SECTORAL TRENDS IN EMPLOYMENT AND SHIFTS IN THE PHILLIPS CURVE

By

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KEY TO SYMBOLS

TERM	DEFINITION
a	constant
A	aggregate sum of the squares of the residuals
B	coefficient of explanatory variable
C	coefficient of price change variable
E	number employed
G, g	Goods sector variable or parameter
I	productivity related index
k	fixed labor force weight
L, LF	labor force
LF/N	demographic labor force participation
LF/R	industrial labor force participation
m,n	number of observations in sample
N	population
P	prices (consumer price index)
PCR	rate of change in prices
p	number of parameters
R	population deflator for industrial labor force
S,s	Service sector variable or parameter
U	unemployment rate
U_N,V	number unemployed
W	wages (compensation per man-hour)
$\dot{w}$	rate of change in wages

Key to Symbols--continued

Term	Definition
X	any variable quantity
α	variable labor force weight
γ	sector proportion of employment (Chapter III); Price expectations index (Chapter II)
δ	relative wages
μ	relative unemployment
ρ	variable weighting applied to the rate of change in wages
σ^2	dispersion of unemployment rates

Subscripts

A	aggregate figure
g	Goods sector figure
i	industrial data
j	demographic data
p	permanent variable
s	Service sector figure
T	Transitory variable
t	time

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This dissertation develops and tests a "segmented markets" Phillips curve model which is based on the demand-oriented industrial distinctions noted by Victor Fuchs, and is related to recent models emphasizing both excess demand and price expectational influences. The paper first presents and critiques the theoretical and empirical contributions which are used to develop the segmented markets model. Three areas of concern are stressed: Phillips curve theory, industrial sector analysis, and labor force participation research. In order to evaluate the applicability of sector analysis cyclical labor force participation movements are studied with the general conclusion

that these "labor supply-oriented" influences reinforce the sectoral differences cited by Fuchs.

Finally, the segmented markets model is derived and tested. The information provided by Fuchs' research and the analysis of labor force participation in this study serve as bases for the hypothesis that sectoral Phillips curves possess different values for the intercept and coefficients; resulting from differences in the output and labor markets of the sectors. Further, with the assumptions that the independent variables are exogenously determined, and that no aggregation problems (such as dispersion of unemployment effects) are present, the two sector curves are combined to form an aggregate Phillips tradeoff. Tests of the model show that sectoral Phillips curves exist, but that the assumptions underlying the aggregation process limit the interpretation of the aggregate function. However, trends in employment are shown to have "pivoted" the aggregate curve in the wage change-unemployment rate plane, such that the curve using 1970 employment weights is more steeply sloped than the curve using either 1950 or 1960 weights.

The paper concludes that, although higher wage rate increases can be expected at low rates of unemployment using the 1970 employment mix, less additional unemployment will accompany policy measures aimed at reducing the rate of wage inflation. In addition, the difficulties encountered in interpreting the influence of price changes, suggest that

present research should be supplemented by cross-sectional analyses and multi-equation models. In any case, the findings of this paper support the use of disaggregative analysis to develop a model which can be used by policy makers in dealing with the complex issue of inflation-unemployment tradeoffs.

CHAPTER 1

INTRODUCTION

Since the end of World War II, the experience of gradual inflation and the development of disequilibrium macro-economics have caused increased attention to be focused on the inflationary process and its relation to unemployment.[1] During the nineteen fifties this interest was expressed in a series of theoretical explanations ranging from the demand-pull theory to models based on disaggregated market behavior (29) (42a). These theoretical models gave way to broader empirical approaches during the sixties, led by the pathbreaking work of A.W. Phillips (39).[2] The seventies seem to be a time for reassessing the significance of the major empirical contributions, reconciling major theoretical approaches, and, hopefully, finding viable policy mechanisms for dealing with these problems.

Positive and fairly steady growth in wages and prices has characterized the post-war period. However, during the periods of 1946-48, 1950-51, and 1965-1971 the rate of

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[1]This paper will discuss the history of wage inflation, in the United States, as well as the evolution of thought on this matter, for the period since nineteen fifty-eight. For a thorough treatment of the preceding period see Perry (37a).

[2]For a discussion of the theory characteristic of the fifties, as well as an early presentation of the Phillips relationship for the United States see P. Samuelson and R. Solow (41a) (41b).

increase accelerated. Accentuating the problem is the fact that during most of this period a condition of excess supply has existed and that unemployment has been very unevenly distributed. In addition, prices and wages have tended to move concomitantly since nineteen forty-six. Therefore, it is understandable that the central issues in recent inflation discussions have been the relationship between money wages and prices on the one hand, and money wages and excess supply on the other.

This study is primarily concerned with the labor market conditions underlying the apparent wage change-unemployment rate tradeoff. This observed relationship has been labeled the "naive" Phillips curve and is generally assumed to be an inverse relationship. The approach, which is characteristic of a pattern established by Phillips, does not directly consider the issue of price determination, but concentrates on explaining the nature of the wage determination mechanism. Therefore, in this discussion the term "inflationary process" refers to wage inflation.

Since the Phillips curve is viewed from a labor market perspective, we seek to develop a model which incorporates major labor market trends. This study departs from much of recent Phillips curve work by formulating wage determination and labor supply models based on industrial, instead of demographic, data to demonstrate the existence of different labor market characteristics. To the extent that institutional barriers, geographical circumstances, and employment preferences curtail the perfect mobility of labor between

heterogeneous sectors, different labor supply and wage determination patterns will exist. If, in the segmented labor markets making up these sectors, wage bargaining is conducted on an individual basis, and there is internal labor mobility, wage levels and changes will be determined in a competitive manner. Further, the voluntary unemployment in these sectors will not be correlated with money wage rate changes. However, adjustment lags and job-search behavior give rise to frictional unemployment, and institutions such as unionization can cause involuntary unemployment, both of which may be negatively correlated with money wage rate changes. Sectoral Phillips curves can be hypothesized in this case, and to the extent the differences in these sector curves can be explained in terms of labor market differences, insight into the Phillips curve will be gained by studying these relationships. At the same time, the existence of partially segmented, and differentiated labor markets produces disequilibrating influences causing other aggregate Phillips phenomena. While the influence of sector differences on the Phillips curve has been hypothesized previously, this paper represents the first attempt to comprehensively test a sectoral model.[3]

Phillips curve thought, theoretically and empirically, has developed rapidly, with earlier studies assuming that the

[3]Vanderkamp (47) provided an early test of a sectoral model, based on organized and unorganized sectors. His discussion is weak, however, lacking both a rigorous justification for segmenting markets and comparable tests for Phillips phenomena in the two sectors.

curve existed independent of other economic conditions. Recent research has taken a broader perspective by including other parameters and variables in the analysis. In particular, the inclusion of a price term, interpreted as representing the influence of expectations on wage inflation, has resulted in renewed understanding of the Phillips relationship. More recently, disaggregation of demographic data has resulted in increased understanding of the possible causes of and influences on the Phillips curve. The present sectoral examination extends the recent trend toward increasing emphasis on changing economic conditions in studying the complexities underlying the Phillips tradeoff. This analysis concentrates on the sector differences in the cyclical fluctuations and secular trends of key market parameters, and takes the position that the examination of labor market structure yields insight into the nature of the inflationary process. Since this study uses a multi-market approach, it must consider both demand and supply differences among sectors. The paper builds upon Victor Fuchs' (18) valuable analysis of differences in demand. In addition, the labor supply model developed here tests for supply differences which may also affect the Phillips relationship.

Chapter 2 surveys previous research in three areas, considering contributions with respect to the existence and stability of the Phillips curve, the characteristics of different sectors, and those aspects of labor supply research pertinent to this discussion. While the first section

presents an overview of current Phillips curve thought, the last two parts provide a basis for analyzing the demand and supply characteristics of segmented labor markets, a necessary prerequisite to developing a disaggregative Phillips curve model. The first part, the Phillips curve survey, begins with the unemployment dispersion explanation of the Phillips curve presented by Lipsey and others who attempted to deal with heterogeneous labor markets. Holt's job-search theory presents another approach to disaggregative analysis and precedes accelerationist and imperfections interpretations of the Phillips phenomena. The second part, the examination of sectoral characteristics,discusses different approaches, ranging from Baumol's theoretical consideration of secular trends to Fuchs' more empirical work. The third section, labor supply, presents the results of tests of two opposing views of labor supply response, the discouraged worker model, and the neoclassical labor supply model.

Chapter 3 proceeds to develop two models to test for labor supply response over industrial divisions. The chapter analyzes the influence of the discouraged worker effect, the significance of real wages as a basic argument of the labor supply function in the short to intermediate run, and the effect of relative wages on labor supply response. First, a neoclassical model is contrasted with the discouraged worker model to determine the applicability of the competitive model in the short to intermediate run. Second, a relative wage model is developed to test for the significance of

crossover effects, and differential wage and unemployment patterns between sectors. These results offer evidence regarding the nature of the Phillips tradeoff such as money illusion and price expectations effects, and support the tests conducted in the next chapter.

Chapter 4 develops and tests the sectoral Phillips curve model, with the goal of determing the principle factors influencing wage rate growth for the period 1958-1970. First, we examine the theoretical aspects of sectoral differences and establish the characteristics of sectoral Phillips curves. Using the multi-market approach, we consider two effects of market heterogeneity on the aggregate Phillips curve. The first, and most important for the recent period, is the influence of changing employment patterns; toward service-producing employment. Of major importance here is the consideration of the distinction between the imperfections responsible for the sector curves and the market differentiation factors, embodied in relative wages and unemployment rates, which must be considered when aggregating these separate curves. The meaning and significance of additional influences on the relationship provide useful benchmarks for interpreting the tests. These additional effects include the price change variable, as well as the unemployment dispersion, wage rate dispersion, and incomes policy effects. This chapter concludes with a quantitative analysis of the effect of changing economic conditions on the Phillips curve, concentrating on the significance of the trend toward service employment.

Chapter 5 presents some tentative conclusions concerning the nature of the inflationary process in recent U.S. history and develops policy implications from the theoretical and empirical results presented in Chapters 3 and 4.

1) The evidence presented in the study suggests that two sectors having different input and output structures do posses different Phillips relationships, and that the aggregate dynamic response, resulting in a short run Phillips curve, is dependent upon institutional arrangements and the size and makeup of individual sectors.

2) We find that the trend toward Service sector employment has caused the aggregate Phillips curve to pivot, resulting in an apparent outward shift at high wage rate growth.

3) Sector disaggregation implies that a multi-equation approach is needed to capture all of the relevant relationships. The present, partial equilbrium analysis can be viewed as a preliminary exploration of a simple two sector model. However, the regression results suggest that alternative statistical techniques, and more complex models will reveal additional interpretations of the aggregate Phillips tradeoff.

4) While the results of this paper support the familiar "manpower" solution for improving the tradeoff, (21b) (22) (25a) (25d), we conclude that incomes policies, as presently administered, may be relatively ineffective. This conclusion is derived from the difference in policy visibility of the sectors and the differences in market reactions to the imposition of wage-price controls. Not only is the Service sector less likely to be directly controlled, but it is also less likely to be favorably influenced by incomes policy. In addition, if reference standards for wage adjustment depend on relatively high wage rate growth sectors, incomes policy may exacerbate the situation (31).

5) The comparison of demographic and industrial studies suggests that not all the relevant effects can be analyzed using either set of data alone. The demographic data do not permit sectoral breakdowns, while the effect of unemployment dispersion is not fully captured by the industrial data. However, there are more fundamental differences between the two approaches. For example, the concomitant trends toward service oriented employment and higher labor force

participation rates for secondary workers have had different impacts. Because of the first trend, the cyclical response in wages and unemployment has changed. Due to the second, the dispersion of unemployment has increased. While these trends are reinforcing at low unemployment rates, they may be offsetting as unemployment increases.

6) This study does not conclude with a single explanation of the wage determination process, but it does point out that sectoral differences are elements in this process. Because of the importance of this subject for policy purposes, it is necessary that future study incorporate cross section data, as well as more sophisticated models. But certainly, future work should move away from the use of aggregate time series data and the assumption of a single, homogeneous labor market. That research should capture sectoral behavior in a meaningful way to reveal the nature of the market forces creating the perceived inflation-unemployment dilemma.

CHAPTER 2

SURVEY AND CRITIQUE OF PREVIOUS RESEARCH

The sectoral Phillips curve model developed and tested in this paper is derived from three broad areas of research: theories and estimates of Phillips curves; labor market studies stressing sector analysis; and studies of the relationship between changing economic conditions and labor force participation rates.

2.1 Phillips Curve Theory

Much of the importance of and interest in the Phillips curve stems from its policy implications. Since basic goals of modern society include the maintenance of full employment and stable prices, any long-term negative relationship between wage rate changes and unemployment rates suggests that one goal must be "traded off" for the other.

The original Phillips curve was intended to be a statistical study of the wage change-unemployment rate tradeoff. However, Phillips (39) broadly interpreted the results of his tests by concluding that the observed relationship supported a view that the rate of change in wages was functionally dependent on the unemployment rate. Although Phillips' contribution was nontheoretical in nature, this conclusion presents an early attempt to justify the tradeoff.[1] Later

[1]Irving Fisher provided the first statistical study of an inflation-unemployment tradeoff. Interestingly, he viewed the direction of the causation of the functional relationship differently than Phillips, claiming,

research has continued to examine the nature of the Phillips curve in a number of ways. This section will consider some of these additional topics.

2.1.1 R.G. Lipsey: nonlinearities and frictional unemployment

Lipsey (30) provides the first comprehensive theory of the Phillips curve, basing his explanation on differences in the relationship between wage rate changes and unemployment rates for unemployment rates above and below the frictional level. According to this theory, wages rise in a sector only when labor demand exceeds supply. Lipsey states that excess demand exists when the unemployment rate is below the frictional level and excess supply prevails when the unemployment rate is above the frictional level. Assuming that the number of vacancies remains constant when excess supply exists, excess supply will increase linearly with unemployment. When excess demand exists, changes in unemployment are associated with other than linear changes in excess demand since the number of vacancies are also variable at levels below frictional unemployment. Assuming wages move linearly with excess demand, then the resulting nonlinearity between unemployment and excess demand will be transformed into a nonlinear relationship between wages and unemployment.

If Lipsey's assumption regarding the assymetry of vacancy movements is accurate, it is apparent that the rate of wage

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"The fact that deflation causes unemployment has been well recognized for many years in isolated instances,... It has likewise been recognized that inflation carries with it a great stimulation to trade and an increase in employment." (16, p. 785).

change in the aggregate will be greater for a given level of unemployment than the wage change which any sector with the same level of unemployment would produce; as long as the unemployment rate in one sector is below the frictional level. For example, assume a two sector economy with a frictional unemployment rate level of five percent, where one sector has an unemployment rate of four percent and the other a rate of eight percent, and the size of the labor force being the same in each sector. An aggregate rate of six percent would imply a simple linear relationship between wage rate change and the unemployment rate, and the tendency for the economy to equilibrate implies that the wage rate change will be negative when the aggregate unemployment rate is above five percent.

However, a more than proportionate (nonlinear) increase in wage rates would occur in the labor market having only four percent unemployment, which could outweigh the linear decrease in the market with eight percent unemployment, and cause increasing wage rate changes at an aggregate unemployment rate of six percent. The nonlinearity of the relationship also suggests a Phillips curve convex to the origin at aggregate unemployment rates ranging from those considerably below the frictional level to those significantly above this level. Lipsey's sectoral theory is the first comprehensive explanation of why wages tend to rise at overall unemployment rates above the frictional level (or before "full-employment" is reached). The Lipsey explanation suffers from its

reliance on a questionable assumption concerning vacancy rate movements and the absence of a theory to explain why money wage changes necessarily respond to excess demand changes. However, as a technical explanation of the observed tradeoff, the Lipsey model helps to link sectoral behavioral differences with aggregate inflation and unemployment behavior.

2.1.2 G.C. Archibald: dispersion and aggregate unemployment

Archibald (3a) (3b) has recently tested the Lipsey notion of the effect of unemployment dispersion and expanded this to a theory based on market structure. While noting that he has no clear idea of what the "true" labor markets are, Archibald contends that he has found that differences in market structure affect the Phillips relationship.[2] To support this contention he theorizes that separate labor markets exist, with different market characteristics which give rise to different structures of excess demand. He further notes that a theory based on such disaggregation requires that the labor force be imperfectly mobile between sectors (not, however, that it be perfectly immobile). In such a case, he argues, a stable Phillips curve will exist when the structure of excess demand between sectors remains stable over time, (assuming, of course, that the

[2] "the simple correlation between the rates of wage change and the price change is fairly high,... If the former depends upon excess demand in the labor market and the latter on excess demand in the labor market and excess demands for labor and goods are highly correlated, as we should suppose, this is unsurprising. The question however, is whether we can obtain more information about the rate of change of wages from variables specific to the labor market." (3a, pp. 124-25).

relationship between excess demand and the unemployment rate is also stable).

To approach this problem he tests for the existence of an effect of unemployment dispersion on the rate of wage change. This involves two steps. First, he tests Lipsey's assumption that the relationship is positive with a model using geographical data for the U.S. and geographical and industrial data for the U.K. The model used, neglecting lags and additional variables, regresses the rate of change in aggregate wages on the inverse of the aggregate unemployment rate and the cross sectional variance in the unemployment rates.

Archibald's tests support Lipsey's contention of a positive dispersion effect. In addition he finds that there is a significant correlation among the first three moments in an expanded regression model including skewness of unemployment rates. Thus, any two of these variables can be removed from the expanded model and the remaining variable will become highly significant in the regression. This finding suggests that both the aggregate level of excess demand and its distribution, as reflected in dispersion and skewness, are important factors in wage rate movements, and that the stable distribution of excess demand offers a means of shifting the Phillips curve by changing the distribution of unemployment. While further testing is necessary Archibald ventures another conjecture that,

> "if our distributional hypothesis were accepted, the whole debate over 'structural' versus 'demand-deficient' unemployment would require reconsideration, because the two would go together." (3b, p. 218).

