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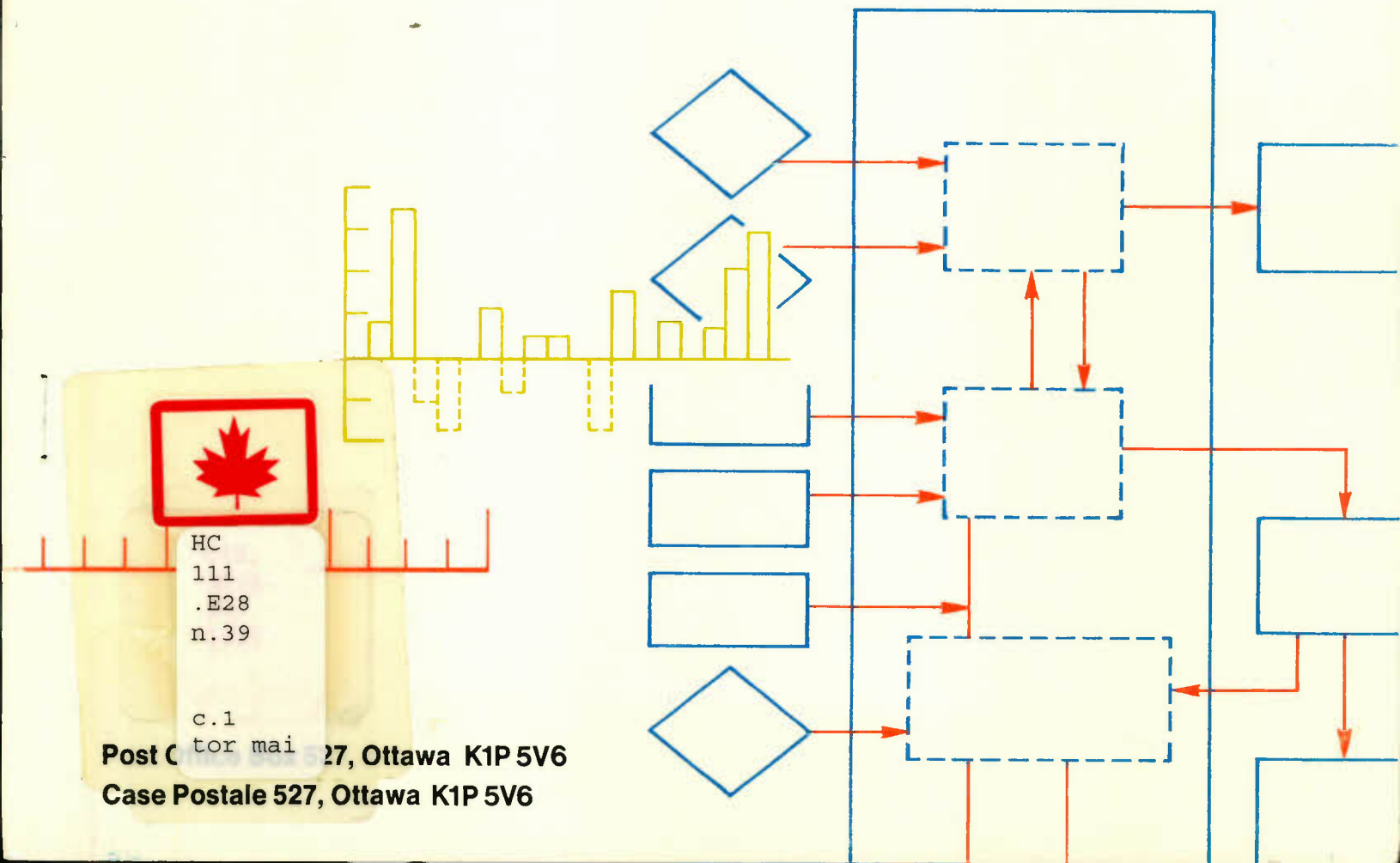

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DISCUSSION PAPER NO. 39

Structural Change in the Unemployment, Job Vacancies Relationship for Canada: A Note*

by Alister Smith
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ABSTRACT

This paper examines the relationship between the unemployment rate and the job vacancy rate in Canada between 1953 and 1973. Previous studies have adduced evidence of an outward shift in the relationship and have attempted to distinguish sub-period relations. The present paper employs, in addition, a specific statistical test for evidence of structural change in the relationship over time.

