1972 and 1973, and Components of Change Since 1970," December 1974.

fiscal problems. More low-income residents force a larger tax bite or a lower level of services on higher-income residents and city businesses. As a result, some businesses and individuals may avoid the increased burden simply by leaving town. This movement in turn may lead to greater tax burdens and/or decreased services for those remaining in the city. (See Tables 3 and 4.)

Because of the exodus of higher-income individuals and firms, cities that continue to provide required services to the poor out of locally raised revenues face the prospect of continually rising expenditures and a continually eroding tax base. This then is one of the major problems associated with the relocation of jobs and people.[12] While Philadelphia has not felt the budgetary pinch as much

[12]For more detail, see Anthony M. Rufolo, "Anatomy of a 'Fiscal Crisis,' " *Business Review* of the Federal Reserve Bank of Philadelphia, June 1975, pp. 3–12.

TABLE 3

WITHIN THE PHILADELPHIA SMSA THE CITY OF PHILADELPHIA HAS A HIGHER PROPORTION OF POOR AND UNEDUCATED THAN MOST OF ITS SURROUNDING COUNTIES

	Welfare Dependency	Schooling
County	Percent of Population Receiving Public Assistance,* 1972	Percent of Population 25 Years and Over With Less Than 5 Years of School Completed, 1970
Philadelphia, Pa.	14.1%	6.7%
Bucks, Pa.	4.0	2.0
Chester, Pa.	3.5	3.5
Delaware, Pa.	3.8	2.8
Montgomery, Pa.	2.1	2.5
Burlington, N. J.	2.7	2.7
Camden, N. J.	15.4	4.4
Gloucester, N. J.	3.6	3.9

*"Public Assistance" is the sum of Old Age Assistance (OAA) and Aid to Families with Dependent Children (AFDC).

SOURCES: U. S. Department of Commerce, Bureau of the Census, *County and City Data Book, 1972;* U. S. Department of Commerce, Bureau of the Census, *Current Population Reports,* Series P-25, No. 537, "Estimates of the Population of Metropolitan Areas, 1972 and 1973, and Components of Change Since 1970," December 1974.

as some cities, these fiscal concerns are clearly evident.

The flight of upper-income residents first raised the cry of alarm. Many people thought that the suburban exodus was nothing more than an attempt to avoid city tax payments. While this was probably a contributing factor, studies by economists indicate that significant forces other than income redistribution through taxes and services affect population shifts. These studies find that changing economic conditions, such as rising incomes and lower commuting costs in terms of time also induce population shifts. And the studies conclude that to a substantial extent this shift can lead to a better allocation of resources for society as a whole. (See Box 2.) However, there may be costs that individuals do not take into account in responding to these forces. Flight from the city can result in costs not borne by those who decide to exit. Examples are the increased crime rates and deteriorating housing that often accompany an exodus of firms and residents. Thus, the question as to whether such population shifts are in the best interest of society is not fully settled.

Perhaps the best example of such "negative externalities," as economists often call them, involves the deterioration of housing. An owner of a home or factory may find it advantageous to move out of Philadelphia. This may in turn result in a deterioration of his vacated home or factory. But having a run-

TABLE 4

PHILADELPHIA RANKS POORLY ON ALL MEASURES OF INCOME

	Percent of Families Below Low-Income Level	Percent of Families With Female Head	Median Income: All Families	Median Income: White	Median Income: Black	Black Income as A Percent Of White Income	Per Capita Income
SMSA	7.3%	12.9%	$10,780	$11,338	$7,517	66.3%	$3,401
Philadelphia, Pa.	11.2	18.9	9,361	10,220	7,373	72.1	3,017
Bucks, Pa.	4.1	6.5	11,649	11,703	8,255	70.5	3,403
Chester, Pa.	4.6	7.7	11,603	11,816	8,382	70.9	3,659
Delaware, Pa.	4.6	10.6	11,819	12,074	7,593	62.9	3,713
Montgomery, Pa.	3.3	7.9	12,743	12,866	9,159	71.2	4,383
Burlington, N. J.	5.3	7.8	11,352	11,569	8,434	72.9	3,294
Camden, N. J.	6.8	12.1	10,959	11,316	7,370	65.1	3,343
Gloucester, N. J.	5.8	8.2	10,620	10,768	8,302	77.1	3,032

SOURCE: U. S. Department of Commerce, Bureau of the Census, *Census of Population and Housing: 1970, Census Tracts,* Final Report PHC(1)-159, Philadelphia, Pa.–N. J. SMSA, 1972. Data are for 1969.

BOX 2

PHILADELPHIA'S POPULATION

For many individuals, any decline in the power or prestige of the city is bad. The popularity of such terms as "fiscal crisis" and "suburban exploitation" indicates a genuine concern that the central city has not been fairly treated. Another emerging view, however, is that changes in the distribution and mix of population reflect rational responses to basic economic forces—changes which may have some good in them from the overall standpoint of society.

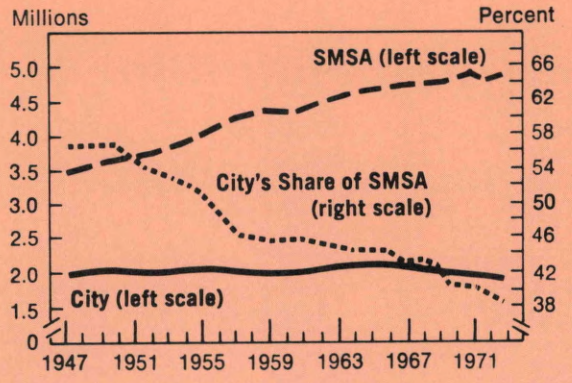
Population. A review of historical statistics reveals that the absolute population of the city of Philadelphia remained remarkably stable between 1930 and 1970, hovering within a band of 5 percent (or 100,000) more or less than two million. While the population has dropped below this band during the last few years, it is not clear whether this indicates a new trend or is merely a cyclical phenomenon. However, the dominance of the city of Philadelphia in its region (as measured by the percentage of the region's population living in the central city) has been declining since 1910. (For recent trends, see Chart 7.) While the population of the Philadelphia region mushroomed from 1900 to 1970, the counties surrounding Philadelphia absorbed most of the increase after 1920. Thus, in this sense, it seems unfair to charge the suburbs with having stolen any significant fraction of population from the central city. This stability in the absolute size of the city's population does not imply that the composition of that population remained the same, however.

The Changing Population Mix and Its Associated Problems. Philadelphia is characterized by the low income of its residents relative to their neighbors in surrounding counties.* Of the eight

*Of course there are exceptions within each area. For example, incomes in Center City and Chestnut Hill compare favorably to those of many suburbs, and incomes in the suburban areas are not uniformly high.

CHART 7

THE PHILADELPHIA POPULATION HAS REMAINED STABLE BUT HAS DROPPED AS A PERCENTAGE OF REGIONAL POPULATION.



SOURCE: Philadelphia Region Econometric Model Databank, Economics Research Unit of the University of Pennsylvania; U. S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-25, No. 537, "Estimates of the Population of Metropolitan Areas, 1972 and 1973, and Components of Change, Since 1970," December 1974.

counties in the SMSA, Philadelphia has (1) the highest percentage of families below the poverty level; (2) the highest percentage of families with a female head (a proxy for low earning ability); (3) the lowest median family income for all families; and (4) the lowest per capita money income. It also appears that the city's relative position has worsened steadily. In 1950 the ratio of city to SMSA median family income was 95.8 percent; by 1960 the ratio had declined to 89.9 percent and by 1970 further to 86.8 percent.** Also, it is evident that within the Philadelphia area, welfare recipients are heavily concentrated in the city with 14.1 percent of the city population receiving public assistance compared with 5.2 percent in the Philadelphia suburbs in 1972. (See Tables 2, 3, and 4.)

In addition to this shift in relative income, Philadelphia now has a greater concentration of groups, such as the aged and nonwhites, who often require higher levels of government expenditures. For example, Philadelphia's concentration of nonwhites has increased from 18.3 percent in 1950 to 33.5 percent in 1970.** Thus, the evidence indicates that the observed problems are really a result of a shift in the mix of people in terms of their government service needs, rather than an absolute decline in the number of people in the city.***

The Effect of Economic Factors. Many economists have come to the conclusion that much of the change over time in population distribution can be explained as a logical response to changing economic factors.**** These studies indicate that loss of the upper-income population occurs

**U.S. Census, 1950, 1960, and 1970.

***The most recent census statistics (1973) suggest that growth rates not only have slowed but actually turned negative for the region as well as the city since 1970, but it is not clear whether this is a new trend or just a cyclical downturn.

****The pioneering study with respect to population and housing is Richard F. Muth, *Cities and Housing* (Chicago: University of Chicago Press, 1969). And a discussion of recent contributions can be found in Edwin S. Mills and James MacKinnon, "Notes on the New Urban Economics," *Bell Journal of Economics and Management Science* 4 (1973): 593–601.

because of increases in income and decreases in the time and cost of commuting. New houses and large lots are desirable to many, and these are most efficiently provided outside of the central city. This leaves the older, less valuable housing in the central city to be adapted to use by low-income residents. The change reflects rational decisions by the individuals involved and is likely to lead to a better allocation of resources than if new housing were to be provided in the central city.

However, it would be wrong to imply that all of these changes would necessarily improve the allocation of resources for society as a whole. Although each individual may be responding to forces in a rational way from his or her own perspective, a number of those forces distort the market choice (for example, see Box 3), and these may have led to an excessive decline for the central city. However, the fact remains that rational responses to forces that contribute to the improvement of the allocation of society's resources help explain some of the change in population mix.

down building on the block may reduce the value of housing for many other residents. Preliminary investigation indicates that such external effects may indeed be present in Philadelphia. (See Box 3.) And according to some, there are many such "external" costs that result from the loss of people and jobs in urban economies.

Thus, the changing make-up of employment and population within Philadelphia can have ramifications far beyond that of just affecting the size of a city or the total number of workers employed. City fiscal problems, deteriorating neighborhoods, and crime may all

BOX 3

ABANDONED HOUSING AND NEIGHBORHOOD DETERIORATION

What causes a neighborhood to deteriorate? Some people argue that as housing ages it becomes more expensive to maintain and less worthwhile to do so. It is then allowed to deteriorate in quality and is passed on to lower and lower income groups until it is finally abandoned. This explanation is usually called filtering.* Proponents of the filtering explanation argue that neighborhoods are often involved because housing in an area tends to have the same general age and quality. In addition, if low quality is related to changes in technology, such as electrical wiring, old housing will be more likely to be of low quality.

An alternative contention is that while filtering does explain some deterioration, there are factors called "neighborhood effects" (or externalities) which lead to excessive deterioration.** This argument implies that buildings in declining areas are allowed to deteriorate faster than is warranted by their inherent condition. This occurs because the value of a building is affected by the condition of other buildings in the neighborhood. Each owner individually cannot capture the increased value of other buildings when he improves or maintains his building and he does not suffer the costs to other buildings when he allows his building to deteriorate, so he will tend to *undermaintain* the building. This is considered especially relevant to neighborhoods that already show some signs of deterioration.