While this analysis tests for an important influence of heterogeneous labor markets, it provides only an indirect view of labor market differences and captures only one effect, the dispersion of unemployment rates.

2.1.3 J. Vanderkamp: sectoral Phillips curves

Vanderkamp's (47) two sector analysis seeks to examine the effect of market differences more directly, by estimating different Phillips curves for two industrial sectors. He emphasizes the differences in unionization and divides the labor market into organized and unorganized sectors. Although he does not present a theoretical justification for segmenting sectoral labor markets and considers only one aspect of market heterogeneity, Vanderkamp's results are of interest to the present research; he finds that, for Canada for the period 1946-1962, wage changes are less sensitive to variations in unemployment in the unorganized sector. This analysis is flawed by both the lack of a comprehensive disaggregative model and the attempt to compare estimates containing different explanatory variables. However, the study indicates that more research, using disaggregated models, is needed before the influences of market heterogeneity can be fully understood.

2.1.4 C.C. Holt: job-search theory

Holt (25b) (25c) has recently developed an alternative

method of disaggergating market behavior with a job-search theory of the inflationary process, the basis of which is that job search requires effort due to informational and other imperfections in the labor market. A new entrant into the labor market will probably take some time to locate the "best opportunity". The growth in population alone will insure positive unemployment rates in such a case. However, changes in aggregate demand provide the mechanism to generate Phillips curves under this theory. As aggregate demand expands there is a rise in the derived demand for labor (indicated by an increase in vacancies in actual labor markets). A high flow of labor into and out of the market relative to the number employed introduces an element of uncertainty for employers. An individual employer must guess at the wage rate which will be offered by a competitor, and (due to the technical heterogeneity of the labor force) the productive contribution of the new employee. At the same time, the employer tends to increase wages in this situation to retain current employees. The combination of these factors gives an upward impetus to wages which would not occur in a neo-classical world, so that an expansion is characterized by increasing vacancies, increasing wages rates, and less job-search (i.e., lower unemployment). However a counter tendency occurs to partially or wholly offset this relationship. As the unemployment rate declines, more labor is induced into the market, with the attendent effect of holding wage increases below what otherwise would occur.

In summary Holt concludes:

> "It is the prime contention of the market search theory of the Phillips relation that the rate of wage inflation depends on the interaction between the size of the labor force and the level of aggregate demand," (25c, p. 230).

In addition, under conditions of low unemployment, the wage level tends to drift upward.

> "The inflow of new workers into the market through increased labor participation that occurs when unemployment declines tends to restore unemployment. This allows greater increases in aggregate production with less inflation response than would occur otherwise." (25c, p. 231).

2.1.5 E.S. Phelps: accelerationists and unstable Phillips curves

Phelps (38a) (38b) draws on Holt's work and neoclassical labor theory to advance a sophisticated version of the accelerationist view of the inflationary process. First, he states that during upswings, simply the expectation that vacancies will increase beyond that desired by employers can cause increasing money wage rates. However, such money wage adjustment will, presumably, not occur without concomitant price adjustment, and therefore, real wages will not change radically due to this reaction. Job searchers, seeing an increase in money wages, accept positions not previously acceptable to them because they are momentarily fooled by the acceleration in money wage rates. (See McCall (33) and Mortensen (35).)

At the onset of an expansion, increases in labor demand can be considered a shock to the equilibrium situation. The tendency is for firms to initially increase money wages and

to adjust as the uncertainty concerning wage levels and rates of change dissolves through observation of market reaction. At the same time, once a steady rate of money wage increase is obtained, firms quickly attain their desired vacancy levels. Employees, recognizing that all wage rates are now increasing at a constant rate, in step with price increases, will adjust their job-search behavior, and unemployment will increase until the equilibrium level is reached. As long as no other shocks occur, the equilibrium rate of wage change will closely approximate productivity growth plus the expected and observed growth in prices, and will be unrelated to the unemployment rate.

Further, assuming a direct relationship between wage and price inflation, all inflation in this steady state would be expected and constant. The unemployment rate in such a case would remain at what Friedman (17) has called the "natural rate of unemployment". This rate is based upon the institutional factors giving rise to the frictional and structural conditions existing at any given time. If the unemployment rate is held below this natural level, persistent underestimation of the equilibrium value of the real wage rate results, which causes, in turn, constant revision of the wage expectations on the part of both employees and employers, and a steadily accelerating rate of inflation (thus the term "accelerationist theory"). This rise in the rate of inflation will initially "buy" a lower unemployment rate. However, this rate will increase and approach the natural rate as the expectations of accelerating inflation develop.

Therefore, Phelps concludes,

> "the Phillips curve, in terms of percentage price (wage)increase, shifts uniformaly upward by one point with every one point increase of the expected percentage price increase (or expected wage increase). The equilibrium unemployment rate is independent of the rate of inflation." (38b, p. 130).

He states that

> "society cannot trade between steady unemployment and steady inflation, on this theory; it must eventually drive (or allow) the unemployment rate toward the equilibrium level or force it to fluctuate around the equilibrium level." (38b, p. 130).

Although Phelps' theory is highly developed, he leaves two questions unresolved: is job-search behavior the only major determinant of Phillips curve phenomena, and is the short run stability of the Phillips curve sufficiently long to permit it to be used as a policy frontier? Tobin seeks answers to these questions with a disequilibrium model of inflation and unemployment.

2.1.6 J. Tobin: disequilibrium dynamics

Tobin (45a) (45b) derives his theory from the same basis that Phelps does, Holt's study, using elements of the Lipsey-Archibald dispersion theory. He begins his argument by making two points concerning the accelerationist view. First, he states that the accelerationist view espoused by Phelps assumes that employment beyond the natural rate is socially inefficient since the time could be better spent searching new jobs. Secondly, the job-search theory, on which Phelps develops his theory, assumes that a job can be more effectively searched when one is unemployed. Tobin doubts whether either of these conditions is necessarily true.

Tobin theorizes that vacancies have a much stronger upward effect on wage rate changes than unemployment has in retarding wages. The fact that vacancies can be changing constantly, and that the effect in markets with excess demand outweighs the effect in markets with excess supply, produces a nonlinear relationship between wage rate changes and excess demand. This result has three central implications. First, it provides an alternative to Lipsey's explanation of nonlinear Phillips curves. Secondly, the variance among markets in excess demand gives an upward bias to wage rate changes. The greater the variance, with a given level of aggregate demand, the greater the wage inflation. Finally, since vacancies are more influential than unemployment on the rate of growth in wages, full employment (equality of the number of vacancies and unemployed), is incompatible with price stability.

Tobin's view is that unemployment is basically a disequilibrium phenomenon. The equilibrium component of unemployment, which is pertinent to the accelerationist viewpoint, is usually supplemented in actual markets by a significant disequilibrium component. Disequilibria continually arise because the structural conditions of the labor market are in a continual state of flux, regardless of the stability or instability of aggregate demand. Similarly, so long as labor markets remain in disequilibrium, money wage rate changes are also expressed through the action of a strong disequilibrium factor.

Tobin accepts Keynes assumption that relative wages form a basic argument for both labor supply and labor demand in an equilibrium situation, and are conditioned by past experience and the wage rates for those employed in each sector. The "equilibrium" referred to here is a steady state situation not envisaged by the neoclassical model, since it is one in which aggregate demand can remain unchanged while constantly changing "institutional" arrangements produce Phillips curve phenomena.

> "Reference standards for wages differ from market to market. The equilibrium wage increase in each market will be some function of past wages in all markets, and perhaps of past prices too. But the function need not be the same in every market." (45a, p. 12).

The equilibrium concept based on the relative wage model diverges from that predicated in terms of real wages:

> "A system in which only relative magnitudes matter has only a neutral equilibrium, from which it can be permanently displaced by random shocks. Even when a market is in equilibrium, it may outdo the recent wage increases in related markets. A shock of this kind, even though it is not repeated, raises permanently the steady state inflation rate." (45a, p. 13).

The equilibrium situation is not defined in the same manner in this system as in the accelerationist system, since the disequilibria which produce Phillips curves are constantly arising. The possibility for a long term, stable Phillips tradeoff exists in Tobin's model where it does not exist in Phelps' model.[3]

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[3]Lancaster (28) has recently developed a rigorous model considering the interrelationships among segmented markets. His model relies on a "demonstration effect" among markets which requires cognizance of the fastest growing wages by all sectors. He also shows under what conditions this leads to a nonlinear Phillips curve which is convex to the origin.

2.1.7 Lucas and Rapping: rational motivation for money illusion

Lucas and Rapping (32a) (32b) have constructed a single market model which assumes that labor supply (in terms of man-hours worked) is sensitive to short run price and wage deviations. They find that labor supply movements are positively related to price and wage movements. While this finding means that a form of money illusion is involved in labor's supply decision, they view this money illusion as rationally motivated behavior, based on neither informational lags, nor behavioral distortions.

> "money illusion results not from a myopic concentration on money values but from our assumption that the suppliers of labor are adaptive on the level of prices, expecting a return to normal price lavels regardless of current prices, and from the empirical fact that the nominal interest rate does not change in proportion to the actual rate of inflation." (32b, p. 269).

Therefore, while Lucas and Rapping employ Holt's search unemployment concept to explain Phillips phenomena, they present evidence that the curve results from rational motivation, and not from irrational behavior, uncertainty or lack of knowledge. The model is neoclassical with the exception that workers must search for new or better jobs and in the process, weigh the costs and benefits of such a search.

The Lucas-Rapping study also draws a distinction which will be of use to the present labor supply analysis, that not all workers are equally well equipped to search for employment. Those who have been "laid off" (as opposed to those who have been "dismissed") are presumed by Lucas and Rapping to have a better knowledge of "their" current wage rates than other

workers. While the authors use this distinction to draw conclusions concerning the permanence of one's employment, we will find it useful to make similar distinctions when classifying the labor force by industrial structure. Yet such classification also depends upon the nature and size of individual labor markets. Lucas and Rapping are primarily concerned with aggregate data and do not deal with problems which arise when heterogeneous markets exist. Gordon and Perry have considered some of these issues in a series of articles.

2.1.8 R.J. Gordon and G.L. Perry: data adjustments and demographic studies

Gordon (19a) (19b), and Perry (37b) (37c), in separate studies, have recognized that the heterogeneity of labor markets can affect the interpretation of the aggregate Phillips curve. Each has proposed data adjustments which compensate for market differences.

Gordon's work on wage rate adjustment attacks the data problems inherent in this type of research; he notes that the compensation per man-hour data published by the Labor Department has two basic weaknesses. These data are not corrected for either overtime differences between periods or for sectoral shifts in the employment mix. The result is that when these data are left uncorrected they distort the rate of change in wages for Phillips curve purposes. He contends that this is basically an index number problem involving an attempt to compare dissimilar data. When overtime and inter-industry mix changes are not considered, fluctuations in

wages are possible with no cyclical response in unemployment rates. For example, a shift in employment from a high wage industry to a low wage industry can result in the aggregate wage rate falling in the presence of minimal frictional unemployment. The change in labor force composition distorts the theoretical interpretation of the results found when using such data, and complicates the theoretical interpretation underlying these movements.[4]

Also of major concern is a theoretically valid and empirically useful measure of labor market tightness to serve as an independent variable in regression analysis. Different weighting schemes for obtaining an aggregate unemployment rate have been suggested in recent years (9) (11) (36) (43). These indices are not necessarily mutually exclusive, but each has its own implications with respect to underlying causal relationships and policy actions. That is, no index can be expected to reflect all the subtle changes in labor force composition or industrial mix.

Perry weights the unit of labor by hours worked and hourly earnings, using age-sex groupings. With these weighted units he computes both an unemployment and a dispersion index. He finds that those groups with higher earnings have a stronger influence on the rate of increase in wages than those with lower earnings, and that the existence of dispersion

[4]Gordon's study has resulted in a recent addition to Labor Department earnings data. Since 1971 the Labor Department has published adjusted earnings figures in its publication, Employment and Earnings.

among demographic unemployment rates reflects inflationary pressures. He concludes that this weighted unemployment rate-dispersion proxy for labor market tightness is more useful in explaining wage rate changes within the Phillips framework than the simple unemployment rate.

Perry's approach differs from Gordon's in that the former's adjustment has a theoretical basis and the latter's a technical basis. Perry hypothesizes that those groups which contribute more to the economy through higher output per labor input, also exert the greater pressure on the Phillips curve relationship. He reasons that the loss of each unit of labor input, as traditionally measured, is not equally effective in slowing wage rate increases. He used earnings as a proxy for productivity and thus, his measure of excess demand measures labor units in terms of their contribution to final output and not in terms of individual workers.

2.2 Sector Analysis

The sectoral model has been the core of many studies of unemployment, inflation, and Phillips curve phenomena. This section considers three recent contributions to thought in this area.

2.2.1 W. Baumol: unbalanced growth

Baumol (4a) (4b) presents one theoretical model attempting to capture essential characteristics of an observable trend toward increased employment in less technologically progressive sectors.

This theory assumes that two sectors exist, that one sector is technologically progressive and the other is non-progressive, and that wages grow at the same rate in both sectors, which is the rate of growth in productivity in the progressive sector. If price and income elasticities of demand for output are such that the proportion of final output in both sectors remains constant over time, a fixed labor force will shift out of the progressive into the non-progressive sector. The equilibrium rate of this change will be the rate of growth in productivity in the progressive sector. Baumol concludes that this model suggests that balanced growth in output, when unbalanced productivity exists, leads to a declining rate of per capita growth in the economy. Grossman and Fuchs (20) have recently challenged the empirical relevance of this conclusion for the U.S. economy. They find that since 1929, changing labor force composition between Goods and Services has not affected the secular growth of productivity in the economy. On the other hand, they observe that the cyclical effects of such shifts on productivity can be quite important.

2.2.2 V. Fuchs: goods and services as identifiable sectors

In his pathbreaking book, The Service Economy, Fuchs (18) describes a two sector model, emphasizing the cyclical movements in various labor market variables. He divides the nonagricultural economy into two sectors, the Service sector and the Goods sector, and notes that the Service sector has experienced rapid growth in its relative labor force during

the last twenty-five years. In order to show the significance of the changing sector mix in employment on cyclical stability, he discusses the broad interrelationships among each of four areas of concern; employment, output, productivity, and wages.[5]

For the purpose of analysis, Fuchs defines the Service sector as including wholesale and retail trade, finance, insurance and real estate, and service industries and government;[6] and the Goods sector as including the industry groups of mining, contract construction, transportation and public utilities, and manufacturing.

Since labor demand is derived from the demand for output, output differences serve as a starting point for the discussion. A major difference between sectors is that the Goods sector, in general, produces "stocks" of consumer goods (products characterized by durability), while the Service sector produces a "flow" of consumables. If the commodity in question may be purchased as a stock, with an indefinite consumption life, its pattern of demand will be more variable than one which must be purchased as a flow. In the former case, consumption (the actual use of the product) and demand for output may vary considerably in time. In the case of services, consumption must coincide with output. At the same

[5]See the Appendix for an empirical discussion of these relationships.

[6]The wage rate data for the government sub-sector is not available, so this industry group is excluded from consideration in the present study except for certain tests in the Appendix. We believe that the inclusion of this group would strengthen the case for the broad sector analysis used in this research.

time, during downturns in the business cycle, inventories of a stock decrease the necessity of current production. Stockpiling is impossible in the case of a flow. Both the consumption and production characteristics of the two sectors indicate that the cyclical pattern for output should be more volatile in the Goods sector.

If the demand for output is more cyclically stable in the Service sector, the derived demand for labor should also be more stable, ceteris paribus. Other factors which could influence the cyclical behavior of employment and wages are the wage determination process, the costs of hiring workers, and the share of salaries paid in the form of commissions. If wages are periodically fixed at given levels without consideration of the demand and supply for labor, employment will have to fluctuate to absorb shocks to the labor market. Since the Goods sector is more highly unionized, we expect the administered wage influence to be greater here. The Service sector experiences greater hiring costs because there are a larger number of firms competing in the market and very little organization of the available supply (such as through unionization). These cost and organizational differences imply that the Service sector will lean more toward cutting wages (or hours) than laying off workers during short recessions, while the Goods sector will react in the opposite manner.

Finally, since wages paid by commission adjust rapidly to cyclical changes in output demand, employment (in terms of both hours worked and absolute numbers of employees) for

such workers should be relatively stable.[7] The wages should fluctuate significantly to absorb changes in output demand. The salesmen and brokers to which this is most applicable are found overwhelmingly in the Service sector. All of the above point to greater cyclical stability in employment, but more volatility in wages in the Service sector. These points suggest that the cyclical patterns differ between the two sectors with respect to unemployment and its effect on wages changes: they also might differ with respect to the relationship between price changes and wage changes.

In addition, job search characteristics, job definitions, market power, and mobility are all very different between the two broadly defined sectors. Job search is affected since it is more difficult to apply and be interviewed at a large number of heterogeneous firms than at a single, large manufacturing establishment. Since many Service sector industries are highly competitive, owner-operated, or are related to professionals, information regarding the "going wages" should be readily available to those making offers. Yet a person looking for work will have only a rough idea of how various skills are weighed in the different occupations--and thus he may reject a "good" offer on the basis of ignorance. Mincer notes that for secondary workers, there is competition of non-market work with market work, and a lower percentage of time normally is devoted to market labor (34). Thus, the

[7]Fuchs attributes this "flexible" wages argument to Jacob Mincer.

net gain of moving into the labor force is small, as is the net loss from leaving it. Women, in particular, will tend to enter the market when job search costs are low and labor market conditions "attractive", explaining the greater volatility of unemployment rates for certain demographic groups. The changing character of the labor market is further complicated to the extent that certain demographic groups tend to be employed in different industrial sectors.

