Regional Unemployment Rate Convergence in Israel

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Abstract

Since the 1990s, many labor market economists have examined the persistent disparities in regional unemployment rates in most economies. In Israel, too, significant and increasing differences between unemployment rates in different regions were documented. This paper implements time-series techniques to test whether quarterly unemployment rates in the six Israeli districts converge. Although the gaps between regional unemployment rates widened in the period under consideration, empirical tests show that all regional unemployment rates converge in the long run, except that in the Southern district. Additional tests on pairs of regions show that the unemployment rates in the majority of pairs converge, most notably in the case of adjacent regions.

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1. Introduction

In the last few decades, most European economies suffered from high and persistent unemployment. Numerous macroeconomic studies examined the differences in the labor market institutions—such as the system of unemployment benefits, the rate of unionization and trade union power, the extent of wage bargaining co-ordination, employment protection laws and labor taxes—and showed that they were the main reasons for unemployment rate disparities among countries (Burda, 1988, Layard et al., 1991, Fitoussi et al., 2000, Nickell et al., 2005, and others). At the beginning of the 1990s labor market economists focused on the significant regional unemployment rate disparities (between the regions of the same economy), since it became obvious that the dimensions of the regional unemployment disparities are comparable with the differences in the economy-wide unemployment rates.[1]

Although regional unemployment rates usually move in the same direction as the national unemployment rate, regional disparities still persist. In many countries, especially in Europe, an impressive stability in the regional unemployment rate disparities for prolonged periods allows division of the regions into high- and low-unemployment 'clubs.' Overman and Puga (2000), who examined regional unemployment rate evolutions in 11 member countries of the European Union during 1986-96, found that their location order remained the same. The unemployment rates in Wales, Scotland and north of England were higher than those in the south and east of England as early as in the 1950s and 1960s, when unemployment in Britain was relatively low (Martin, 1997). In the U.S., the regional unemployment system operates differently: there are no clubs—a high-unemployment region in one year may be characterized by low unemployment in another (Blanchard and Katz, 1992). Evans and McCormick (1994) found a high correlation between the 1975 and 1987 unemployment rates in Britain, Italy, and Japan, a moderate correlation in Germany and Sweden, but no significant correlation in the U.S. Note that labor market institutions cannot explain the existence of regional unemployment disparities because they are the same among regions.[2]

In this paper, we employ time-series techniques to examine regional unemployment rate convergence in Israel. In particular, we use stationarity tests to distinguish

[1] For example, Taylor and Bradeley (1997) showed that in 1984-94 regional unemployment disparities in Italy, Germany, and Britain were larger than the differences between their economy-wide average unemployment rates.

[2] However, this argument is not valid for North American countries.

between permanent and temporary regional disparities. Existing economic convergence literature focuses primarily on narrowing regional differences in regional product per capita and its growth rate, or in regional income per capita or wages. To the best of our knowledge, the only research which used growth convergence analysis techniques on regional unemployment rate convergence, was carried out in Germany (Bayer and Juessen, 2006). The relative abundance of data on regional unemployment rates in Israel—quarterly data as compared to yearly data in above-mentioned paper—enables us to construct time series, which are long enough to rely on simple stationarity tests[3] and to employ additional time-series techniques.

The rest of the paper is organized as follows: section 2 provides the theoretical background for convergence, section 3 presents graphical analysis of regional unemployment disparities in Israel from 1970 on, section 4 presents the research methodology, section 5 reports the empirical results, section 6 discusses unemployment rate convergence between pairs of regions as a measure of regional integration, and finally, section 7 concludes.

2. Theoretical background

Four factors influence regional unemployment rate differences: individual decisions with regard to labor force participation, residential and migration choices by households, location choices by firms, and the extent of wage flexibility (Aragon et al., 2003). To illustrate, consider an enterprise closure in some region as a negative shock to employment. In the framework of the labor market competitive model, some newly unemployed decide to migrate to another region characterized by a relatively low unemployment rate and therefore with a higher probability of finding a job. As the surplus of labor supply in the problematic region pushes the wage down, those individuals whose wage threshold is higher than the competitive wage leave the labor force voluntarily, while a relatively low wage attracts new employers to the region. The simultaneous operation of all these forces narrows regional differences in the unemployment rates until they disappear. But since the process of convergence is in general slow, it could be the case that regional unemployment disparities will remain for prolonged periods. The slowness of the convergence process and resulting

[3] Relatively short time-series of yearly data for 1960-2000 forced Bayer and Juessen (2006) to handle panel stationarity test.

persistence of the regional disparities are determined by the speed of the above-mentioned adjustment mechanism.

Blanchard and Katz (1992) stressed that a quick return of the regional unemployment rates to their long-run averages and a low persistence in regional disparities in the U.S. are likely to be a result of widespread internal migration in response to the shocks in the regional labor demand. In Europe, regional disparities are much more persistent, while internal migration rates are substantially lower than in the U.S. One explanation for the different migration patterns in Europe and in the U.S. is found in Oswald's (1997) paper, in which he asserts that a relatively high residential ownership rate in most of the European countries significantly raises the cost of moving and harms the geographic mobility of their citizens. Regional differences in housing ownership rates are likely to curb worker mobility and to prevent regional unemployment disparities from being reduced. Another explanation for persistent regional disparities in Europe is the fact that there is a uniform minimum wage level in all regions, while in the U.S. each state may set its own minimum wage (that is equal to or higher than the federal one). This uniform level of minimum wage is likely to be relatively high compared to labor productivity in economically lagging poor regions.[4] Generous unemployment insurance systems also slow down regional unemployment-rate convergence, because the unemployed are not really forced to seek a new job as long as they receive subsistent unemployment benefits.

An alternative approach assumes that persistent regional unemployment disparities are not caused by regional differences in labor demand, but originate from the differences in regional equilibrium unemployment rates. Each region has its own natural unemployment rate; shocks drive the whole regional system out of equilibrium, but after an adjustment process regional unemployment-rate differences return to their equilibrium values. As claimed by Marston (1985), the equilibrium differences between regional unemployment rates reflect individual preferences for settling down in specific regions. A simple regional model assumes that the equilibrium unemployment rate in each region is a function of living arrangements, infrastructure quality and the quantity of production factors, so that the differences in all these generate the differences among regional natural unemployment rates. Since regional

[4] Because wage bargaining is usually centralized and collective agreements are common for all regions in European countries, the average level of wages in poorer regions is heavily influenced by the threshold wage level of the workers in more prosperous regions (Brunello et al., 2001).

characteristics are changing slowly, if at all, the change in the differences between regional unemployment rates is slow. In this model, workers maximize utility, which is a function of consumption (*C*) and regional amenities (*A*), subject to their budget constraint. Without unemployment insurance, consumption cannot exceed expected earnings, which equal the wage rate times the probability of being employed (roughly, wage rate times one minus unemployment rate). Optimizing yields an indirect utility function of the form:

$$V(w_i^*, u_i^*, A_i) = K \tag{1}$$

for each region *i* and for some constant utility level, *K*, where w_i^* and u_i^* are the optimized values for wage and unemployment rates. In the equilibrium, a worker derives the same level of utility in any region by different variations of amenities, wage level and unemployment rate. For example, mild climate, a clean environment, developed infrastructure and active cultural life may compensate for a relatively high unemployment rate in the region. Another consequence is that a region characterized by relatively low living expenses, other things being equal, has to be a high-unemployment region. For given a nominal wage level lower prices could be interpreted as a higher real wage. Because the most important component of the living costs is housing cost, relatively high unemployment rate is expected in the regions where housing expenses, including rent, are low. In Israel, housing market prices are characterized by high regional differences.[5] In this connection, it is important to note that uniform national unemployment insurance system is likely to slow down the job-seeking process in the relatively cheap regions compared to expensive ones and to reinforce the unemployment disparities between them.