Some statistical tests were used to determine whether the age of buildings or neighborhood

*For an exposition of the filtering argument see Ira S. Lowry, "Filtering and Housing Standards; A Conceptual Analysis," *Land Economics* 36 (1960): 362–70.

**See Jerome Rothenberg, *Economic Evaluation of Urban Renewal* (Washington: The Brookings Institution, 1967), for a more complete discussion of this.

effects were the major factors in neighborhood deterioration. Our study in Philadelphia indicates that it is primarily neighborhood effects which determine whether or not a building will be allowed to deteriorate. (For details of the study, see Technical Supplement F.)

This finding has relevance for government policy decisions. Since such effects appear to be a significant factor in neighborhood deterioration (and if borne out in studies in other cities), government intervention to slow such deterioration or to remove abandoned buildings may be appropriate. For example, urban renewal dollars, instead of focusing on rebuilding badly deteriorated areas, may be more effective if aimed at reducing the spillover effects of existing deterioration. (For example, Philadelphia's new program of demolishing abandoned buildings might be speeded up or housing codes more strictly enforced.)*** The most appropriate action will depend on each program's costs and benefits. However, it is clear that ignoring neighborhood effects could easily lead to the choice of an inappropriate policy.

***The city currently has a plan to demolish its 22,000 abandoned houses at the rate of 4,000 per year and cost of $10 million per year or $2,500 per house. This clearly would remove the spillover effect of the abandoned house, but we do not know exactly what the value of this benefit is, so we do not know if the program is worthwhile or not. Similarly, building code enforcement may prevent some deterioration, but it may also cause other buildings to be abandoned because it is not worthwhile to make them meet the code. The point is that we must compare all benefits and costs of a program, including the external ones, to determine which is the most desirable for achieving a particular objective.

be influenced by changing population and job trends. Yet, these trends themselves reflect a rational response on the part of individuals and firms to changing economic forces. Therefore, public policies that can affect job and population location must take account of the broader implications of these trends if society's best interests are to be served.

WHAT DOES IT ALL MEAN?

The main conclusions from examining job trends in the Philadelphia region and the city are the following:

1. There is no clear evidence of long-term job loss in the region since 1950 (after allowing for the cyclical impact of recession and short-term economic adjustments).
2. The city of Philadelphia has experienced a small job loss since 1950.
3. The important factor has been the *shift* in type of activity—away from manufacturing to nonmanufacturing. This shift in activity has been more pronounced in the city than in the suburbs.
4. The outlook is for an overall increase in jobs for the region by 1980 with nonmanufacturing jobs growing at a faster pace than manufacturing employment.
5. The city is expected to post a small gain in total employment by 1980 as the decline in manufacturing employment is likely to be more than offset by job gains in the nonmanufacturing sector.
6. Underlying these trends for the most part are some basic economic forces such as changes in national demand, input prices, transportation costs and technology, to which business firms can be expected to respond if they are to remain competitive and profitable.

These findings *do not* support the "gloom and doom" predictions too often heard about Philadelphia. They point to an urban area changing and evolving, not necessarily decaying and withering. Too often pessimistic forecasts stem from comparing Philadelphia growth with the rest of the country or particular urban areas. Relative decline does not mean an absolute decline. The westward movement of the frontier meant that the original 13 colonies had to decline *relative* to the

West, but that does not mean the Eastern seaboard is worse off today than 200 years ago. A more meaningful way to view Philadelphia is in absolute terms and by that criterion it is holding its own and the region is growing.

These findings do say something to those concerned about attracting jobs to the city. Basic economic forces such as transportation costs, labor pool availability, cost of space and so forth, dominate where firms choose to locate. There is probably not much a city can do to alter these basic forces. For example, there is very little, if anything, Philadelphia can do in a fundamental sense to stop the changing mix of employment. The nation as a whole and other urban areas have had the same experience. The number of manufacturing jobs here will continue to shrink, and nonmanufacturing jobs will continue to rise. Some effort at the margin may ease the transition, but the transition itself, barring some major new technological or social developments, is likely to be unstoppable. Therefore, efforts aimed at attracting manufacturing employment in general will likely be unproductive over the long haul. However, this does not necessarily mean that specific efforts by the city will not be helpful in certain cases.

What then might Philadelphia's City Government do or refrain from doing in an effort to influence the city's future? First, activities of local governments that involve redistributing income to the poor, most would agree, are best left to state or national government. The argument is that while society has an obligation to care for the indigent, there is no clear reason why the burden should fall on property owners in a particular community. Direct payments from the Federal Government would lead to more equal treatment for the poor in different communities, and would relieve inequitable burdens on city property owners. This, in turn, would reduce the incentive of firms and people to move solely to avoid local tax payments aimed at redistributing income.

Positive government action, however, may be called for in dealing with the spillover effects that may result as firms and higher income people leave the city. If neighborhoods are declining faster than inherent economic conditions would warrant because of the negative impact of abandoned factories or housing, then it may be worthwhile for government to step in. Demolition of abandoned structures might be speeded up or housing codes tightened and enforced more rigorously. The appropriate action, of course, would depend on each program's costs and benefits. Such programs, if economically feasible, would retard the deterioration of neighborhoods, improve the city's tax base and ease the effects of a changing population and job mix.

Another potentially fruitful area of government action involves efforts to improve the services provided for each tax dollar. That is, local government could attempt to boost its productivity. Providing more or better services for each tax dollar could help, at the margin, to retain or attract jobs and people.

On the policy menu, too, is the possibility of city government officials choosing policies which they believe would directly affect the net profit calculations of firms. They might, for example, engage in major land development programs in an effort to make Philadelphia a more profitable place in which to do business. Such a policy may help attract jobs to Philadelphia, but are the added jobs worth the cost? While many argue for policies of this nature, others regard them as intrusions in the private sector which are unlikely to benefit society in the long run. Definitive resolutions of these issues must await further research.

In sum, the future of Philadelphia and the region in terms of employment does not appear at all discouraging. Both the city and the region should experience job growth over the long haul. It is true the mix of jobs and the make-up of the population are changing, and change always generates some problems. But many of these problems, with appropriate public policies, can be resolved or ameliorated as Philadelphia moves into the next decade.

TECHNICAL SUPPLEMENTS

Technical Supplement A describes some of the conceptual and practical difficulties involved in generating data for local areas, enumerates the major sources of variation among employment estimates, and describes the data series used in the study.

Technical Supplement B contains charts and tables describing employment trends in Philadelphia and the SMSA by industry between 1954 and 1972.

Technical Supplement C describes in general terms the statistical method of multiple regression analysis. The method was used in the empirical analyses reported in Technical Supplement D, E, and F.

Technical Supplement D presents an empirical test, using Philadelphia and other large city data, of the hypothesis that the input characteristics of industries have a significant influence on the location of manufacturing industry employment within a metropolitan area.

Technical Supplement E describes the characteristics of the University of Pennsylvania Philadelphia Region Econometric Model. Limitations and a possible modification of the model are discussed. Tables of employment projections through 1980 are presented at the end of the section.

Technical Supplement F presents an empirical test of the "filtering" and "neighborhood externalities" theories explaining housing abandonment using Philadelphia data.

TECHNICAL SUPPLEMENT A
LOCAL EMPLOYMENT DATA: SOURCES AND PROBLEMS

A useful set of employment data for this study of Philadelphia would include separate series for the SMSA (Standard Metropolitan Statistical Area), the city, and the suburbs, broken down by county. These would be comparable to the data series available at the national level. Quarterly time series for the post-World War II period would enable us to look at both trends and cyclical patterns. Annual data for the pre-war period would be sufficient for examining longer-term trends.

Unfortunately, no single set of data meeting these criteria is available. In fact, it is not possible to achieve all these ends, even by drawing on the entire range of sources available. For the SMSA, annual time series on employment beginning with 1952 are available from the U.S. Bureau of Labor Statistics (BLS), the primary source of national employment data. However, sources other than the BLS must be tapped to get estimates of employment in the city and suburban counties for comparable time periods and to get estimates for the SMSA and city for earlier years.

This Technical Supplement aims (1) to indicate some of the conceptual and practical difficulties involved in generating data for local areas, (2) to enumerate the major sources of variation among employment estimates made by various methods, and (3) to describe the series used.

DIFFICULTIES OF GENERATING DATA FOR LOCAL AREAS

Two alternative approaches to the problem of generating data for local areas are available: allocation of national estimates among local areas, and direct estimation at the local level.

There are both practical and theoretical problems involved in the first approach—allocation of national estimates among local areas. The design of the sample poses a major practical problem: since economic activities are not evenly distributed geographically, a sample survey that adequately covers the nation may not adequately cover a smaller area. If resources were not limited, this problem could be better solved by direct estimation at the local level—that is, by redesigning the sample, increasing its size, or even conducting a census.

The more serious problems involved in generating local data are theoretical. They involve the difficulty of properly delineating a local economy. The national economy encompasses an overwhelming proportion of the economic activities of the firms, households, and governments located within the geographic United States. For subnational geographic areas, however, the problem of deciding on appropriate boundaries becomes quite complicated. For example, the market area within which a firm buys its inputs may differ greatly from the market area within which the firm sells its output, and these markets vary from industry to industry. Therefore, no single area is equally satisfactory for analyzing each of many different activities. The definition of Standard Metropolitan Statistical Areas (and their coincident Labor Market Areas) represents an attempt to delineate functional economic areas.

Since the spheres of influence of local governments do not often coincide with functional economic areas, and, further, since local governments have few instruments of economic policy at their disposal, the perceived usefulness of local economic information relative to its cost of production has generally not been sufficient to involve many local governments in extensive data collection. As the usefulness of local economic data grows and becomes more apparent, however, more usable information becomes available from both Federal and local agencies. At present, more information is available on employment than on income, output, prices, or other measures of economic activity. This study has, therefore, drawn most heavily on these employment data.

ISSUES IN MEASURING EMPLOYMENT

Several practical data collection issues can lead to inconsistencies among the employment estimates available from various government agencies.

1. Should employment be measured at place of work or place of residence? This distinction is unimportant at the national level, but its importance increases as the area under consideration grows smaller. Measurement of employment at place of work usually measures number of jobs, while measurement at place of residence counts number of employed residents. For a small area, the number of employed residents may be quite different from the number of jobs because many people live in one area and work in another. Workers holding more than one job constitute an additional source of discrepancy between the number of jobs and the number of employed persons.
2. Should entire firms or their individual operating establishments be the units used in assigning industry classifications? Measuring employment at the establishment level makes more sense for local areas, and all estimates of employment at place of work do this. Even individual operating establishments often produce more than one product, however. Employment could be allocated among the several industries in which an establishment produces, but resource limitations make this impractical. Therefore, the establishment's entire employment is assigned to the industry into which most of its product falls. The issue of whether to measure product in terms of physical units, dollar value of output, or quantity of labor used is usually resolved by using information on annual sales volume, as recommended in the *Standard Industrial Classification Manual.** However, different policies regarding classification of establishments whose product mix varies from year to year can result in an establishment's being classified in different industries by different agencies.
3. Classifying central administrative offices and auxiliary units such as warehouses, research laboratories and maintenance locations is difficult. Should these be classified according to their own products or functions, or according to the principal functions of their respective firms? The former method can lead to distortions of the relative sizes of industries when separate units occur more frequently in some industries than in others. The latter is inconsistent with the collection of data on an establishment basis. Once again, the distinction between these two methods is more important for local than for national estimates.
4. In addition to the "definitional" issues discussed above, there are the issues of timing, sample size and design, and accuracy. First, a single observation is likely to differ from an annual average of monthly or quarterly observations because of seasonal variation in employment. In order to minimize this discrepancy, most government agencies conduct annual surveys in March, a month in which employment levels are expected to vary little from annual averages. Second, differently designed samples, or even "complete" census counts, can be expected to yield differing estimates even when they are consistent in definition. Third, sampling variability and response errors can also produce discrepancies.
5. Another problem, common to all local data series but more serious for counties than for SMSAs or states, is that of suppression. Government agencies are prohibited by law from publishing data that disclose the operations of an individual employer. The problem affects some counties and certain industries more seriously than others. Data suppression is more likely in smaller counties where there is greater likelihood that an industry will be represented by only one or two establishments. It is also more likely in industries in which the size of establishments tends to be large, for the same reason. The amount of employment suppressed in the latter case is likely to be large.