RÉSUMÉ

Dans ce document, nous étudions le rapport entre le taux de chômage et le taux d'emplois vacants au Canada de 1953 à 1973. Des études antérieures ont démontré, par des analyses graphiques, que le rapport entre ces deux taux s'était déplacé vers le haut au cours de la période étudiée; elles ont tenté aussi d'identifier des sous-périodes à ce déplacement. Le présent document recourt à un test statistique spécifique pour obtenir plus de renseignements sur l'évolution structurelle de ce rapport au cours des ans.

The relationship between unemployment and job vacancies has served as an important indicator of labour market conditions at least since the seminal article on the subject by Dow and Dicks-Mireaux [2]. Its fascination for economists is further enhanced by recent theoretical developments linking the theory of job search, the unemployment-vacancies (u, v) relation and the Phillips relation.[1] Moreover, the current combination of high rates of both inflation and unemployment in many countries lends additional interest to underlying labour market developments.

Attempts to examine the u, v relation for Canada by Penz [6] and Zaidi [10] suggest an outward shift in the relation, reflecting greater degrees of "structural maladjustment" in the labour market. Both studies suffer from their reliance upon administrative data for estimates of job vacancies,[2] and neither study goes beyond 1966.[3] Both, moreover, employ the critical assumption of a rectangular hyperbolic shape for the u, v relation, which permits the calculation of the degree of structural maladjustment as $m = \sqrt{uv}$. Increasing values of m over time are then said to reflect increasing structural maladjustment and, as in the case of the Zaidi study, common values of m may be used to distinguish sub-period u, v relations. In neither study, however, was an attempt made to test statistically for evidence of structural change in the relationship. The present paper reports such a test for Canada in the period 1953-73, using a new vacancy series constructed by Denton et al. [1].[4]

Table 1

REGRESSION EQUATIONS FOR OVERALL PERIOD AND THREE SUB-PERIODS

Equations	Time period for dependent variable -- vacancy rate	Independent variables			Durbin-Watson	Standard error of estimate	$\bar{R}^2$	F	Theil's inequality coefficient
		Constant	Unemployment rate	Time trend					
1	IQ53-IVQ73 First quarter 1953 to fourth quarter 1973	$.8875 \times 10^{-2}$ ($.4816 \times 10^{-3}$) (18.47)	$-.9624 \times 10^{-1}$ ($.9153 \times 10^{-3}$) (-10.52)	$.4016 \times 10^{-4}$ ($.4769 \times 10^{-5}$) (8.42)	.94	$.1029 \times 10^{-2}$	.64	73.75 with (2,81) degrees of freedom	$.867 \times 10^{-1}$
2a	IQ53-IVQ59 First quarter 1953 to fourth quarter 1959	$.1022 \times 10^{-1}$ ($.6761 \times 10^{-3}$) (15.12)	$-.1363$ ($.1887 \times 10^{-1}$) (-7.22)	$.8615 \times 10^{-4}$ ($.3245 \times 10^{-4}$) (2.65)	1.40	$.9786 \times 10^{-3}$	.70	32.20 with (2,25) degrees of freedom	$.876 \times 10^{-1}$
2b	IVQ59-IVQ66 Fourth quarter 1959 to fourth quarter 1966	$.3849 \times 10^{-2}$ ($.2768 \times 10^{-2}$) (1.39)	$-.5210 \times 10^{-1}$ ($.2335 \times 10^{-1}$) (-2.23)	$.1033 \times 10^{-3}$ ($.3715 \times 10^{-4}$) (2.78)	1.70	$.6361 \times 10^{-3}$	.86	83.75 with (2,26) degrees of freedom	$.537 \times 10^{-1}$
2c	IVQ66-IVQ73 Fourth quarter 1966 to fourth quarter	$.6569 \times 10^{-3}$ ($.1235 \times 10^{-2}$) (.53)	$-.1935$ ($.2652 \times 10^{-1}$) (-7.30)	$.2300 \times 10^{-3}$ ($.2872 \times 10^{-4}$) (8.01)	1.67	$.7807 \times 10^{-3}$	.70	33.21 with (2,26) degrees of freedom	$.566 \times 10^{-1}$

Results

The vacancy rate is regressed on the unemployment rate and a time trend[5] (t) for the period 1953-I (first quarter of 1953) to 1973-IV (fourth quarter of 1973) and for the sub-periods 1953-I to 1959-IV, 1959-IV to 1966-IV, and 1966-IV to 1973-IV.[6] The results are shown in Table 1 in equations (1), (2a), (2b), and (2c), respectively. Each cell in the main body of this table contains an estimated coefficient and, in parentheses, standard errors followed by student's t-statistics. We have also provided values for an F-statistic associated with tests of significance of all explanatory variables, and values for Theil's inequality coefficient. A number of features are of interest. The equations (2a), (2b) and (2c) explain more of the variation of their dependent variables than equation (1). The coefficient on the unemployment rate is always negative. All variables are significantly different from zero except for the constants in equations (2b) and (2c). Equation (2b) has a remarkably good fit judging by the F ratio and the coefficient of multiple determination.