Two alternative approaches to regional unemployment disparities were summarized by Marston (1985, p. 57):

> *"Economic and social barriers may separate local labor markets. If these barriers restrict mobility severely, then weak labor demand in one geographic area will raise the unemployment rate there above its level in areas with stronger labor demand.*
>
> *On the other hand, if mobility is relatively free between areas, then strong labor demand elsewhere will lure workers away from a high unemployment area. Excess labor in the area will vanish quickly unless workers are compensated in some way*

[5] For example: according to the CBS data, average apartment rent in the Southern region is lower by 40 percent than that in the Tel Aviv metropolis and the price for an average owner-occupied apartment in the Southern region is lower by approximately 60 percent than that in the Tel Aviv metropolis.

that induces them to remain there voluntarily. Any persistent geographic unemployment differentials, then, are not evidence of uneven labor demand, but reflections of workers' underlying preferences for certain areas."

Let u_i and u_j be the unemployment rates in regions *i* and *j* and assume that, at some initial point, the unemployment rate in region *i* was higher than that in region *j*, $u_{i0} > u_{j0}$. The difference between the two unemployment rates at each point of time, *t*, is $u_{it} - u_{jt}$. Implementation of Bernard and Durlauf definition 2.1 (1995, p. 99) for regional unemployment rates presents convergence as long-run forecast equalization, while the forecasting horizon tends to infinity:

$$\lim_{k\to\infty} E\left(u_{i,t+k} - u_{j,t+k} \middle| I_t\right) = 0 \quad \text{for all } t, \tag{2}$$

where I_t is the information set available at time *t*. This type of convergence is defined as 'unconditional convergence.' To define an equilibrium with time-invariant differentials we use the following definition of 'conditional convergence':

$$\lim_{k\to\infty} E\left(u_{i,t+k} - u_{j,t+k} \middle| I_t\right) = c \text{ for all t}, \tag{3}$$

where *c* is a constant. Regional unemployment rates u_i and u_j converge in the long run up to some constant differential.

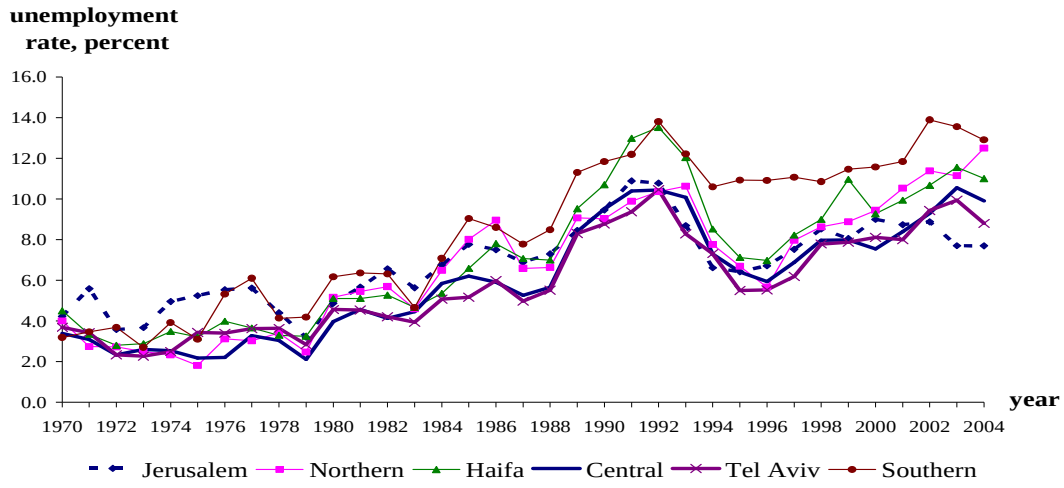
Because internal migration is one of the adjustment mechanisms, the speed of convergence depends upon workers and firms mobility. But migration can exert an influence in another way, actually preventing convergence. Empirical studies show that spatial mobility is rather selective and usually characterizes young, well-educated individuals with initiative (see for example, Martin, 1997, Aragon et al., 2003). If such workers decide to leave the region after the rise of unemployment—the brain drain—and those who stay are less educated and less skilled, the temporary influence of the demand shock is likely to become a permanent problem of the regional labor force quality. Firms are usually reluctant to locate in the areas where high proportion of the unemployed are older and less skilled (Aragon et al., 2003). A decrease in the average educational level of the regional labor force and an accompanying decrease in labor productivity hamper employment growth and even cause economic retreat, thus deepening the problem of unemployment. In other words, instead of being an effective mechanism of restoring equilibrium, internal migration is likely to cause a divergence of the regional unemployment rates and to lead to greater inter-regional inequality.

3. What can be learned about the persistence of regional unemployment disparities—a graphical presentation

Chart 1 presents the evolution of regional unemployment rates during the period 1970-2004 for the Jerusalem, Northern, Haifa, Central, Tel Aviv and Southern districts, as determined by the CBS (Central Bureau of Statistics) administrative division. Regional unemployment rates were calculated from the raw data of the Labor Force Surveys, as the number of unemployed divided by the labor force, multiplied by 100.

Chart 1 shows that regional disparities were noted as early as in the 1970s, when the economy was at full employment. Although there is marked similarity among the general patterns, except for the Southern district,[6] the absolute differentials widened with time.

Chart 1: Unemployment rates in Israeli districts, 1970-2004

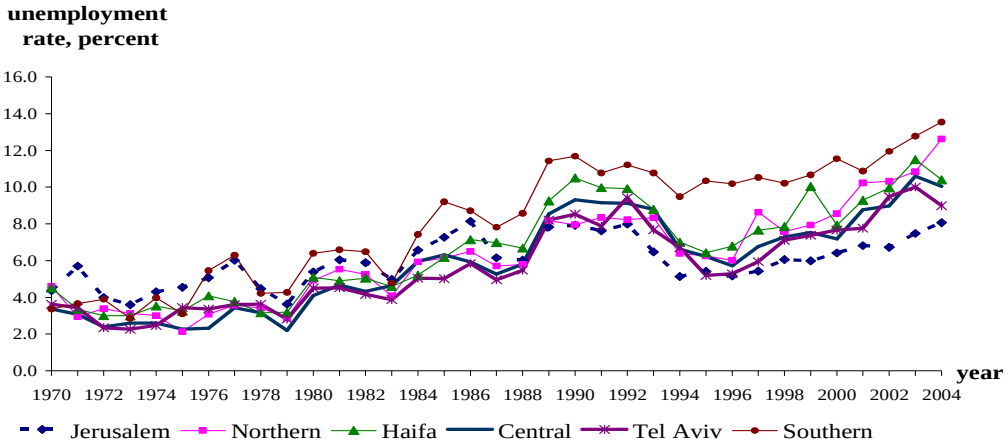


Source: Central Bureau of Statistics and authors' calculations

Preliminary observation of the regional unemployment rates suggests that regional unemployment disparities originate from a non-uniform geographic dispersion of new immigrants (who arrived in 1990 and after) and Arabs, because their unemployment rates generally differ from that of the veteran Jewish population. But more detailed examination reveals that regional differences among the veteran Jewish regional unemployment rates are also substantial.