2.2.3 M.L. Wachter: interindustry wage structure

A recent study by Wachter (48a) provides a useful means of simplifying some of the complex relationships between sectors. He hypothesizes that the gap in relative industrial wages fluctuates cyclically. If it is first assumed that all wages only move upward (for ease of explanation), then Wachter's thesis can be stated as follows: wage rate changes in low wage industries will be greater during expansions; and these increases will be greater during contractions for high wage industries. He bases his explanation of this phenomenon, in part, on market power. High wage industries are characterized by unionization and greater market power than low wage industries. Therefore, high wage industries are better able to obtain wage increases during recessions. On the other hand, a certain amount of competition in wages exists between industries, so that during expansions low wage earners benefit from the existence of excess demand in the labor market; competition among firms causes wage increases which close the wage rate gap.

2.3 Labor Force Participation

The question of labor force participation was touched upon in the previous section. New entrants are induced into the labor market as employment opportunities increase (8) (12). However, they do not join the labor force only in response to the creation of new job vacancies (34). The wages (real and relative) associated with these vacancies are also important. These "hidden unemployed" tend to be composed of secondary workers (the young, the old, and married women). Since the specific employment shortages rarely coincide exactly with these workers' "qualifications", secondary workers tend initially to swell the unemployment ranks with their entrance into the labor market. The two studies described in this section provide insight into the movement of the secondary workforce. In addition, these studies provide a basis for studying labor supply functions sectorally; a necessary analysis if sectoral Phillips curves are to be developed.

2.3.1 N.J. Simler and A. Tella: discouraged worker effects

Simler and Tella (43) have formulated and tested the hypothesis that the Phillips curve model, adjusted to take account of unreported labor reserves, will have improved predictive capacity. The labor supply model upon which this estimation is based is called the "discouraged worker model" and has as a basis the belief that the marginal worker times his labor force participation to coincide with periods of low employment.[8]

[8]In contrast, Lucas and Rapping (32b) emphasize the real wage effects on labor force participation.

In constructing the revised Phillips model several theoretical and empirical points are noted. In the first place, some groups experience more stable participation rates than other groups. Prime age males have extremely stable participation rates while females, teenagers, and older workers have more volatile rates. This implies that some labor force statistics for the latter group (secondary workers by definition) are more dependent upon changes in aggregate demand. When demand increases and job opportunities improve, unemployed primary workers accept jobs and secondary workers enter the labor force. As full employment is reached the labor reserve shrinks and strong upward pressure is exerted on wages. The concomitant tendencies for wages to be flexible only in the upward direction, and for productivity changes to be passed on in the form of higher wages (rather than lower prices) means that general wages tend upward over time. If aggregate demand remains unchanged and the labor force participation rate of secondary workers tends to increase over time, the labor reserve for this group will also grow. If the labor reserve (as well as the measured labor force) affects wages within a Phillips curve framework, this secular growth will tend to retard the growth of wages.

Simler and Tella draw the following conclusions from their tests:

> "(a) the rate of increase in money wages will be approximately equal to the growth in productivity so long as there are unemployed primary workers and reserves of secondary workers; (b) that wages will begin to increase faster than productivity as unemployment approaches a frictional minimum and the participation rate of secondary workers a cyclical maximum; and (c) wage increases will accelerate once full employment is reached." (43, p. 47).

2.3.2 M.L. Wachter: the neoclassical labor supply model

Wachter (48b) takes exception to the use of the "discouraged worker" model as an exclusive explanation of labor force behavior. He favors the use of real wages as determinants of labor force participation.

Wachter tests both the neoclassical and discouraged worker models for the period 1948-1968 using demographic data representing the various segments of the secondary work force.[9] He concludes from his tests that three major areas of concern with respect to Phillips curve theory are illuminated by this study.

> "First, participation behavior is primarily explained by real wages." (48b, p. 141).

> "Secondly, the supply of labor responds positively to a variable that reflects the rate of inflation. The inclusion of this variable follows a formulation proposed by Friedman (1968). He conjectures that a form of money illusion in the supply function of labor is the foundation of an empirically observable, short run Phillips curve. Thirdly, the labor supply is found to respond to changes in excess demand conditions in the labor market only during the period of chronic, high unemployment, 1958-1966 and even during that period, the effect observed is considerably smaller than that noted in earlier studies." (48b, p. 141).

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[9]The explanatory variables are hourly earnings and the consumer price index, representing wages and prices, respectively.

It is to these conclusions that we turn in the next chapter, which uses industrial sectors, instead of demographic classifications, to examine the labor force participation of stably employed workers; the primary work force.

CHAPTER 3

SECTORAL ANALYSIS AND CYCLICAL EMPLOYMENT OF "PRIMARY" WORKERS

Industrial sector analysis provides a potentially useful method of examining Phillips curves, as long as industrial labor force participation movements can be explained in terms of cyclical fluctuations in the market variables; wages, prices and unemployment.[1] If such movements are unrelated to market characteristics, we cannot predict that different sectoral Phillips phenomena will arise for structural reasons, even when sectoral market differences exist. This conclusion is drawn from the presumption that Phillips curves are based on the interaction of demand and supply phenomena (15). It follows that if the labor force participation movements can be explained in terms of underlying market structures, we will be able to develop a theory of sector Phillips curves based on Fuchs' demand oriented industrial classifications, since the demand and supply considerations will be reinforcing.

3.1 Labor Market Boundaries and Labor Force Mobility

The differences in cyclical labor force response by industrial structure have not been intensively examined

[1]The additional, necessary requirements for the existence of a segmented markets model are discussed in Chapter 4.

because true labor market boundaries are ambiguous and considerable labor market crossover is possible (2) (26). We must assume that the industrial classifications used in this study give a good first approximation to actual markets; if so we can develop a labor force participation measure reflecting this market segmentation. The advantage of approaching labor supply from this perspective is that we have a better estimate of the real wage argument of the neo-classical theory of labor supply. Data exist for wages by industries, but have to be estimated in the case of demographic studies, or as with Wachter (48b), the aggregate wage serves as the proxy for all demographic groups. This chapter will concentrate on market segmentation when considering the question of the cyclical response of the labor force, with the purpose of developing an industrial labor force participation variable, and of using this variable to test labor supply behavior on an industrial basis for the period 1958-1971.

The first approximation to separate markets used in this study is based on the Goods-Services distinction developed by Fuchs (18).[2] Fuchs has shown that the two sectors vary in their labor market characteristics. Although his analysis is concerned with employment and wage differences arising from differences in the demand functions, sectorally,

[2]These include a Service sector composed of wholesale-retail trade, finance, insurance and real estate, and services, and a Goods sector composed of manufacturing, contract construction, transportation and public utilities, and mining.

this classificatory system provides a basis for also comparing the influence of different market structures on the supply of labor. The structural differences of concern here center on wage levels and cyclical wage movements, unemployment rate movements, and the degree of unionization and demographic composition. Fuchs found that wages are higher and less volatile cyclically in the Goods sector due to a greater degree of unionization in this sector and the relatively larger number of workers paid on a commission basis in the Service sector. The relatively greater swings in output in the Goods sector, coupled with relatively smaller swings in wage rate changes, cause the relatively larger shifts in derived demand to result in larger swings in unemployment in this sector. Finally, the Service sector has a larger proportion of women workers, and can generally be more closely identified with the secondary work force. Therefore, we expect this sector, ceteris paribus, to have labor supply characteristics more closely associated with this demographic group.

It is important to note that industrial data exclude a segment of the measured labor force included in demographic studies. This group is composed of the newly entering and reentering unemployed workers. These are primarily the job seekers who possess neither adequate technical nor job search skills. While not all secondary workers are included in the above group, its composition is primarily of secondary workers. The assumption is made that by excluding this

cyclically volatile group a major influence of the secondary work force on labor supply is removed. The remaining group is stereotyped as the primary workforce and a labor force participation model based on the primary force is hypothesized. While some of the relative labor supply movement can be explained in terms of the demographic composition of the various industry groups, much of the explanation lies in different production structures.

The general results of the chapter are:

(1) Labor markets differ along industrial lines, and can be analyzed in terms of Victors Fuchs' industrial characteristics.

(2) The neoclassical model provides more insight into the supply phenomena of industrial labor markets than does the simple discouraged worker model for the short to intermediate length period. In other words, wages and prices are more important market indicators than unemployment rates for the industrial labor force.

(3) Labor force participation responds positively to price changes in the short run. Also, labor overcompensates for this short run response to the rate of increase in prices in the intermediate run, supporting the neoclassical theory for the existence of short run Phillips curves which shift over the intermediate period. However, the money illusion appears to be strongly motivated by rational behavior and dependent on the given labor market structure; a result which is not considered by neoclassical theorists.

(4) When real wages change, substitution effects are more important than income effects in determining the reaction of the industrial labor force. That is, the industrial labor force participation curves are upward sloping.

3.2 Labor Force Participation in Heterogeneous, Segmented Labor Markets

The central proposition of this research is that different labor markets do exist and that the labor force participation in each is dependent both on the demographic characteristics of the group and the structural characteristics of the specific sector. Segmented markets possessing different structures, skills, and job characteristics should possess different supply functions and real wage rate arguments. It follows from this assumption that the labor supply for any given industrial group can be predicted better in terms of the real wage for that industry than for an aggregate real wage rate, and that each labor supply function can be interpreted in terms of the characteristics of its respective market.

The present model is derived from the labor force participation work by Wachter (48b).[3] The starting point for his model is neoclassical labor theory which holds that labor supply is a function of real wages. In comparative statics this relationship is instantaneously adjusting. However, for empirical purposes it is generally recognized that only in the long run will the supply of labor be able to

[3]One difference in data source between Wachter's work and this research is pertinent. The wage variable in this case was drawn from compensation per man-hour under the assumption that pecuniary fringe benefits are relevant to a primary worker's marginal decision regarding employment.

respond fully to wage and price changes. It is for this reason that Wachter derives the comparative static supply function and the equilibrium real wage rate in terms of permanent wages and prices. Wachter assumes that in the long run the coefficient of the price term is exactly that of the wage term and excludes consideration of the price term. While this study uses the terms permanent and transitory, following Wachter's nomenclature, the definition of permanent wages and prices differs from Wachter's. Wachter considers permanent money wages to be equivalent to long run real wages. Due to data limitations, the present study is constrained to a period of twelve years, thus precluding statements on the long run association among the various market variables and parameters. Therefore, the term permanent refers to intermediate run variables and no a priori assumptions can be made concerning different industrial labor force responses under long run conditions.[4]

The relevant equation for the intermediate run supply function is

$$(1) \quad (LF/R)_{ip} = a_p + B_p \ (W^* - \gamma_p P^*) \ .$$

where: $(LF/R)_i$ = labor force participation (variables described below),

[4]The permanent real wage used in this study is found by taking the three year average of wages and prices. This proxy is developed to preserve both the size of the sample used and the concept of intermediate run adjustment. Presumably, a longer period for the average would eliminate some of the expectations effect noted in the present study. Since lagged responses could conceivably be distributed over the period studied, a model incorporating such considerations could improve the present results.

a_p = constant,

W^* = intermediate wages,

P^* = intermediate prices,

B_p = the coefficient of the real wage term,

λ_p = an index of price expectations in the intermediate run.

All variables are in logarithmic form.[5] When $\lambda = 1$ expectations adjust instantaneously, when $\lambda > 1$, overcompensation occurs, which is expected in the intermediate run.

The labor force participation variable, $(LF/R)_i$, is calculated by dividing the labor force, LF_i, in each industry group by a population deflator, R_j. The deflator is calculated by multiplying the proportion of the total employment for both men and women in industry group i, E_{ij}/E, by their respective total population, N_j. When LF_i is divided by R_j the following obtains:

$$(2) \quad (LF/R)_i = LF_i \div \sum_{j=1}^{2} (E_{ij}/E) \cdot N_j \ .$$

where: LF_i = labor force in industrial sector i,

R_j = population of demographic group j,

E_{ij} = employment of group j in industry i,

E = total employment,

N_j = total population of group j, and

j = is divided into men and women in this study.

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[5]Note that the specification of the supply function is such that the slope (in wage-quantity space), rather than the intercept, is affected by intermediate price levels. An alternative functional form with the reverse property is:

$$(LF/R)_{ip} = a'_p + B'_p \log \left(\frac{W^*}{\lambda_p{}' P^*}\right) \ .$$

The logarithm is used in estimations of the labor supply function. These calculations are necessitated by data considerations, since labor force participation rates by sex-age, and industrial groupings are not available. The assumption is made, that the population for the industrial group is proportional to the employment in that group, which does not consider non-labor force jobs and makes a very restrictive assumption regarding prospective preferences of the secondary workers. However, it does permit the formulation of a deflator which removes average supply changes due to population growth.

In the present study we wish to consider separately the wage and price reactions in the intermediate run. Therefore we will consider an equation of the form,

$$(3) \quad (LF/R)_{ip} = a_p + B_1(W^*) - B_2(P^*).$$

The expected sign of B_1 is positive if an upward sloping labor force participation function prevails. If the value of $\gamma_p > 0$ there should be a negative value of the coefficient, B_2, when $B_2(P^*)$ is separately considered, where $B_2 = B_p\gamma_p$ from (1). Similarly, as long as $\gamma_p > 1$, $|B_2| > B_1$.

Like Wachter, we examine three short run topics: short run real wage rate changes, money illusion, and the discouraged worker effect. The first two are used to measure the response of the labor force to short run divergences in real wages from the equilbrium (long run) level. This effect could be examined by an equation of the form,

$$(4) \quad (LF/R)_{iT} = a_T + B_T\ (W - \gamma_T P)$$

where: a_T = constant,

B_T = coefficient of the real wage term,

W = transitory wages,

P = transitory prices,

γ_T = money illusion index .

All variables are logarithmic. If no expectations existed in the intermediate run, the simplest measure of the effect of transitory wage rate changes could be found in equation (4). At the same time, when the steady state neoclassical solution exists, the short run and intermediate run supply functions will coincide with the long run function. When the steady state is disrupted by a transitory divergence of real wages, the real wage rate will diverge and the possibility arises for money illusion in the short run. As the system equilibrates, the further possibility exists for intermediate run overcompensation. We use $(W - W^*)$ and $(P - P^*)$ to determine the effect of the divergence when adjustment lags and overcompensation occur. For example, assume a disequilibrium situation where $\gamma_p > 1$ and $\gamma_T < 0$. The total labor force response when this short run divergence is included in the labor force participation equation will be measured as,

$$(5)\quad (LF/R)_i = a + B_1(W^*) - B_2(P^*) + B_3(W - W^*) + B_4(P - P^*) .$$

This equation will be the first tested in this paper.

If the value of B_3 is zero, there is no short run divergence from equilibrium due to wage rate changes. We have assumed a positive supply function and B_3 should,

therefore, be greater than zero when there is a disequilibrium movement in wages. In the present case, the transitory effects occur in a disequilibrium situation, so both the effect of the disequilibrium caused by the short run shock and the prevailing disequilibrium situation must be considered when evaluating the effect of money illusion. In this case B_4 has three possible influencing factors, short run divergence in prices, money illusion, and expectations adaptation. For the present case we know that P is always greater than P*. With our previous assumption of a positively sloping participation function this would, ceteris paribus, indicate that B_4 should be less than zero. When expectations exist, $\gamma_p > 1$ and the value of the variable will increase, ceteris paribus, and $B_4 < 0$. B_4 will be greater than zero given an upward sloping supply curve, only if $\gamma_T < 0$ and its absolute value is greater than the combined effect of the trend growth in prices and expectations adaptation.

The coefficient of the wage and price variables can be compared to reveal sector labor supply characteristics. For example, Wachter has shown that the relative wage variable coefficient, B_3, can be compared to the permanent wage variable coefficient, B_1, in order to determine the predominance of substitution or income effects. If $B_1 > B_3$ we can assume that labor reacts to increases in wages by taking more leisure (cutting back labor) and the income effect will dominate. While we expect that $B_3 > B_1$ for all of the industrial labor force, we can also use demographic differences,

sectorally, to predict differences in the magnitude of the dominance of the substitution effect. Wachter has found that women of childbearing years are more affected by the income effect than other groups. Since we expect more of these workers in the Service sector, we also expect it to show less predominance of substitution effects, ceteris paribus.[6]

The relationships among coefficients can also be used to evaluate the money illusion effect. The reaction of the industrial labor force to unexpected wage and price movements is a central feature of the monetarist explanation of Phillips curve phenomena. Search unemployment theory, as interpreted by Phelps (38a) (38b), relies on money illusion by workers to account for the short run actions of workers facing change in aggregate demand. Phelps views the reaction as an informational lag problem, and assumes that workers will finally adjust their expectations to future changes. The adaptation of expectations occurs over time and requires that some workers leave their present positions to search for better jobs as money wages fall and that some unemployed workers accept jobs at previously unacceptable wage rates as wages rise. When these workers realize that all wages are changing similarly, in step with price and productivity changes, they will adjust their behavior accordingly, and

[6]The percentage of women in the Service sector increased from 72% to 75% between 1960 and 1970. During the same period the percentage of men in the Service sector grew from 45% to 52%.

the natural rate of unemployment will be obtained. As long as future price and wage changes are expected, this unemployment rate will prevail. Since we expect that the informational problems concerning current money wage levels will be more evident in the less structured Service sector, we also assume that "informational lag" money illusion will be most evident in this sector.

Lucas and Rapping (32a), (32b), suggest that money illusion on the part of workers is rational behavior, motivated by a desire to maintain real income at a constant level. This paper also assumes that money illusion may have a rational basis. We associate the character of money illusion with demographic and job characteristics. First, we assume that labor force sensitivity to cyclical changes is inversely related to the degree of market organization. The Goods sector, with more market organization, is expected to be less influenced by both wage and price changes. This result is due to the worker's view of union membership as a condition of employment, which carries both costs and benefits. One cost is that the worker cannot move from firm to firm and industry to industry seeking better terms of employment. The benefits include higher wages, seniority rights and effective exclusion from the labor force of non-union members (see Alexander (2)). The inherent value of retaining this membership acts to maintain labor force participation when real wages fall (with the worker realizing that wage gains will be made at the next bargaining session). If real wages rise,

the effective exclusion of non-union members maintains the labor force size. On the other hand, to the extent that workers who are identified with Wachter's secondary workers are included, to a greater degree, in the Service sector we might expect stronger Lucas-Rapping effects here. This conclusion is based on the previously mentioned finding that certain secondary workers possess stronger income effects than the general labor force. Lucas and Rapping would predict that as real wages fall the labor force would increase, a result calling for roughly the same motivation. Therefore, we cannot predict a priori whether the Service or Goods sector will exhibit stronger money illusion effects. However, we can use distinctions discussed here to interpret empirical tests in order to determine the relative importance of demographic and industrial factors.

