Trends in Unemployment Rates in Korea: Search-Matching Model Interpretation

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Abstract: We investigate the steady decline in aggregate unemployment rates in Korea since the 1960's. We argue that a pronounced decrease in the intensity of reallocation shocks, which resulted in a downward trend in the natural rate of unemployment, has been an important factor in this decline. Our claim is based on a structural search-matching model, the times series of job-separation and job-finding rates, and sectoral-shift measures that we construct from a micro data for the past three decades.

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1. Introduction

The pattern and distribution of production opportunities change constantly in a modern economy. These changing opportunities spur a time-consuming, and otherwise costly, reallocation of resources. The hypothesis that the movement of workers across jobs is a significant contributor to the fluctuations in the aggregate labor market has been debated since David Lilien's (1982) seminal paper (e.g., Abraham and Katz (1986) and Davis (1987)). While much of the previous research effort has been spent on the cyclical fluctuations, in this paper we investigate the role of reallocation shocks in the determination of the long-run movement of the aggregate unemployment rate. Our study is based on both empirical and quantitative analyses of the labor market in Korea over the past three decades.

Ever since the official figures on the labor market began to be published, unemployment rates in Korea have fallen continuously. For the aggregate economy, unemployment rate decreased from 8.1% in 1963 to 2.0% in 1996. The decline was even more dramatic in the non-agricultural sector; in this sector unemployment rate decreased from 16.2% to 2.3% during the same period. (See Figure 1.)

While the shifts in the natural rate of unemployment have been studied extensively for European economies (e.g., Blanchard and Summers (1986), Bentolila and Bertola (1990), and Sargent and Ljungqvist (1998)), the Korean unemployment rate provides an interesting backdrop on which to study the natural rates for two reasons. First, during the dramatic decline of the unemployment rate, the Korean economy has shown a steady output growth throughout except for the 1979-80 recession.[1] This makes us believe that the decline in the unemployment rate reflects mostly structural rather than cyclical components. Second, high-quality micro data are available for a fairly long period. We construct a panel data set from successive monthly cross-sections based on the Economically Active Population Survey (EAPS) for 1981-1994. From this panel we find the distinctive behavior in the labor market flows: the job-separation rate has shown

[1] Unemployment rate increased dramatically in 1997 and 1998 during the currency crisis in Korea. This event is beyond the scope of this study because we focus on structural changes in the economy prior to 1996.

a strong downward trend along with the unemployment rate, whereas the job-finding rate did not exhibit any trend. This evidence is used to distinguish the competing hypothesis for the decline in the unemployment rate. Specifically, we ask whether there was any change in the labor market that could have led to a significant downward trend in both the unemployment rate and the job-separation rate without having much impact on the job-finding rate.

We also ask whether the decline in the aggregate unemployment rate can be accounted for by a change in the composition of the labor force. In fact, the share of young and male workers who, on average, tend to exhibit a high unemployment rate decreased during the sample period. Yet according to our decomposition, the compositional change of the labor force can account for, at best, 40% of the decline in the aggregate unemployment rate. Nevertheless, the decline in the unemployment rate occurred in all demographic groups.

Our search for the source of the shift in the unemployment rate is guided by a search-matching theory. We compute the steady-state equilibrium of a Mortensen and Pissarides (1994) economy where the job-separation rate, as well as the job-finding rate, is endogenously determined. The novel feature of this approach is its parsimony. The labor-market equilibrium is characterized by a small set of structural parameters. A shift in a structural parameter can easily be translated into changes in the labor-market environment. The structural changes in the Korean labor market we consider are: an increase in return to market activities, the increased bargaining power of labor, a downward trend in the real interest rate, shifts in matching technology, and a decrease in reallocation or sectoral shifts.

Our findings can be summarized as follows. According to the model, among the structural changes we consider, only the decrease in reallocation shocks is capable of making all three variables – unemployment rate, job-separation rate, and job-finding rate – move consistently with the data. While we do not preclude the possibility that a combination of multiple structural changes may have been responsible for the downward trend in aggregate unemployment, we do find strong evidence of a decrease in reallocation shocks during the sample period. Primarily from the three-digit industry employment data in the Monthly Labor Survey (MLS), we construct sectoral-shift measures following Lilien (1982) and Neumann and Topel (1991). According to these measures, the standard deviation of reallocation shocks decreased by a factor of 3 or more from 1970 to 1994. A quantitative analysis of the structural model shows that such a decrease in reallocation shock is clearly capable of generating the movement of the three labor market variables we observe in the data.

Some researchers have studied a link between the growth rate of output and unemployment rate in search models (e.g., Pissarides (1990), Aghion and Howitt (1994), and Bean and Pissarides (1993)). We, however, do not view the growth rate per se as the primary reason for the decline in the natural rate of unemployment in Korea. First, the GDP growth rate has been fairly stable during the sample period. Second, while the job-finding rate plays a key role in the determination of the unemployment rate in those types of models, we do not find any trend in job-finding rates in Korea during the sample period. Finally, other East Asian countries that experienced similar output growth – such as Taiwan, Singapore, and Hong Kong – did not exhibit any noticeable trend in unemployment rates.

The paper is organized as follows. Section 2 documents some stylized facts about the labor market in Korea. We evaluate to what extent the compositional change in the labor force can account for the decline in aggregate unemployment rate. We then document the distinctive behavior of the job-separation rate and the job-finding rate using our panel data. Section 3 presents and quantifies the structural model for empirical purposes. We examine the model's responses to shifts in various structural parameters. Finally, we report a pronounced decline of sectoral-shift measures in the data to support the important role of reallocation shocks in the steady decline of the aggregate unemployment rate. Section 4 is the conclusion.

2. Some Stylized Facts about the Korean Labor Market

2.1 Trends in the Unemployment Rate

This section summarizes some of the stylized facts regarding the trend in unemployment rates in Korea. Figure 1 shows the annual unemployment rates of the aggregate and non-agricultural economy from 1963 to 1996. The aggregate unemployment rate decreased from 8.1% in 1963 to 2.0% in 1996. The decline is even more striking in the non-agricultural sector where the unemployment rate decreased from 16.2% to 2.3%. Unemployment rates rose only temporarily during the 1979-80 recession. A steady decline, as opposed to a structural break, in unemployment rates for such an extended period appears to be a unique event.[2]

While the data we use are of a particular country, we think they provide a suitable case for studying the sources of shifts in the natural rate of unemployment. As Figure 2 shows, the Korean economy has shown a steady growth in aggregate output in terms of GDP during the sample period except for the 1979-80 recession due to an oil shock and political turmoil (the assassination of President Park Chung Hee). This implies that the unemployment rate is not so seriously contaminated by cyclical fluctuations. Before we discuss any structural changes in the labor market, we first investigate whether the decrease in the unemployment rate can be accounted for by a compositional change in the labor force.