[6] Note that in 1994, when the labor market situation improved all over the economy as a result of absorption of new immigrants in employment, the unemployment rate in the Southern district remained high, above 10 percent.

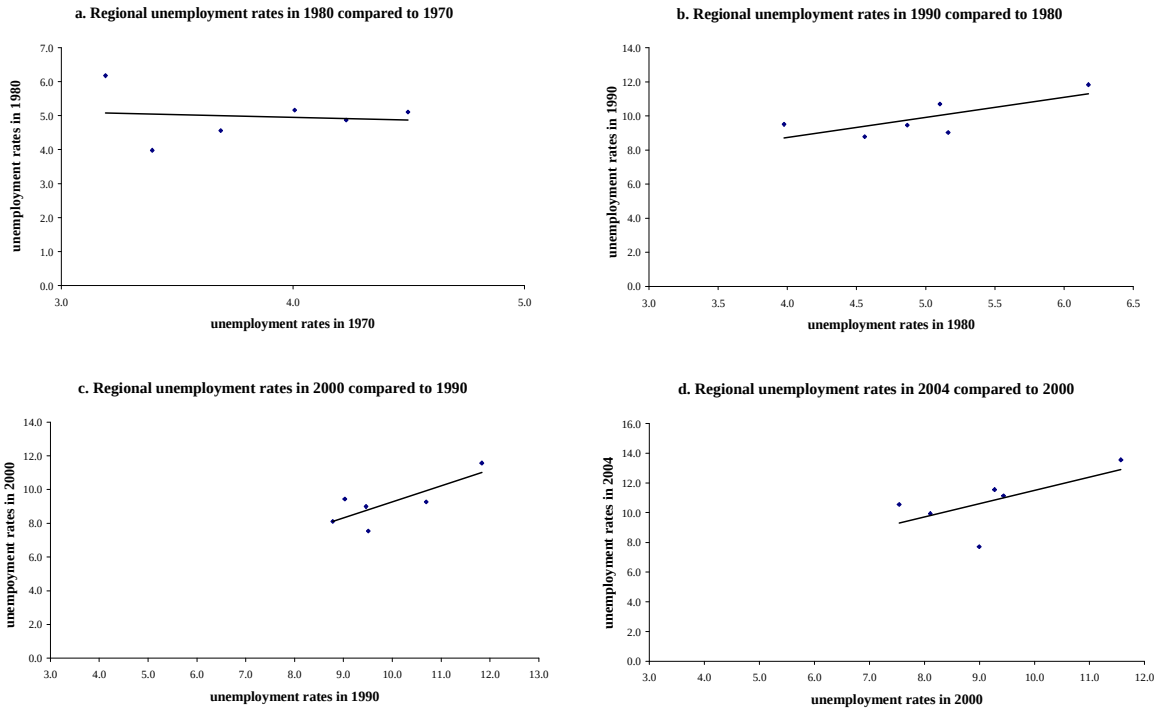
Chart 2: Unemployment rates among Jewish veteran population (without new immigrants), 1970-2004



Source: Central Bureau of Statistics and authors' calculations

To evaluate the extent of persistence of the regional unemployment gaps, the whole period was split into decades: 1970s, 1980s, 1990s and 2000-2004. Chart 3 presents unemployment rates in the same region at the beginning of each period and at the beginning of the following one.

Chart 3



Addition of a trend line indicates the intensity of the correlation between the unemployment rates in the two time points. High/low unemployment rates in the two periods and a rising trend line match the case of high persistence, when a region is characterized by a consistently high/low unemployment rate. On the other hand, in a region which can be characterized by a high unemployment rate in one year and by low unemployment rate in another, there will be no correlation between the unemployment rates in these two years. Chart 3a shows that this situation was typical in the 1970s, but the next decade was marked by an emerging trend of persistency, which strengthened in the 1990s. Additionally, the rate of unemployment increased substantially, following the 1985 stabilization plan and thereafter—as a consequence of massive immigration from the former U.S.S.R.

An alternative presentation of the persistence of regional gap traces the evolution of regional unemployment rates compared to those in the rest of the economy. For the purpose of this comparison unemployment rates in the rest of the economy were calculated as unemployment rates in the economy without a district itself.[7] In such a way we examined the evolution of the unemployment rate in the Jerusalem district compared to the evolution of weighted average of the unemployment rates in the Northern, Haifa, Central, Tel Aviv and Southern districts and repeated this exercise for each one of the six districts.

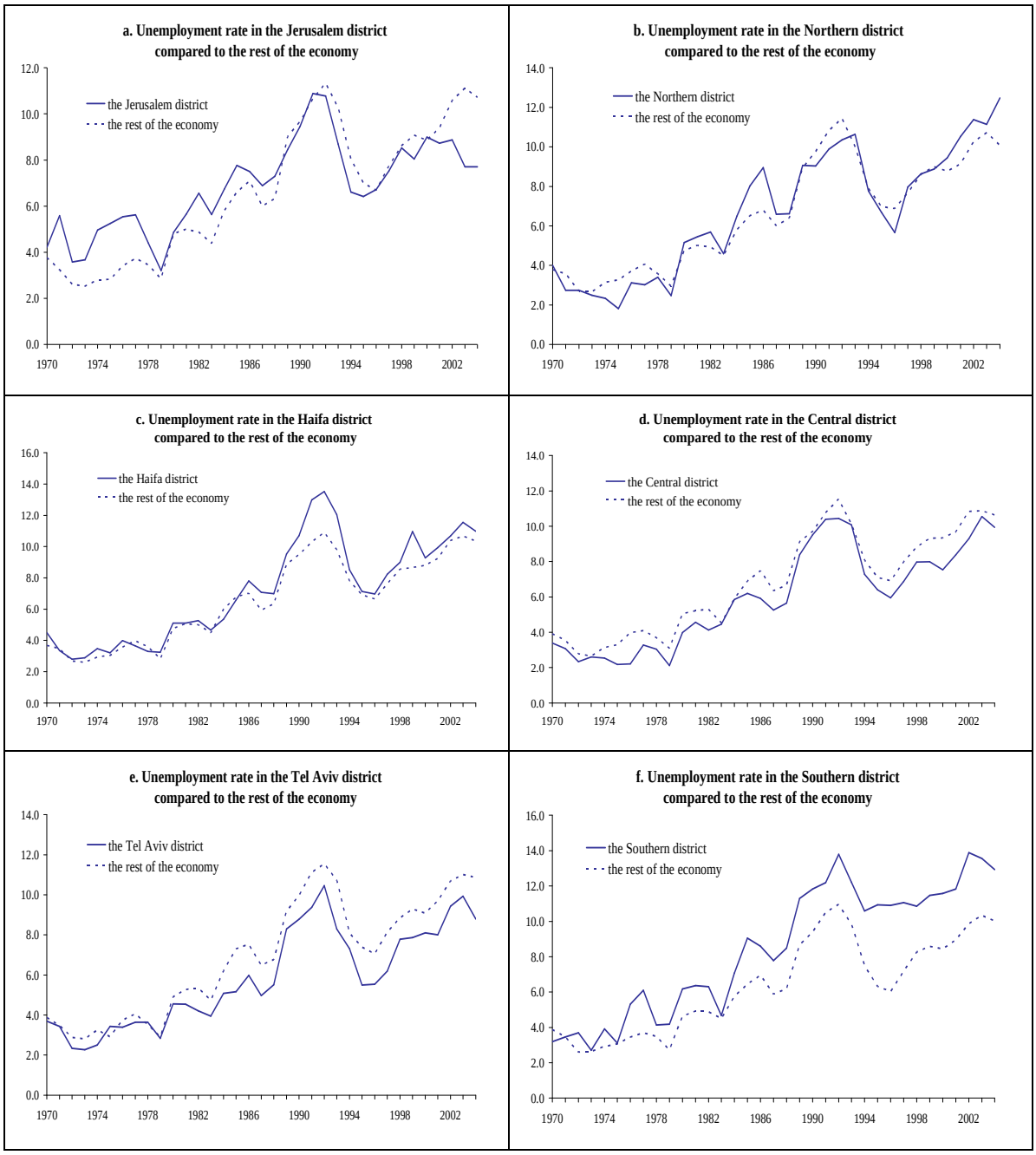
Chart 4 indicates following trends:

In the Jerusalem district, the unemployment rate was significantly higher than in the rest of the economy during the 1970s, but at the end of the decade the gap narrowed and over the course of the 1980s the district's relative status improved. From the beginning of the 1990s the situation improved in the Jerusalem district, which then operated better than the rest of the economy, especially in the 2000s.

It is not possible to identify any persistent trend in the Northern district. Its unemployment rate was low compared to the rest of the economy in the 1970s, higher than that during most of the 1980s, equal to or less than that in the rest of the economy in the 1990s and again, higher than that in the 2000s.

[7] We prefer to use 'the rest of the economy' unemployment rate instead of the overall economy unemployment rate, which is a weighted average of all the regional unemployment rates, including one under consideration. As a result, there is a correlation between the region's unemployment rate and national unemployment rate, which strengthens as the relative size of the regional labor force (weighting factor) increases (for a discussion see Shepherd and Dixon (2002, p. 471-2).

Chart 4



In the Haifa district, the labor market operated like the rest of the economy until the middle 1980s, but since then its unemployment rate was higher than in the rest of the economy, with a gap expanding in the first years of mass immigration from the former U.S.S.R (as a result of substantial proportion of immigrants settling down in the district).

The unemployment rates in the Central and Tel Aviv districts were characterized by the same pattern: they were consistently lower than in the rest of the economy. On the other hand, the Southern district's labor market was operating poorly all the time

(except for the beginning of the 1970s). The gap between the Southern district and the rest-of-the-economy unemployment rate widened in the middle 1980s (during the stabilization plan era), remained high at the beginning of mass immigration from the former Soviet Union (a large proportion of immigrants chose to settle down in the Southern district due to relatively cheap housing and high accessibility to public housing) and has continued to increase since the second half of the 1990s. So the data indicate that regional unemployment-rate disparities persisted in the Central, Tel Aviv and Southern districts only.

For the purposes of empirical tests, which will be discussed in details in the next section, we constructed twelve quarterly seasonally adjusted series for regional unemployment rates. For each region j two series were constructed: the unemployment rate in the region, u_j and the weighted average unemployment rate in the rest of the economy, $\overline{u}_{N/j}$. Then, a series of the differences was calculated for each region, $u_j - \overline{u}_{N/j}$, i.e., the regional unemployment rate less the rest-of-the-economy unemployment rate.

4. Methodology

In the growth literature, the neo-classical convergence hypothesis is based upon two assumptions. Firstly, the GDP per capita in the steady state does not depend on its initial level and secondly, there is a negative correlation between the growth rate and the initial GDP per capita in the cross-section of economies, a relationship which is known as β-convergence.[8] Convergence hypothesis was tested empirically according to these theoretical assumptions in a large cross-section of countries. Bernard and Durlauf (1995) criticized this cross-sectional approach to the test of convergence, especially due to the test hypotheses definition. They claimed that "*the cross-section procedures work with the null hypothesis that no countries are converging and the alternative hypothesis that all countries are, which leaves out a host of intermediate cases*" (p. 98). Bernard and Durlauf (1995, 1996) proposed an alternative definition for the convergence tests relying on a time-series approach. A new proposed technique enabled testing for the existence of the sub-groups of converging economies

[8] A negative correlation between the GDP per capita at the beginning and its growth rate marks a process of catching up, as initially less-developed economies grow faster than economies with initially high GDP per capita.

(defined as having common long-run stochastic and deterministic trends) so improving an 'all or nothing' approach. This new definition led to the use of co-integrative techniques for testing the convergence hypothesis.

Definition 2.1 in Bernard and Durlauf (1995, p. 99), which characterizes convergence between a pair of economies, *i* and *j*, could be expanded to the group of *N* economies, in which each pair satisfies the convergence condition. Convergence in the group *N* is defined as zero differences in the long-run forecasts in each pair of countries, as the forecasting horizon tends to infinity:

$$\lim_{k\to\infty} E(u_{1,t+k} - u_{n,t+k} | I_t) = 0 \text{ for all } n \neq 1 \ . \tag{4}$$

From the empirical point of view, to satisfy this definition of convergence the process $u_{1,t+k} - u_{n,t+k}$ has to be mean zero stationary. In other words, convergence results from the fact that these differences are transitory and in the long-run they converge to zero. According to this definition, the series of differences have to be stationary without a deterministic trend or intercept as a necessary condition for convergence, and the series of the regional unemployment rates have to be co-integrated as an additional condition. But even if the series do not converge by definition (4) they can contain a common trend if the long-term forecasts of unemployment rates are proportional in period t (according definition 2.2' in Bernard and Durlauf (1995, p. 100):

$$\lim_{k\to\infty} E(u_{1,t+k} - \alpha_n' \overline{u}_{t+k} | I_t) = 0 \text{ , where } \overline{u}_t = \left[u_{2,t} u_{3,t} ... u_{n,t}\right] \ . \tag{5}$$

If the series are trend-stationary, all of them have to be characterized by a common deterministic time trend.

Bernard and Durlauf (1995) suggested performing empirical tests in the Vector Error Correction Model (VEC) framework. As a preliminary stage for the test, a simple unit-root test for each individual series is needed to determine its order of integration. Note that a co-integration test is econometrically reasonable only if all the individual series are integrated of the same order. The co-integration test is implemented by Johanssen's (1988) approach.

While Bernard and Durlauf (1995) proposed the definition for unconditional convergence, for which it is hard to reject the null of no convergence, other researchers (Mankiw et al., 1992, Carlino and Mills, 1993, Evans and Karras, 1996) assumed that convergence may be conditional, meaning that each region approaches its own steady-state unemployment rate, keeping the regional differentials constant in

equilibrium (as in the definition (3) above), which can be viewed as compensating differentials. These differentials may be caused by regional industry specialization or/and by labor force characteristics, such as educational and skills level, participation rates, etc. or by the differences in amenities.

We use a basic model proposed by Evans and Karras (1996), whose definition of convergence enables us to distinguish between conditional and unconditional types of convergence (based on definition 2.1.4, p. 252). We implement this model for unemployment rates and use the weighted average of the unemployment rates in the rest of the economy instead of the average overall unemployment rate in the economy:

$$\lim_{k\to\infty} E_t(u_{j,t+k} - \bar{u}_{N/j,t+k}) = \mu_j\,, \qquad (6)$$

where $\bar{u}_{N/j,t}$ is the average rest-of-the-economy unemployment rate calculated as $\sum_{i=1,i\neq j}^{N} \frac{u_{it}}{N}$.