*See U.S. Bureau of the Budget, *Standard Industrial Classification Manual, 1967.*

SOURCES OF EMPLOYMENT SERIES

The following description of sources of employment series emphasizes the data used in this study. It is not an exhaustive catalog of employment estimates for the Philadelphia area.

Census of Population. The U.S. Bureau of the Census collects data on employment in broad industry groups, by place of residence, in the decennial Census of Population. These provide useful benchmarks for 1950 (the census year in which the basic concept of "standard metropolitan statistical area" was introduced), 1960 and 1970 for the Philadelphia SMSA. These "place of residence" estimates should not differ significantly from "place of employment" estimates in terms of total employment because the number of commuters into and out of the SMSA is not large. This difference is significant for the city and each of the other counties, however.

The Bureau of the Census uses a special industry classification system (rather than the Standard Industrial Classification (SIC) system, which was designed for establishment reports and is used for all the other estimates of employment described below) for these "place of residence" estimates. Census estimates relate only to the week prior to the April 1 census date.

Economic Censuses. The economic censuses cover manufactures, wholesale and retail trade, selected services, construction industries, mineral industries, and transportation.** They measure employment at place of work (establishment basis), and all of them relate to the week prior to the census date. The time intervals given below are approximate; these censuses have not been taken as regularly as the Census of Population.

The Census of Manufactures is the oldest economic census. It provides estimates of employment by industry for selected large counties and cities, including Philadelphia, at ten-year intervals from 1899 to 1958 and five-year intervals thereafter. The Census of Retail Trade and the Census of Wholesale Trade provide employment in these two industry divisions at ten-year intervals beginning in 1929 and five-year intervals beginning in 1958. The Census of Selected Service Industries*** was taken three times in the 1930s and is available at five-year intervals beginning in 1948.

County Business Patterns. The Bureau of the Census provides another set of employment estimates, covering each county in the U.S., as a by-product of information collected under the Social Security Program. There are data on the city of Philadelphia, each of the other seven counties, and the SMSA as a whole. *County Business Patterns* provides the most detailed information available on nonmanufacturing for the city (and other counties) over a long period of time.

Because *County Business Patterns* data include only employment covered by the Social Security Program, a significant percentage of employment is omitted; for 1972, it was estimated that employment covered by *County Business Patterns* represented only about 76 percent of paid civilian wage and salary employment.† No government employment is reported in *County Busi-*

**For more information, see U.S. Department of Commerce, Bureau of the Census, *1972 Economic Censuses Publication Program,* September 1972.

***The selected service industries include most personal and business services; hotels, motels, trailering parks, and camps; automotive services; miscellaneous repair services; amusement and recreation services; legal services; and architectural and engineering services. Data are not included for medical and other health services, educational services, museums and art galleries, nonprofit membership organizations, religious organizations, and private household services.

†U.S. Department of Commerce, Bureau of the Census, *County Business Patterns, 1972,* U.S. Summary CBP-72-1, p. 1.

ness Patterns, and some railroad employees (who would be classified in transportation and public utilities) are omitted.††

County Business Patterns data, which represent mid-March pay period employment, are available irregularly beginning in 1946 and annually beginning in 1964. It is tempting to use them for intertemporal comparisons because they are available for so many more years than the census series. Unfortunately, the data are not strictly comparable over time because of changes in Social Security coverage and Standard Industrial Classification industry definitions. These data have never been revised to incorporate changes in SIC definitions, as has been done for some Census of Manufactures and BLS data.

For use in this study, data for the eight counties of the Philadelphia SMSA for 1951, 1959, 1967, and 1972 were taken directly from *County Business Patterns.* In these four years, there were no instances of suppression in Philadelphia County and only one in Montgomery, the second largest county; 12 of the 43 suppressions occurred in Gloucester County, the smallest. In this sample, suppression occurred only in the manufacturing sector; data were suppressed in 12 of the 19 two-digit manufacturing industries. Manufacturing data for four cities for 1969 were also collected from *County Business Patterns* for use in the employment location model (see Technical Supplement D). When suppression occurred in this sample, the observation was simply dropped.

Pennsylvania Industrial Census. An additional source of estimates of employment in manufacturing industries for Pennsylvania counties is provided by the Pennsylvania Industrial Census.††† Data for individual counties are available irregularly beginning in 1919 and annually beginning in 1951. Because the Census is limited to Pennsylvania counties, it is not possible to calculate totals for the Philadelphia SMSA, which includes three New Jersey counties. However, it does provide estimates for the city (county) of Philadelphia, and it is particularly interesting because the data extend over so long a period of time. Annual data for recent years are averages of quarterly reports. Separate central administrative offices and auxiliary units are excluded from this census.

BLS Nonagricultural Wage and Salary Employment. The monthly data on employment by industry collected in the BLS national establishment survey are broken down (by cooperating state agencies) into estimates for labor market areas. A labor market area may be thought of as an area within which workers may readily change jobs without changing their place of residence—a very large proportion of the people living in the area work there and vice versa. All SMSAs are designated major labor market areas, so these data are available for the Philadelphia SMSA. The longest series are those for manufacturing, beginning in 1949. The series on total nonagricultural wage and salary employment begins with 1952; series for some nonmanufacturing industries begin later than that.

One advantage of using these data is that they are fully comparable with the BLS national employment series. They are based on a large sample, and the annual estimates are averages of 12 monthly observations. (The monthly estimates are based on the payroll period which includes the twelfth of the month.)

In general, BLS estimates for labor market areas have not been broken down into estimates for the areas' component counties or their central cities because counties and cities rarely constitute labor markets.The BLS currently publishes employment estimates for only two cities, New York and Philadelphia. The series for Philadelphia are a recent innovation, beginning with 1969.

USES OF THE SERIES

Discrepancies among the employment series described above have been noted throughout the report. Technical Supplement E illustrates this problem in the context of the Philadelphia Region Econometric Model.

††Other groups excluded are self-employed persons, farm workers, and some domestic service workers.

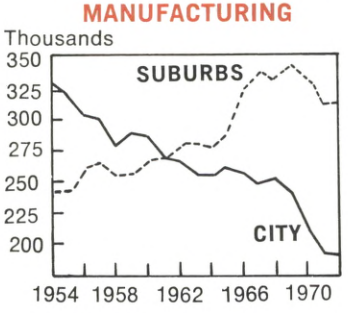
†††Commonwealth of Pennsylvania, Department of Commerce, Pennsylvania Industrial Census Series.

TECHNICAL SUPPLEMENT B

EMPLOYMENT TRENDS IN PHILADELPHIA AND THE SMSA, 1954-72

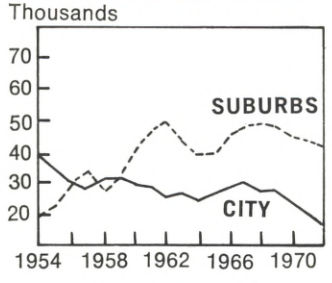
A. DISTRIBUTION OF MANUFACTURING EMPLOYMENT BETWEEN THE CITY OF PHILADELPHIA AND ITS SUBURBS, 1954-72*

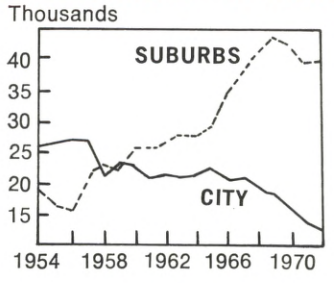
Since 1954 concentration of manufacturing employment in the Philadelphia region has shifted from the city to the suburbs.

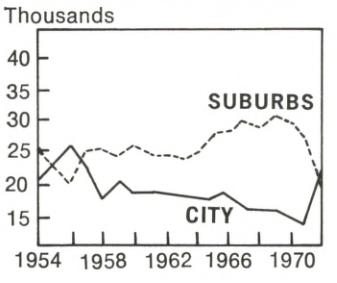


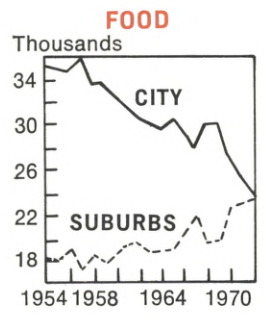
*SOURCE:
Suburban series are the difference between the regional series and city series; data for the region are from U. S. Department of Labor, Bureau of Labor Statistics, "Employment and Earnings, States and Areas, 1939-72," Bulletin 1370-10, and Commonwealth of Pennsylvania, Department of Labor and Industry, Bureau of Employment Security, "Total Civilian Work Force, Unemployment & Employment By Industry: Annual Average, 1964-1973, Philadelphia Labor Market Area" (June 1974); data for the city are from Philadelphia Region Econometric Model Databank (February 21, 1975), Economics Research Unit of the University of Pennsylvania.

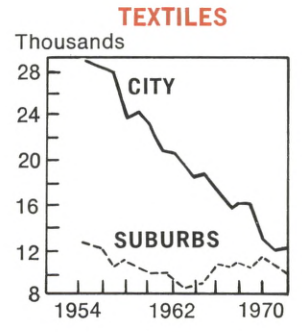
The same shift has occurred in six of the 11 most important manufacturing industries.

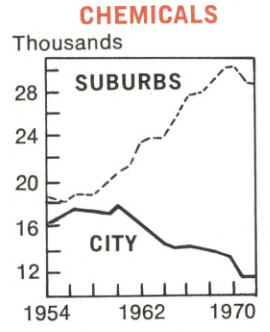






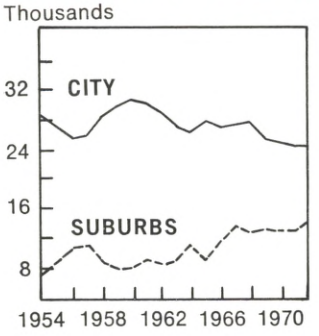




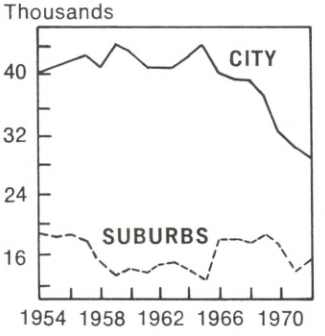


The trends in printing and publishing and apparel have been in the same directions, although the city retains its dominance in both industries.