2.2 Changes in the Composition of the Workforce

As a result of industrialization, the Korean economy has experienced a significant change in the composition of its labor force. The share of male workers and that of very young workers, both of which tend to exhibit lower unemployment rates, has decreased significantly. For example, the share of male workers in the labor force decreased from 64.1% in 1970 to 59.1% in 1996. The share of young workers aged 15 to 24 decreased from 24.7% to 12.1% over the same period. A similar pattern can be found in the non-agricultural sector. Despite the decrease in the share of male and young workers in the labor force, we find that unemployment rates decreased in all demographic groups during the sample period. Table 1 shows the changes in unemployment rates for various groups. To avoid a possible business-cycle effect, we calculate three-year-average unemployment rates. For the entire labor force, from 1970-72 to 1990-92, the unemployment rate

[2] For example, Western European countries showed higher levels of unemployment rates in the 1980's and early 1990's. In Japan the unemployment rate has been very stable at around 2% before the recent recession. Among the East Asian countries that have experienced similar economic growth, Singapore and Hong Kong exhibited a very mild downward trend, whereas Taiwan showed a stable unemployment rate.

decreased from 4.57% to 2.40%. It decreased from 5.42% to 2.67% for male workers, and from 2.87% to 1.94% for female workers. By age groups, we classified the labor force into three groups: the young (aged 15 to 24), primary (25 to 54), and old (55 and above). The unemployment rate of young workers decreased mildly from 9.04% to 7.39%, whereas that of primary workers fell from 3.21% to 1.75%, and that of old workers from 1.85% to 0.54%. As the bottom of Table 1 shows, this pattern is more pronounced in the non-agricultural sector. While the unemployment rates have declined in all demographic groups, it is still of interest to examine how much of the decline can be accounted for by the compositional changes in the labor force. This factor can be measured as follows. The aggregate unemployment rate at time *t*, UR_t, is a weighted average of unemployment rate of group *i*, UR_{it},

(1) $$UR_t = \sum_{i=1}^{n} s_{it} UR_{it} ,$$

where s_{it} is the share of group *i* in the labor force. A change in the aggregate unemployment rate can be decomposed into three parts:

(2) $$\Delta UR_t = \sum_{i=1}^{n} \Delta s_{it} UR_{it-1} + \sum_{i=1}^{n} s_{it-1} \Delta UR_{it} + e_t .$$

The first term represents the composition effect in the labor force. The second term represents the change in the aggregate unemployment rate holding the composition of the labor force constant, which we call the unemployment-rate effect. The third term is an approximation error due to first-differences in discrete time. In this decomposition, we divide the labor force into 20 small groups based on sex and age.

Table 2 reports the result of the decomposition. To avoid a possible business-cycle effect, we report the result based on three-year-average unemployment rates (from 1970-72 to 1990-92). The compositional change in the labor force accounts for 41.1% and 32.5% of the decline in the aggregate and non-agricultural unemployment rates, respectively. On the other hand, the unemployment-rate change, holding the composition constant across time, accounts for 42.9% and 78.3% of the decline in unemployment rates for the aggregate economy and the non-agricultural sector, respectively. In sum, while the change in the composition of the labor force has played an important role, we have yet to discover the source of the steady decline in unemployment rates.

2.3 The Job-Finding Rates and Job-Separation Rates

Unemployment rate measures the stock of workers available for work in the labor force. It is useful to examine the flows into and out of unemployment over time in understanding the shift in unemployment rate. First, we measure the flows of workers across three states –employed, unemployed, and non-labor force– from the Economically Active Population Survey. While the EAPS is cross-sectional monthly household-survey data, many households stay in the sample for a fairly long period, which allows us to construct panels from the successive cross-sections. Appendix A provides a detailed explanation of the data. The panel data we use here are restricted to the years after 1980 due to data limitations in earlier years.[3]

Consider a Markov transition matrix among three states of employment: employed (*E*), unemployed (*U*), and non-labor force (*N*).

(3) $$S_t = S_{t-1} \times \Pi, \quad \Pi = \begin{pmatrix} ee & eu & en \\ ue & uu & un \\ ne & nu & nn \end{pmatrix},$$

where $S_t = [E_t \;\; U_t \;\; N_t\,]$, and *eu* represents the probability of moving from employed at time *t*-1 to unemployed at time *t*, and so forth. Each year, annual average transition probabilities are calculated from the monthly panel data. Based on these probability matrix Π, we calculate the average monthly job-finding rate, ϕ, and the job-separation rate, ψ, as:

(4) $$\phi = ue + un \times \gamma$$

(5) $$\psi = eu + en \times (1-\gamma),$$

where $\gamma = ne \,/\, (ne+nu)$.

[3] We have constructed the extended time series of separation rates and finding rates for every year since 1970 using various supplementary data. The behavior of the extended time series was similar to the one we discuss here.

The job-finding rate consists of two components: (i) the probability of moving from unemployed to employed (direct transition) and (ii) the probability of moving from unemployed to non-labor force *and* from non-labor force to employed (indirect transition). Similarly, the job-separation rate consists of (i) the probability of moving from employed to unemployed and (ii) the probability of doing so via the non-labor force. In the steady state, the unemployment rate is $\psi / (\psi + \phi)$.

Figure 3 shows the average monthly job-separation rates for the aggregate economy and the non-agricultural sector for 1981-1994. Both rates exhibit strong downward trends. The monthly job-separation rate of the aggregate economy decreased by 50% (from 1.2% in 1981 to 0.61% in 1994), and that of the non-agricultural sector decreased by 53% (from 1.26 to 0.60%). Figure 4 shows the movement of the job-finding rates. Unlike the job-separation rates, the job-finding rates did not exhibit any definite trend, although they have shown some fluctuations.

This evidence is used to distinguish the competing hypothesis for the decline in the natural unemployment rate. Specifically, the underlying source responsible for the decline in the unemployment rate should be consistent with a downward trend in job-separation rates; at the same time, such changes should not have a big impact on the job-finding rates.

3. A Structural Model and Quantitative Analysis

Our investigation of the steady decline in unemployment rates in Korea is guided by the search theory developed over time by Diamond (1982), Pissarides (1990), and Mortensen and Pissarides (1994), among others. In particular, we characterize the steady-state equilibrium of Mortensen and Pissarides (1994). This model has several appealing features for our study. First, the job-separation as well as the job-finding rates, whose distinctive movements in Korea are summarized in Section 2, are endogenously determined by a small set of structural parameters. Second, each structural parameter provides immediate economic interpretation. Third, the model has been widely used in the literature and has been successful in matching the key aspects of aggregate labor-market fluctuations. This allows us to draw on earlier studies in the literature in choosing the key parameters for the benchmark case. Once we calibrate the model, we ask whether any of the shifts in structural parameters can generate the finding in our empirical analysis in Section 2: a steady decline in unemployment rates and job-separation rates with no apparent trend in job finding rates.