Given the information set available at time *t*, regional unemployment-rate deviations from the average of the rest of the economy are expected to converge to the constant values as the forecasting horizon tends to infinity. Definition (6) holds only if the series of deviations, $u_{jt} - \bar{u}_{N/j,t}$, are stationary with the mean μ_j for $j = 1,2,...,N$. All *N* regions are defined as converging if each regional series, u_{jt}, is not stationary but all the deviation series, $u_{jt} - \bar{u}_{N/j,t}$, are. Unconditional convergence is defined as $\mu_j = 0$ for all j and conditional convergence is defined as $\mu_j \neq 0$ for some *j*'s. The regions are diverging if the series $u_{jt} - \bar{u}_{N/j,t}$ are non-stationary for all *j*.

Carlino and Mills (1993) and Evans and Karras (1996) showed that a stochastic convergence test can be implemented through the Dickey-Fuller unit root test for the series of regional deviations. In our case the test will examine the unit root in the unemployment-rate differences, $u_j - \bar{u}_{N/j}$:

$$\Delta(u_{j,t} - \bar{u}_{N/j,t}) = \phi + (\rho - 1)(u_{j,t-1} - \bar{u}_{N/j,t-1}) + \sum_{k=1}^{h} \delta_k \Delta(u_{j,t-k} - \bar{u}_{N/j,t-k}) + \varepsilon_t\,. \quad (7)$$

Unit root presence in the series of differences ($\rho = 1$) indicates divergence. An alternative hypothesis is $|\rho| < 1$, meaning a stationary series of differences. The stationarity test enables us not only to test for convergence in the regional unemployment-rate series, but also to distinguish between conditional and

unconditional convergence and between equilibrium and non-equilibrium approaches to the regional unemployment disparities, as pointed out by Marston (1995). Unconditional convergence corresponding to the non-equilibrium approach is characterized by zero mean, which can be defined as $E(u_t) = \mu = \frac{\phi}{1-\rho}$. So the unconditional convergence is characterized by zero intercept, $\phi = 0$, in equation (7). Rowthorn and Glyn (2002) showed that the unconditional convergence hypothesis can be tested by the stationarity test, which estimates regression (7) without a deterministic time trend and intercept. Conditional convergence, which corresponds to the equilibrium approach with time-invariant differences in the regional natural unemployment rates, is interpreted as level stationary series with non-zero intercept, $\phi \neq 0$, in equation (7).

To summarize, below are conditions for all three possible outcomes:

Unconditional convergence	Conditional convergence	Divergence
$\lvert\rho\rvert < 1,\ \phi = 0$	$\lvert\rho\rvert < 1,\ \phi \neq 0$	$\rho = 1$

Incorporation of a deterministic time trend is not supposed to indicate lack of convergence, because the convergence under consideration is a stochastic one. Nonetheless a time trend in the data is likely to indicate difficulty in narrowing the gap and lengthening the period necessary for convergence.

5. Results

At the first stage of the empirical analysis, we test for unconditional convergence according to Bernard and Durlauf's (1995) approach using the Vector Error Correction Model. As stated earlier, applying the VEC model requires stationarity tests to be performed for all regional unemployment-rate series. But prior to that some discussion regarding unemployment-rate variable possible non-stationarity is required.

Theoretically, the unemployment-rate variable cannot be non-stationary because its value is limited (between 0 and 100 percent). In practice, it is defined in a much narrower range. Nevertheless stationarity holds in the long run; during the relatively short periods (and in this context 30 years is a relatively short period of time) stationarity tests generally detect non-stationarity in the unemployment-rate time series in the majority of countries. Empirical evidence can be found in the bulk of

studies; we will mention only a few examples. In his comprehensive study dealing with possible explanations for the rise of unemployment in the OECD countries, Elmerskov (1993) pointed out that in 1969-91 unemployment rates were non-stationary in the majority of countries under consideration.[9] In a similar way, Arestis and Biefang-Frisancho Mariscal (1999) reported that ADF tests in 26 OECD countries could not reject a unit root hypothesis, based on 1960-97 data. Papell et al. (2000) could not reject a unit root hypothesis in the sample of 16 OECD countries' unemployment rates in 1955-97, not only in the individual time series (with and without deterministic time trend), but also in the panel data set.

High and persistent unemployment documented in the majority of OECD countries since the middle 1970s led economists to change their way of thinking: a simple model of a long-run equilibrium allowing unemployment-rate fluctuations around its equilibrium value in the short run has been challenged by more sophisticated models, such as hysteresis theory, explaining extreme persistence in the unemployment rates, and structuralist theories, which allow the natural rate of unemployment to change over time. Gradual change of the natural unemployment rate may result from demographical and institutional changes, such that unemployment-rate series can be trend-stationary. However, occasional sharp jumps in the natural unemployment rate are hard to explain. Such jumps must originate from a shock whose influence turns out to be permanent, while the shocks are usually temporary and their effect ends sooner or later.

In the absence of other reasonable explanations, hysteresis theory became the most popular one in the studies on dramatic increases in unemployment in Europe. Blanchard and Summers (1986) defined hysteresis as "*a very high dependence of current unemployment on past unemployment*"; technically, discovering hysteresis in the data is identical to the non-rejection of the unit root (p. 17). Alternatively, structuralist theories describe the natural unemployment rate as the current equilibrium steady-state rate appropriate to the current level of capital stock and other variables. Phelps (1994) developed a series of models in which real structural factors, such as sectoral demands, supply of production factors, technology, tax rates, real interest rates throughout the world and real exchange rates, influence the natural rate

[9] In the Elmerskov (1993) paper, simple unit root test (ADF) could not reject the non-stationarity hypothesis in even one country. After adding deterministic components to the equation, the unit root hypothesis was rejected at a reasonable significance level only in the U.S., Britain, Canada, Australia, Finland, Island, Spain, Sweden and Switzerland.

of unemployment. Therefore shocks to these factors cause permanent fluctuations in the natural unemployment rate.

Alongside the development of theoretical models, new statistical procedures for their empirical examination were developed. Stationarity tests incorporating structural breaks attracted economists' attention since Perron's (1989) test; this test, which allows one structural break, succeeded in rejecting a unit root null in the majority of macroeconomic series. Later, tests allowing for several structural breaks were invented. However, the structural break model is problematic. First, there is no consensus about choosing the break point; to prevent correlation between the break date and the data the emphasis is put on exogeneity, such that choosing the date is completely technical, based on *t*-tests to increase the power of the statistical test.[10] In contrast, the choice of the break date based on economic analysis ought to take into account only events which cause really permanent changes that can be considered structural changes. Second, the structuralist model does not limit the number of breaks, although finding three, four or more breaks[11] is actually equivalent to finding unit root in the series.

5.1. Test for convergence using the VEC Model

For the stationarity tests we employed an ADF test with the number of lags chosen based on Akaike and Schwarz's criteria, *t*-tests and residual tests (in which the residuals have to exhibit white noise characteristics). Table A1 in the appendix presents the results of stationarity tests, which show the presence of the unit root in all the regional series, except for the Southern district. A basic test model included only an intercept, but for each series an alternative model with deterministic time trend was tested. Adding the time trend did not change our conclusion of non-stationarity; however, regarding the unemployment rate in the Southern district the result depends crucially on the inclusion of a deterministic time trend. A time trend model was chosen based on Akaike criterion and trend variable statistical significance. According to stationarity tests, the unemployment-rate behavior in the Southern district differs significantly from that in the rest of the regions. This unemployment-rate series is the only one for which non-stationarity hypothesis was rejected, at the 1% significance

[10] The choice based on economic logic causes an endogeneity problem (a correlation between the break date and the data) and harms the power of the test.