PRINTING AND PUBLISHING

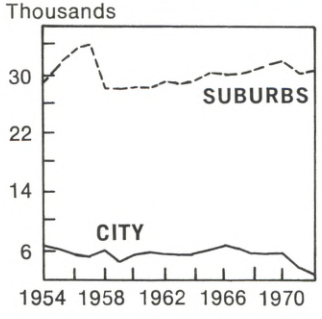


APPAREL

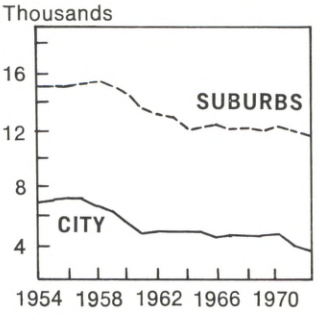


Employment in primary metals and petroleum has remained concentrated in the suburbs.

PRIMARY METALS

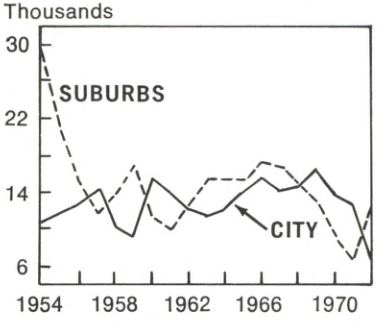


PETROLEUM



Only in transportation equipment has employment been approximately equally divided between city and suburbs throughout the period.

TRANSPORTATION EQUIPMENT



B. EMPLOYMENT GAINS AND LOSSES, BY INDUSTRY, IN THE CITY OF PHILADELPHIA AND ITS SMSA, 1959-72

Total employment in the Philadelphia SMSA grew more than 18 percent between 1959 and 1972. In manufacturing as a whole there was an 8 percent drop in employment, with most industries experiencing decline. Overall, nonmanufacturing grew about 31 percent, though individual growth rates differed widely.

TABLE B-1

	Employed Persons*		Percent Change
	1959	1972	1959–72
TOTAL EMPLOYMENT	1713.8	2034.7	18.7%
Manufacturing	544.5	500.9	− 8.0
Electrical machinery	63.0	56.7	−10.0
Apparel	57.5	43.8	−23.8
Food	51.1	45.7	−10.6
Nonelectrical machinery	46.0	51.8	12.6
Fabricated metals	43.9	39.0	−11.2
Chemicals	37.2	40.4	8.6
Printing and publishing	37.7	38.0	0.8
Primary metals	32.6	32.9	0.9
Textiles	34.9	22.2	−36.4
Transportation equipment	26.2	19.2	−26.7
Petroleum and coal products	21.5	15.6	−27.4
All other manufacturing	92.9	95.6	2.9
Nonmanufacturing	1169.3	1533.8	31.2
Wholesale and retail trade	297.1	384.3	29.4
Services	204.5	343.0	67.7
Government	177.3	273.9	54.5
Federal	75.6	82.7	9.4
State and local	101.7	191.2	88.0
Transportation and public utilities	110.1	104.5	− 5.1
Finance, insurance and real estate	78.7	107.7	36.8
Contract construction	72.0	86.0	19.4
Other nonmanufacturing	229.6	234.4	2.1

*Data are in thousands.

SOURCE: Commonwealth of Pennsylvania, Department of Labor and Industry, Bureau of Employment Security, "Total Civilian Work Force, Unemployment & Employment by Industry: Annual Average, 1964–73, Philadelphia Labor Market Area." (June 1974); U.S. Department of Labor, Bureau of Labor Statistics, "Employment and Earnings, States and Areas, 1939–72," Bulletin 1370–10.

Total employment in the city of Philadelphia grew about 2 percent between 1959 and 1972. In manufacturing as a whole there was a 34 percent drop in employment, with virtually all industries declining.

TABLE B-2

	Employed Persons*		Percent Change
	1959	1972	1959–72
TOTAL EMPLOYMENT**	713.0	728.4	2.2%
Manufacturing	288.0	189.4	−34.2
Electrical machinery	31.5	16.0	−49.2
Apparel	44.5	29.0	−34.8
Food	33.7	22.9	−32.0
Nonelectrical machinery	23.5	12.6	−46.4
Fabricated metals	20.1	20.3	1.0
Chemicals	17.2	11.6	−32.6
Printing and publishing	29.8	24.0	−19.5
Primary metals	4.5	2.6	−42.2
Textiles	24.2	12.1	−50.0
Transportation equipment	9.1	7.0	−23.1
Petroleum and coal products	6.5	4.0	−38.5
All other manufacturing	43.4	27.3	−37.1

*Data are in thousands

**This estimate of total employment does not incorporate an estimate of government employment. See Technical Supplement E.

SOURCE: Philadelphia Region Econometric Model Databank (February 21, 1975), Economics Research Unit of the University of Pennsylvania. No detailed breakdown of the nonmanufacturing sector is available from this source.

In the city, nonmanufacturing excluding government grew about 12 percent. Services and finance registered large increases.

TABLE B-3

	Employed Persons*		Percent Change
	1959	1972	1959–72
Nonmanufacturing excluding government**	444.3	499.0	12.3%
Wholesale and retail trade	186.8	172.7	− 7.5
Services	114.7	166.8	45.4
Transportation and public utilities	54.4	56.5	3.9
Finance, insurance and real estate	53.4	70.6	32.2
Contract construction	31.1	29.2	− 6.1
Other nonmanufacturing	3.9	3.2	−17.9

*Data are in thousands.

**_County Business Patterns_ data do not cover government employment; see Technical Supplement A.

SOURCE: U.S. Department of Commerce, Bureau of the Census, _County Business Patterns_, 1959 and 1972.

TECHNICAL SUPPLEMENT C
MULTIPLE REGRESSION ANALYSIS

This section provides a basic explanation of the statistical method of multiple regression analysis. The description is designed to supplement the empirical analyses reported in Technical Supplements D, E, and F.

Economic events are often the result of a large number of factors. Understanding the consequences of these events and being able to indicate what public policy should do about them requires sorting out the influences that created the situation. Usually, an economist develops a hypothesis about what factors "explain" the event. Then, the statistical technique known as multiple regression analysis can be applied to the empirical evidence which is available, in an attempt to sift the importance of the various factors.

Suppose a policymaker is interested in investigating what determines the percentage of a city's firms that will move to the suburbs in any one year. He may hypothesize that the rate at which firms leave depends on the relative tax rates in the city and suburbs and on general business conditions. Since he cannot perform the preferred experiment of varying the relative tax rates or the general business conditions while holding other things constant, he must draw upon data from a number of actual cases to see how rates of business exodus vary with these major influences. In this case, data from the Philadelphia region in each of the last 25 years would provide a good empirical basis for analyzing the problem.

The percentage of firms in Philadelphia that move to the suburbs in any given year, say Y, would be the dependent variable—the event to be explained. The difference between the property tax rate for the city and the average rate for the suburbs (X_1), and the unemployment rate in the region (X_2), would be the independent or explanatory variables. X_1 measures a characteristic of one prominent local tax on businesses. X_2 is a proxy for the general condition of the economy of the city. The estimated multiple regression equation, which could be calculated by the method known as ordinary least squares, might be $Y = 5.0 + 1.0\,X_1 - 2.0\,X_2$.

The coefficients of this hypothetical regression equation would be interpreted this way. 1.0 indicates that with the unemployment rate held constant, a one mill greater difference between the property tax rate for the city and the average for the suburbs would result in 1.0 percentage point more firms leaving. Similarly, an increase of 1 percentage point in the unemployment rate, and no change in relative property tax rate, would mean a decrease of 2.0 percentage points of firms exiting.

Now, suppose the analyst thought that the proportion of blue cars in the city in a particular year would also affect business exodus. He would include this variable as X_3 in another version of the equation. Since, actually, the color of autos almost certainly does not affect firm location, the coefficient of X_3 should be zero. In other words, with tax rates and the unemployment rate constant, an increase of 1 percentage point in the proportion of cars that are blue should cause zero increase in the percentage of firms that leave the city. The coefficient for blue cars, however, might, in the equation, turn out to be different from zero. This nonzero value of the estimated coefficient could result either from randomness causing the estimated coefficient to differ from the true coefficient of zero, or from an actual relationship between the independent and dependent variables. A statistical test will indicate which is the case.

The formal test involves comparing the value of the coefficient and the standard error of the coefficient. The standard error indicates a range around the actual coefficient in which we can expect the estimated coefficient to be. If the ratio of the value of the coefficient to the corresponding standard error (a ratio called the t-statistic) is less than something in the neighborhood of 2, it turns out that about 95 percent of the time zero will be in the interval of possible values of the

actual coefficient.* If this is true, then the coefficient is not significantly different from zero or, as is often said, it is not statistically significant. It would be appropriate, then, to conclude that the independent variable has not been shown to be related to the dependent variable. The coefficient can be regarded as equivalent in interpretation to zero. Presumably, the t-statistic for the proportion of blue cars would be less than 2.**

To get an idea of the explanatory power of the whole equation, the economist looks at the R^2 statistic. The R^2, which must be between 0 and 1, indicates what percentage of the variation in the dependent variable is explained by all the independent variables in the equation together. For example, an R^2 of .50 indicates that half the variation in the dependent variable has been accounted for by changes in the independent variables. The rest of the variation is because of other factors. Some important variables may have not been included because the data needed to measure them are not available.*** Further, a multitude of small factors that cannot be accounted for can cause some variation in the dependent variable. For example, there may have been a case where the marriage of the brother-in-law of a company president caused a firm to move out of the city. Such an event will cause some minor variation in the rate of business exodus, but it cannot be accounted for in an estimated equation. Given these two causes of unexplained variation in the dependent variable, an R^2 of 1 (an equation which explains *all* the variations in the dependent variable) is essentially impossible.

In sum, multiple regression analysis is a powerful tool for social scientists. It is their substitute for controlled laboratory experiments.

*The actual value that the t-ratio must exceed for a coefficient to be significant at the 95 percent level depends on the number of observations and the exact nature of the hypothesis. In this example, with 25 observations and only three explanatory variables, the critical t-value at the 95 percent level in a two-tailed test would be 2.08.

**The proportion of blue cars was picked because it is obviously unrelated to business exodus. This example should not be construed to imply that only ridiculous variables will turn out to be insignificant.

***Actually, inclusion of almost any variable will raise the R^2 slightly. To account for this, R^2 is usually reported in a form called "R^2 adjusted for degrees of freedom." The adjusted R^2 is less likely to rise when unrelated variables are added to an equation.

TECHNICAL SUPPLEMENT D
CHARACTERISTICS OF INDUSTRIES AND LOCATION CHOICE: CITY VERSUS SUBURBS

Why do some firms locate in the central city and others in the suburbs? One explanation is that there may be identifiable differences in the characteristics of firms which influence their choice. For example, differing labor and capital production requirements may help to explain the observed differences in central city concentrations of employment in various industries. In more formal economic terms, it seems useful to test the hypothesis that the input characteristics of industries have a significant influence on the location of manufacturing industry employment within a metropolitan area. This Technical Supplement discusses such a test. In the first section the theory underlying this hypothesis is stated. In the second section the model (mathematical

statement) incorporating the hypothesis is described. And in the third section the results of the empirical testing of the model are summarized.