3.1 Matching Model

Job Creation and Destruction

Jobs are continually created and destroyed. New jobs are productive; if paired with a worker, they produce output $y = a + \sigma\varepsilon$, where a represents the average productivity and σ the standard deviation of job-specific productivity ε. Each period λ percent of jobs draw new productivity ε from the distribution $F(\varepsilon)$, which has a finite support over $[\underline{\varepsilon}, \overline{\varepsilon}]$ with zero mean and unit standard deviation. Job separation is endogenous. Existing jobs will be destroyed if they are not profitable. When new jobs are created, they start with productivity ε^0.[4]

Unemployment, Vacancies, and Matching

Let the number of workers looking for jobs, unemployment, be equal to u. Normalize the labor force to be one, so that this is also the unemployment rate. Let the number of jobs looking for workers, vacancies, be equal to v. The process through which workers and jobs find each other is represented by a matching function $m(v,u) = kv^{1-\alpha}u^{\alpha}$. The rate at which vacancy will be filled is $q(x) = m(v,u)/v = kx^{-\alpha}$, where x (= v/u) represents the tightness of the labor market, the vacancy-unemployment ratio. The rate at which unemployed find jobs, the job-finding rate, is $\phi(x) = m(v,u)/u = kx^{1-\alpha}$.

Free Entry

[4] Although Mortensen and Pissarides (1994) assume that new jobs start with the highest possible productivity, we disagree with this assumption because there is ample empirical evidence of the tenure effect in wages. (e.g., Topel (1991))

The creation of new jobs is determined by a free-entry condition. It costs c to create a new job. There is creation of jobs until the value of a new job is equal to this cost. Since we study the steady-state equilibrium of the model economy, we assume a constant interest rate r. Nash bargaining is assumed between workers and firms with workers' share β, which is between 0 and 1.

Equilibrium

Consider the problem of the worker. Assume that he is risk-neutral and consumes current income. Let w be the wage paid by the firm and thus consumption when employed. Let b be the level of consumption when unemployed.[5] Let $W(\varepsilon)$ denote the expected present value of consumption if currently employed with productivity ε,

(6) $$rW(\varepsilon) = w(\varepsilon) + \lambda[E[\max\{W(\varepsilon'),0\}] - W(\varepsilon)],$$

where $E[\ ]$ is the expectation operator and ε' is the new draw of idiosyncratic productivity. The rate of return from being employed is equal to the current wage plus the expected capital gain. Also, let U represent the expected present value if currently unemployed. Since new jobs start with productivity ε^0,

(7) $$rU = b + \phi[W(\varepsilon^0) - U],$$

where ϕ is the rate at which workers find jobs, the job-finding rate.

Consider the problem of the firms. The firm is risk neutral. Let $J(\varepsilon)$ be the value of a job with idiosyncratic productivity ε. The existing jobs will be destroyed if $J(\varepsilon) < 0$. The arbitrage-like condition is

(8) $$rJ(\varepsilon) = a + \sigma\varepsilon - w(\varepsilon) + \lambda[E[\max\{J(\varepsilon'),0\}] - J(\varepsilon)].$$

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[5] Since the unemployment benefit program did not exist during the sample period in Korea, we interpret b as the value of non-market such as home production or leisure.

The rate of return from the job $rJ(\varepsilon)$ equals the current profit plus the expected capital gain. Finally, the asset value of vacancy V is determined as

(9) $$rV = -c + q[J(\varepsilon^0) - V],$$

where q is the rate at which a vacancy will be filled with a worker.

This economy possesses a reservation property so that there is a critical level of productivity below which jobs are destroyed. The labor-market equilibrium can be expressed in terms of two conditions: job-destruction and job-creation equations. First, the job-destruction equation is

(10) $$a - b + \sigma\varepsilon^* = \frac{\beta c}{1-\beta}x - \frac{\sigma\lambda}{r+\lambda}\int_{\varepsilon^*}^{\bar{\varepsilon}} [1 - F(\varepsilon')]\, d\varepsilon'.$$

(See the Appendix for the derivation.) This equation represents the trade-off that the firm faces at the critical level of productivity ε^* below which jobs are destroyed. The market-productivity net of value from non-market activity, the left-hand side, must be equal to the opportunity cost of vacancy, the right-hand side. The first term of the right-hand side represents the expected return from a new match, expressed in terms of vacancy cost, as they are equal in equilibrium. The second term represents the operational loss that firms are willing to bear based on the anticipation of realization of higher productivity than ε^*.

The second equilibrium condition (the job-creation equation), is

(11) $$\frac{(1-\beta)q(x)\sigma(\varepsilon^0 - \varepsilon^*)}{r+\lambda} = c.$$

(See the Appendix for derivation.) The left-hand side reflects the present value of a new job and the right-hand side the cost of a vacancy. Firms will continue to create jobs until both sides are equal. Job creation and job-destruction equations (10) and (11) make up a system of equations for x and ε^*. An equilibrium pair of x and ε^* fully characterizes the other aspects of the labor market such as the job-finding rate ($\phi = kx^{1-\alpha}$), job-separation rate ($\psi = \lambda F(\varepsilon^*)$), and unemployment rate ($u = \psi / (\psi + \phi)$).

3.2 Quantitative Analysis

In this section, we calibrate the model for empirical purposes. We explore the changes in the labor-market environment, by varying structural parameters of the model, to see whether such a change can generate the movement in the unemployment rate, job-finding rate, and job-separation rate that we found in Section 2. In particular, we look for the case in which both the unemployment rate and the job-separation rate exhibit strong downward trends while the job-finding rate is little affected.

We set the parameters of the benchmark case as follows. The model is calibrated at monthly frequency consistent with job-separation and job-finding rates in the data. The real interest rate r is set to 0.0035 to yield an annual rate of 4.17%, which is the average expected real interest rate for a general-bank loan during the years of 1975-1994 in Korea. The average labor-income share for 1970-1996 in Korea was 0.51. In the benchmark case the bargaining power for labor share β is set to 0.5. The elasticity in the matching function, α, is also set to 0.5, which is the midpoint of estimates obtained by Blanchard and Diamond (1989) based on the U.S. data. This also guarantees the efficiency of the competitive equilibrium (so-called Hosio's condition) given our choice of β. We assume that the value of non-market activity is 30% lower than that of market wage. As we normalize the average productivity a to 1, this implies b = 0.7. The job-vacancy posting cost c is 0.5, half the average wage, which is slightly higher than the value used in Millard and Mortensen (1995).

The distribution of idiosyncratic shocks, F, is assumed to be uniform at the interval [-1, 1]. New jobs start with $\varepsilon^0 = 0$, the mean of F. The arrival rate of idiosyncratic productivity λ is 0.03, implying that each month 3% of existing jobs receive new idiosyncratic shocks.[6] The scale parameter in the matching function k and the standard deviation of idiosyncratic component σ are set to make the equilibrium unemployment rate, job-finding rate, and job-separation rate close to what they were in

[6] The same parameter is set to 0.081 in Mortensen and Pissarides for the quarterly model.

1981, the starting year of the time series of flow variables. The choice of $k = 0.45$ and $\sigma = 0.2$ yields an equilibrium unemployment rate, job-finding rate, and job-separation rate of 4.7%, 31.3%, and 1.1%, respectively. They were 4.6%, 29.2% and 1.2%, respectively, in 1981.[7]

We now investigate the effect of changes in the labor-market environment by varying the structural parameters of the model around the benchmark values. The structural changes of our interest are general productivity growth, the return to market relative to non-market activities, the bargaining power of workers, the real interest rate, matching technology, and, finally, the intensity of reallocation shocks.