Below the surface, however, lies an interesting aspect of the equations: the behaviour of the partial correlation coefficients of the unemployment and vacancy rates. These are shown in Table 2.

Table 2

PARTIAL CORRELATION COEFFICIENTS OF THE UNEMPLOYMENT AND VACANCY RATES

Time period	Unemployment rate			Time trend		
	1953-I to 1959-IV (2a)	1959-IV to 1966-IV (2b)	1966-IV to 1973-IV (2c)	1953-I to 1959-IV (2a)	1959-IV to 1966-IV (2b)	1966-IV to 1973-IV (2c)
Vacancy rate	-.8010	-.9086	-.1565	-.3697	.9165	.3779
Unemployment rate				.7088	-.9250	.7975

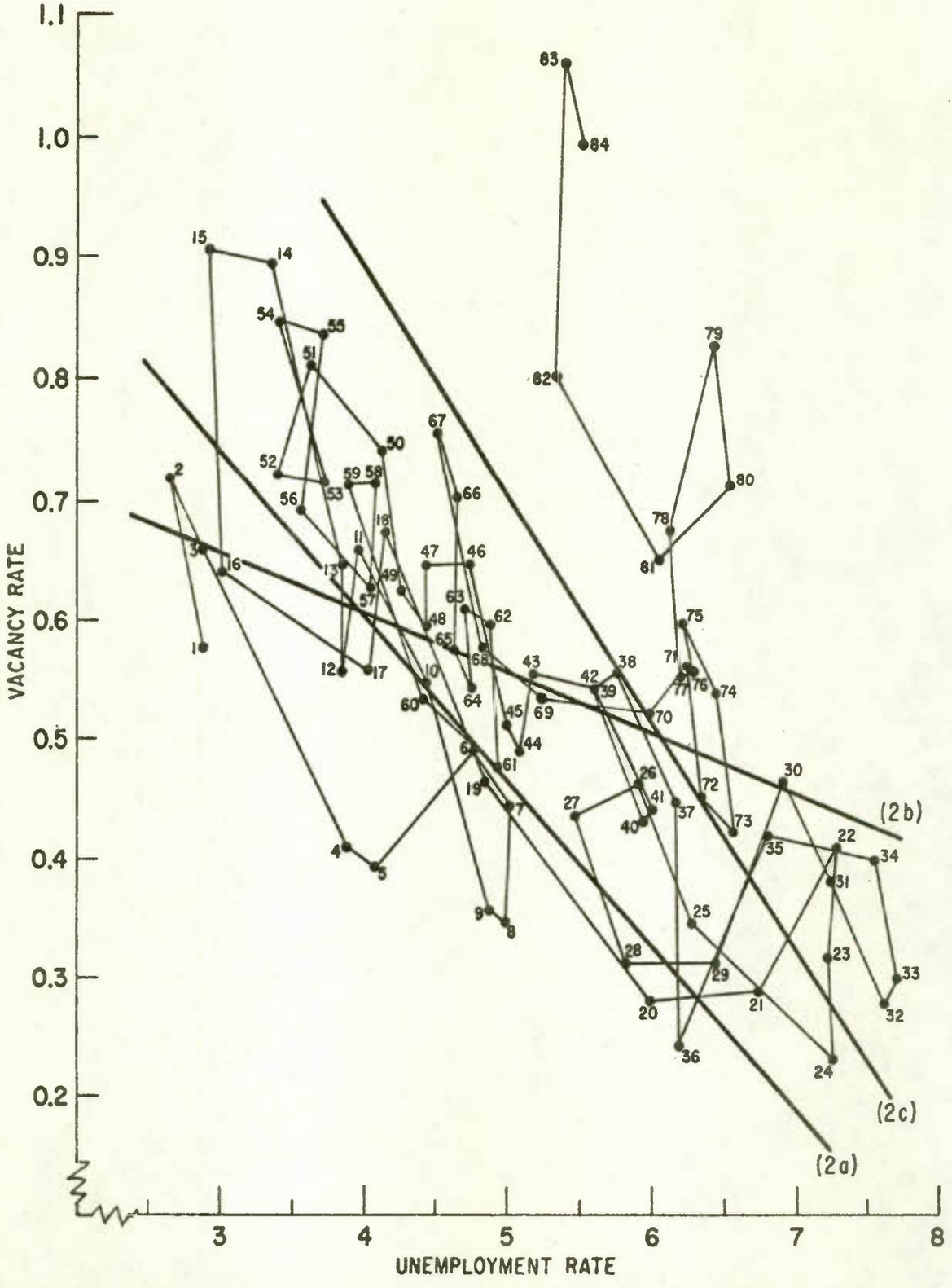
Both in the 1953-1959 and 1960-1966 periods, we observe a strong negative correlation between vacancy and unemployment rates. In the 1967-1973 period, on the other hand, we observe a very small partial correlation coefficient relative to those in the previous two periods. The previously strong (inverse) relationship between vacancy and unemployment rates is considerably weaker in the 1967-1973 period.