Finally, the discouraged worker effect can be added to explain short run divergences not explained by the rest of the model (Simler and Tella (43)). As explained by Wachter, this effect should be most prevalent during times of high, prolonged unemployment and should, therefore, be represented by an unemployment variable, U_D, during such periods. A universal application of the unemployment rate, U, in the neoclassical model can yield deceiving results since in many cases U and W overlap in explaining labor supply changes. Assume, for example, that population remains constant so that

$$LF = E + U_N \ .$$

where i

E is the number employed and

U_N, the number unemployed.

For a movement along the supply function LF is constant, so that an increase in E means a decrease in U_N. If the function is upward sloping and elastic, this implies that,

$$(W/P) = f(U_N) = f(U)$$

where i

(W/P) is real wages and

U is the unemployment rate.

and the relationship between real wages and unemployment or the unemployment rate is negative. This relationship provides a mechanism for "discouraged worker" models to explain neoclassical labor supply phenomena. Unless the labor force reserve is unresponsive to real wage rate changes, the two are also related for shifts in labor force size. If it is assumed the reserve labor force responds to real wage changes in the same way as the current labor force, then the relationship is roughly the same as noted above. In this case,

$$LF + \Delta LF = E + U_N + \Delta LF,$$

or

$$LF + \Delta LF = E + \Delta E + U_N + \Delta U_N.$$

As long as $\Delta U_N \neq 0$, a negative relationship between real wages and unemployment can be hypothesized. It is for this reason that the unemployment rate variable, U, should be included in the Wachter model only during times of prolonged unemployment. It is during these periods that the greatest

probability of unresponsiveness to real wage rate change exists. By adding U_D and the independent variables in equation (5), we form the second model tested in this paper:

(6) $(LF/R)_i = a_1 + B_1(W^*)+B_2(P^*)+B_3(W-W^*)+B_4(P-P^*)+B_5(U_D)$

where B_5 represents the effect on $(LF/R)_i$ for those periods when the rest of the equation is less effective. U_D is the logarithm of the unemployment rate during periods of prolonged, high unemployment.[7] B_5 will be negative in the case of positive sloping labor force participation functions, indicating that the labor force contracts when prolonged high unemployment exists and expands as the unemployment rate falls.

Here we argue that the "discouraged worker" effect is associated with labor market structure in the case of the primary work force. As mentioned previously, the discouraged worker effect is only a useful adjunct to the neoclassical model where labor responsiveness to real wage rate changes is minor. Assuming that, as economic conditions change, labor demand shifts, causing concomitant changes in real wages, and the labor supply function is stable over the business cycle, there are two major circumstances when the neoclassical model will not accurately predict labor force participation movements. The first is the case of job

[7]The unemployment rate, as measured industrially, is used in this study as the unemployment variable, and is effective during the period 1958:1 to 1964:2.

seekers whose reservation wage is below the minimum wage rate. Their supply must be governed by some other market parameter, presumably the duration and rate of unemployment. This situation can be permanent as long as the value of the marginal product for the worker is less than the minimum wage (deflated by prices). The other case occurs during recession when the value of the marginal product of the unemployed worker falls below his reservation rate. While this condition cannot last indefinitely, its existence is prolonged by unemployment insurance, savings, etc. It is quite conceivable that the discouraged worker effect would be evident during short recessionary periods (those long enough to permit a prolonged period of high unemployment, but short enough so the reservation wage does not adjust downward). In the present study a large number of the first group of discouraged workers are excluded. Therefore, not only should the discouraged worker effect be less pronounced than found by Simler and Tella (43) and Wachter (48b), but it should be significant only in prolonged, high unemployment periods.

3.3 Empirical Results for Two Broad Industrial Groups

Empirical analysis using time series data and seeking to determine specific functional relationships has the problem of distinguishing between movements along the curve and shifts in the curve. In this study we make the assumption that we are analyzing the labor force participation of primary workers, implying cyclical stability in the functional

relationships. Therefore, unless a secular movement in labor force participation is evident (a trend toward greater or less labor force participation) we can interpret our results in terms of movements along a supply function, and not in terms of shifts in the function. The two sectors studied here have exhibited trends toward increased labor force participation for the period under consideration, 1958:1-1971:1. While we will not dwell on this point, these trends do give a slight positive bias to the coefficients of the estimates of the functions, which should be kept in mind when interpreting the results.[8]

The first task of this study is to examine the assumption underlying the earlier discussion, that markets for labor, with different characteristics do exist. Unless the two sectors examined here behave in different ways, much of the interest in a sectoral markets model disappears. To test this assumption a Chow (10) test was conducted, based on equation (5), for the Goods and Service sectors, for the period 1958-1971:1 (all regressions cover this period). The null hypothesis that the two markets operate within similar structures was rejected at the .01 confidence level.[9] This

[8]With the exception of the results shown in Table 3 the inclusion of a trend term had little affect on the regressions used in this section.

[9]The Chow test with a null hypothesis of similar regression characteristerics is run using the following equation:

$$(A - S - G)/p \div (S + G)/(n + m - 2p)$$

distributed as $F(p, n + m - 2p)$. Where A is the aggregate, S the Service sectors' and G the Goods sectors' sum of the squares of the residuals. The value of A is found by pooling S and G. n and m are the number of observations in S and G respectively and p is the number of parameters, so that

suggests that the two broad markets are sufficiently different so that conclusions concerning differences in their supply functions may be interpreted in terms of these structures.

The segmented markets model is next used to analyze the following four questions.

(1) The relative labor supply response to general versus specific labor market indicators.

(2) The presence of money illusion in the short run supply curves, and an expectations effect in the intermediate run.

(3) The relative magnitude of the discouraged worker effect in each sector.

(4) The magnitude and nature of cross effects.

3.3.1 General versus specific labor market indicators

We will initially consider the four equations of Table 1. The first facet of these results which is of interest is that, despite the separate workings in each broadly defined market, both supply functions can be explained at least as well in terms of general as specific market parameters. Since we would expect that segmented markets would be most sensitive to changes in their specific market variables, this result suggests some overlap between sectors. The section dealing with cross effects suggests that while the

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for this test, using equations (1) and (2) of Table 1.

A = .00146 S = .00056
G = .00045 p = 4 n = m = 45.
The Chow ratio is 9.15 and when this is compared to
F(4,82)=3.56 the null hypothesis is rejected, since 9.15>3.56.

Table 1. Labor Force Participation Functions For A Neoclassical Model, For Industrial Data-- 1958:1-1971:1

Variable/ Sector	constant	W_A*	W_i*	W_A-W_A*	W_i-W_i*	P*	P-P*	R^2/see	D.W.	rho
1 SERVICE	.2727 (0.695)	.2494 (3.025)		.6538 (3.267)		-.3564 (-2.352)	.8843 (2.944)	.9884 .0038	1.93	.76
2 GOODS	-.3250 (-0.801)	.1947 (1.960)		.2271 (1.297)		-(.1634) (-.954)	.8802 (3.126)	.9895 .0034	2.13	.81
3 SERVICE	1.492 (1.957)		.2941 (2.670)		1.0091 (2.873)	-.4271 (-2.334)	.6841 (1.957)	.9876 .0039	1.87	.67
4 GOODS	.2708 (0.332)		.1906 (1.334)		.3510 (1.734)	-.1467 (-.702)	1.0039 (3.552)	.9891 .0035	2.03	.85

Source: U.S. Department of Labor, Employment and Earnings. All data are quarterly averages, and the variables are in logarithmic form. The terms in parentheses are t-statistics. The subscript A refers to aggregate data. All regressions are corrected for first order autocorrelation using the Hildreth-Lü (23) method.

labor force overlaps sectors, its response to relative wage and unemployment changes is related to changes in aggregate demand. To the extent that this relationship prevails, we expect the importance of cross effects to be diminished.

For example, we see that for equations (1) and (2) (using general arguments for the Service and Goods sectors, respectively) the coefficients of determination, standard errors of estimate and Durbin Watson statistics, are approximately the same as those for equations (3) and (4) (using specific arguments). While these results are not sufficiently good to establish the superiority of either general or specific arguments, we must question any assumptions of complete market (sector) autonomy. An alternative hypothesis was tested that workers respond to general conditions in the short run, but adjust their supply over time to specific market indicators. The results of this test were similar to those shown in Table 1.

3.3.2 Money illusion and expectations

The second finding of significance is that money illusion and expectations are important in the short and intermediate runs, respectively, in the Service sector. The signs of the coefficients of both the money illusion variable, $(P - P^*)$, and the expectations variable, P^*, are those we expect from the discussion of the preceeding sections, assuming $\gamma_p > 0$ and $\gamma_T < 0$; the case where money illusion is present in the short run and over compensation exists as workers adapt their expectations. On the other hand, only γ_T is significant in the Goods sector.

Search unemployment theory as developed by Phelps (38a), (38b), leads us to expect that the Service sector, with less market organization, and therefore, poorer communications, than the Goods sector, would be most affected by the recognition problems implicit in the money illusion interpretation. However, we find that while the expectational adaptations influence is more important in the Service sector, money illusion is more important in the Goods sector (γ_p is relatively larger in the Service sector and γ_T is relatively larger in the Goods sector), supporting a different interpretation of the phenomena.

The expectations term, γ_p, equals $|B_2|/ B_1$, while the money illusion term, γ_T, equals B_4/B_3. For the Service sector, the value of γ_p is approximately 1.5 while its value is approximately 0.9 in the Goods sector. The value of γ_T in the Service sector ranges from 0.7 to 1.4 (depending upon whether specific or aggregate figures are used to compute γ_T) and from 2.7 to 4.0 in the Goods sector. Although all of the coefficients in these equations are important for labor supply analysis, we are especially interested in the values of expectational terms, since these are also important to Phillips curve interpretation.

We have assumed that the Service sector would be more susceptible to neoclassical money illusion. The fact that the valuesof γ_p and γ_T are approximately equal in the Service sector suggests that the neoclassical explanation of money illusion is applicable in this sector. We will use

the Lucas-Rapping idea of rationally motivated money illusion to explain why the Goods sector results deviate from the Service sector findings.

If the Service sector can be characterized as composed of many small firms and many worker bargaining groups, with poor informational flows, the Goods sector might be typified as having a few large firms and few worker bargaining units. Further, the Goods sector is characterized as having administered wages which mitigate the job-search explanation of money illusion.

One hypothesis supported by this research, is that union membership is maintained during price inflation and the labor force is, effectively, not permitted to fall with the drop in real wages. This effect does not need to arise through coercion or even be explicit union doctrine. The recognition that wage rate change must await the next bargaining session, and the inherent value of the union membership that might be lost by deciding to withdraw from the labor force could maintain the level of sector supply. Likewise, as real wages improve in the Goods sector, as a result of bargaining at the next negotiating session, we expect to see relatively less labor force participation fluctuation since labor supply is dependent upon union membership. Therefore, although the labor force participation rate might grow while real wages fall in the short run, it will not adjust over time, even when the real wage losses are evident. In such a case a value of γ_p of approximately one is expected.

The Service sector appears to fit the neoclassical labor supply model better for primarily structural reasons. As equations (1) and (2), or (3) and (4) of Table 1 show, the coefficients and t-statistics for the wage variables are more significant in the Service sector. The greater flexibility in wage rates and the relative lack of significant market organization suggests a more elastic supply function for the Service sector. At the same time, we see that the value of the relative wage coefficient, B_3, is greater than the permanent wage coefficient, B_1, supporting our contention that strong substitution effects affect the industrial labor force.

3.3.3 Prolonged high unemployment effect

In Table 2 we add a dummy unemployment rate variable, U_A for aggregate data and U_i for sector data, for 1958-1964:2, the period of high unemployment industrially. First, it will be noticed that this additional variable is negatively related to labor force movements (the coefficients of U_A and U_i are negative), and is relatively significant. Our earlier discussion led to a conclusion that unemployment rates should be negatively related to labor force participation, if the labor force is sensitive to this market indicator. This reaction has been found by Wachter to be applicable to secondary workers. This research suggests that primary workers also respond significantly to extreme unemployment conditions by adjusting their labor force participation.

Table 2. Labor Force Functions Combining Neoclassical and Discouraged Worker Models.

Variable/ Sector	Constant	U_A	U_i	W_A^*	W_i^*	$W_A-W_A^*$	$W_i-W_i^*$	P^*	$P-P^*$	R^2/see	D.W.	rho
1. SERVICE	.1690 (0.444)	-.1458 (-2.052)		.1618 (1.798)		.5666 (2.876)		-.2466 (-1.589)	1.049 (3.501)	.9895 .0036	1.97	.76
2. GOODS	-.3509 (-.897)	-.2096 (-3.678)		.1753 (1.556)		.0843 (0.555)		-.1379 (-.769)	.9942 (3.920)	.9921 .0030	2.10	.91
3. SERVICE	.7487 (.999)		-.1753 (-2.665)		.1390 (1.209)		.9497 (2.923)	-.2398 (-1.319)	.9134 (2.851)	.9895 .0036	1.82	.66
4. GOODS	-.5201 (-.074)		-.2060 (-3.813)		.0892 (.708)		.2472 (1.401)	-.05172 (-.285)	1.154 (4.679)	.9921 .0030	1.90	.85

Source: U.S. Department of Labor, Employment and Earnings. All Variables are in logarithmic form. Terms in parentheses are t-statistics. All regressions are corrected for first order autocorrelation using the Hildreth-Lu (23) method.

At the same time, the addition of the dummy unemployment rate variable reduces the coefficient of the permanent real wage variable. Notice that the values of B_1 and B_2 are lower in each equation in Table 2, than they are for the same equations in Table 1 (where the equations with the same reference number represent equivalent data bases). This reduction in the coefficient of real wage variables suggests some overlap between the discouraged worker and neoclassical model in explaining labor supply movement.

However, the values of the coefficients of B_1, B_2, and B_5 in Table 2 only partially tell the story of the magnitude of the discouraged worker effect. First, it should be noted that regressions in which the unemployment rate variable was operative for the entire period showed a negative relationship between labor force participation and unemployment rates and considerable distortion in the permanent supply function variable.[10]

3.4 Discouraged Worker Effect

Separate regressions testing the "discouraged worker" effect, as specified by Wachter, were also run (see equations (1) and (2) Table 3). Most of the labor force participation is explained by the constant and trend term in the discouraged worker model, which leaves considerable room for

[10]The addition of the unemployment rate variable for the entire period, 1958-1971 caused the sign of the coefficients of permanent prices in the Service sector and of permanent and transitory wages in the Goods sector to change. Considerable interrelationship between real wages and unemployment rates for the majority of the sample period is suggested by these sign reversals.

Table 3. Discouraged Worker and Crossover Effects on Labor Force Participation-1958-1971:1

Variable/ Sector	Constant	U_A	W_s/W_g	U_s/U_g	Trend	R^2/see	D.W.	rho
1. SERVICE	-.1631 (-14.043)	-.7351 (-4.760)			.0321 (7.015)	.9898 .0035	1.86	.91
2. GOODS	-.1776 (14.460)	-.1375 (-0.842)			.0345 (7.141)	.9872 .0037	1.90	.91
3. SERVICE	-.1114 (-.478)		.02865 (.106)	.03449 (2.926)	.0488 (8.361)	.9833 .0044	1.76	.99
4. GOODS	-.0200 (-1.177)		.0528 (0.233)	.0177 (1.811)	.0315 (7.225)	.9881 (.0051)	1.80	.89

Source: U.S. Department of Labor, Employment and Earnings. Terms in parentheses are t-statistics. All regressions are corrected for first order autocorrelation using the Hildreth-Lu (23) method.

improvement in explaining labor force participation. It appears that much of this is explained by the neoclassical model. When the present results of testing for the discouraged worker effect are compared with Wachter's results, it appears that this effect is most applicable to the secondary work force (excluded in large part in the present case). As would be expected, the results in this case are less significant than comparable demographic studies (6) (15) (43) (48b), with respect to the discouraged worker effect, and the results in the Goods sector suggest that labor supply is relatively more constant, cyclically, where unionization is strong (whatever the cyclical movement in employment, unemployment or real wages may be).

3.5 Crossover Effects

The final question considered by this chapter concerns crossover effects. Crossover effects occur when workers in one sector base their labor force participation decisions in part or totally on movements in the variables in the other sector. It is most often assumed that such behavior results in migrations from one market to the other, so that when these effects are sufficiently strong the labor force participation in one market might change perceptibly without any change in its real wages or unemployment rate arguments, when these arguments change in the other market.

Tables 1 and 2 show results that support the assumption that labor supply functions for primary workers are upward sloping. It seems reasonable, therefore, that workers

will react to changes in relative wages or unemployment in such a way as to migrate from the sector with falling relative wages or rising relative unemployment, to the sector with rising relative wages and falling relative unemployment. The model may be described as:

(7) $(LF/R)_i = a_1 + B_6(U_s/U_g) + B_7(W_s/W_g)$.

where

s = Service sector,

g = Goods sector.

and all variables are as previously defined, but are not in logarithmic form.

If there is a significant crossover effect the signs of B_6 and B_7 will be positive and negative, respectively, in sector g, and negative and positive, respectively, in sector s. Table 3, equations (3) and (4) show the results for regressions testing this model in both sectors. Although the coefficients of determination are high in both sectors, the signs of the unemployment rate and wage rate variables cast doubts on the significance of the correlation for crossover effects.