Productivity Growth: *a* and *b*

To examine the labor-market equilibrium in terms of general productivity growth, suppose there is a technological progress of *g* percent each period. The market productivity at time *t* is $y(t) = a(t) + \sigma(t)\varepsilon$, where $a(t) = a_0 e^{gt}$ and $\sigma(t) = \sigma_0 e^{gt}$. As the wage rate increases the vacancy cost is likely to grow at the same rate in the long run: $c(t) = c_0 e^{gt}$. If the productivity growth in the market is accompanied by an increase in unemployment benefit or non-market productivity, *b* is likely to grow at the same rate in the long run: $b(t) = b_0 e^{gt}$. It is straightforward to show that labor-market equilibrium conditions (10) and (11) are unaffected with respect to proportional changes in *a*, *b*, *c*, and σ.[8] In fact, according to Blanchard (1998), based on "Anglo-Saxon" countries data, there is no systematic relationship between unemployment rate and total factor productivity growth.

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[7] With these values, the equilibrium vacancy-unemployment ratio *x* is 0.49 and the critical level of idiosyncratic productivity for job-separation ε* is -0.26. The vacancy-unemployment ratio is between 0.4 and 1 in the U.S.

[8] One may interpret this property as a balanced-growth path in a standard one-sector growth model. Under the standard utility, a permanent increase in productivity is associated with an income effect that increases the value of leisure proportionally. Improvement in general technology is likely to increase the productivity of the aggregate economy including the market and non-market (or home production) sectors in the long run. See Greenwood, Rogerson, and Wright (1995) for an aggregate neo-classical growth model that explicitly considers home production activities.

While the labor-market equilibrium is neutral to the productivity growth common to market and non-market sector, it seems plausible to imagine an increase in the *relative* productivity between market and non-market activities, an increase of *a-b*, over the course of economic development.[9] According to the model, however, changes in the relative return between market and non-market affect the job-finding rates most strongly as they affect the incentive to work. Figure 5 shows the equilibrium unemployment rate, job-separation rate, and job finding rate for the values of *a-b* from 0.2 to 0.4– reflecting the case where the return to non-market activity is 20% to 40% lower than the return to market activity. As the relative return *a-b* increases, the equilibrium unemployment rate decreases as in the data, but only slightly for the job-separation rate. At the same time, the job-finding rate increases significantly, while we did not find any trend in the job-finding rate.

Some researchers have studied a link between the growth rate of output and unemployment rate in search models (e.g., Pissarides (1990), Aghion and Howitt (1994), and Bean and Pissarides (1993)). However, we do not view the growth rate per se as a major reason for the decline in the natural rate of unemployment in Korea. First, the output growth rate has been fairly stable during the sample period in Korea. Second, in those models, the job-finding rate plays a key role in the determination of the unemployment rate as in the case of an increase in the relative return in our model. Yet, again, job-finding rates did not exhibit any trend in Korea during the sample period.

Bargaining Power of Labor: β

The labor-income share increased dramatically from 0.31 in 1970 to 0.64 in 1996 in Korea. To reflect this change, we increase the bargaining power of workers by increasing the parameter β from 0.4 to 0.6 in the model. According to Figure 6, an increase in β increases the unemployment rate by decreasing the job-finding rate, as a high value of β reduces the firms' incentive to create new jobs. The job-separation rate is barely affected.

Real Interest Rates: r

[9] We do believe that the relative return to market sector has increased in Korea during the sample period, as there had been a positive trend in the labor market participation rate. The participation

The expected real annual interest rates of general-bank loans and corporate bonds in Korea have been between -5% to 12% with no definite trend during the time period. However, because of government regulation imposed on such interest rates during most of the sample period, the official interest data may not reflect the actual discount rates of the economy. According to Rhee (1997), in fact the expected real interest rates in the curb market exhibited a downward trend from 22% in 1975 to 10% in 1994. Figure 7 presents the labor-market equilibrium from the model with various values of r – from 1% to 24% in annual rate. A decrease in r increases all three labor-market variables of our interest. Nevertheless, the figure suggests that the labor-market equilibrium is barely affected across a wide range of real interest rate.

Matching Technology: k

It is hard to infer the shift in efficiency of matching function k. However, the effect of the change in k makes the unemployment rate and the job-separation rate move in opposite directions in the model, whereas they have decreased together strongly during the sample period. (See Figure 8.) Moreover, the matching technology parameter, k, has a big impact on the job-finding rate, which did not exhibit any trend in the data.

Intensity of Reallocation Shocks: σ and λ

Finally, we investigate the intensity of reallocation shocks. According to the reallocation hypothesis put forward by Lilien (1982), a constant reallocation of workers across jobs manifests itself as unemployment. In the model, the standard deviation (σ) and/or arrival rate (λ) of new idiosyncratic productivity reflects the intensity of reallocation shocks. According to Figure 9, a decrease in σ decreases both the unemployment rate and the job-separation rate without having much impact on the job-finding rate. For instance, in response to a decrease of σ from 0.2 to 0.1, the equilibrium unemployment rate decreases from 4.7% to 3.1%. At the same time, the job-separation rate decreases from 1.1% to 0.7%. The job-finding rate is not affected at all by the variation in σ.

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rate has increased from 55.7% in 1964 to 62.2% in 1996.

Figure 10 shows the labor-market equilibrium for various values of λ. A bigger value of λ, implying a frequent arrival of new shocks, generates a high unemployment rate and job-separation rate with little effect on the job-finding rate. For instance, as λ decreases from 0.03 to 0.02, the unemployment rate and the job-separation rate decrease from 4.7% to 3.3% and 1.1% to 0.8%, respectively, whereas the job-finding rate increases only from 31% to 32%. This suggests that a decrease in reallocation shocks (parameterized by a decrease in σ and/or λ) may be capable of accounting for the observed behavior in unemployment rates, job-separation rates, and job-finding rates in the data.

Table 3 summarizes our comparative static analysis from the model. Among six structural changes in the labor market we consider, a change in the intensity of reallocation shocks is the only case that generates the behavior that is consistent with the data in all three labor-market variables. In the next section, we present strong evidence of the steady decline of reallocation of workers in Korea. Our claim is based on sectoral-shift measures from three-digit employment data from 1970 to 1994.[10]

3.3 Sectoral Shifts in Korea

Over the past three decades, the industrial structure of Korea has changed dramatically, as the economy has evolved from an agriculture-dominant economy to a manufacturing and service economy. The output share of the agricultural sector was only 5.8% in 1996, but was 43.3% in 1963 (See Figure 11.). At the same time, the output share of manufacturing increased from 14.7% in 1963 to 28.9% in 1996. Even within the manufacturing industry its major products have shifted from the light industries such as clothing to the heavy industries such as shipbuilding, automobiles, and electronics. A rapid change in industrial structure requires constant movement of labor across sectors, which may result in a high unemployment rate in transition.

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[10] According to Davis and Haltiwanger (1992), the reallocation of workers within an industry as well as across industries plays an important role in the U.S. labor market. While this is an important issue, we could not address it because relevant data are not available for the time period of our analysis of the Korean market.