[11] For example Papell et al. (2000) found 4 significant breaks in the unemployment rate in France, Germany, Italy and the Netherlands and 3 significant breaks in Japan.

level. The unemployment rate in the south fluctuates around a rising time trend; this finding is not surprising considering the fact that for decades the Southern district attracted the most economically disadvantaged segments of the population due to relatively low housing prices and high accessibility of government housing, while stronger segments of the population abandoned the region for the economically more developed central regions (Braude and Navon, 2006). In the Northern district, addition of the time trend helps to reject the unit root, but at relatively low significance level (10%). Because construction of the VEC model is possible for the series of the same order of integration, we cannot include the Southern district unemployment rate in our further analysis.

The results of applying Johansen's likelihood methodology to examine stochastic convergence between the five series (excluding the Southern district) are reported in Table 1. The table reports Johansen's trace and max statistics, indicating whether the statistics are statistically significant at the 5% level (*).

Both the Akaike and Schwartz information criteria suggest the model with three lags and intercepts in VAR and co-integration equation. Table 1 shows that the trace statistic and the maximum eigenvalue statistic yield conflicting results. The first test indicates that there are three co-integrating equations, while the second test suggests only one such equation. Moreover, the number of long-run trends is sensitive to the lag length chosen for the VAR. According to the trace statistics, there are two co-

Table 1. Maximum likelihood co-integrated results (Vector Error Correction Model with five variables and three lags)

Trace Test				
Hypothesized number of co-integration equations (CE)	Eigenvalue	Trace statistic	Critical value at 5% signif. level	Probability *p*-value
None*	0.2889	100.38	69.82	0.0000
At most 1*	0.1609	54.01	47.86	0.0118
At most 2*	0.1391	30.05	29.80	0.0455
At most 3	0.0480	9.78	15.49	0.2979
At most 4	0.0225	3.09	3.84	0.0787
Maximum Test				
Hypothesized number of co-integration equations (CE)	Eigenvalue	Trace statistic	Critical value at 5% signif. level	Probability *p*-value
None*	0.2889	46.36	33.88	0.0010
At most 1	0.1609	23.86	27.58	0.1396
At most 2	0.1391	20.37	21.13	0.0636
At most 3	0.0480	6.69	14.26	0.5263
At most 4	0.0225	3.09	3.84	0.0787

Integrating equations in two-lag VAR, and there is one equation in a four-lag system (results are not reported). Thus, when considering all five series as a group, we find clear evidence of common trends, but no evidence of stochastic convergence as defined by Bernard and Durlauf (1995).

5.2. Test for convergence using difference series

At the next stage of the analysis we turn to convergence tests according to Carlino and Mills (1993) and Evans and Karras's (1996) methodology. For these tests we use the series of differences between the unemployment rate in the region and that in the rest of the economy, as they were defined earlier. The examination is carried out by the ADF test; for each difference series a model without an intercept represents unconditional convergence and a model with an intercept represents conditional convergence. As in the previous tests, these also do not include the Southern district.

Results presented in Table 2 show that the unemployment rates in the Jerusalem and Northern districts seem to unconditionally converge with the rest of the economy; the unit root null is rejected in these two series without an intercept at 5% significance level. In the Haifa district, too, we are able to reject the unit root, but the residual test indicates that the residuals are not a white noise process. Additional lags did not solve this problem, but the model with an intercept did; so the estimation results indicate

Table 2: Convergence test results for region *j* and the rest of the economy, quarterly seasonally adjusted data, 1970-2004.

District	Unconditional convergence			Conditional convergence			
	lags (*k*)	$\rho - 1$	*p*-value	lags (*k*)	ϕ	$\rho - 1$	*p*-value
Jerusalem	2	-0.128** (2.231)	0.0252				
Northern	4	-0.218** (2.169)	0.0294				
Haifa	2	-0.164** (2.511)	0.0122	2	0.152*** (1.867)	-0.256** (3.147)	0.0255
Central	8	-0.069 (1.174)	0.2186	1	-0.434* (4.509)	-0.520* (5.455)	0.0000
Tel Aviv	8	0.008 (0.173)	0.7349	4	-0.271* (2.638)	-0.228*** (2.627)	0.0900
Tel Aviv with trend				4	-0.142 (1.271)	-0.465** (3.755)	0.0220

t-statistic in parentheses

* *coefficient is significant at the 1% level*

** *coefficient is significant at the 5% level*

*** *coefficient is significant at the 10% level*

conditional convergence at 5% significance level. In the Central and Tel Aviv districts the unit root null is not rejected for the model without an intercept. In the conditional convergence test, the unemployment rate in the Center converges with the rest of the economy at the 1% significance level, while in Tel Aviv—only at the 10% significance level. So for the Tel Aviv district we ran an additional model with an intercept and a time trend. This model, in which the unit root null is rejected at 5% significance level, is preferred by both the Akaike and Schwarz criteria.

Our results so far fit empirical data rather well. Chart A1 plots regional yearly unemployment rates in 1970-2004 against the weighted average of the unemployment rates in the rest of the economy (excluding the region). The 45-degree line illustrates the relationship between the district and the rest of the economy unemployment rates.[12] The chart shows that unemployment rates in the Jerusalem and Northern districts are, on average, similar to that in the rest of the economy,[13] the unemployment rate in the Haifa district is higher than that in the rest of the economy in most years, and unemployment rates in the Central and Tel Aviv districts are consistently lower than in the rest of the economy.

As an additional exercise, we calculated the speed of convergence as the number of periods (quarters) required for shocks to half-die. The calculation was made according to the commonly accepted formula $\frac{\ln 0.5}{\ln \rho}$. A relatively high speed of convergence characterizes the Central and Tel Aviv districts, while the Jerusalem district converges at the slowest speed. The half-life of the shock is calculated to be only 0.9 and 1.1 quarters in the Center and in Tel Aviv respectively, 2.3 and 2.8 quarters in Haifa and in the North respectively, and as long as 5 quarters in Jerusalem.

5.3. Convergence in the regional unemployment rates among different educational levels

Because there are significant unemployment-rate disparities between high-skilled (13 and more years of schooling) and low-skilled (0-12 years of schooling) in Israel, we decided to check if there is any difference in the convergence patterns of unemployment rates among those two groups. To implement these tests we calculated

[12] It is obvious that if the unemployment rate in the district is equal to that in the rest of the economy during all the period, all the data points are plotted on the diagonal line.

[13] Note that the rest of the economy includes also the Southern district, which has a consistently high rate of unemployment.

unemployment rates among skilled and unskilled in a way similar to our basic data calculations: for all regions and for the rest of the economy for each one of them. At first, we ran stationarity tests for each regional series among two groups of population; Tables A2-A3 present the results. Table A2 shows that the unit root null cannot be rejected for even one series of unemployment rates among the low-skilled, including the Southern district (even in the model with deterministic time trend). On the other hand, for the unemployment rates among the skilled the unit root null is rejected in the Northern and Southern districts in the model with an intercept at 1% significance level and is not rejected in any other district (besides the Tel Aviv district, but only at 10% significance level). Likewise, the series of the unemployment rates in the rest of the economy are non-stationary in all regions.