THEORY

The empirical investigation was designed to test several interrelated hypotheses. Most basic is the theory that the choice of location by a profit-maximizing firm depends upon (1) the variation across different geographical locations (spatial variation) in the prices of inputs and outputs, and (2) the firm's input and output requirements. Since it is assumed that industries place different relative importance on the various production factors they consider, each industry is likely to respond differently to variations in individual input and output prices in a region. This reasoning leads to the hypothesis that employers for whom certain inputs are important will locate where those inputs are relatively cheap. The presumption is that there will be a reduction of costs at that location with savings on the major input factors more than offsetting any increases in costs resulting from the higher prices of minor factors.

The purpose of the model is to develop estimated equations whose coefficients would indicate whether an input is associated with a characteristic influencing location choice. Since the prices of input factors such as land and labor are generally not easily obtained for a given location, it is hypothesized that prices depend upon—and can be represented by—characteristics of that location. Land prices, for example, are expected to be higher in a central city location, while the cost of interfirm communication is expected to be lower in the city. The fact of a central city location, then, can be used as a proxy for land price and the cost of interfirm communication, as well as for the prices of other inputs.

MODEL

Five Basic Assumptions. The model employs the following basic assumptions which simplify the analysis:

1. The regional level of employment in an industry is assumed to be determined by forces other than those explored in this project. These determining forces, regarded as exogenous to the model, include aggregate national demand for the product, regional demand, and differences in cost from one region to another. This model is only concerned with accounting for the distribution of that predetermined level of employment across the metropolitan area.
2. The current pattern of employment across the metropolitan landscape is assumed to reflect a stable adjustment to the underlying supply and demand forces. This condition, whereby a system remains at one point because there is no impetus to change under existing conditions, is known as the equilibrium condition. Consistent with this assumption of equilibrium in the existing distribution of employment, the analysis of location is not directed toward *changes* in employment location (the result of new location decisions by firms), but rather at *aggregate levels* of employment. This reflects the cumulative impact of decisions regarding the expansion, contraction, births and deaths, as well as the relocation, of individual firms.
3. The prices of inputs and outputs facing firms are assumed to be essentially equal at all locations within the city and equal at all locations within the suburbs. But the city price-level is expected to differ from the suburban level.
4. Each firm in each industry is assumed to select a site where its profits are maximized.
5. To simplify the problem of obtaining data, it is assumed that the production process or input requirements are the same for all firms within an industry. This permits an aggregation from the firm to the industry level at which data are more generally available. Production requirements are assumed to vary across industries, however. Some industries, for example, employ relatively more labor in their production processes, while others use more machinery. It is precisely these variations in industry characteristics which will be examined in the

attempt to explain differences in employment location patterns.

Sample. The original sample represented just the Philadelphia SMSA. Only 13 observations on manufacturing area employment* were available for the dependent variable. After initial tests on the Philadelphia sample proved encouraging, the number of observations was increased to 72 by pooling data from New York, Baltimore, St. Louis, and Denver as well.**

Description of the Model. There are many factors whose prices may influence the profitability of a firm's production at a particular location. These include labor, land, capital (dollars and equipment), raw materials, intermediate products, business services, energy, public services (including taxes), hazards to persons and property (crime, fire, flooding), and transportation costs. Not all of these factors could be accounted for in this initial exploration.

A detailed description of the industry variables actually included and their data sources are presented in Table D-1. In brief, the dependent variable is the percentage of employment in an industry in an SMSA which is located in the central city of that SMSA ($\%CE_{ij}$). The independent variables are the ratio of dollars of capital stock to dollars of output (K_i), the ratio of labor man-hours to dollars of output (L_i^1), the percent of the industry's employment classified by the percent of its labor force in eight major occupation categories ranging from professionals to laborers (L_{ik}^2), the national average wage paid by the industry (L_i^3), an indicator of whether the industry produces a durable good or not (D_i), and the SMSA's average percentage of manufacturing employment in the central city (A_j).

Regression Equations. The basic form of the regression equation tested can be expressed in terms of these categories of variables:***

$$\%CE_{ij} = a + b_1K_i + b_2L_i + b_3D_i + b_4A_j + e_{ij}$$

where $\%CE_{ij}$ = the percent of employment in industry i in SMSA j which is located in the central city;

a = a constant term;

K_i = capital-output ratio for industry i;

L_i = labor requirements for industry i which may take any of the following forms:

L_i^1 = labor-output ratio for industry i;

$\sum_{k=1}^{8} L_{ik}^2$ = percentage of industry i's employment in each of eight major occupation categories, k;

L_i^3 = average wage (nationally) in industry i;

D_i = a dummy variable which takes the value of 1 if industry i produces durable goods and 0 otherwise;

A_j = the average percentage of manufacturing employment located in the central city of SMSA j;

e_{ij} = a random error term;

b_1, b_2, b_3, b_4 = the estimated coefficients;

i = subscript indicating the individual industry;

j = subscript indicating the individual SMSA or region.

*The manufacturing industries included correspond to two-digit SIC codes, examples of which are included in Appendix B.

**These four cities are also counties. Consequently, similar data on the distribution of manufacturing employment between the central city and the suburban counties of the SMSA are readily available from *County Business Patterns*.

***The basic model used in this investigation was developed by Peter Kemper. For more detail see his "Manufacturing Location, Production Requirements, and Market Characteristics," Swarthmore College, October 1974.

TABLE D-1
DATA DEFINITIONS AND SOURCES

Dependent Variable	
Central city employment as a percentage of SMSA employment in the industry	Employment data (1969) for two-digit SIC codes in manufacturing, from five cities (which are also counties) and the surrounding counties in their SMSAs: Philadelphia, New York, Baltimore, St. Louis, Denver. A total of 72 observations. U. S. Department of Commerce, Bureau of the Census, *County Business Patterns, 1969.*
Independent Variables	
Constant	Takes a value of 1 (one) for all observations.
Capital-Output ratio Labor-Output ratio	Estimated by industry for 1966. Gross labor (man-hours) and capital (dollar) figures as well as index numbers (1958 = 100) from John W. Kendrick, *Post-War Productivity Trends in the United States, 1948–1969* (New York: National Bureau of Economic Research, 1973). Gross output figures (dollars) from U. S. Bureau of the Census, *1958 Census of Manufactures,* I: 46.
Durable good dummy	Variable takes a value of 1 (one) if the industry produces durable goods, 0 (zero) otherwise. U. S. Bureau of the Budget, *Standard Industrial Classification Manual, 1967.*
Percentage of industry employment by occupation category: craftsmen, managers, professional, sales, service, clerical, laborers, and operatives	National average composition in 1970. U. S. Department of Labor, *Tomorrow's Manpower Needs,* 4, The National Industry-Occupational Matrix and Other Manpower Data, Revised 1971, Bulletin 1737.
Average industry wage	National wage level, 1974. *Monthly Labor Review,* February 1974, p. 110.
Average percentage of central city employment for the SMSA	Average of the dependent variable (across industries) for each SMSA, 1969. The value of this variable is the same for all industry observations in a given metropolitan area. *County Business Patterns, 1969.*

The investigation was conducted in three stages, each of which is represented by one equation in Table D-2. The first equation was tested on the Philadelphia sample only. Because of the small number of observations (13) the number of independent variables which could be included was restricted to four to strengthen the statistical results. The same equation was estimated (Table D-2, Equation 2) on the five-SMSA sample to verify that economic relationships similar to those in the Philadelphia region were likely to exist in the other metropolitan regions chosen as well. With the larger number of observations (72) made available by the five-SMSA sample, it was statistically possible to increase the number of variables included in any one regression. Equation 3 of Table D-2 is the "best fit" regression, reflecting the general findings of the empirical investigation and the greatest statistical reliability.

RESULTS

Hypothesized Results

(L_i^1) Industries requiring relatively more labor in their production process were

TABLE D-2
CENTRAL CITY EMPLOYMENT LOCATION REGRESSIONS

Dependent Variable: Central City Employment
as a Percentage of SMSA Employment in the Industry

Independent Variable	Regression Coefficients† (1) Philadelphia Only	(2) Five Metropolitan Areas	(3) Five Metropolitan Areas
1. Constant	0.211	0.537**	1.235**
	(1.33)	(5.72)	(5.06)
2. Labor-Output Ratio	1.775*	0.863*	—
	(2.84)	(2.31)	
3. Capital-Output Ratio	−0.003	−0.011	0.071**
	(−0.11)	(−0.55)	(3.10)
4. Durable Good Dummy	−0.122	−0.212**	−0.345**
	(−1.51)	(−4.41)	(−4.41)
5. % Employees Craftsmen	—	—	0.042**
			(4.35)
6. % Employees Managers	—	—	0.065**
			(2.85)
7. % Employees Professionals	—	—	0.011
			(1.60)
8. % Employees Sales	—	—	−0.007
			(−0.27)
9. % Employees Clerical	—	—	−0.044*
			(−2.41)
10. % Employees Laborers	—	—	−0.014*
			(−2.58)
11. % Employees Service	—	—	0.015
			(0.26)
12. Average Industry Wage	—	—	−0.011**
			(−4.42)
13. Average of Dependent Variable by City	—	—	0.616
			(1.98)
14. Adjusted R^2	.47	.24	.51

*Coefficient is significant at the 5 percent level.

**Coefficient is significant at the 1 percent level.

†The t-statistics are reported in parentheses.

hypothesized to tend toward locating in the central city, the location most accessible to the majority of the region's labor force. The sign on the labor-output ratio variable, then, was expected to be positive.

(K_i) However, industries requiring extensive investment in plant and machinery per dollar of output were hypothesized to prefer a noncentral location where space (land) would

be less expensive. The coefficient on the capital-output ratio was expected to be negative.

(D_i) Durable good producing firms, which require less timely access to consumer markets, were not expected to compete vigorously for a central location in the region. Consequently, the coefficient on the durable goods dummy was expected to be negative.

(L_i^3) Urban location theory suggests that, with other factors held constant, wages should decline with increasing distance from the central city since workers' housing and commuting costs will also decline. This implies a positive coefficient on the wage variable meaning higher wages at central locations.

($\sum_{k=1}^{8} L_{ik}^2$) There are few well-known theoretical arguments or empirical findings to guide the expectations regarding the signs on the industry labor force when broken down into occupational categories. Since the type of labor represents other characteristics of a firm as well, the results on the occupation variables might also be interpreted in terms of other related features of the firm. Several such relationships appear to be reasonable.

(a) A high percentage of craftsmen, managers, or professionals would imply less standardization of procedures and output and more interaction with other firms, each of which is likely to make a central location more attractive. (Positive signs on these coefficients were expected.)

(b) High percentage of sales workers would indicate an orientation toward the consumer and, hence, no direct pull either into or out of the city; dispersion according to the density of the market might be predicted. The number of service workers is expected to be proportional to the size of the establishment with no particular location tendency. (The coefficients on these variables were not expected to be significantly different from zero.)