To measure the degree of reallocation of workers, Lilien (1982) calculated the weighted sum of deviations of the growth rate of industry employment from that of aggregate employment. In addition to Lilien's sectoral-shift measure, we report Neuman and Topel (1991)'s measure designed to eliminate some short-run components in Lilien's measure. For sectoral employment, we draw on the three-digit employment data from the MLS and the EAPS. A detailed explanation of how to combine the two data sets is provided in the Appendix.

Figure 12 shows the sectoral-shift measures of Lilien and Neuman andTopel. Both measures clearly show strong downward trends during the sample period. The Lilien measure, for example, falls sharply from 9% in 1970 to 2% in 1990. In fact, the correlation coefficients between the Lilien measure and the unemployment and job-separation rates are 0.87 and 0.76, respectively.

The decrease in reallocation shocks obviously lowers the natural rate of unemployment. However, we have yet to examine the quantitative importance of such decrease. From 1970 to 1996 the decline in sectoral-shift measures ranges from a factor of 3 to 4. During the same period the aggregate unemployment rate decreased from 4.5% to 2% – it fell from 7.4% to 2.2% for the non-agricultural sector. The job-separation rate also fell from 1.2% in 1981 to 0.6% in 1994. Given our decomposition in Section 2, the decline of the unemployment rate by a factor of nearly 2 is still unexplained even after controlling for the compositional change in the labor force. To answer this question, consider the following. According to Figure 10, a decrease in σ by a factor of 3, from 0.3 to 0.1, leads to a decrease in unemployment rate from 5.29% to 3.12% and in job-separation rate from 1.24% to 0.71%. Our model suggests that the decline of reallocation shocks, measured by sectoral shifts in the data, is clearly capable of generating the downward trend in unemployment rate and job-separation rate observed over the last three decades.

4. Conclusion

In this paper, we search for the source of the steady decline in aggregate unemployment rates in Korea over the past three decades. We note that there have been distinctive movements in the labor-market flow variables in Korea: the job-separation rate has decreased significantly, whereas the job-finding rate has not shown any trend. This evidence, combined with a standard matching model, provides a parsimonious way to examine the sources of the steady decline in unemployment rates.

Among the six structural changes in the labor market that we consider, a decrease in the intensity of reallocation shocks reproduces the behavior in all three labor-market variables; unemployment rate, job-finding, and job-separation rates. From the three-digit employment data, we find that the reallocation of labor measured by a sectoral shift fell by a factor of 3 or more from 1970 to 1994. We show, based on a structural model, that such a decrease in reallocation shock is clearly capable of generating the observed decline in unemployment rates and job-separation rates found in the data. While we do not preclude the possibility that a combination of multiple structural changes, the reallocation played an important role in the decline of unemployment rate in Korea since the 1960's.

Appendix A: Data

Job-Separation Rates, Job-Finding Rates, and Transition Probabilities

A large-scale population census is conducted every five years in Korea. The Economically Active Population Survey (EAPS) extracts a sub-sample of 32,500 households (17,500 households prior to 1988) from the census, and surveys them repeatedly over the next five years, which allows us to construct a panel from successive cross-sections. The EAPS started in 1963 as a quarterly survey and became a monthly survey in July 1982. The data prior to 1980 are not available from the Office of Statistics. Our data consist of quarterly data from 1981 to 1982 and monthly data from 1983 to 1994. Our annual transition represents the six-month averages of monthly rates (from July to December of each year since 1983 and the third to fourth quarter for 1981 and 1982). The followings are the transition probabilities for the starting and end year of the sample:[11]

$$\Pi_{1981} = \begin{pmatrix} .793 & .012 & .195 \\ .358 & .519 & .123 \\ .044 & .004 & .952 \end{pmatrix} \text{ and } \Pi_{1994} = \begin{pmatrix} .972 & .003 & .025 \\ .226 & .725 & .049 \\ .025 & .003 & .972 \end{pmatrix}.$$

Employment Data for Sectoral-Shift Measure

While the Monthly Labor Survey (MLS) provides the disaggregate employment data at a three-digit level, it includes only non-agricultural establishments of ten or more workers. We supplement the agricultural employment data from the EAPS, which provides a one-digit industry classification including the agricultural sector. Inclusion of the agricultural sector is potentially important because the movement from the agricultural to the non-agricultural sector is a significant source of sectoral shifts, especially in earlier years. Two data sets are combined as follows. First, for each year, the employment ratio of the agricultural to the non-agricultural sector is calculated from the EAPS. Total employment (of the non-agricultural sector) from the MLS is multiplied by this ratio to yield the agricultural employment that is comparable to the non-agricultural employment data in the MLS.

[11] See Nam (1997) for the detailed explanation and transition probability of each year in the sample.

Appendix B: Derivation of Job-Destruction and Job-Creation Equation

This derivation parallels the one in Mortensen and Pissarides (1994). The free-entry condition implies that the expected return from vacancy is equal to vacancy cost c per unit of time:

(A.1) $$q(x)J(\varepsilon^0) = c\,.$$

Total surplus from the match with productivity ε is

(A.2) $$S(\varepsilon) = J(\varepsilon) + W(\varepsilon) - U\,.$$

Total surplus of the match is split between the worker and firm proportionally:

(A.3) $$W(\varepsilon) - U = \beta S(\varepsilon)\ .$$

Adding up (6)-(8) and making use of sharing rule (A.2),

$$(r+\lambda)S(\varepsilon) = a + \sigma\varepsilon - b + \lambda\int\{\max[S(\varepsilon'),0] - S(\varepsilon)\}dF(\varepsilon') - \beta qxS(\varepsilon^0)\,.$$

Since S(ε) is monotonically increasing in ε, job destruction satisfies reservation property. That is, $J(\varepsilon^*) = (1-\beta)S(\varepsilon^*)$. This condition and the fact that $S'(\varepsilon) = \sigma/(r+\lambda)$ imply, after integration by parts,

$$(r+\lambda)S(\varepsilon) = a + \sigma\varepsilon - b + \lambda\int_{\varepsilon^*}^{\bar{\varepsilon}} S'(\varepsilon')[1 - F(\varepsilon']d\varepsilon' - \beta qxS(\varepsilon^0)$$
$$= a + \sigma\varepsilon - b + \frac{\sigma\lambda}{r+\lambda}\int_{\varepsilon^*}^{\bar{\varepsilon}}[1 - F(\varepsilon')]d\varepsilon' - \beta qxS(\varepsilon^0)\,.$$

Since $S(\varepsilon^0) = J(\varepsilon^0)/(1-\beta)$, $S(\varepsilon^*) = 0$, (A.1), and (9) imply the job-destruction equation (10).

Jobs are created until the expected return from vacancy equals cost. From (A.1) and the sharing rule, $q(x)(1-\beta)S(\varepsilon^0) = c$,

(A.4) $$S(\varepsilon^0) = \frac{q(x)(1-\beta)}{c}\,.$$

Since $S'(\varepsilon) = \sigma/(r+\lambda)$, $S(\varepsilon) - S(\varepsilon^*) = \frac{\sigma}{r+\lambda}(\varepsilon - \varepsilon^*)$.

Combined with (A.4) and $S(\varepsilon^*) = 0$,

$q(x) = \frac{c}{1-\beta}\frac{\sigma}{r+\lambda}(\varepsilon^0 - \varepsilon^*)$, which is job-creation equation (11).