The test results, presented in Tables 3-4 below, reinforce previous results of the overall unemployment-rate analysis (without skills-level division). On the other hand, these new results reveal the essential differences the behavior of the unemployment rates in the skilled and unskilled groups. While the unemployment rates among the low-skilled converge conditionally in most districts, excluding Jerusalem and Haifa, convergence of the unemployment rates among the high-skilled is unconditional in all the districts for which the test was implemented. The difference might be a result of differences in geographic mobility between the skilled and unskilled. Higher mobility among the skilled enables regional gaps between the rates of unemployment among them to be closed. An additional important result is the different behavior of the unemployment rates among the skilled in the Northern and Southern districts, two peripheral regions of the Israeli economy. Although these two series are non-stationary, the nature of unemployment in the South differs from that in the North. While the skilled rate of unemployment in the Southern district is very high, the corresponding unemployment rate in the Northern district is relatively low and during some years it is even the lowest in the whole economy. Therefore the reasons for finding non-stationarity are different. Apparently, the high rate of unemployment in the South is a result of the geographical mismatch between labor demand and supply (and also the non-suitable human capital of new immigrants, whose proportion is relatively high in the South), which is reinforced by substantial distance to the center, and which prevents skilled southern unemployed residents from commuting to the employment centers. The relatively low unemployment rate among the skilled in the North results from the relatively low supply of skilled labor compared to other

regions. Skilled workers in the Northern district are able to find employment in the nearby Haifa metropolis. Although these are only hypotheses, their proof is beyond the scope of this paper.

Table 3: Convergence test results for region *j* and the rest of the economy, unskilled unemployment rates, quarterly seasonally adjusted data, 1970-2004

District	Unconditional convergence			Conditional convergence			
	lags (*k*)	$\rho - 1$	*p*-value	lags (*k*)	ϕ	$\rho - 1$	*p*-value
Jerusalem	2	-0.155** (2.330)	0.0196				
Northern	4	-0.153*** (1.868)	0.0591				
Haifa	2	-0.209* (2.844)	0.0047				
Central	4	-0.098 (1.496)	0.1256	1	-0.367* (2.790)	-0.378** (3.178)	0.0235
Tel Aviv	8	0.011 (0.207)	0.7448	8	-0.240*** (1.662)	-0.133 (1.295)	0.6306
Tel Aviv with trend				4	-0.072 (0.447)	-0.625* (4.256)	0.0049
Southern	4	-0.052 (0.943)	0.3065	4	0.798* (2.973)	-0.313** (3.043)	0.0335
Southern with trend				4	0.443 (1.503)	-0.583* (4.086)	0.0084

t-statistic in parentheses
* *coefficient is significant at the 1% level*
** *coefficient is significant at the 5% level*
*** *coefficient is significant at the 10% level*

Table 4: Convergence test results for region *j* and the rest of the economy, skilled unemployment rates, quarterly seasonally adjusted data, 1970-2004

District	Unconditional convergence		
	lags (*k*)	$\rho - 1$	*p*-value
Jerusalem	4	-0.141** (1.985)	0.0454
Haifa	4	-0.153** (2.083)	0.0362
Central	2	-0.340* (3.980)	0.0001
Tel Aviv	4	-0.247* (2.597)	0.0096

t-statistic in parentheses
* *coefficient is significant at the 1% level*
** *coefficient is significant at the 5% level*
*** *coefficient is significant at the 10% level*

6. Regional integration checks based on the unemployment rates

All the tests performed so far examined possible convergence between all regions. This was expressed in testing the regional unemployment rate against the weighted average of unemployment rates in the rest of the economy. But it is reasonable to assume that convergence itself and its type and speed are influenced by existing inter-district economic and geographic knots. Let's assume that a shock to the demand, e.g., a factory closure, occurred in the Central district. There is a high probability that dismissed workers will search for a new job in their nearest surroundings; such an outcome enables them to commute (which is easier and cheaper alternative for internal migration) and allows them to maintain the lifestyle they were used to. Such an option is especially suitable for households with two or more wage earners. On the other hand, searching for a new job in the far-away regions in the South or in the North seems to be much less realistic. These considerations are reflected in the commuting data: in Israel, commuting prevails between adjacent regions (for example, Tel Aviv—Center, North—Haifa); on the other hand, Jerusalem and Southern districts are relatively autonomous labor markets, characterized by low in- and out-commuting rates, compared to other regions (Presman and Arnon, 2006). Therefore we perform additional bivariate convergence tests between unemployment rates on the pairs of regions, similar to the pairs of the countries in Greasley and Oxley (1997). We expect that unemployment rates in the Tel Aviv and Central districts and in the Northern and Haifa districts converge at a relatively high speed.

As Table 5 shows, strong unconditional convergence was indeed found between unemployment rates in these two pairs of regions (at the 1% significance level). Furthermore the unemployment rates in Center-North and in Jerusalem-Tel Aviv pairs converge unconditionally at the 5% significance level. This result however is less intuitive. Conditional convergence was found between Center-Haifa, Center-Jerusalem and North-Tel Aviv unemployment rates. No type of convergence was found between Jerusalem-Haifa, Haifa-Tel Aviv and Jerusalem-North.

Table 5: Convergence test results, pairs of regions

Pairs of districts	Unconditional convergence			Conditional convergence			
	lags (k)	$\rho - 1$	p-value	lags (k)	ϕ	$\rho - 1$	p-value
Jerusalem-Northern	4	-0.069 (1.032)	0.2710	4	-0.082 (0.784)	-0.061 (0.896)	0.7872
Jerusalem-Haifa	8	-0.079 (1.105)	0.2431	8	0.109 (1.055)	-0.089 (1.239)	0.6564
Jerusalem-Central	4	-0.100*** (1.789)	0.0701	1	-0.155 (1.437)	-0.215** (3.305)	0.0165
Jerusalem-Tel Aviv	4	-0.119** (2.024)	0.0416				
Northern-Haifa	2	-0.227* (2.890)	0.0041				
Northern-Central	2	-0.189** (2.335)	0.0194				
Northern-Tel Aviv	4	-0.067 (1.000)	0.2834	1	0.229** (2.202)	-0.233** (3.176)	0.0236
Haifa-Central	8	-0.074 (1.367)	0.1589	8	-0.457* (3.086)	-0.377** (3.388)	0.0131
Haifa-Tel Aviv	12	-0.021 (0.657)	0.5198	4	0.279** (2.137)	-0.193 (2.350)	0.1580
Central-Tel Aviv	4	-0.334* (2.970)	0.0032				

t-statistic in parentheses
* *coefficient is significant at the 1% level*
** *coefficient is significant at the 5% level*
*** *coefficient is significant at the 10% level*

Table 6 summarizes the speed of convergence in all the pairs of districts for which any type of convergence was found. The shortest shock half-life characterizes Center-Tel Aviv and Haifa-Center pairs. On the other hand, the unemployment-rate gap closure between Jerusalem and Tel Aviv is the slowest. Nonetheless it has to be stressed that this hypothetical speed of convergence does not mean that the regional gaps ought to be closed (or, in the case of conditional convergence—to stabilize at some constant level) by the calculated period of time, because new shocks are created simultaneously in the regional system. In fact what we see instead of a dying 'old' shock is the influence of a 'new' one. In other words, the lack of convergence apparent from the graphical presentation is a result of our inability to isolate each shock and wait for its disappearance.