The signs of both coefficients in each sector are positive. This result is most easily explained in terms of the relationship between these relative movements and the cyclical changes in the aggregate. For the period studied, wages in the Service sector increased, relatively, during expansions and declined, relatively, during contractions. Similarly, Service sector unemployment rates grew, relatively,

during expansions and fell relatively during contractions. Assuming that the labor supply function is positively sloped, we would expect increased labor force participation during expansions and decreased labor force participation during contractions. This hypothesis is supported by the results of Table 3.

We are unable to conclude that there is no crossover effect between sectors. However, since the analysis of crossovers can be explained in terms of aggregate changes, we find support for the contention that crossover effects are not cyclically exogenous phenomena. We conclude that the crossovers that occurred during the sample period are due to aggregate cyclical changes.

3.6 Conclusions

We have found support for the theory of segmented labor markets. The Service sector market is characterized by neoclassical market mechanisms and its labor supply function can be best interpreted using this model. The Goods sector has a market characterized by more rigid institutional arrangements, which constrain the movement of the labor force, and produces a less steeply sloped function (one which is less responsive to price or wage changes). The result is that the sector with better information transfer mechanisms, the Goods sector, displays more money illusion and expectation adaptations problems. Since this behavior is related to institutional arrangements it can be expected to be of a longer duration, and, thus, more

important to Phillips' curve phenomena, than the money illusion problems arising from informational limitations and lags.

The discouraged worker model, employing the unemployment rate as the principle explanatory variable, is much less useful in explaining industrial labor force participation behavior of primary workers than is the neoclassical model. This result would be expected due to the fact that the primary workforce represented in the industrial data is stably employed and does not view unemployment as a relevant market parameter, except during periods of prolonged, high unemployment. The overlap in explanation between unemployment and real wage variables is therefore more a result of concomitant movements in the two, than a result of a strong functional relationship between primary labor force participation and unemployment rates.

While this research indicates that significant differences in price expectational behavior patterns exist between sectors, more cross sectional analysis, aimed at studying the complex interrelationships among occupational, demographic and industrial groups is also suggested.

CHAPTER 4

SECTORAL EMPLOYMENT AND SHIFTS IN THE AGGREGATE PHILLIPS CURVE

We have seen that the two sectors differ with respect to labor force reactions to wage and price changes. While these differences imply different neoclassical-expectational Phillips relationships in the two sectors, we must more fully explore labor market heterogeneity before the labor market tightness influences are evident. This chapter serves to develop such an analysis and to verify the expectational conclusions found in the previous chapter.

This chapter develops a two sector model based on the production-employment characteristics described by Fuchs (18) estimates expectational Phillips curves for Goods and Services, and contrasts the present industrial estimates with those presented by Perry (37b). We establish the existence of sectoral Phillips curves which possess predictable structures. In addition, the estimates support the contention that disaggregative analysis is a useful tool for explaining observed aggregate Phillips curves.

Although the model and conclusions derived in the present paper provide new information concerning the observed trade-off, a primary function of this chapter is to introduce an alternative method of examining inflationary problems. The

disaggregation we employ is based on a general equilibrium system, which involves the complex interdependences of wage rate changes, price changes and labor market tightness, among the major variables. However, this first attempt at such an approach is limited to a partial equilibrium analysis, which restricts the depth of the study and limits the inferences we can draw from the results. Nevertheless, the single equation model captures some essential differences between behavior in the Goods and Service sectors.

Of the various central issues of stabilization policy during the past decade, few have been subject to more research and controversy than the observed relationship between the percentage change in the aggregate wage rate and the aggregate unemployment rate. Phillips (39) interpreted the aggregate tradeoff as reflecting a functional relationship between money wage rate changes and the aggregate demand for labor. The monetarist writers of the sixties took exception to this view, claiming that no permanent Phillips tradeoff existed (17). A third interpretation, by Lipsey (30), is that not only is the aggregate unemployment rate a surrogate for the aggregate excess demand for labor, but it is also a proxy for the inflationary influences of labor market heterogenity (3a) (3b). Here we examine the effect of structural differences among industrial sectors on this aggregate relationship.[1]

[1]Archibald (3b) has examined the effects of unemployment dispersion, an index of product and labor market heterogeneity, over both geographical and industrial divisions; his results show a positive relationship between unemployment dispersion and wage inflation.

Labor market heterogenity can be examined in terms of demographic, industrial, or occupational characteristics. This study examines industrial differences in contrast to Perry (37b), who recently examined the influence of labor supply heterogenity on wage rate changes, focusing on the effect of more youth and women in the labor force. Perry concludes that the influx of these groups into the labor force has caused the Phillips relationship to shift out when one uses a conventionally measured aggregate unemployment rate. The sectoral model developed in the present research demonstrates that when the labor force is imperfectly mobile, differences in labor demand functions produce different Phillips curves for the resulting segmented markets. The analysis of the estimated sectoral "Phillips curves" suggests that for zero price inflation a 4 percent unemployment rate corresponds to a 2.8-3.0 percent rate of change of wages for 1950, but a 3.2-3.4 percent rate for 1970. However, this study indicates that the shift is not uniform, but is the result of a pivoting of the aggregate Phillips curve.

4.1 Disaggregation Into a Two Sector Model

Research using disaggregative functional relationships may be required due to two basic problems of aggregation in a diverse world. The first is the famous paradox of composition, in which the whole is something more or less than the sum of its parts. Because of this problem, Lipsey and Archibald suggest that unemployment rate dispersion should

be included with the aggregate unemployment rate in equations explaining wage rate changes.[2] The second is the difficulty encountered in attempting to aggregate over different functional relationships, when such aggregation obscures the underlying economic structures. Perry addressed this problem from the labor supply side, via demographic differences while we focus on industrial sector differences, as well as on the supply characteristics of the primary work force.

4.1.1 General aggregation issues

The problem of identifying sectoral contribution to an aggregate functional relationship has both a theoretical and a technical (index number) basis. Perry's approximation of demographic groups' contribution to excess demand is grounded in a theory of the inflationary process. He contends that differences in supply characteristics of eight demographic groupings give rise to varying degrees of inflationary influence. Perry's excess demand variable is:

$$(1)\quad U^*_A = \left(\sum_{j=1}^{8} (I_j)(V_j)\right) / \left(\sum_{j=1}^{8} (I_j)(L_j)\right) .$$

where:

U^* is the weighted aggregate unemployment rate,

I_j is the productivity index for demographic group j,

[2]The problem of dispersion effects is treated in section 4.2.3. Since the dispersion model we test is essentially that formulated by Archibald, we have not treated its derivation in the present section. We assume in the remainder of this section that the paradox of composition is not present. The additional consideration of dispersion effects complicates the analysis, but it does not invalidate the conclusions drawn in this section concerning aggregating over different functional relationships.

V_j is the number unemployed of group j, and

L_j is the total labor force for group j.

The Perry model emphasizes supply influences through weights given the eight components of the unemployed portion of the labor force.

In the present case, we use a simple two sector model which assumes that two heterogeneous labor markets exist, and that the movement of labor between them is restricted. Such an approach, which may be contrasted with Perry's weighting technique, provides a more direct test of sectoral influences on the aggregate observed variables. The aggregate Phillips curve equation in linear terms is:

$$(2)\ \dot{w}_A = a_A + B_A(U_A) + C_A(PCR).$$

where $\dot{w}_A$ is the rate of change in compensation per manhour,[3]

U_A is the aggregate unemployment rate, and

PCR is the rate of change in expected prices, $\left(\frac{P_{t-1}-P_{t-5}}{P_{t-1}}\right)$.

The intercept and the coefficients of the independent variables are subscripted with A to distinguish them from later, disaggregated versions of the model.

Of course, the estimate of the above aggregate relationship will be biased if shifts occur in underlying components. Gordon (19a) has shown that the aggregate value of the compensation per manhour variable is subject to bias from both secular and cyclical shifts in both industrial workforce composition, and changes in hours worked. Gordon suggests that the employment and hours worked figures, which

[3]Although wage rate and compensation per manhour will be used interchangeably, it should be understood that our empirical work involves the use of the latter.

serve to weight wage rates over industries, be held constant at the median value for the period under consideration. In this way, fluctuations in aggregate compensation per manhour will be due only to changes in the industry wage rates, not to other secular and cyclical intersectoral shifts. For example, a change in relative employment from high wage to low wage industries would result in the observed aggregate wage rate falling, yet Gordon would argue that the labor market tightness variable (U or 1/U) could be unchanged. Estimates that did not make this technical adjustment would be biased.

Assuming two industrial sectors, Goods (g) and Services (s), equation (2) can be modified in compliance with both Gordon's and Perry's adjustments.[4]

$$(3)\quad \Delta\left(\sum_{i=1}^{n}\gamma_i w_i\right)/\left(\sum_{i=1}^{n}\gamma_i w_i\right) = a_1 + B_1\ (U_A^*) + C_1(PCR)$$

where

γ is the constant relative employment weight given the wage rates of the individual sectors substituted for the time variable weights used in official aggregate statistics,

i is the ith industry group, and

$\Sigma\gamma_i = 1$.

While Perry has analyzed a model similar to (3), such analysis can be significantly extended by using data on

[4]The Perry model tests the reciprocal of the unemployment rate against the rate of change in wages, which reflects the belief that a nonlinear relationship exists between U_A, as a proxy for excess demand, and the rate of increase in aggregate wages. Although, this paper estimates both linear and nonlinear forms, the theoretical discussion is limited to the linear case for ease of mathematical manipulations.

industrial categories. Perry compares his results with those using an unweighted unemployment rate to indirectly test a specific sectoral influence: demographic differences in productivity. Due to data limitations and the absence of broad labor market characteristics for demographic groups, sectoral Phillips curve analysis based on supply (demographic) categorizations are limited to these Perry-type models. However, industrial categorizations remove the data problems and permit broad labor market structures to be used in developing sectoral Phillips curves. When theoretical differences exist among industries, we can hypothesize different sectoral Phillips phenomena, since both w_i and U_i are classified by industries.[5] We argue that this separation is legitimate as long as there are basic structural differences between sectors and there is partial labor immobility among sectors.[6]

[5]It is important to note that industrial data exclude a segment of the measured labor force included in demographic studies. This group is composed of the newly entering and reentering unemployed workers. These are primarily the job seekers who possess neither adequate technical nor job-search skills. While not all secondary workers are included in the above group, its composition is primarily of secondary workers. Related research suggests that the aggregate Phillips curve will be steeper when this cyclically volatile group is removed from the data.

[6]The assumption of labor immobility is sufficient but not necessary for the functional differences to have a meaningful economic interpretation. The labor immobility assumption is a useful simplifying assumption for developing a sectoral model, and one that could be empirically tested. Initially, we assume that perfect market segmentation exists. When this occurs, the model described in equations (4) and (5) demonstrates the problems involved in identifying aggregate inflationary patterns in a multisector world. The assumption of a homogeneous market model used by others, is that the functional relations in both sectors are the same and that perfect labor mobility exists between sectors. The actual

If the above conditions are met, we can hypothesize different Phillips relationships between industrial sectors, such that for a two sector world,

$$(4) \quad \dot{w}_g = a_g + B_g U_g + C_g(PCR),$$

$$(5) \quad \dot{w}_s = a_s + B_s U_s + C_s(PCR).$$

where both equations are of the form of (2) above, so that

$\dot{w}_s$ is the rate of change in wages in the Service sector,

$\dot{w}_g$ is the rate of change in wages in the Goods sector,

U_s is the unemployment rate in the Service sector,

U_g is the unemployment rate in the Goods sector, and

subscripts, g and s, designate the individual sectors. For simplicity we will assume that U and PCR are independent, and focus on the determinants of B_s and B_g. As will be seen, this approach overlooks essential interrelationships.

These two Phillips curves are the basis of the segmented markets model. The differences in the markets associated with the curves provide the means for predicting different functional forms for equations (4) and (5). Following this interpretation, the aggregate function is only an average representation of the various sectors (ignoring the aggregation problems previously mentioned). Therefore,

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situation, and the one more fully considered in the empirical work in this paper, is that functional distinctions exist in a world where partial labor mobility occurs between sectors. This hedge does not nullify the model presented in equations (4) and (5), but, as will be seen later, introduces additional, complicating elements into the analysis.

the aggregate function is dependent upon both the cyclical changes affecting each individual market and the secular trends affecting the relationships among markets.

Four additional parameters are introduced to facilitate the aggregation of the individual sector curves to obtain the curve for the economy as a whole:

(5a) $\mu = U_g/U_s$

where μ is the <u>changing</u> proportionality factor relating the observed unemployment rates of the two sectors;

(5b) $W_A = \gamma_s W_s + \gamma_g W_g$

where γ provides <u>fixed</u> weighting for sectoral wages following Gordon, and $\Sigma\gamma = 1$ (i.e. $\gamma_s = 1 - \gamma_g$);

(5c) $\delta = W_g/W_s$

where δ is a <u>changing</u> proportionality factor reflecting relative wage movements in the sectors; and

(5d) $U_A = \alpha U_g + (1 - \alpha) U_s$

where α is the <u>changing</u> weighting factor for the unemployment rates based on the size of the labor force in each sector.

A listing of other labeling conventions also is presented to make the analysis more accessible:

W = money wages,

$\dot{w}$ = rate of change in wages,

U = unemployment rate,

a = intercept for linear Phillips curve,

B = slope for linear Phillips curve, in the wage change-unemployment plane,

C = slope for linear Phillips curve, in wage change-price inflation plane,

A = subscript which indicates aggregate,

s = subscript for Service sector,

g = subscript for Goods sector,

i = subscript for industry i, example: retail trade,

γ_i = employment in sector i divided by total employment, fixed at some average value.

Thus, if we aggregate equations (4) and (5), we must define the coefficients a_A, B_A, and C_A in terms of the sector values of the intercept and slopes. The four parameters introduced above are necessary to relate the sector curves to the aggregate Phillips curve. That is, the aggregate must reflect changes in the relative unemployment rates (μ), wage rates (δ), and labor force weights (α, $1-\alpha$), and the fixed employment weight given wages in each sector (γ_s and γ_g). To illustrate how these parameters come into play, let us derive the aggregate curve.

We have defined $\dot{w}_s$ and $\dot{w}_g$ as follows:

(6a) $\dot{w}_s = (W_{s1} - W_{s0})/W_{s0}$,

(6b) $\dot{w}_g = (W_{g1} - W_{g0})/W_{g0}$, where $_0$, ^{1} are time periods

Therefore,

$$(7)\quad \dot{w}_A = (W_{A1} - W_{A0})/W_{A0} = ((\gamma_s W_{s1} + \gamma_g W_{g1}) - (\gamma_s W_{s0} + \gamma_g W_{g0}))/(\gamma_s W_{s0} + \gamma_g W_{g0}) \ .$$

Recombining terms in (7), and substituting δ_0, the relative wage factor, into the denominator results in:

$$(8)\quad \frac{\gamma_s (W_{s1} - W_{s0})}{(\gamma_{s0} + \gamma_g \delta_0) W_{s0}} + \frac{\gamma_g (W_{g1} - W_{g0})}{(\gamma_g + \gamma_s/\delta_0) W_{g0}} \ .$$

Remembering that $\gamma_s = 1 - \gamma_g$, and substituting, we obtain:

$$(9) \quad \frac{\gamma_s \dot{w}_{s0}}{\gamma_s + \delta_0 - \gamma\ \delta_0} + \frac{\gamma_g \dot{w}_{g0}}{\gamma_g + 1/\delta_0 - \gamma_g/\delta_0}$$

$$= \frac{\dot{w}_{s0}}{(1 + \delta_0/\gamma_s - \delta_0)} + \frac{\dot{w}_{g0}}{(1 + 1/\delta_0\gamma_g - 1/\delta_0)} .$$

Now we can see that to obtain the rate of change of aggregate wages, $\dot{w}_A$, the sector rate of change of wages will be weighted by <u>only</u> the fixed factors γ_s, γ_g (as in 5b) only when $\delta_0 = 1$, a case when a sector analysis is rendered less interesting, since wages in the sectors would be equal. Note that the Gordon technical adjustment holds the γ's constant over the time period; so that instead of using the actual economy-wide $\dot{w}_A$, for estimation purposed, another aggregate wage variable is used which does <u>not</u> reflect changes in the composition of employment.

Pursuing this analysis further, we define

$\rho_s = 1/(1 + \delta_0/\gamma_s - \delta_0)$, and

$\rho_g = 1/(1 + 1/\delta_0\gamma_g - 1/\delta_0)$.

so that we simplify the "rate of change" version of (5b) to

$$(10) \quad \dot{w}_A = \rho_s \dot{w}_s + \rho_g \dot{w}_g .$$

Summing equations (4) and (5), and utilizing (10) yields

$$(11) \quad w_A = \rho_s a_s + \rho_g a_g + \rho_s B_s U_s + \rho_g B_g U_g + \rho_s C_s (PCR)$$

$$+ \rho_g C_g (PCR)$$

$$= a_A + B_A(\alpha U_g + (1-\alpha)\ U_s) + C_A (PCR) .$$

Thus

$$(12) \quad a_A = \rho_s a_s + \rho_g a_g,$$

$$(13) \quad B_A = (\rho_s B_s U_s + \rho_g B_g U_g)/((1-\alpha)\ U_s + \alpha U_g),$$

and since $U_g = \mu U_s$,

$$(14) \quad B_A = (\rho_s B_s U_s + \rho_g B_g \mu U_s)/((1-\alpha)U_s + \alpha\mu U_s),$$

$$= (\rho_s B_s + \rho_g \mu B_g)/(1-\alpha + \alpha\mu),$$

and

$$(15) \quad C_A = \rho_s C_s + \rho_g C_g \ .$$

Equation (11) and the underlying determinants of the observed aggregate intercept, a_A, the slope, B_A, and the price expectations coefficient, C_A, as shown in (12)-(15) indicate the complex interrelationships which are hidden in the estimation of an economy-wide expectations Phillips curve. The intercept and the price expectations coefficient depend upon relative wages, δ, and relative employment size, γ, while the slope also depends on relative unemployment rates, μ, and relative sizes of the labor forces in the two sectors, α. <u>If</u> the sectors are independent and have different slopes and intercepts, a trend movement in γ, as well as the movement of δ, μ, and α over the period,will be reflected in a <u>shift</u> in the aggregate curve.[7] However, we must qualify this interpretation of C_A, since the aggregation process has involved strong assumptions, including complete independence of price expectations and labor market tightness.