References

Abraham, K., and L. Katz (1986) "Cyclical Unemployment: Sectoral Shifts or Aggregate Disturbances?" Journal of Political Economy 94 (3), 507-22.

Aghion, Phillipe and Peter Howitt (1994) "Growth and Unemployment," Review of Economic Studies 61, 477-494.

Bean, C. and C. Pissarides (1993) "Unemployment, Consumption and Growth," European Economic Review 37, 837-54.

Bentolila, S. and G. Bertola (1990) "Firing Costs and Labour Demand: How Bad is Eurodclerosis?" Review of Economic Studies 57, 381-402.

Blanchard, O., (1998) "Technological Change, Productivity Growth, and Unemployment," Lecture Notes on Unemployment, manuscript, MIT.

Blanchard, O. and P. Diamond (1989) "The Beveridge Curve," Brookings Papers on Economic Activity 1, 1-51.

Blanchard, O. and L. Summers (1986) "Hysteresis and European Unemployment Problem," NBER Macroeconomics Annual, edited by S. Fischer. Cambridge, Mass., MIT Press.

Bureau of Labor of Korea, Korean Labor Statistical Annual.

Davis, S. (1987) "Fluctuations in the Pace of Labor Reallocation," Carnegie-Rochester Conference Series on Public Policy 27, 335-402.

Davis, S. and J. Haltiwanger (1992) "Gross Job Creation, Gross Job Destruction and Employment Reallocation" Quarterly Journal of Economics 107, 819-63.

Diamond, Peter (1982) "Wage Determination and Efficiency of Search Equilibrium," Review of Economic Studies 49, 217-227.

Greenwood, J., R. Rogerson, and R. Wright, (1995) "Household Production in Real Business Cycle Theory" In: T. Cooley, eds., Frontiers of Business Cycle Research, Princeton University Press.

Lilien, David (1982), "Sectoral Shifts and Cyclical Unemployment," Journal of Political Economy 90, 777-93.

Millard, S. P. and D. T. Mortensen (1995) "The Unemployment and Welfare Effects of Labour Market Policy: A Comparison of the US and UK," mimeo, Northwestern University.

Ministry of Labor of Korea, Data of Revision Results on Employment (I), (II), 1991.

Ministry of Labor of Korea, Survey Report of Monthly Labor Statistics.

Mortensen, D. and C. Pissarides (1994) "Job Creation and Job Destruction in the Theory of Unemployment," Review of Economic Studies, 61, 3, 397-415.

Nam, Jaeryang (1997) "Research on the Trend in the Unemployment Rate of Korea." Seoul National University Economics Ph.D. Thesis.

National Statistical Office of Korea (1994) Changes in the Employment Situation for the Past 30 Years - A Review of the Economically Active Population Survey.

National Statistical Office of Korea, Economically Active Population Survey.

National Statistical Office of Korea, Special Survey Report of Employment Structure.

Neuman, George R., and Robert H. Topel (1991) "Employment Risk, Diversification and Unemployment," Quarterly Journal of Economics 106, 1341-1365.

Pissarides, C. A. (1990), Equilibrium Unemployment Theory, Oxford: Basil Blackwell.

Rhee, Changyong (1997) "Curb Market Interest Rates in Korea," Korea Social Science Journal 24 (1), 91-118.

Sargent, T. and L. Ljungqvist (1998) "The European Unemployment Dilemma," Journal of Political Economy 106:3, 514-550.

Topel, Robert (1991) "Specific Capital, Mobility and Wages: Wages Rise with Seniority," Journal of Political Economy 99, 145-176.

Table 1: Changes in Unemployment Rates across Groups

Sector	period	All	Male	Female	Young	Primary	Old
Aggregate	70-72	4.57	5.42	2.87	9.04	3.21	1.85
	90-92	2.40	2.67	1.94	7.39	1.75	0.54
	Change	-2.16	-2.75	-0.93	-1.64	-1.45	-1.31
	(%)	(-47.6)	(-50.7)	(-32.4)	(-18.2)	(-45.3)	(-70.7)
Non-agricultural	70-72	7.47	8.46	5.18	13.9	5.35	4.46
	90-92	2.73	3.02	2.31	7.38	1.96	1.60
	Change	-4.73	-5.44	-2.87	-6.53	-3.39	-2.87
	(%)	(-63.4)	(-64.3)	(-55.4)	(-47.0)	(-63.4)	(-64.2)

Note: Numbers in parenthesis represent percentage changes.

Table 2: Decomposition of Unemployment Rate between 1970 and 1996

Sector	Frequency	Actual Change	Composition Effect	Unemployment-Rate effect	Approx. Error
Aggregate	Annual	-2.08	-.85 (41.1)	-.89 (42.9)	-.33 (16.0)
	3-year avg.	-2.17	-.87 (40.4)	-1.11 (51.4)	-.18 (8.2)
Non-agri.	Annual	-4.76	-1.55 (32.5)	-3.73 (78.3)	.51 (-10.8)
	3-year avg.	-4.72	-1.47 (31.1)	-3.81 (80.7)	.56 (-11.8)

Note: Numbers in parenthesis show the contribution of each component in percentage.

Table 3: Labor Market Response to Changes in Parameters

Changes in Parameters	Unemployment Rate	Job-Separation Rate	Job-Finding Rate
Increase in g	0	0	0
Increase in (a-b)	–	–	+
Increase in β	+	–	?
Decrease in r	+	+	+
Increase in k	–	+	+
Decrease in σ	–	–	0
Decrease in λ	–	–	+ (very little)
Data	–	–	0