(c) A high percentage of clerical workers is usually associated with management functions and is, therefore, likely to lead to a central location. (A positive coefficient was expected.)

(d) High percentages of laborers or operatives imply standardized output and routine processes and, thus, a suburban location might be expected. (Negative coefficients were anticipated.)

(A_j) The average percentage of regional manufacturing in the given central city is included to standardize for the varying geographical composition of SMSAs. The coefficient is hypothesized to be positive: where the concentration of employment in a city relative to its SMSA is high, any industry in that city can be expected to reflect this aggregate concentration.

Empirical Results. These findings are preliminary and are subject to various interpretations. However, they do appear to support the notion that input requirements of industries strongly influence location decisions. The results presented in Table D-2 are based on information from manufacturing industries only.

Labor-Output Ratio. Both the Philadelphia and five-SMSA samples support the conclusion that firms using large amounts of labor in their production process are more likely to locate in the central city. The coefficient on the labor-output ratio variable is positive and statistically significant in both cases (Row 2, Columns 1 and 2).

Capital-Output Ratio. The capital-output ratio coefficient displayed the most erratic behavior, changing in both sign and significance when more variables were included in the equation. While in some tests it appeared that capital-intensive firms tended to prefer a noncentral location, more comprehensive tests indicated that they may, in fact, prefer central sites. In the

four-variable version, for both the Philadelphia and five-SMSA samples, the coefficient on this variable was negative, but not statistically significant (Row 3, Columns 1 and 2). When the more detailed labor force and city share variables were included, the coefficient on the capital-output ratio became both positive and statistically significant (Row 3, Column 3). In the four-variable regression, the capital-output ratio may have reflected the impact of other omitted characteristics associated with a noncentral location. Higher costs of land and buildings (which are included in capital) in the city may be reflected in this positive coefficient once other production characteristics have been accounted for. The result of a positive relationship between the capital-output ratio and central city location was also found by Kemper† in his study of the location patterns of new firms in New York City.

Durable Goods Production. The results consistently suggest that the producers of durable goods tend toward a noncentral location. Although the coefficient on the durable goods variable was negative in all three regressions, it was statistically significant only in the five-SMSA equations (Row 4, all columns).

Labor Force Occupational Composition. The labor force occupation variables were tested in various combinations,†† but the results on the individual variables were generally not sensitive to these minor changes in the equation. Regression 3 (Column 3) is the equation of "best fit" from this testing series. It revealed a number of interesting relationships between location and occupational mix.

Having a relatively high fraction of its labor force as craftsmen or managers seems to imply a central location for an industry, but the case is not clear for professionals. The coefficients for percentage of craftsmen (Row 5) and percentage of managers (Row 6) were consistently positive and significant. However, the coefficient for percentage of professionals (Row 7) while generally positive, was seldom significant.

Employment of sales workers seems to have been appropriately identified as having no special tendency toward either a city or suburban concentration. The coefficient (Row 8) frequently changed sign and was seldom significant.

The findings suggest that the characteristic of a labor force with a large percentage of clerical workers is associated with a noncentral location. This contradicts the hypothesis that the association of clerical work with management functions suggests a tendency toward a central city location. Perhaps the dominant nature of clerical work is routine functions which are associated in turn with noncentral locations. In contrast to expectations, then, the coefficient for the percentage of clerical workers (Row 9) was consistently negative. Although this coefficient was seldom significant in the battery of preliminary tests, it was significant in Regression 3.

As hypothesized, having a high percentage of the work force in laborer positions was found to be associated with noncentral locations. In the final occupation category reported, the percentage of laborers was found to have a consistently negative and significant coefficient (Row 10).

Although not significant in this equation of "best fit" (Regression 3), the coefficient for the percentage of workers in service occupations (Row 11) was always positive and often significant. While janitors and guards are classified as service workers, groundskeepers and gardeners are classified as laborers. Suburban plants tend to rely more heavily on outside maintenance relative to city plants. This type of distinction in the data collection categories may help account for the positive coefficient on service workers and the negative coefficient on laborers.

†Kemper (1974).

††One occupation category had to be excluded in any regression to insure that the matrix would be invertible.

The hypothesis that a high fraction of the labor force engaged as operatives would suggest a noncentral location was not supported by the findings. In alternate specifications not reported here the coefficient for the percentage of operatives was consistently positive and significant, indicating a central location.

Average Industry Wages. The empirical findings did not support the hypothesis that higher wages were associated with central locations. Location theory indicates that when other variables are held constant, wages should decline with increasing distance from the central city. There are several possible explanations for the finding here that even with other job characteristics held constant, lower-paying industries are still found to favor city locations. One is that higher income workers tend to live in the suburbs and this, in turn, attracts firms which pay relatively high wages. Another is that high wage firms may also represent a noncompetitive segment of the economy which chooses a suburban location for aesthetic reasons. Finally, it is possible that suburban firms are more stable than the average and may pay higher wages to reduce labor turnover or that a noncentral location puts a firm at a disadvantage in attracting labor. However, all of these explanations require further investigations. The coefficient on the average wage in the industry was consistently negative and significant (Row 12, Column 3).

Regional Average Employment Concentration in the Central City. Accounting for the average dominance of the central city in the region's manufacturing employment made only a small contribution to explaining the share of employment in the city for individual industries across SMSAs of differing geographical composition. Although not significant in Regression 3 (Row 13, Column 3), the coefficient on the average percentage of the region's manufacturing in the given central city was positive and usually significant. However, it had little effect on the R^2, or on the size or significance of any other coefficients.

CONCLUSIONS

The implication of these findings is that a firm's input characteristics and market orientation seem to explain a large amount of the variation among manufacturing industries in their city-suburban location preference patterns. In particular, the labor- and capital-intensiveness of production, the skill composition of the labor force, the wage rate in the industry, and the nature of the industry's output (durable versus nondurable goods) helped to explain why some industries tended to concentrate in the central city, while others preferred the outlying areas of the SMSA.

These results should be interpreted cautiously. Further research is needed at a more detailed industry or, preferably, at an individual firm level. Also, a more careful specification of the demand and supply for the various production and marketing inputs would help to identify underlying economic relationships with greater confidence. At this stage the results should only be viewed as suggestive of causal relationships affecting the location decisions of firms within the metropolitan economy.

TECHNICAL SUPPLEMENT E
THE PHILADELPHIA REGION ECONOMETRIC MODEL

A number of large scale econometric models are used for predicting the future of the national economy,* but there are few available for forecasting the economies of local areas. There are two

*For an extended explanation of a national econometric model, see Nariman Behravesh, "Forecasting the Economy with Mathematical Models: Is It Worth the Effort?" *Business Review* of the Federal Reserve Bank of Philadelphia, July/August 1975, pp. 15–25.

basic obstacles to building local econometric models: The number of large models built in the country is limited by the substantial expertise and resources required for each model, and the data needed for a full scale econometric model are often not available for local areas.** Nevertheless, some forecasting models for the Philadelphia region do exist, including the Philadelphia Region Econometric Model.*** This model, which was built by Norman Glickman and his associates at the University of Pennsylvania, provides projections on the economy of Philadelphia and the Philadelphia SMSA. The output of this model is a set of estimates of future employment and output by industry, future income, future tax receipts and public expenditures, and a number of other economic variables.

CHARACTERISTICS AND LIMITATIONS OF THE MODEL

Analysis of the structure of the model and some of the individual equations reveals some interesting aspects of the Philadelphia economy, as well as some advantages and disadvantages of the model.

Size. Probably, the most obvious characteristic is the model's size—101 equations and 100 additional identities. This allows considerable detail in the predictions and in analysis of the region's economy.

Subregional Detail. The model is area-stratified, containing equations for both the SMSA and the city of Philadelphia. By taking the difference between the values for the SMSA and the city for each item forecast, the model yields projections for the suburbs as well.

The usefulness of this detail is somewhat limited by problems associated with the employment data for the subregions (see Technical Supplement A and below for a more detailed description of local employment data problems and sources). The employment series for past years used for the city are low relative to other estimates. If the other estimates are more correct, the residual series for the suburbs would be too high. Consequently, the city and suburban series used in estimating the model are probably more reliable as indicators of the direction of movements over time than as measures of relative levels of employment in city and suburbs.

Simultaneity. The Philadelphia model allows feedback among equations. This characteristic, which makes the model "simultaneous" rather than "recursive," allows for greater realism in the economic relationships portrayed.

A model having a recursive system of equations must predict one variable first. Then it can use that prediction in the forecast of the second variable, and so on through the model. However, a recursive system allows no feedback in the equations; the predicted value of the second variable cannot affect the forecast of the first variable. A simultaneous model allows such feedback, but at the price of a complicated (and costly) numerical method of "solving" the system of simultaneous equations.

Annual Data. The model is basically an annual model. Data for many important local variables are not available on less than an annual basis. Thus, although there is a block of equations in which some items are forecast quarterly,† the model is forced to forecast many items on an annual basis.

There is a second side effect of this data deficiency; the number of observations in each series is

**See Norman J. Glickman, "Son of 'The Specification of Regional Econometric Models,' " University of Pennsylvania Discussion Paper 27, April 1974, for a technical discussion of the relationships of regional models to the national models and the differences in types of data available for each.

***Norman J. Glickman with Kenneth Ballard, "The Philadelphia Region Econometric Model IV," Economics Research Unit of the University of Pennsylvania, 1973, mimeo.

†The quarterly model is still under development. The number of items forecast quarterly will be increased as this development advances.

relatively few. Each estimation equation can, therefore, only contain a relatively small number of explanatory variables. This, combined with the nonexistence of some local variables even on an annual basis, means that some variables which, ideally, would have been included are not.

Industry Detail. The Philadelphia area economy is very diverse. Thus, the decision to construct the model so that it forecasts the important industries of the Philadelphia economy forced the model's builders to include equations on a large number of individual industries.

Demand Orientation. The model ignores comparative costs of production in the region and implicitly assumes that the supply of factors of production is elastic. The basic determination of output in the region or the city is the demand for that output. Differences in costs of production between this region and others or between the city and the rest of the region are not considered.

This limitation arises from the use in the Philadelphia model (as well as in many other regional models) of what is called the export-base approach—an approach based on demand relationships. In an export-base model, the industries of the region are divided into export industries, whose output levels are determined primarily by the level of national demand, and local industries, whose output levels are determined mainly by local demand. Thus, for example, output in the electrical machinery industry in the region depends heavily on the demand from the whole nation. The regional output in the finance, insurance and real estate industry, by way of contrast, is derived mainly from estimates of personal income in the region. Determination of which are export industries was made through careful examination of a Philadelphia region Input-Output table.[††] This table also yielded information on interindustry relationships in the region such as the influence of the apparel industry on the textile industry. This information influenced the design of the equations of the model. Thus, output in the apparel industry was one of the determinants of output in the textile industry, reflecting the fact that a large part of the demand for textiles comes from the apparel manufacturers.

This emphasis on demand is adequate for forecasting purposes. However, it limits the ability of the model to predict future changes that result from changes in comparative costs or factor supplies.