Table 6: The speed of convergence of the unemployment rates, pairs of regions

Pairs of districts	Type of convergence	Half-live of unemployment shock, quarters	Full decay of unemployment shock, quarters
Jerusalem-Central	conditional	2.86	5.7
Jerusalem-Tel Aviv	unconditional	5.48	11.0
Northern-Haifa	unconditional	2.69	5.4
Northern-Central	unconditional	3.30	6.6
Northern-Tel Aviv	conditional	2.61	5.2
Haifa-Central	conditional	1.47	2.9
Central-Tel Aviv	unconditional	1.71	3.4

7. Summary and conclusions

Although absolute regional unemployment-rate gaps increased over time, empirical tests indicate that there are clear signs of convergence between the regions. Since the unemployment-rate series in the Southern district differs from the rest of the series and is characterized by stationarity, it was not possible to include that district in the convergence tests. Each one of the five remaining series tended to converge with the rest of the economy, at a different speed. The replication of convergence tests for skilled and unskilled unemployment rates reinforces previous results, but also reveals that unemployment-rate behavior in these two groups is different. While convergence between the unemployment rates among the low-skilled is conditional in most regions, convergence between the high-skilled unemployment rates is unconditional in all the regions, excluding the North and the South, where skilled unemployment rates are trend-stationary.

The test for convergence on pairs of regions (bivariate convergence) discovered seven pairs of converging regions. The test results confirm our expectation based on theoretical principles that unemployment rates in the adjacent regions possessing similar economic features converge more notably and faster. According to these considerations, relatively high-speed unconditional convergence was found between the Central and Tel Aviv districts and between the Northern and Haifa districts.

However, why do intra-regional unemployment-rate gaps seem to be so large and expanding over time? One possible answer to this question is the difference between absolute and relative gaps in the regional unemployment rates, because the average unemployment rate (an overall economy unemployment rate) was on a rising path since the early 1970s. Indeed, closer examination of the relative gaps points out that absolute gaps expansion could be misleading.

Chart 5 presents simple indices of dispersion in unemployment rates in six districts versus overall economy rate of unemployment (which is a weighted average of six district unemployment rates). Chart 5a plots the absolute difference between the highest and the lowest regional unemployment rates (chosen for each year) against the unemployment rate in the country. It is obvious that during the period under examination the absolute gap had risen, but this rise was parallel to the general rise in the level of unemployment. The second chart, Chart 5b, shows that a relative gap, which is calculated as an absolute gap divided by the overall economy unemployment rate, changes in a different way. In the periods of high unemployment the relative regional gap tends to shrink and in the periods of low unemployment it actually tends

Chart 5a: Absolute dispersion in regional unemployment rates vs. overall economy rate of unemployment

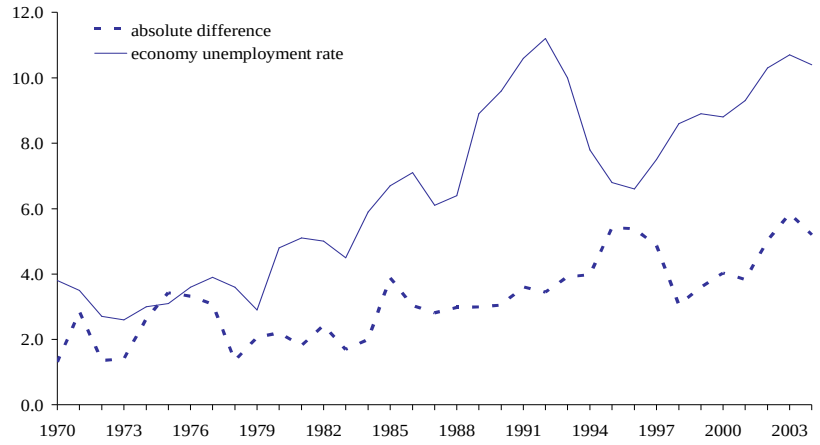


Chart 5b: Relative dispersion in regional unemployment rates vs. overall economy rate of unemployment

to expand. This finding reinforces our empirical results, which indicate that growing regional gaps in unemployment do not point to regional divergence, despite the rise in the absolute gap.

The results of the empirical analysis can serve policy makers in their decisions regarding regional economic policy. Convergence in regional unemployment rates indicates that a general growth-promoting policy for the economy as a whole is supposed to improve economical conditions in all the regions. Different evolution of the unemployment rate in the Southern district requires special treatment of the unemployment problem there. A stationarity test shows that the rate of unemployment in the Southern district fluctuates around a statistically significant rising trend. Improvement in the employment situation in the Southern region requires special treatment and active policy intervention. In the past, some steps to promote employment in the periphery were undertaken, particularly through the Encouragement of Capital Investment Law (ECIL), whose objectives included the creation of new jobs. However, several studies which examined the ECIL influence on peripheral employment found that if it existed at all, it was minimal, and that the law itself was detrimental to efficiency in the economy (for the details see Box 2.3 in the 2006 Bank of Israel Annual Report, pp. 73-76). In 2003, a new employment program started its operation in Israel that provides a direct hiring subsidy in development towns and ultra-Orthodox localities. Important additional step in improvement of the employment opportunities for the peripheral residents could be infrastructure and public transportation development, which will enable a tighter economic relationship between the periphery and the center.

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Table A1: Results of the ADF tests on regional unemployment rate series, quarterly seasonally adjusted data, 1970-2004

District	lags (k)	Deterministic components	$\rho - 1$	p-value
Jerusalem	5	intercept	-0.080 (1.906)	0.3287
Northern	3	intercept and trend	-0.196*** (3.308)	0.0693
Haifa	3	intercept	-0.027 (1.188)	0.6785
Central	8	intercept	-0.029 (1.305)	0.6261
Tel Aviv	1	intercept and trend	-0.115 (2.540)	0.3088
Southern	9	intercept	-0.024 (0.839)	0.8044
Southern	1	intercept and trend	-0.255** (3.790)	0.0199

t-statistic in parentheses
** *coefficient is significant at the 5% level*
*** *coefficient is significant at the 10% level*

Table A2: Results of the ADF tests on regional unskilled[14] unemployment rate series, quarterly seasonally adjusted data, 1970-2004

District	lags (k)	Deterministic components	$\rho - 1$	p-value
Jerusalem	2	intercept	-0.077 (1.828)	0.3656
Northern	4	intercept and trend	-0.164 (2.708)	0.2348
Haifa	8	intercept	-0.024 (1.044)	0.7360
Central	8	intercept	-0.024 (1.139)	0.6990
Tel Aviv	1	intercept and trend	-0.152 (2.901)	0.1656
Southern	8	intercept	-0.018 (0.536)	0.8793
Southern	8	intercept and trend	-0.313 (2.795)	0.2018

Table A3: Results of the ADF tests on regional skilled[15] unemployment rate series, quarterly seasonally adjusted data, 1970-2004

District	lags (k)	Deterministic components	$\rho - 1$	p-value
Jerusalem	4	intercept	-0.169 (1.972)	0.2991
Northern	1	intercept and trend	-0.332* (4.541)	0.0019
Haifa	4	intercept	-0.050 (1.413)	0.5742
Central	4	intercept and trend	-0.184 (2.519)	0.3185
Tel Aviv	1	intercept and trend	-0.212*** (3.256)	0.0781
Southern	2	intercept and trend	-0.365** (3.837)	0.0174

[14] Unskilled are defined as those with 0-12 years of schooling.
[15] Skilled are defined as those with 13 and more years of schooling.

Chart A1: Unemployment rate in the district vs. weighted average unemployment rate in the rest of the economy