Figure 1: Unemployment Rates in Korea for 1963-1996

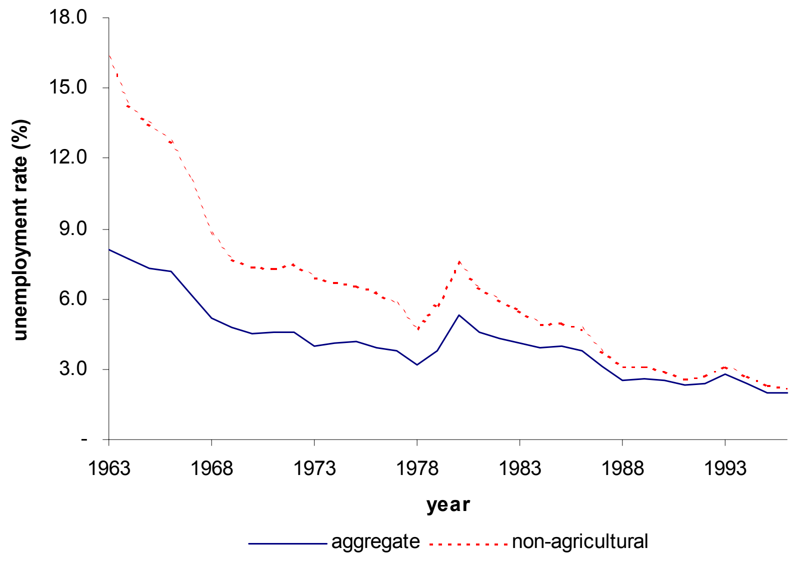

Figure 2: GDP Growth Rates of Korea

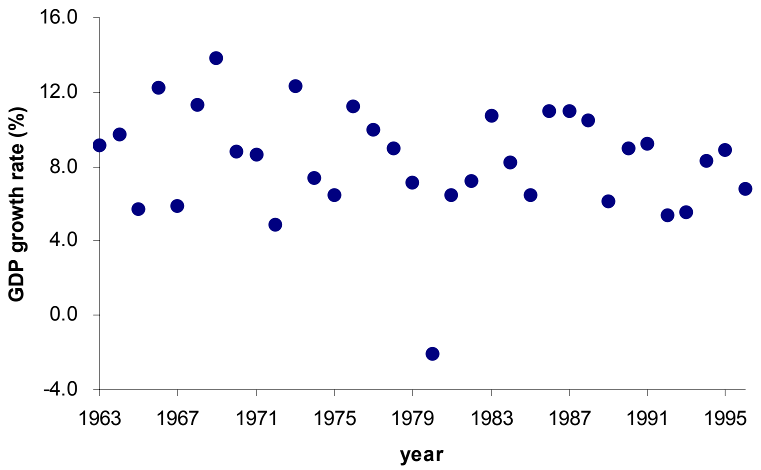

Figure 3: Job-Separation Rates

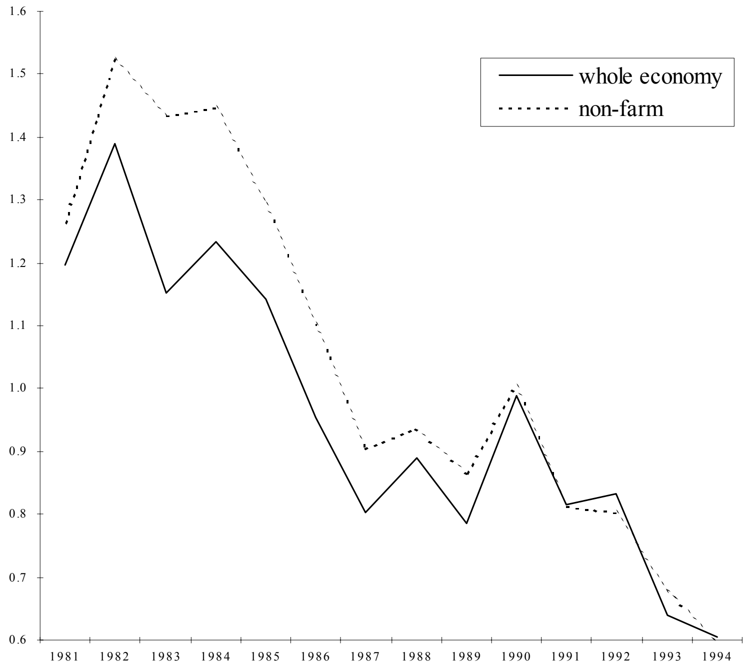

Figure 4: Job-Finding Rates

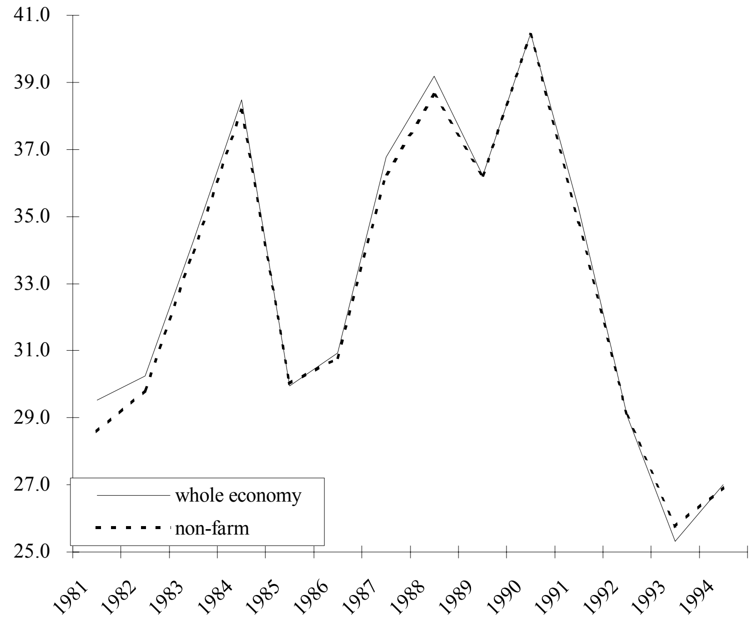

Figure 5: Labor Market Equilibrium with Various Values of *a-b*

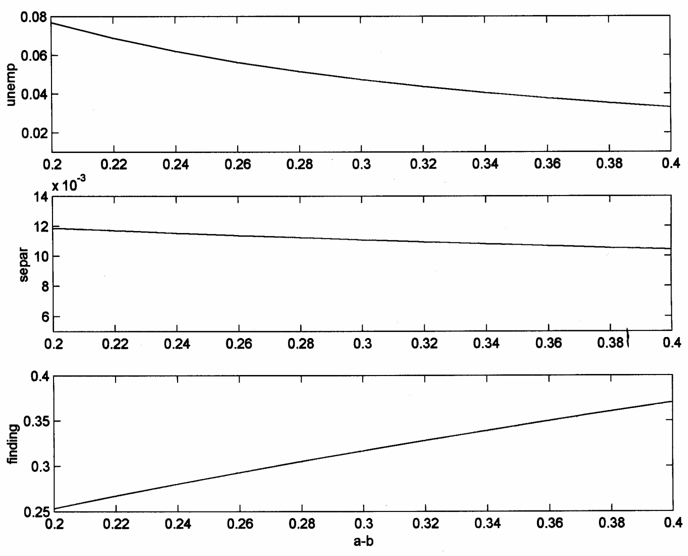

Figure 6: Labor Market Equilibrium with Various Values of β

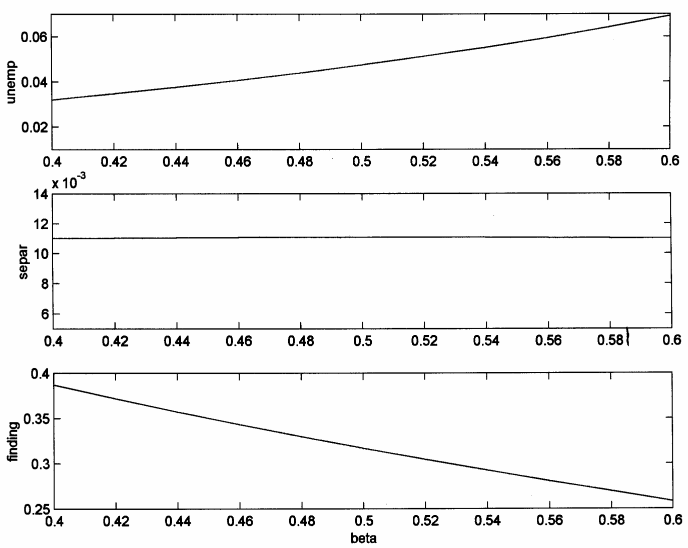