Tie-in with the National Model. The nature of these demand relationships in the export industries and other influences of the nation on the Philadelphia economy require that the Philadelphia Region Econometric Model be closely linked with predictions for the national economy. For this reason, the Philadelphia model is designed to be "plugged-in" to a national model. This means that the major components of the national economy are forecast separately in a national model that takes no special account of the Philadelphia area. Projections from this national model are then made available for use in forecasting the Philadelphia economy—that is, for the purposes of the Philadelphia model, they are taken as given (regarded as exogenous) and not forecast within the model.

Local Exogenous Variables. In addition to the national exogenous variables, there are some local variables that are also treated as exogenous—for example, the Philadelphia property tax rate and the level of intergovernmental aid to the city.

The economist using the model must supply the projections of these exogenous variables. In some ways this is an advantage. It would be possible, for example, to try out several levels of the Philadelphia property tax rate in the model to see how the economy can be expected to react to the

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††Walter Isard, T. W. Langford, and E. Romanoff, *The Philadelphia Region Input-Output Study*, Philadelphia: Regional Science Research Institute, 1967. Also, see Norman Glickman with Kenneth Ballard, loc. cit.

alternative tax rates. The results of these experiments would be useful to policymakers in setting tax rates.

Time Trends. The model uses a time trend in its equations for output and employment in the city of Philadelphia. Output and employment in manufacturing in the city are regarded as dependent on the national and regional output and employment (through personal income) and on a time trend. Essentially, the time trend is intended to indicate that over time certain factors are gradually causing employment to decentralize, although they are offset some by rises in national output and personal income. Unfortunately, this time trend, though perfectly adequate for short-term forecasting, limits the model's usefulness in analyzing the structural causes of decentralization.

DATA BASE OF THE MODEL

Several sources were used in compiling employment series for the Philadelphia Region Econometric Model. For the SMSA, Bureau of Labor Statistics series were used for all SIC industries: "Total nonagricultural wage and salary employment" can be calculated as the sum of these. (See Technical Supplement A.) "Total employment" in the model, however, includes agricultural employment and self-employed and unpaid family workers and domestic workers in private households; estimates of these are available from the Pennsylvania Bureau of Employment Security.

For the city of Philadelphia, manufacturing series are from the Pennsylvania Industrial Census; total employment was taken from *County Business Patterns;* and nonmanufacturing employment is the difference between total and manufacturing employment. The suburban series in the model are simply the difference between the SMSA and city series.

Compared with the BLS estimates for the city for 1969–1972, which are consistent with the series used for the SMSA, the series used in the model tend to underrepresent the level of employment in the city. For example, total manufacturing employment used in the model is about 93 percent of BLS manufacturing employment for 1969 and about 89 percent of BLS manufacturing employment for 1972. Nine of the model's eleven two-digit industries are lower than BLS estimates in both years. The differences between the two sets of estimates are substantial for some industries. The agencies responsible for generating the data have suggested that the discrepancies arise from different industry classification procedures, confusion of mailing addresses with actual establishment locations, exclusion of separate central administrative and auxiliary units from the Pennsylvania Industrial Census, and, since 1972, use of different versions of the Standard Industrial Classification code. The model's total employment estimate for 1972 is only 83 percent of BLS "total nonagricultural wage and salary employment" for the city, and its nonmanufacturing estimate is 81 percent of the BLS figure.

OUTPUT OF THE MODEL

Employment projections, the major concern of this study, come from a block of equations relating regional employment to several variables, including regional output, in the corresponding industry. The results of this block are forecasts of regional employment in each of eleven manufacturing industries and six major classifications of nonmanufacturing industries.

Other blocks of equations in the model predict other major components of the regional economy including incomes, prices, investment, and government finance. The most significant block for this study, however, is the Philadelphia city block. This block of equations projects personal income, output, employment, and a number of government-related variables for the city. Both output and employment are projected for manufacturing in the city. Only employment is projected for nonmanufacturing. There are, in addition, some equations for output in groupings of industries—durable and nondurable goods manufacturing, for example.

A POSSIBLE MODIFICATION

Although the model's equations perform well for the purposes of forecasting, they do not explain fully the structural relationships involved in decentralization of employment. It is possible, however, that the basic equations could be modified to include structural variables that are related to the causes of decentralization. As part of this study, a modification of some equations was attempted. The results indicate that such revisions are possible and fruitful.

Other work in this study (reported in Technical Supplement D) suggests that input characteristics (including the capital-output and labor-output ratios) and output characteristics (durable goods and nondurable goods manufacturing, for example) are related to the locational preference of firms. Thus, an obvious project is to modify the equations for durable goods and nondurable goods output in the city to include the capital-output and labor-output ratios.

Tables E-1 and E-2 show the results of these modifications. In each of the tables, the first equation is the equation as it appears in the Philadelphia Region Econometric Model.††† The second equation is a modified form of the model's equation.

Substitution of the output-to-capital ratio, the output-to-labor ratio and the level of national output in place of the regional output and the city output in the previous year improved the equation for durable goods manufacturing output in the city (Table E-1, Equation 2). The difference between short-term and long-term interest rates—a proxy for the business cycle—was retained. This variable is regarded as a proxy for the business cycle because the short-term interest rate is generally lower than the long-term rate and becomes substantially lower during recessions.

The output-to-labor ratio coefficient was negative, suggesting that as labor productivity (the amount of output per man-hour) increases, output in the city drops, a result expected from the analysis reported in Technical Supplement D. The output-to-capital coefficient was insignificant but had the appropriate positive sign. The sign of the coefficient of the difference between the short-term and long-term interest rates became negative. This somewhat implausible negative coefficient is probably a result of the complex interrelationships (multicollinearity) among all the independent variables. Although there are reasonable explanations for such a change in sign, it raises a question about the benefit of the alternative variables in explaining changes in durable goods output. The substantial rise in R^2 (from .82 in the original specification to .93 in Equation 2, Table E-1) suggests, however, that some additional insight into the basic structural relationships has been gained.

The equation for nondurable goods was not altered as successfully. The coefficient of the output-to-labor ratio was insignificant when this variable was added to the original equation. A similar result occurs when the output-to-capital ratio is substituted for the output-to-labor ratio (although the parameters are different, of course). It is interesting, though, that the time trend also becomes insignificant in the modified equation. This implies that in the revised equation the output-to-labor ratio is explaining some of the variation in the independent variable that the time trend captured in the original equation. It was, of course, precisely the goal of this analysis to employ structural variables to explain the effects being picked up by the time trend. It appears, then, that modification of this equation for nondurables also yields useful information on the structural relationships of the economy.

INTERPRETING THE MODEL'S FORECASTS

In reviewing the Philadelphia Region Econometric Model's forecasts of employment in the

†††The actual parameters are slightly different from those reported in Glickman and Ballard, loc. cit., because the sample was shortened slightly.

TABLE E-1

REGRESSIONS FOR PHILADELPHIA OUTPUT IN DURABLE-GOODS MANUFACTURING†

Dependent Variable: Level of Output in Philadelphia in Industries Classified as Durable-Goods Manufacturing by Year

Independent Variable	Regression Coefficients†† Equation 1	Equation 2
Difference between short- and long-term interest rates	76.71 (2.17)	−76.41* (−2.36)
Region's durable-goods output	0.111* (2.73)	
Philadelphia's durable-goods output for preceding year	0.367 (1.48)	
Output-to-capital ratio for durable-goods manufacturing		1.55 (0.78)
Output-to-labor ratio for durable-goods manufacturing		−16.16** (−4.15)
National output in durable-goods manufacturing		12.84** (5.12)
Constant	468.7 (1.57)	1173.2** (3.67)
Adjusted R^2	0.75	0.89

†SOURCE: Data for regressions are from the Philadelphia Region Econometric Model Databank (February 21, 1975), Economics Research Unit of the University of Pennsylvania; John W. Kendrick, *Post-War Productivity Trends in the United States, 1948–1969,* (New York: National Bureau of Economic Research, 1973).

††The t-statistics are reported in parentheses.

*The coefficient is significant at the 5 percent level.

**The coefficient is significant at the 1 percent level.

region and in the city (see Tables E-3 and E-4) several important points should be considered.

1. The problems associated with the model as outlined above (as well as other forecasting problems) could make the forecasts deviate from what will actually happen. This is especially true if there are changes in comparative costs or if there is a reversal of the time trend associated with decentralization out of the city.
2. Because errors build up, the longer the forecast period, the less confidence one should put

on the actual levels forecast. Thus, the 1980 forecasts are not as reliable as the 1976 ones.

3. The projections from the national model that were used as exogenous variables in the Philadelphia model describe a very slow recovery from the recession with substantial unemployment even in the beginning of the new decade. Any revisions in these national forecasts would, of course, have significant impact on the regional forecasts.
4. If the input data used to measure the level of employment are too low (as might be the case in the light of the higher BLS estimates) then the absolute levels of employment forecast would also be too low. The direction and the scope of the change in the level of employment would not necessarily be affected, however.
5. Despite all these problems, the model has a respectable "track record" of short-run forecasting.

In a nutshell, these forecasts can be used with reasonable confidence to indicate future relationships of different sectors of the economy. However, economists and policymakers should not rely too heavily on the precise forecasts of future levels of employment, especially in the distant future.

TABLE E-2

REGRESSIONS FOR PHILADELPHIA OUTPUT IN NONDURABLE-GOODS MANUFACTURING†

Dependent Variable: Level of Output in Philadelphia in Industries Classified as Nondurable-Goods Manufacturing by Year

Independent Variable	Regression Coefficients†† Equation 1	Equation 2
Time Trend	− 33.58*	− 163.0
	(− 2.89)	(− 1.53)
Region's nondurable-goods output	0.462**	0.471**
	(3.63)	(3.81)
Philadelphia's nondurable-goods output for preceding year	0.747**	0.906**
	(4.80)	(4.55)
Output-to-labor ratio for nondurable-goods manufacturing		29.61
		(1.22)
Constant	−302.3	−2041.9
	(− 0.96)	(− 1.38)
Adjusted R^2	0.81	0.82

†SOURCE: Data for regressions are from the Philadelphia Region Econometric Model Databank (February 21, 1975), Economics Research Unit of the University of Pennsylvania; John W. Kendrick, *Post-War Productivity Trends in the United States, 1948–1969,* (New York: National Bureau of Economic Research, 1973).

††The t-statistics are reported in parentheses.

*The coefficient is significant at the 5 percent level.