[7]Imperfect labor mobility between sectors limits crossovers in response to relative wages (δ) or labor market tightness (μ). See Arthur Alexander's RAND study (2) which addresses this problem using cross-section data for the period 1958-67.

4.1.2 Industrial labor force composition and pivots in the naive Phillips curve

For the estimated parameters to have any meaning, we must have some way of identifying different markets. Archibald (3b) has commented that "true" labor markets are difficult to find. Yet, Fuchs (18) has provided a good first approximation with his characterization of the Serivce and Goods sectors. Fuchs' work on the trend toward a Service economy indicates that important differences in employment behavior exist between sectors. These can be summarized as follows: Goods sector employment fluctuates more over the business cycle than Service sector employment, affecting both μ and α over the cycles, but Goods sector wages are relatively more stable cyclically, affecting δ. Fuchs cites several reasons for the tendency of the labor demand function in the Service sector to be less elastic than that in the Goods sector, and for the demand function to shift less over the business cycle in the Service sector. The numbers of persons paid by commissions in the Service sector, plus the greater hiring and search costs due to a lack of organization of the market (many small firms and little unionization), imply that the Service sector employers will lean more toward wage and/or hours reductions than worker layoffs during short recessions, while the Goods sector will have the opposite tendency. This observation means that when a labor demand shock of equal magnitude is applied to each sector, the reactions will be different due to different labor demand functions.

In addition, labor demand shocks are unlikely to be of equal magnitude, so excess demand for labor will not be at the same level or change at the same rate in the two sectors. As Fuchs points out, the demand function for labor will tend to shift more over the business cycle in the Goods sector since output is more volatile here. In other words, the actual shocks to each labor market will differ with any given change in aggregate demand, as will the reaction to any given shock.

In general, we could expect that for the linear model, the absolute value of the slope in the Service sector, B_s, will be greater than the value of B_g. For example, assume that for sectors s and g, g is a highly organized production sector, producing a durable output, and s is a competitive sales and service sector. The two are perfectly segmented, g has no informational transfer problems, s has imperfect information flows concerning available positions and workers, and the sales personnel are paid on a commission basis. What will happen if an aggregate demand shock occurs? If the shock is recessionary, s will tend to maintain employment levels and absorb downturns with effective salary cuts for employees on commission. Following the monetarist writers (38b), a short-run Phillips curve will arise due to search unemployment by workers seeking to improve their wage situation. Assuming that the recession has equally affected all firms in sector s, such unemployment will be short term, lasting only as long as it takes for workers to discover that their

opportunities are the same with each firm. In an upturn, with wages and prices rising, unemployed job seekers accept jobs with real wages which were not previously acceptable. As the monetarists point out, such behavior on the part of the unemployed betrays money illusion and the observed Phillips curve can be expected to be short-run.

Now, assume that the firm and one union bargain for the services of all labor in sector g, the firm and union in g have agreed to bargain wages to last for considerable periods of time, and money wages are based on the previous rate of growth in productivity and previous prices, such that during the period for which wages are bargained, wages will increase proportionally to the average productivity plus price growth for the previous period. In a downturn, money wages will continue to grow at a given rate of increase, and unemployment will absorb the brunt of the recession. In upturns, increases in productivity will increase profits, but will not immediately affect money wage rates. Unemployment in this situation can be expected to fall as long as marginal revenue product exceeds the going real wage rate.

The Phillips curve in g will be a perfectly horizontal line which will shift up (when the trend in the growth rate of productivity is upward) or down (when the trend is downward) with new wage negotiations. The Phillips curve in s will be very steeply sloped, showing a tendency to absorb shocks in money wage changes. The curve will not be perfectly inelastic due to some search unemployment.

When the extreme assumptions of this example are relaxed, we still predict different sectoral Phillips curves. However, partial mobility between sectors will tend to mitigate the extreme results stated above, by permitting some of the employed and unemployed in each sector to seek better employment or salary situations in the other sector. Similarly, the lack of perfect organization in sector g will cause some slope to its Phillips curve whith the introduction of some other elements, such as less organization and imperfect information flows. Likewise, the slope of curve s will likely be less steep since some wages in this sector are inflexible and the workers paid these wages will be laid off when their marginal revenue product falls and will be rehired at going wages when aggregate demand increases. However, we can conclude that the inflation-unemployment relationship for each sector is functionally distinct, is based upon labor and industry structure, and that the sectors can be expected to have different Phillips curves based on these functional differences. To reiterate, as the weighting shifts from one sector to the other, we can expect the aggregate Phillips curve to pivot.[8]

4.1.3 Price expectations and shifts in the Phillips curve

Phelps (38b), Lucas-Rapping (32b), and Eckstein-Brinner (14), among many others, have shown that the inclusion of a price change variable in the Phillips' equation helps to

[8]Vanderkamp (47) examines what amount to sectoral Phillips Curves for Canada. However, the theoretical justification for breaking the economy into organized and unorganized sectors is weak, and his conclusions are not those expected from the discussion above.

explain wage inflation. The addition of this variable suggests that wages may rise independently of changes in the demand for labor. The expectations interpretation of the price change coefficient means that single equation models fail to capture all the interrelationships involved in the inflationary process. Prices are not exogenous phenomena and cannot be interpreted as an independent influence on wage adjustment.

In this chapter we focus on the effects of labor market tightness and constrain the price change term. A priori we have no basis for judging the sectoral differences in expectational influences. On the other hand, we have seen in the previous chapter that the primary labor force responds to price changes differently in the two sectors. We will use these results when analyzing the estimates obtained in this chapter. Although this method cannot substitute for a simultaneous equation model, it does provide an initial interpretation of some of the complexities underlying segmented markets (36). Multi-equation models and other approaches should improve the estimates of price change coefficients.

In summary, this analysis suggests that the source of the shock to the economic system is of utmost importance. For example, if the shock is due to a change in capital investment decisions, the relative difference in the impact of the shock will be more in evidence than if the shock takes the form of a uniform change in consumer expenditures. That is, the existence of partially segmented, heterogeneous

labor markets offers support for Tobin's (45b) contention that significant Phillips phenomena can exist when there is no change in aggregate demand. The permanence of an aggregate Phillips curve becomes a stochastic problem in this situation, dependent upon the actual number of relatively separate sectors, and the size and frequency of disturbing shocks to the system. In addition, the position of even short run aggregate Phillips curves depends on the shocks to and proportion of the labor force in each sector.

4.2 Empirical Analysis of the Two Sector Model

In this section we consider tests of the segmented markets hypothesis and contrast this approach to Phillips curve analysis with the approaches developed by Perry and Archibald. The analysis presented here suggests that sectoral breakdowns provide a potentially powerful mechanism for analyzing Phillips' phenomena. By specifying functional relationships at the sectoral level, we can predict secular shifts in the Phillips curve, as well as potential short run Phillips movements due to any given change in excess demand.

This section uses three variables, the rate of change in wages, the unemployment rate, and the rate of change in prices. The wage rate change and unemployment rate variables are considered in the aggregate and as sectoral values, while price changes are in terms of aggregate price levels. The rate of change in wages is computed both as the four-quarter and as the one-quarter percentage change in civilian, non-agricultural compensation per man-hour, adjusted for

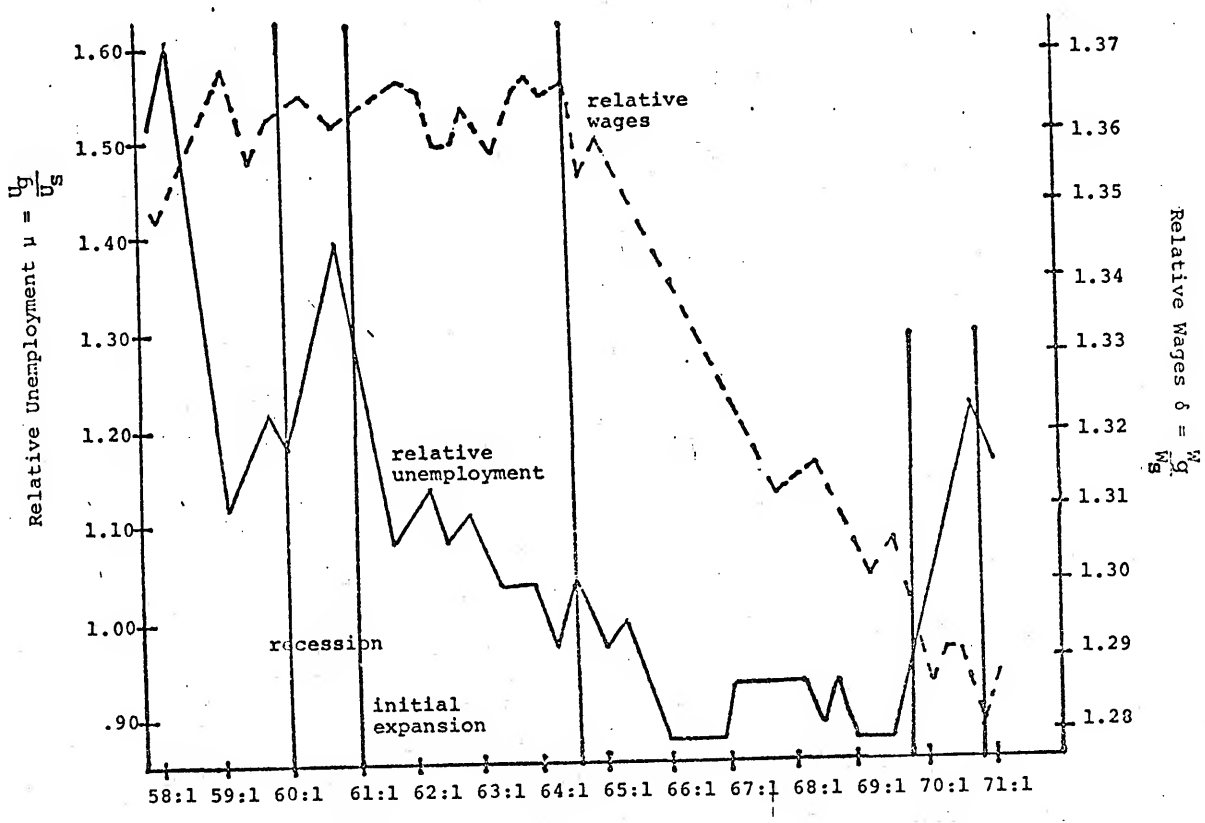
interindustry shifts in labor force, among the seven industrial groups comprising the Service and Goods sectors. The aggregate unemployment rate, U_A, is based on labor force data for the wage and salary workers in the industrial groups covered by this study. The rate of change in proces, PCR, is the four quarter percentage change in the consumer price index, lagged one quarter.

4.2.1 Sector unemployment rates and wage rates

The unemployment rates for the Goods sector, U_g, and the Service sector, U_s, are drawn from the same data as the industrial rate, U_A. During recessions, we expect the unemployment rate to rise more in the Goods sector, and that it will fall more rapidly in this sector during an expansion, as both rates approach a minimum, frictional rate. This prediction is based on Fuchs' observation that employment fluctuates more over the cycle in the Goods sector.[9] The sector wage rate changes, $\dot{w}_s$ and $\dot{w}_g$, for the Service and Goods sectors respectively, are also drawn from the same data as the aggregate.

Fuchs (18) predicts that wages will fall more rapidly during recessions and rise more rapidly during expansions in the Service sector. Wachter (48a) has shown that the relative movement in wages, industrially, is dependent upon the ability of workers in non-unionized industries to exert upward pressure on their wage rates. This ability is

[9]This contention also requires that the labor force size remain relatively constant in both sectors. Industrial labor force data excludes newly entering and re-entering workers who are unemployed. We assume that the major cause of cyclical volatility in labor force size is removed with the exclusion of these workers from the data base.



Graph 1. Movement in Relative Wages and Unemployment Rates 1958-1971.

restricted during recessions when each worker's job is threatened. As labor markets tighten, these workers gain confidence and demand and receive larger wage boosts. This theory, if applicable to sector differences, supports Fuchs' view and suggests that the turning point in relative wage rate growth is related to labor market tightness.

In Graph I, we have traced the movement in relative wages (δ) and unemployment rates (μ) for the period 1958:1-1971:1. We find that in general, during recessions, the unemployment rate in the Goods sector rises relative to that in the Service sector, and during the initial phase of expansions, the Goods rate falls rapidly with respect to the Service sector rate, until the two rates are roughly equal. We also find, that during this period, Service wages have tended to increase relative to Goods wages. During recession and the initial phase of expansions, this trend is not evident. Once the unemployment rates are equalized, Service sector wages grow rapidly with respect to Goods wages. This observed behavior appears to fit that predicted from the Fuchs and Wachter studies.

Turning to the regression results for the sectoral Phillips curves, we find that, as expected, the wage change-unemployment rate tradeoff in the Goods sector is flatter than in the Serivce sector, using a linear tradeoff. In Table 4, equations (1) and (2) show the results for Serivce and Goods industries, respectively. Tests were also run using the assumption of nonlinear Phillips curves. These tests

Table 4. Linear Phillips Curves 1958:1-1971:1.

Dependent Variable	Constant	U_{st}	U_{gt}	U_{At}	$PCR_{(t-1)}$	R^2/see	D.W.
1. $\dot{w}_s$	.0570 (11.960)	-.5692 (-7.143)			.6137 (13.190)	.9105 .0043	.60
2. $\dot{w}_g$	.03379 (7.181)		-.1394 (-2.112)		.5390 (8.030)	.6930 .0066	.62
3. $\dot{w}_A$	.0413 (10.130)			-.2776 (-4.459)	.6252 (12.570)	.8706 .0048	.57

Table 5. Nonlinear Phillips Curves 1958:1-1971:1.

Dependent Variable	Constant	$1/U_{st}$	$1/U_{gt}$	$PCR_{(t-1)}$	R^2/see	D.W.
1. $\dot{w}_s$	-.000133 (-.0392)	.001397 (7.457)		.5992 (12.940)	.9176 .0042	.63
2. $\dot{w}_g$	.01828 (5.589)		.0004062 (2.250)	.5285 (7.755)	.7088 .0066	.64

Source: U.S. Department of Labor Employment and Earnings. t and t-1 refer to time period relationship between the independent variables and the dependent variable, assuming $\dot{w}$ is taken for period t. The terms in parenthesis are t-statistics.

yield slightly better fits, but the general conclusions of this paper remain unchanged with this latter formulation. The results based on a model of the form $\dot{w} = a + B(1/U) + C(PCR)$ for the Service and Goods sectors are presented in equations (1) and (2) of Table 5. For the linear curves, the coefficient B_s is -.5692 or approximately three times the coefficient B_g. The coefficient of PCR is .6137 in the Service sector and it is .5390 in the Goods sector. This result is consistent with the finding of Chapter 3 that labor force participation in the Services involves less "money illusion" than the labor force participation in the Goods sector. Thus, increases in PCR induce relatively fewer participants into the Service sector, and are associated with relatively greater wage inflation.

A Chow (10) test conducted to determine whether or not the two sectors have significant differences in their Phillips behavior rejected the null hypothesis of similar structures at the .01 level of confidence.[10]

4.2.2 Complications in the estimation of Phillips curves

Some of the problems of estimating complex relationships with a single equation model, are apparent in the autocorrela-

[10]The null hypothesis that both sectors are governed by the same relationship was tested with the equation $(A-S-G)/p \div (S + G)/(n + m - 2p)$ distributed as $F(p, n + m - 2p)$. In this equation, A is the sum of squares of the residuals for the pooled equation; S is the sum of squares of the residuals for the Service sector; G is the sum of squares of the residuals for the Goods sector; n and m are the number of observations included in the Service sector and Goods sector regressions respectively; and p is the number of parameters. For this test, A = .02692, S= .004050, G = .004803, p = 3 and n = m = 48. Using the above figures, the Chow ratio is 28.6. Since F (3,90) at the one precent level of significance is 4.04, the two sectors can be reasonably assumed to operate under different relationships. The null hypothesis is rejected.

Table 6. Phillips Curves with Autocorrelated Disturbances Removed.

Dependent Variable	Constant	U_{st}	U_{gt}	U_{At}	$PCR_{(t-1)}$	R^2/see	D.W.	rho
one-quarter changes								
1. $\dot{w}_s$*	.0663 (6.294)	-.7040 (-3.998)			.5894 (5.730)	.7063 .0095	2.11	
2. $\dot{w}_g$*	.0314 (2.697)		-.1274 (-.7805)		.6629 (3.991)	.3553 .0164	2.36	
3. $\dot{w}_A$*	.0439 (4.701)			-.3189 (-2.243)	.6772 (5.949)	.6189 .0109	2.22	
Hildreth-Lu technique								
4. $\dot{w}_s$	.0567 (6.482)	-.4649 (-2.526)			.2897 (2.861)	.9649 .0028	1.65	.99
5. $\dot{w}_g$	.0379 (5.437)	[illegible]	-.2326 (-2.390)		.6173 (5.791)	.9032 .0043	1.99	.68
6. $\dot{w}_A$	.0537 (6.181)			-.3971 (-3.084)	.4006 (3.422)	.9439 .0032	2.07	.85

Source: U.S. Department of Labor Employment and Earnings. The terms in parentheses are t-statistics.

tion indicated by the poor Durbin-Watson statistics on Table 4. As Kuh observed,

> "...artifical serial correlation is often introduced through the overlapping process which partially neutralizes the confidence to be placed in the larger t-statistics." (27, p. 346).