Figure 7 Labor Market Equilibrium with Various Values of *r*

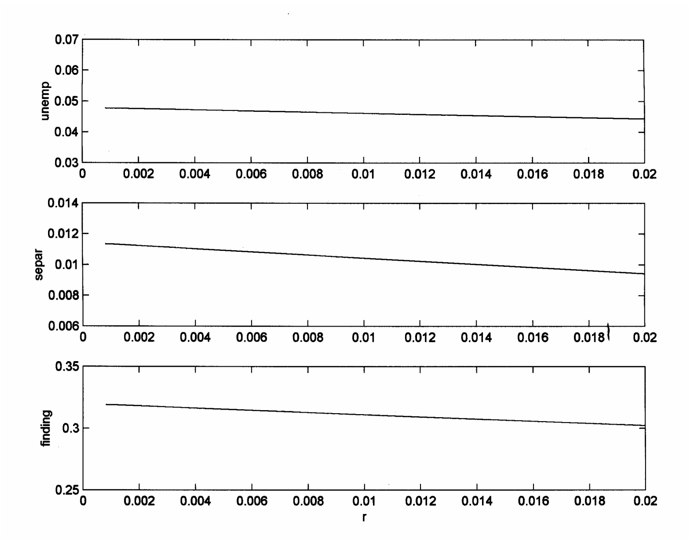

Figure 8: Labor Market Equilibrium with various values of *k*

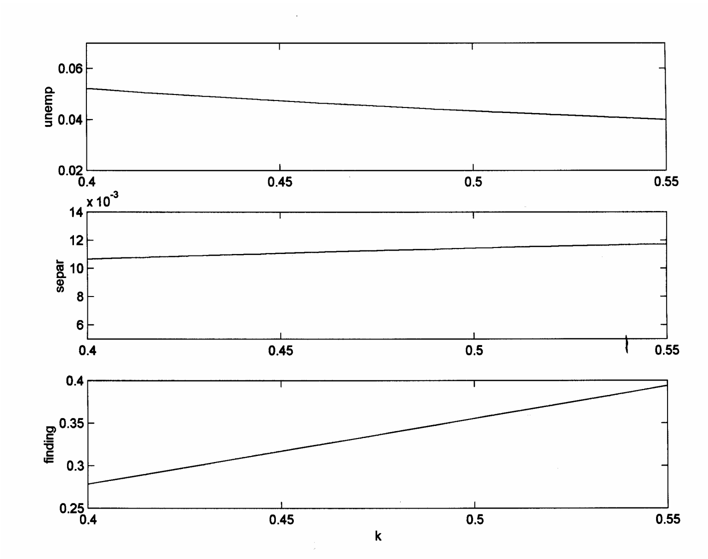

Figure 9: Labor Market Equilibrium with Various Values of σ

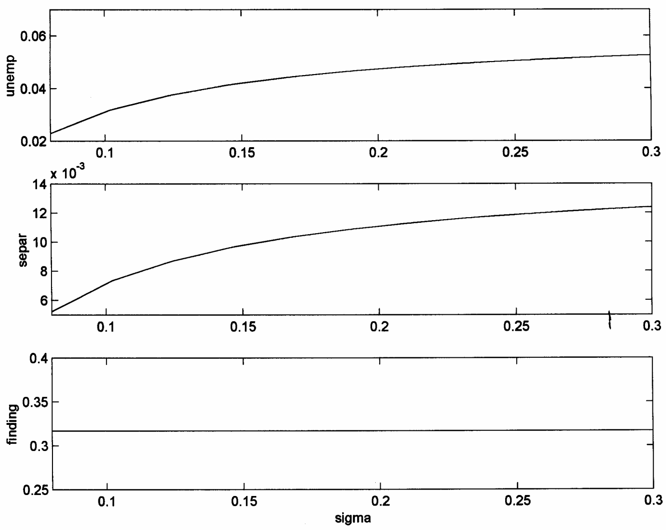

Figure 10: Labor Market Equilibrium with Various Values of λ

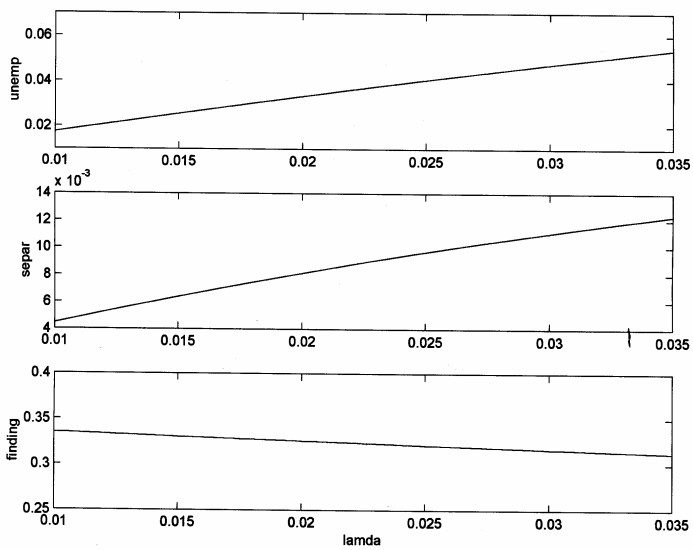

Figure 11: Output Share in GDP

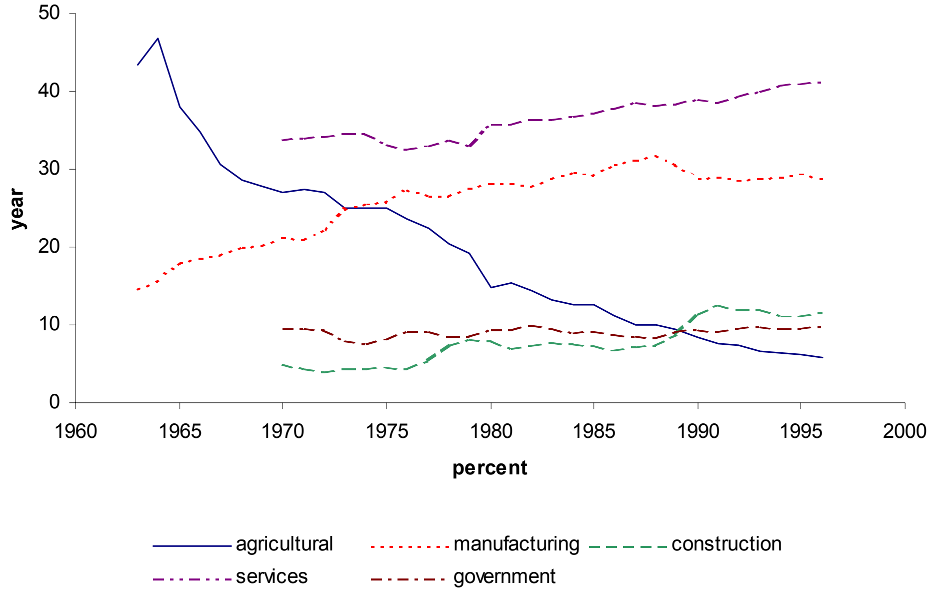

Figure 12 Sectoral-Shift Measures