**The coefficient is significant at the 1 percent level.

TABLE E-3

ACTUAL AND PROJECTED EMPLOYMENT FOR THE REGION*

	Actual 1955	Actual 1965	Projected 1975	Projected 1980	Percent Change 1975–80
Manufacturing	561.3	548.6	520.1	565.2	8.7%
Electrical machinery	57.1	64.0	54.7	57.4	4.9
Nonelectrical machinery	42.9	51.3	49.3	55.0	11.6
Food	52.8	49.0	44.0	45.5	3.4
Apparel	59.3	56.6	39.6	41.0	3.5
Chemicals	35.2	39.6	41.1	45.6	10.9
Fabricated metals	46.1	43.6	37.3	42.7	14.5
Printing and publishing	35.7	36.9	36.5	38.2	4.6
Primary metals	37.9	36.3	33.3	38.8	16.5
Textiles	41.8	28.0	21.1	23.2	10.0
Transport equipment	32.8	29.2	19.1	22.7	18.8
Petroleum and coal	22.3	17.1	15.1	15.9	5.3
All other manufacturing	97.4	97.4	129.0	139.2	7.9
Nonmanufacturing	1137.2	1281.4	1523.6	1672.8	9.8
Wholesale and retail trade	292.3	322.5	386.3	423.7	9.7
Services	182.2	243.2	350.8	405.8	15.7
Total government	166.4	205.8	287.0	320.3	11.6
State and local	89.1	129.3	203.0	224.1	10.4
Federal	77.3	76.5	84.0	96.2	14.5
Finance, insurance and real estate	73.8	87.4	110.2	115.7	5.0
Transportation and public utilities	122.7	107.7	101.2	108.9	7.6
Contract construction	79.7	76.1	83.5	92.7	11.0
Other nonmanufacturing	220.1	234.9	204.6	205.7	0.5
TOTAL EMPLOYMENT	1698.5	1830.0	2043.7	2238.0	9.5

SOURCE: Philadelphia Region Econometric Model Databank (February 21, 1975), Economics Research Unit of the University of Pennsylvania; *Philadelphia Econometric Model Project, February 21, 1975, Post-Meeting Control Solution,* Economics Research Unit of the University of Pennsylvania, distributed by Wharton EFA, Inc., Philadelphia, Pa.

*All employment figures are in thousands.

TABLE E-4

ACTUAL AND PROJECTED EMPLOYMENT FOR THE CITY*

	Actual 1955	Actual 1965	Projected 1975	Projected 1980	Percent Change 1975–80
Manufacturing	320.0	259.0	164.2	156.8	−4.5%
Nonmanufacturing	420.0	465.0	523.6	543.7	3.8
Total Employment	740.0	724.0	687.8	700.5	1.8

SOURCE: Philadelphia Region Econometric Model Databank (February 21, 1975), Economics Research Unit of the University of Pennsylvania; *Philadelphia Econometric Model Project, February 21, 1975, Post-Meeting Control Solution,* Economics Research Unit of the University of Pennsylvania, distributed by Wharton EFA, Inc., Philadelphia, Pa.

*All employment figures are in thousands.

TECHNICAL SUPPLEMENT F
HOUSING ABANDONMENT

One aspect of the urban environment receiving considerable public attention is the existence of neighborhoods with large amounts of visibly deteriorated or "blighted" housing. Development of an appropriate public policy response to these blighted neighborhoods depends on an understanding of the forces that generated this condition. This supplement presents an empirical test which begins to address the conflict between two theories about the causes of housing deterioration.

One theory, the filtering hypothesis, suggests that deterioration in a neighborhood is primarily related to the type of housing in that area. An area with more structurally undesirable units will experience more deterioration than another area. According to the theory, as a given house ages, its quality dwindles. This reduction in quality occurs basically because (1) new building technology makes an older house somewhat outmoded and thus less desirable, (2) changes in the structure of the city may make the location of a house less advantageous, and (3) time alone causes a house to deteriorate. Since neighborhoods tend to have similar types and ages of housing units, whole neighborhoods may experience considerable deterioration. However, the main impetus for this deterioration is linked to aspects of the individual units, not to characteristics of the whole neighborhood.

The other theory, the "neighborhood externalities hypothesis," emphasizes the impact of the conditions in the immediately surrounding area in retarding or accelerating the process of deterioration that results from changes in the structural aspects of the individual units. According to this hypothesis, any housing unit, new or old, will be more likely to deteriorate if located in a neighborhood with undesirable external influences. Thus, in a stable neighborhood where most of the houses are well maintained, the value of the neighborhood makes it unlikely that many units will be allowed to deteriorate. However, the theory suggests that once an area starts to decline, the adverse effect of the neighborhood will generate deterioration of housing units in the adjacent area.

The most desirable empirical test of the two hypotheses would come from a statistical analysis of

a large sample of housing units relating housing value to many characteristics—characteristics of the individual housing units such as their age and quality and characteristics of the surrounding neighborhood. As part of this decentralization study, a less ambitious empirical project has been conducted using totals for whole neighborhoods rather than individual unit data.

Specifically, this project concentrated on explaining the extreme manifestation of deterioration—abandonment. If the filtering hypothesis were valid, then certain variables relating to housing quality or housing structure would provide a reasonable statistical "explanation" of the percentage of abandoned housing units in an area. If the "neighborhood externalities" hypothesis were true, the structure-related variables would explain only a small proportion of the abandonment. In this case, other variables relating to conditions in the surrounding area would provide a better explanation than would the structure variables alone.

The standard tools of multiple regression analysis were employed to test these alternative hypotheses (see Technical Supplement C for a description of this technique). The dependent variable in the equations is the proportion of abandonment among housing units in the census tract. This variable, PHA, is measured by a count of abandoned units in 1973 (supplied by the Philadelphia City Planning Commission) divided by the total number of housing units in the census tract in 1970 (from the 1970 Census of Housing). The sample is all the census tracts in the city of Philadelphia, except those tracts with zero or few housing units. Three hundred and thirty-nine observations were used.

The independent variables, most of which also come from the 1970 Census of Housing, measure the types of characteristics mentioned above and can be divided into individual structure-related variables and neighborhood-related variables.

Age, building technology, and location are the three categories of structure-related variables. The age of the units in the tract is measured, not by average age, but by three variables: the percentage of units in the tract built before 1940 (labeled P1940), the percentage built between 1940 and 1949 (P4049), and the percentage built between 1960 and 1964 (P6064).* Technological obsolescence is gauged by the percentage of units with no plumbing (PNP). Finally, advantages associated with a location having a greater or lesser accessibility to the central business district are captured by using the distance between the tract and City Hall (DIST).

The second group of independent variables relates to conditions in the neighborhood. The median value of the housing units in the tract (MVAL) and the short-term vacancy rate (PVAC) are variables that express conditions in the housing market of the area. To some extent, these two variables will be influenced by the effects of filtering, but they should also reflect conditions in the neighborhood. The percentage of units that are overcrowded (POVC) is related to living conditions in the neighborhood. Finally, one variable directly measures the externality involved in abandonment in the surrounding area. This variable (NEVA) is defined as the average percentage of abandoned units in the surrounding tracts.

The equations, estimated by ordinary least squares, are of the general form:

$$PHA = C_0 + C_1X_1 + C_2X_2 + C_3X_3 + \ldots$$

where X_1, X_2, X_3 . . . are the independent variables, C_0 is the estimated constant term and C_1, C_2, C_3 . . . are the estimated coefficients.

*Variables relating to all of the age periods were not included because doing so would create collinearity problems. Obviously, every building existing in 1970 was built sometime. If every time period was included, the sum of the percentages would be 100 percent for every census tract. Such a condition makes estimation by least squares impossible. The standard procedure in such cases is to drop one member of the set of related variables. In this case, the variables relating to the time periods 1950–59 and 1965–70 were highly correlated with some of the other age variables, so both were dropped. Alternative specifications of the equation were run using different combinations of the age variables including the 1950–59 and 1965–70 periods as well as those defined above. Results of these tests are not reported because they yielded essentially the same conclusions.

Table F-1 shows the estimated values for the C_i's in four equations. Equation 1 indicates that the age structure does not explain much of the variation in the proportion of houses abandoned. None of the age coefficients differs significantly from zero. Equation 2 shows that when the market variables and the overcrowding variable are substituted for the age and technology variables, the R^2 (the percentage of the variation in the dependent variables that is explained) is considerably higher. Equation 3 adds the neighborhood variable and the proxy for technological obsolescence to equation 2. This increases the percentage of the variation in the proportion of abandoned houses which is "explained" by the equation. However, equation 4 shows that reintroducing the age variable leads to no further improvement. In addition, the only variables in equation 4 which are significantly different from zero are those related to the "neighborhood effects."

The equations must be interpreted very carefully. In general, proper use of regression analysis requires prior knowledge of the relationships of each independent variable to the dependent variable and the use of independent variables that are statistically independent of each other. However, satisfying these requirements necessitates a complete model and more data. Therefore, this study can only be used to infer which set of factors is most closely associated with neighborhood deterioration. The conclusion here is that neighborhood and market variables are probably the most significant determinants of abandonment, with some additional effects resulting from technology. Age alone does not seem to be an important factor.

TABLE F-1

LEAST SQUARES ESTIMATES OF EQUATIONS EXPLAINING EXTENT OF HOUSING ABANDONMENT IN PHILADELPHIA, 1973†

Variable	Equation			
Dependent-PHA	(1)	(2)	(3)	(4)
Independent				
P1940	0.02			0.01
	(1.78)			(1.08)
P4049	0.006			0.02
	(0.21)			(1.19)
P6064	0.02			−0.001
	(0.49)			(−0.05)
PVAC		0.40**	0.21**	0.21**
		(8.90)	(4.08)	(4.16)
MVAL		−0.0003	−0.0005	−0.0003
		(−0.87)	(−1.80)	(−1.00)
POVC		0.47**	0.24**	0.25**
		(6.29)	(3.39)	(3.48)
PNP	0.35**		0.06	0.07
	(5.69)		(1.18)	(1.18)
DIST	−0.45**	−0.15*	0.03	0.07
	(−5.08)	(−2.08)	(0.42)	(0.99)
NEVA			0.001**	0.001**
			(9.43)	(9.51)
CONSTANT	0.04*	0.002	−0.004	−0.02
	(2.36)	(0.24)	(−0.50)	(−1.37)
R^2 ADJUSTED	.32	.51	.61	.61

†The t-statistics are reported in parentheses. The sample is 339 of the census tracts in the city of Philadelphia.

*The coefficient is significant at the 5 percent level.

**The coefficient is significant at the 1 percent level.

Variables††

Dependent Variable

PHA — Percentage of all housing units in the tract that are abandoned according to Philadelphia City Planning Commission survey.

Age Variables

P1940 — Percentage of all housing units in the tract in 1970 that were built before 1940.

P4049 — Percentage of all housing units in the tract in 1970 that were built between 1940 and 1949.

P6064 — Percentage of all housing units in the tract in 1970 that were built between 1960 and 1964.

Technology Variable

PNP — Percentage of all housing units in the tract in 1970 that had no plumbing.

Location Variable

DIST — Straight line distance from the central point of the tract to City Hall.

Market Variables

PVAC — Percentage of all housing units in the tract in 1970 that were judged by the Census Bureau to be short-term vacant.

MVAL — Median value of all housing units in tract in 1970.

Neighborhood Variables

POVC — Percentage of all housing units in the tract in 1970 that were overcrowded (more than 1.01 persons per room).

NEVA — Average percentage of housing units abandoned in all neighboring tracts (not counting tracts separated by some major boundary such as a river).

††SOURCES: The count of abandoned housing units, used in calculating PHA, was supplied by the Philadelphia City Planning Commission. DIST and NEVA were generated by the Department of Research, Federal Reserve Bank of Philadelphia. Other variables are from the U.S. Department of Commerce, Bureau of the Census, *Census of Population and Housing: 1970, Census Tracts,* Final Report PHC(1)-159, Philadelphia, Pa.—N.J. SMSA, 1972.

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