Recently, Rowley and Wilton (40) have examined the assumptions sufficient for the specification of the "four-quarter overlapping-change" model in Phillips curve analysis and have used generalized least squares estimators to determine coefficients. Unfortunately, the assumptions for the wage determination process are very strong, which brings into question their complete specification of the error matrix. In fact, their correction for serial correlation may explain why the coefficients for the explanatory variables are generally insignificant in their analysis. Nevertheless, their results point out the sensitivity of estimates to different specifications of the distribution of errors.

We use two methods to remove this autocorrelation. The first method involves the Hildreth-Lu maximum likelihood procedure to remove the autocorrelated distrubances (23). Although Rowley and Wilton question whether the error is generated by a first order autoregressive process, the implied loss of efficiency need not be great. The second method uses Gordon's (19a) techique of altering the quarterly differences in the wage rate change variable. The results of these tests are shown in Table 6. Equations (1) to (3) are estimates using dependent variables computed as the

one-quarter rate of change in wages, indicated by the term $\dot{w}^*$. Equations (4) to (6) remove the serial correlation of the error terms using the Hildreth-Lu technique and include the value of rho which accomplishes this.

While the Durbin-Watson statistics are in the acceptable range for all the equations in Table 6, the coefficients differ between the first and second set of three regressions. In the first set, the difference in the slope coefficients, B_s and B_g, are greater than observed in Table 4, (B_s = .7040 and B_g = -.1274), while these coefficients are more nearly equal in equations (4) and (5), (B_s = =.4649 and B_g = -.2326). However, in both cases the values of B_s and B_g support our earlier contention that the slope of the Service sector curve will be steeper.

The most significant differences are in the values of the coefficients of the price change variables. In both cases we see that the value of C_g exceeds that of C_s and that this difference is significant in the second equation set; C_s is .2897 and C_g is .6173. We found that C_s exceeded C_g in the uncorrected equations. Thus, no definite conclusion can be made with respect to sectoral differential responses to price inflation. The aggregation process used to compute a rough estimate of the extent of the pivot must take this ambiguity into account.

4.2.3 Aggregating sector Phillips curves

In order to fully consider both the effect of the pivot of the wage change-unemployment curve and the shift in the

expectational conditions, we will aggregate both equations (1) and (2) of Table 4 and equations (4) and (5) of Table 6. The results can be used to infer the extent of the shifts due to changing labor market structure and can be compared to the actual estimates to judge the accuracy of the aggregation method used in this study. Recall that α, ρ, and μ are time dependent weighting factors, so for this exercise, we will approximate them with their median values for the period under consideration. The values of the terms in equations (1) and (2) of Table 4 above are: $\rho_g = .582$, $\rho_s = .418$; $\alpha_g = .513$; $(1-\alpha) = .487$; $\mu = 1.14$; $B_s = -.5692$; $B_g = -.1394$; $a_s = .0570$; $a_g = .0338$; $C_s = .6137$; $C_g = .5390$. The values of the coefficients in equations (4) and (5) in Table 6 are $a_s = .0567$, $a_g = .0379$, $B_s = -.4649$, [illegible], $B_g = -.2326$, $C_s = .2897$, $C_g = .6173$.

Over the 1960-1970 period, the proportion of the labor forces in the Service sector, α, grew from .429 to .525. The relative employment grew from .432 to .529 during the same period. Relative wages, δ, fell from 1.36 to 1.30, reflecting the relative increase in Service sector compensation. The relative unemployment, μ, changed from approximately 1.27 to about 1.18.[11]

These trends in relative values suggest that as long as the nature of the two sectors did not significantly

[11]These trend values were computed by taking a three-quarter average for the peak values for the 1960-61 and 1969-70 recessions. We will refer to predictions based on the earlier values as the 1960 equation and the later values as the 1970 equation.

change over the period, the aggregate function should be more dependent upon Service sector characteristics and less upon Goods sector characteristics during the last part of the period.

As long as perfect labor mobility is not present, and there are no significant dispersion effects (or other similar aggregation problems), we should be able to aggregate the Phillips curves in Tables 4 and 6 following equations (12) through (15) in the preceding section. The simple sectoral model provides for three possible outcomes when the separate market Phillips curves are aggregated. If there is no paradox of composition, and if the independent variables are exogenously determined, then the two curves can be weighted, following our previous discussion, to yield the aggregate curve. However, two possible problems exist. The first is the unemployment dispersion alluded to at the beginning of the chapter. The other is the problem of interdependence of the variables not explained by the specification of the present model. The addition of dispersion effects alters a_A and B_A, bringing them closer to the predicted values, but does not significantly affect the value of C_A. For example, when a dispersion variable, σ_u^2, ($\sigma_u^2 = \sum_{i=1}^{7}(U_i - U_A)$ for the seven industrial groups of this study) is included in the equations, we obtain:

Constant	U_{At}	$PCR_{t-1)}$	$\sigma_{\mu t}^2$	R^2/see	D.W.
.04163	.2919	.6282	1.424	.8762	.57
(8.60)	(-2.161)	(11.21)	(.1197)	.0048	

Table 7. Aggregate Phillips Relations with Different Sectoral Weights

Unadjusted for serial correlation

(1) $\dot{w}_A = .0413 - .2766\ U_A + .6252\ PCR$ (aggregate estimated)

(2) $\dot{w}_A = .0435 - .2971\ U_A + .5700\ PCR$ (sectoral, period average weight)

(3) $\dot{w}_A = .0426 - .2821\ U_A + .5673\ PCR$ (sectoral, 1960 weights)

(4) $\dot{w}_A = .0450 - .3299\ U_A + .5750\ PCR$ (sectoral, 1970 weights)

Table 8. Aggregate Phillips Relations with Different Sectoral Weights

Adjusted by Hildreth-Lu technique

(1) $\dot{w}_A = .0537 - .3971\ U_A + .4006\ PCR$ (aggregate estimated)

(2) $\dot{w}_A = .0458 - .3250\ U_A + .4804\ PCR$ (sectoral, period average weight)

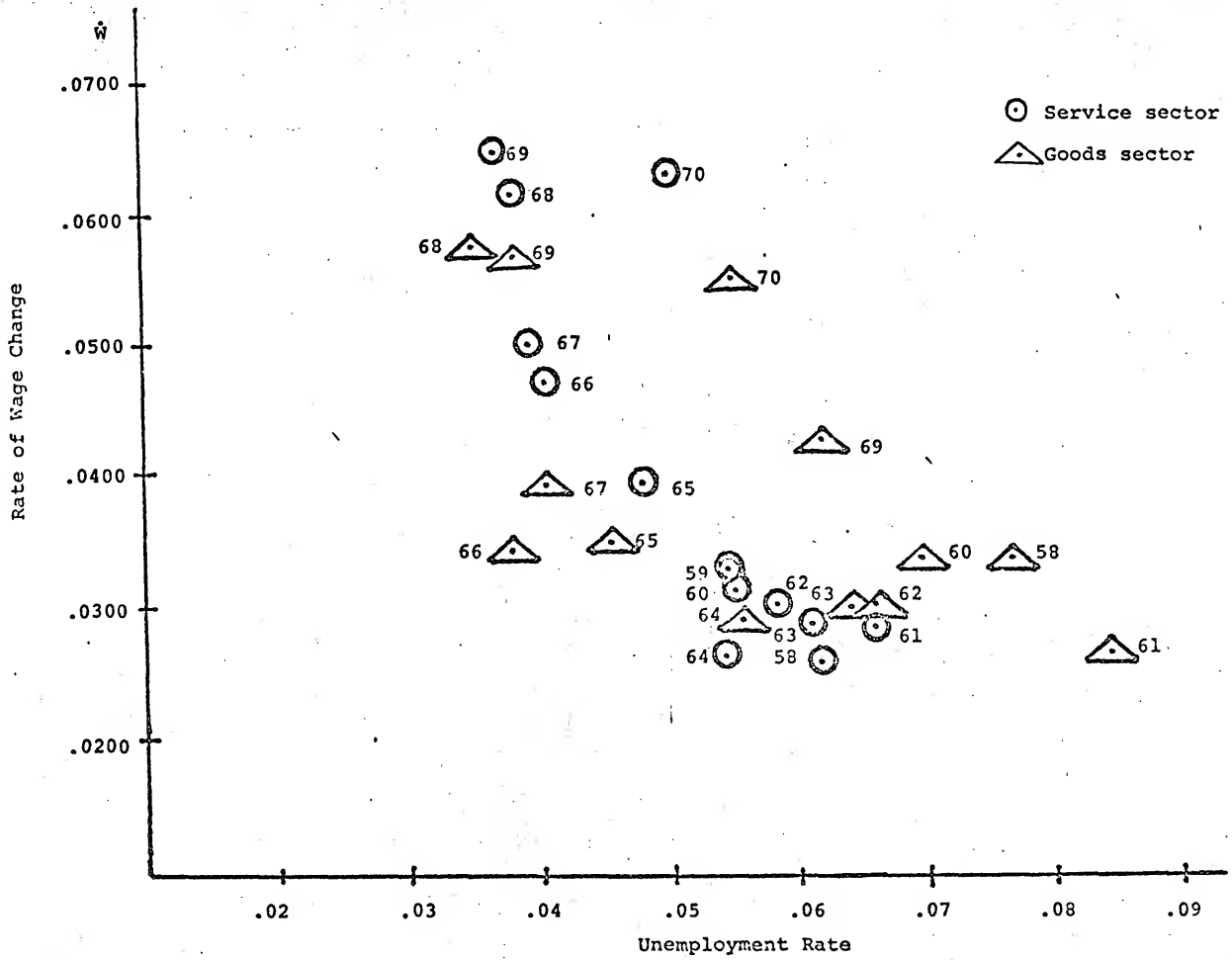
(3) $\dot{w}_A = .0450 - .3127\ U_A + .4931\ PCR$ (sectoral, 1960 weights)

(4) $\dot{w}_A = .0470 - .3374\ U_A + .4594\ PCR$ (sectoral, 1970 weights)

A more detailed analysis of dispersion effects is not justified by these preliminary results. In addition, the fact that B_A is larger than the sector average for the equations corrected using the Hildreth-Lu technique brings into question the significance of positive dispersion of unemployment over industrial groups.

The equations of Table 7 and 8 illustrate the accuracy of the aggregation technique developed in this paper and show the effect of the pivoting of the Phillips curve which results as sectoral employment shifts. The first equation of each Table is the actual aggregate regression for the period. The second equation is based on the average values inserted into the sectoral estimator. The third and fourth are based on the average values of the parameters for 1960 and 1970, respectively.

In the first four equations we see that the intercept and coefficient of the unemployment rate have been slightly overestimated, while the value of C_A has been considerably underestimated by the aggregation method. In the second equation set we see that the intercept and slope coefficient are underestimated and the expectations coefficient is overestimated. However, all values are in the same range and the pivot of the naive Phillips curve is apparent. An expectational shift in the Phillips curve due to the changing industrial labor force mix is suggested by the results in equations (2) to (4) of Table 8, although the estimates shown in Table 7 are inconsistent with this conclusion.



Graph II. Sectoral Phillips Curves 1958-1970.

There are two sources of ambiguity. First, in Table 7 (unadjusted for serial correlation) the Service sector coefficient is larger than the Goods sector coefficient. Second, the aggregate estimated value of the price coefficient is larger than that for either sector in Table 7, suggesting that not all the interdependencies have been accounted for in this model. The contradictory results with respect to price expectations illustrate the unresolved issues which remain.

A change in expectations at the sectoral level is a possible influence for the present period. The curves in Graph II, plotted for annual averages, show that the 1970 plot deviates considerably in each sector, suggesting a shift in the sector curves, as well as the aggregate curve. The observation of shifts in the sectoral Phillips curves lends support to the monetarist contention that adjustment at low unemployment rates involves a shift in the Phillips curve. The threshold effect examined by Eckstein-Brinner (14) represents an attempt to isolate such shifts.

4.3 Conclusions

This chapter has analyzed the Phillips curve phenomena by disaggregating the data by industrial sectors. Of the two conditions which are necessary for such an exercise to be valid, that the sectors possess different labor market structure and that labor be imperfectly mobile between sectors, the first has been supported by the empirical analysis presented here. The second is partially supported

by Alexander (2), elsewhere. This line of research supports the following hypotheses: (1) Segmented labor markets exist in the United States economy; (2) these segmented markets give rise to different Phillips phenomena; (3) the recent observed shift in the aggregate Phillips curve can be partially explained by a shift toward more Service sector employment and higher relative Service sector wages; and (4) the residual shift in the aggregate curve appears to be due to shifts in the sectoral curves.

The present research contradicts the common assumption that the Phillips curve shifts out in a parallel manner (36) (37b) (46) (42b). The outward shift that is due to changing labor market weighting suggests that the aggregate curve has pivoted, so that the curve lies further out for low unemployment rates, but is more steeply sloped and therefore requires less additional unemployment to reduce the rate of wage inflation than was required earlier.

For example, we know that the trend toward relatively higher Service sector unemployment has been fairly steady since 1950.[12] If the sectoral, industry structure has remained constant, we can weight equations (3) and (4) from tables 7 and 8 by the 1950, 1960 and 1970 sector employment weights, to obtain an idea of the magnitude of the pivot in the curve due to industrial influences. Since we are concentrating on changes in labor market tightness conditions, we will assume that expectational influences are not present

[12]See Table A-1 for an example of the magnitude of this change.

Table 9. Estimated Phillips Tradeoffs (assuming PCR = 0).

Rate of Wage Change Using:	Unemployment Rates 3%	4%	5%	6%
Unadjusted for serial correlation				
1950 weights	3.1	2.8	2.7	2.7
1960 weights	3.3	3.0	2.8	2.6
1970 weights	3.5	3.2	2.9	2.6
Adjusted by Hildreth-Lu technique				
1950 weights	3.3	3.0	2.8	2.5
1960 weights	3.5	3.2	2.9	2.6
1970 weights	3.7	3.4	3.0	2.7

Table 10. Estimated Phillips Tradeoffs (assuming PCR = 3%).

Rate of Wage Change Using:	Unemployment Rates 3%	4%	5%	6%
Unadjusted for serial correlation				
1950 weights	4.8	4.5	4.4	4.4
1960 weights	5.0	4.7	4.5	4.3
1970 weights	5.2	4.9	4.6	4.3
Adjusted by Hildreth-Lu technique				
1950 weights	4.8	4.5	4.3	4.0
1960 weights	5.0	4.7	4.4	4.1
1970 weights	5.1	4.8	4.4	4.1

and set PCR equal to zero for illustrative purposes. We see in Table 9 that at the 4% unemployment level, the difference amounts to four-tenths of a percent difference in wage inflation when 1950 weights are compared to 1970 weights. The difference narrows as the unemployment rate increases, reflecting the pivoting of the curve over time. The pivot is still apparent when a positive rate of price inflation is present. In Table 10 we see the results for price changes of 3 percent.

Note that the wage variable has already been adjusted for inter-industry employment shifts in accordance with Gordon's technical adjustment; the aggregate tradeoff shifts because of different wage-unemployment tradeoffs between sectors. The shape and position of the aggregate Phillips curve only partially explains why a slight reduction in the aggregate unemployment rate resulted in relatively dramatic jumps in wages in recent years. This analysis is not a substitute for Perry's demographic explanation of the shift, but it suggests that additional, closely related demand factors were also present, if not overwhelmed by inflationary expectations in 1969-70 (19c) (24a) (31).

In summary, this paper recognizes that the motiviation for Gordon's technical adjustment of the aggregate wage variable has implications for the observed unemployment rate. Not only wage, but also unemployment behavior differs over industrial sectors. Perry used a weighting scheme for the unemployment rate based on demographic characteristics which

suggested that a shift in the observed aggregate Phillips curve has occurred. A simple weighting scheme along Perry's lines is inadequate for industrial analysis. Here, we disaggregate the relationship along broad sectoral lines, and find that the aggregate Phillips curve has rotated due to a greater proportion of the aggregate labor force being in the Service sector. If the existence of Service sector job opportunities with flexible hours and education requirements has <u>induced</u> labor market participation by women and youth, then the supply and demand oriented analyses each capture a part of what happened in the late sixties and early seventies.[12]

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[12] Note that when ρ_s and ρ_g vary over time, we must reconsider sectoral theories such as Hines' (24b) and Archibald's (3) comments regarding dispersion effects, which implicitly assume fixed weighting. Basically, they assume that

$$\dot{w}_A = k_s f_s(U_s) + k_g f_g(U_g)$$

where k is the fixed weight, $f_s(U_s)$ is the function of U_s and $f_g(U_g)$ the function of U_g.

To build their arguments they take the first derivative of the above equation, which yields

$$d\dot{w}_A = k_s f_s{}^1(U_s)dU_s + k_g f_g{}^1(U_g)dU_g.$$

If instead, we have

$$\dot{w} = \rho_s f_s(U_s) + \rho_g f_g(U_g),$$

then the first derivative is

$$d\dot{w} = \rho_s f_s{}^1(U_s)dU_s + \rho_g f_g{}^1(U_g) + f_s(U_s)\ \rho_s{}^1 d\delta_s + f_g(U_g)\rho_g{}^1 d\delta_g,$$

which can lead to different conclusions than those of Hines and Archibald.

CHAPTER 5

SUMMARY AND CONCLUSIONS

The primary goal of this study has been to show that the existence of segmented labor markets, possessing different structures, can be used to interpret aggregate Phillips curve phenomena. We approach this problem in three steps: first, by establishing that heterogeneous industrial labor markets do exist; second, by showing that different sectoral Phillips curves are produced by different industrial structures; and finally, by demonstrating that these sectoral curves can be combined to form the observed aggregate tradeoff.

Caution is needed in interpreting the results of this study. Eckstein has offered the following comment concerning the difficulty of using a single method to test for complex relationships:

> "Indeed, it is doubtful whether definitive results about the specific mechanism by which product and labor market variables influence wages can be obtained from any aggregative time series analysis alone." (13, p. 135).

Many researchers agree with this statement and have contributed alternative models and methods, ranging from Kuh's (27) productivity model, to Black and Kalejian's (5) simultaneous equation model, to Eckstein and Brinner's (14) price threshold model. The present disaggregative analysis augments

aggregate analysis with a presentation of the influences of sectoral differences on the Phillips curve. But the present results must still be viewed in the context of other models (46).

5.1 Pivots in the Phillips Curve and Wage Price Controls

The aggregate Phillips curve has "pivoted" during the sixties as a result of the relative growth in employment in the Service sector. Since the Service sector Phillips curve is more steeply sloped, this pivoting has resulted in the appearance of an outwardly shifted aggregate curve for the recent period of high wage inflation. In addition to this structurally related secular pivot in the Phillips curve we find evidence of cyclical and secular shifts due to expectational adjustment (to price inflation) of the workforce. Undoubtedly, the combination of these various shifts in the aggregate tradeoff greatly complicates the issue of the long run stability of the Phillips curve. However, since the shape and position of the curve is a key policy issue, the contribution of sectoral analysis should not be underestimated. The results in Chapter 3 indicate that the cyclical shifts which can be expected as price expectations adjust in the intermediate run take sufficiently long to allow the Phillips tradeoff to be used as a policy frontier. To the extent that the recent shifts due to greater price expectations can be influenced by the recent incomes policy we would expect to see an inward shift of the curve for the period since 1971:2.

Recent policy measures are presumably directed towards influencing the structure and inflationary psychology of the economy. Wage-price controls may be viewed as attempting to influence three components of the linear expectations Phillips curve. First, a reduction in the intercept reflects a reduction in frictional problems (including imperfections, information costs and institutional lags).[1] Second, with a given rate of unemployment as a proxy for labor market tightness, wage increases may be held down by administrative fiat; causing a temporary drop in this coefficient. Third, the coefficient of the price term, PCR, may be reduced by altering producer and consumer inflationary expectations. A study by Lipsey and Parkin (31) of British incomes policies suggests that the effect is to decrease both the slope and intercept of the Phillips curve.

The existence of segemented, heterogeneous markets has, probably, hampered the effectiveness of these controls (14) (21a) (31) (41b). There are two reasons for expecting this influence. In the first place, the two sectors vary in their visibility to policy makers. The high wage, highly organized sector, the Goods sector, is easily identified with inflationary pressure. While studies such as Wachter's, (1) (36) (48b), relative wage research suggest that the less organized and lower wage markets may be equally important in the inflationary process, explicit policy measures are not

[1]For example, Perry (37b), and others use dummy variables to test for parallel shifts due to the Kennedy wage-price guidelines.

as prevalent in these industries. This result may be due to problems of administration in these areas, although highly visible Service sector industries, such as medical care, have been given careful attention. Further, as labor markets become more decentralized, we predict that policy measures applied primarily to the Goods sector are less likely to have an universal impact. Even if this unequal sectoral treatment is recognized and more general policies are used, decision makers must cope with the additional problem of differences in sector reaction to these policies. For example, while large firms also exist in the Service sector, the ability of government to influence wages may be less, due to, among other factors, the difficulty of measuring the output in the Service sector industries. In addition, controlling wages for many small firms becomes administratively burdensome, as evidenced in the rapid reduction in monitoring such firms in Phases 2 and 3 of the present incomes policy.

The manpower programs advocated by Holt (31) and Hall (22b) may shift the Phillips curve through their effect on market structure. However, our study suggests that the recent concern over a Phillips curve shift due to demographic-structural changes may be overplayed. The pivoting of the curve has resulted in a recent Phillips tradeoff which is steeper than previous curves, but there seems to be no clear criteria for determining which curve presents the more favorable policy frontier. On the one hand, the outward shift at low unemployment rates reinforces the parallel

demographic shift noted by Perry. Therefore, we can expect higher wage rate increases for any given rate of wage growth in the present situation, especially at low unemployment rates. However, since the curve has also been affected by an industrial pivoting factor, the amount of additional unemployment which accompanies policy measures aimed at reducing the rate of wage inflation will be less (ignoring the expectational problems).

A major point of interest for both critics and adherents of the Phillips curve model is the comparison of the trade-off across international boundaries. Bodkin, et al. (7) have concluded that such comparisons are hindered by different data bases for individual countries. The research presented here suggests that the comparisons are also hindered by differences in the structure of the output and labor markets in the countries. For example, international Phillips curves will differ both in shape and slope, as well as in their position. In other words, one should not expect international curves to be parallel representations, since the structural conditions in the markets of the various nations are crucial in determining the tradeoff mechanism (24a) (44).

5.2 Implications for Future Research

The long run stability of the Phillips tradeoff has not been ascertained, with the results of this paper. The evidence from labor supply equations, indicating short run money illusion and intermediate run adaptations, favors the accelerationist argument; that short run Phillips curves

exist which shift with changing inflation expectations (17), (24b), (38b). On the other hand, the evidence of market segmentation and heterogeneity, of some labor force participation response to relative wages in the short run, and of continual flux in sectoral disequilibria tend to support the imperfections approach; that Phillips curve phenomena arise due to the structures of output and labor markets, (3a), (37a), (45a), (45b).

The broader implication of this research is that the use of the concept of market heterogenity as an empirical tool facilitates economic analysis. This tool is useful when we can ascertain reasonable first approximations to actual labor markets. Such markets may exist with demographic and geographical boundaries, as well as by industrial classifications, and it is probable that further consideration of sectoral models will emphasize the advantages of testing over different data bases. For example, we have found, by comparing Perry's study to this analysis, that neither the industrial nor the demographic breakdown, by itself, can be used to fully consider all the effects of market heterogeneity. There are several reasons for this conclusion. First, data limitations constrain the demographic sectoral analysis to indirect tests. On the other hand, dispersion of unemployment effects appearsto be more evident among demographic groups than among industrial groups. The primary advantage of industrial sectoral analysis (besides the availability of data) is the highly developed industrial

organization theory which can be employed when interpreting empirical results. Finally, comparisons of demographic and industrial results can provide additional insight into labor market forces. The demographic oriented analysis can be viewed as one which emphasizes the growing importance of the secondary workforce, whereas the industrial research attempts to exclude consideration of secondary workers in order to analyze the industrial changes affecting the primary component of the labor force.

This paper does not provide a basis for definitive statements concerning the wage determination process. The concluding chapter has presented some of the reasons the author feels such statements might be misleading. However, the empirical findings of this research support the contention that further research using sectoral analysis will provide additional insight into the determinants of expectations Phillips curves. One approach that is likely to be productive, [illegible] is to incorporate cross-sectional data in the analysis. Whether future research goes beyond the present analysis by using different data bases, formulating simultaneous equation models, or by developing different theories of labor market behavior (all of which would be valuable), we endorse the use of the multi-market approach. Clearly, the assumptions of a homogeneous labor market and a single labor market tightness variable do not facilitate handling the complex issue of the changing shape and position of the inflation-unemployment tradeoff.

APPENDIX

EMPIRICAL ANALYSIS OF FUCHS' HYPOTHESES

Since the primary contention of this paper is that different sector Phillips curves result from different characteristics of sector labor and output markets, it is crucial that discernible and stable differences exist between sectors. In Chapter 2 we say that Fuchs predicts differences in employment, output, productivity and wages which can be used to develop the present model.

The tables included in this Appendix summarize tests of the hypotheses developed by Fuchs. These results include those that Fuchs obtained for the sample period 1947-1965 and the updated results for the period 1958:1 through 1970. The results obtained by Fuchs supported his explanation of sectoral behavior, with the case of wages being the notable exception. Due to data problems for the period Fuchs tested, wage movements over various industrial groups could not be estimated.

Besides updating and analyzing Fuchs' work, this Appendix examines the problem of wage fluctuations. For the most part, recent experience continues to support the mechanisms described in Chapter 2.[1]

[1]The tests summarized here for both periods include cyclical fluctuations for employment, by sector; and for wholesale and retail trade, and manufacturing for output and productivity. In the case of output and productivity the data concerning the Service sector is sketchy at best. Therefore, the series just mentioned are used as proxies for the sectors to which they belong. Wage movements are tested for the latter period only. The cyclical turning points used here are the same as those employed by Fuchs with the addition

Table A-1 summarizes the changing character of employment since 1950. The trend toward greater employment in the Service sector has continued since 1965.[2] To the extent that Fuchs' empirical work bore out his a priori arguments, the updated figures should show an even stronger inclination toward cyclical stability in employment and output.

Table A-1. Percent Composition of Non-agricultural Employment, by Sector

	1950	1955	1960	1965	1966	1967	1968	1969	1970
SERVICE	50.2	51.4	55.0	57.4	57.4	58.2	58.8	59.2	60.5
GOODS	49.8	48.6	45.0	42.6	42.6	41.8	41.2	40.8	39.5

This hypothesis is supported in Table A-2 which shows the average rate of change in employment during business cycles for the two sector aggregates, for both sample periods. The difference between the average four-quarter rate of change in employment during expansions and contractions removes the trend from the series. The net average cyclical fluctuation is the residual.[3]

of a peak in August, 1969 and trough in November, 1970. The method of computation is that formulated by Fuchs with quarterly data. Using this method, we find the average figures for the recessions and expansions occurring during the sample period, and subtract the recession average from the expansion average to determine the cyclical change net of trend.

[2]The Service sector includes wholesale and retail trade, services, finance, insurance and real estate, and government. The Goods sector includes manufacturing, contract construction, transportation and public utilities, and mining. Due to data limitations with respect to government wages, we include the government subsector only in certain tests in this Appendix; which allows these tests to be compared to Fuchs' results.

Table A-2. Average Rate of Change in Employment During Business Cycles, by Sector

	Average Rate of Change In				Average Cyclical Change	
	Expansion		Contraction		Net of Trend	
SECTOR	1947-1965	1958-1970	1947-1965	1958-1970	1947-1965	1958-1970
SERVICE	3.2 (0.2)	3.7 (0.6)	0.5 (0.6)	2.8 (0.6)	2.7	0.9
GOODS	3.4 (1.2)	2.3 (1.5)	-8.6 (1.4)	-2.0 (4.0)	12.0	4.5

Note: All figures in parentheses are average deviations computed as $\sum_{t=1}^{n} \left| \frac{X_t - \overline{X}}{n} \right|$. Where X is the average for the period.

Table A-3. Effect of Changing Distribution on Average Cyclical Volatility of Total Non-agricultural Employment

Average Rate of Change Using The Average Rates of Change, By Sector, Over the Period 1947-65			Net Cyclical Change Using the Average Rates of Change, By Sector, for the Period Investigated. Actual Cyclical Movement.
Expansion	Contraction	Net Cyclical Change	
1929 2.96	-4.05	7.01	-
1947 3.04	-3.82	6.86	-
1956 3.08	-3.57	6.65	-
1965 3.12	-3.03	6.15	2.22
1970 3.10	-2.72	5.82	2.12

While the relationship between the two sectors remains fairly constant for each period (the cyclical amplitude of the Goods sector being approximately 4.5 times greater than that for Service industries), there has been a significant drop in the overall volatility of employment in the latter period. The magnitude of the aggregate change can be seen in Table A-3 which shows both the effect of the changing distribution of employment on average cyclical volatility, and the actual change which has occured.

The three most probable sources of the residual increase in stability are: smaller fluctuations in aggregate demand from which employment demand is derived; changing employment patterns in both sectors due to greater employment of Service sector type employees in each; and increased volatility in wage rates.

The first explanation is that recent business cycles have been less pronounced or have possessed characteristics which produce less reaction in the labor market. For example, due to the particular movement of several cyclical indicators, the National Bureau of Economic Research has designated this most recent recession as a "growth" recession. Since not all economic indicators moved uniformaly downward during this period, it might not be surprising if changes in output were

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[3]One problem involved in this method of computation is for series which do not move concomitantly with the general business cycles. Fuchs notes that contract construction is the only case of this type of divergence for the period he considers. In the present case only transportation and public utilities seriously diverges. In both cases divergences result in understatement of the cyclical amplitude of the series. However, in neither case does this modify the conclusions of the aggregated data.

not matched by equivalent changes in employment, due to a feeling that further growth in output was just ahead. In the long run this would certainly involve an element of "illusion", but may simply be the outcome of good business practice during a fairly short and inconclusive downturn. This reaction would cause the elasticity of employment, with respect to output changes, to decline during the recent recession and improve overall employment stability for the 1958-70 period, even if output fluctuations remained constant.

The second cause would be significant if Service-type occupations in the Goods sector increased significantly during the latter period, and would have two major effects on the labor market. First, it would increase the number of workers in the Goods industries with the characteristics of Service employees. For the reasons given earlier, this trend should reduce cyclical fluctuations in the Goods sector. Secondly, if white collar-service skills are equally well adapted to both sectors, the increased demand for these workers in the Goods sector should have a "tightening" effect on the market overall.

The third explanation draws on the earlier argument that increased wage flexibility implies less flexible employment, but an explanation for a major shift in the relative volatility of wage rates is not attempted here.

These can be tested by examining three sets of data: output fluctuations, occupational shifts, and wage rate fluctuations. Output fluctuations for the two periods can

serve as an index of the relative severity of the recessions in each. Occupational employment data can be compared to the industrial sector data to determine if there has been a significant increase in service oriented employment outside the Service sector. Wage rate fluctuations for the latter period can also be computed. While these movements cannot be compared to earlier results, the magnitude of the recent changes provides some information regarding this explanation of the increased employment stability.

Table A-4 compares the cyclical fluctuations in output for the two periods.[4] A comparison of the two periods verifies Fuchs' contention that output is relatively more stable in the Service sector, and also shows that of the approximately 65% decline in average cyclical fluctuation in employment in each sector between periods, 40% is explained by output changes in the Service sector and 60% is explained by output changes in the Goods sector. More stable cyclical output fluctuations appear to be a major reason for the increased employment stability in the latter period.

Table A-5 shows that, while the proportion of white collar and service workers has been increasing during the period in question, the gap between industrial and occupational percentages has been steadily closing, suggesting that Service type workers in areas other than the Serivce sector actually exert less influence on the labor market in 1970 than in 1950. Thus, this explanation is rejected.

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[4]These computations and all subsequent tests exclude the government subsector.

Table A-4. Average Rates of Change in Output During Business Cycles, by Sector

	Average Rate of Change In				Average Cyclical Change	
	Expansion		Contraction		Net of Trend	
SECTOR	1947-1965	1958-1970	1947-1965	1958-1970	1947-1965	1958-1970
SERVICE*	4.7	4.0	-3.4	-0.8	8.1	4.8
GOODS**	7.0	5.6	-9.7	-1.0	16.7	6.6

Rate of cyclical change in goods output $\frac{1958-1970}{1947-1965}$:40% ratio of cyclical change in service output $\frac{1958-1970}{1947-1965}$:59%.

*Output equals the sum of output (sales) in Retail Trade deflated by the consumer price index and Wholesale trade deflated by the Wholesale Price Indes.

**Output equals the Manufacturing sales deflated by the Industrial Goods Component of the Wholesale Price Index.

Table A-5. Percent of Non-agricultural Employment, by Occupation

	1950	1955	1960	1965	1968	1970
White Collar and Service	55.4	56.0	59.6	60.8	62.5	63.5
Blue Collar	44.6	44.0	40.4	39.2	37.5	36.5
Occupational Service Percentage minus Industrial Service Percentage (See Table A-1)	5.2	4.6	4.6	3.4	3.7	3.0

Table A-6 shows the cyclical movements of wages for the period 1958-1970. Since wages for both sectors increase more rapidly during contractions than expansion, the hypothesis

Table A-6. Average Rate of Change in Wages During Business Cycles, by Sector--1958-1970

	Average rate in		Average Rate of Change Cyclically,
	Expansion	Contraction	Net of Trend
SECTOR	1958-1970	1958-1970	
SERVICE	2.1 (0.4)	2.3 (0.6)	-0.2
GOODS	2.8 (0.4)	3.1 (0.8	-0.3

that greater compensatory swings in wages have lessened recent employment changes should be questioned. The greater volatility in ghe Goods sector supports the conclusion that during recent contractions, wages have increased (on the average) relatively faster in the Goods sector. However, due to the smoothing of cyclical response implicit in Fuchs' method of computation, the apparent wage effect is insignificant.

The relative wage movements examined in Chapter 4 display much greater volatility than is indicated by the averages cited in this Appendix.

To the extent that wage changes reflect changes in productivity, it is possible that some of the movement in wages is due to the cyclical pattern in productivity. Table A-7 shows the results when the outupt figures previously mentioned are divided by man-hours. While output is more stable in services, productivity is much more volatile, supporting Fuchs' contention for both periods.

Table A-7. Average Rate of Change in Productivity During Business Cycles, by Sector

	Average Rate In				Average Cyclical Change	
	Expansion		Contraction		Net of Trend	
SECTOR	1947-65	1958-70	1947-65	1958-70	1947-65	1958-70
SERVICE	3.1	1.8	-1.2	-2.0	4.3	3.8
GOODS	2.4	2.7	2.1	2.8	0.3	-0.1*

*The actual difference was 2.77-2.72=0.05.

Although these results offer only rough approximations of actual productivity, the magnitude of the difference between wage rate movements and productivity movements (especially in the Service sector) brings into question the validity of using wage rate movements as a proxy for changes in the value of the marginal product. While changes in prices over the business cycle could account for some of the vast difference between productivity and wages, the large

difference in the rate of change of the two in the Service sector (output/man-hour = 3.84 percent cyclical change and wages = -.21 percent change cyclically) suggests that study of these relationships is needed before we can identify the reasons for aggregate cyclical wage rate behavior in the United States.

In conclusion, these results indicate that the discernible differences found by Fuchs have persisted into the recent period. In addition, the updating has raised some issues which the present research cannot resolve. Future study concentrating on the cyclical behavior of relative wage rate movements could redefine our knowledge of these issues.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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