The superiority of equation (2b) over (2c) is evident in the two tables; relative to (2a), (2b) retains explanatory power by virtue of the correlation between the unemployment rate and the time trend. Notice, however, the paradoxical sign of the partial correlation coefficient of these two variables in (2b): over the 1960-1966 period, unemployment rates fell from postwar highs.

Using an average value for the time trend in each equation, the sub-period regressions are superimposed, in Figure 1, on the historical scatter map of u, v combinations for the 84 quarters of the overall time period. The outward drift of the relationship is apparent, though the changing slopes of the sub-period relationships are perhaps the most interesting feature.

Figure 1

Sub-period Regression Lines and the Actual u,v Scatter for the overall Period.



Testing for Evidence of Structural Change

The test of overall homogeneity of the relationship over time sub-periods is equivalent to testing (under the null hypothesis of equal intercept and slope coefficients) for the absence of structural change. The test is based on the significance of the reduction in the residual sum of squares from fitting separate regressions for each time sub-period. The rejection area consists of large values of the calculated F-statistic.

The actual statistic used is the ratio $[(S - \Sigma S_i)/K] \div [\Sigma S_i/(T - 3K)]$ in which S is the sum of squared residuals of the overall relationship, S_i are the residuals' sums for the sub-period relationships, and K is the number of explanatory variables in each equation.[7] The calculated value is 8.622, which exceeds the familiar critical value even at the 1% level. Hence the hypothesis of no structural change in the relationship is clearly rejected.

Conclusion

The results of the simple statistical analysis in the foregoing sections are consistent with the evidence of earlier studies that structural change has taken place in the Canadian unemployment-vacancies relationship. The outward movement of the relation is depicted by the three sub-period regression lines shown in figure 1. The combination of larger magnitudes of the unemployment rate and the vacancy rate suggests that the Canadian labour market has been characterized since 1953 by increasing amounts of unemployment stemming from factors other than aggregate demand deficiency.

Footnotes

[1]See Holt and David [4], Hansen [3], Macrae, Schweitzer and Holt [5].

[2]The deficiencies of the estimates of vacancies based on the National Employment Service listings are documented in Thompson [9], "Collection and Use of Job Vacancy Data in Canada", in NBER, *The Measurement and Interpretation of Job Vacancies* (New York: Columbia University Press, 1966).

[3]More recent work has probably been discouraged by the fact that although vacancy data are now obtained from the Canadian Job Vacancy Survey, the brevity of the series precludes meaningful cyclical analysis.

[4]The series is constructed by splicing the National Employment Service vacancy estimates with the Department of Finance Help Wanted Index and with the vacancy estimates from the Job Vacancy Survey. The methodology is described in Denton et al. [1]. Note that the present exercise is undertaken at the aggregate level. The regional dimension has been explored by Thirsk [8] using NES data up to 1968. The new data permit an extension of Thirsk's work and this should form the basis for a further study.

[5]There was some apprehension about using a time trend since it can lead to serial correlation of the errors, and in fact the Durbin-Watson statistic for the overall period does indicate autocorrelation. However, in the three sub-periods of seven years' duration, that is, 1953-1959, 1960-1966 and 1967-1973, the Durbin-Watson statistic was either inconclusive (in the first period) or indicative of no autocorrelation (in the other two). The presence of autocorrelation does not bias the coefficients but does lead to an underestimation (bias) of the sum of squared residuals for the overall period. Account can be taken of the bias but no adjustment is necessary in this case since the effect of autocorrelation is to increase the probability of accepting a null hypothesis of no structural change and we had no difficulty in rejecting the hypothesis. In more technical terms, autocorrelation reduces the power of the test but since this did not prevent rejection, it is immaterial.

[6]The explicit assumption in analysis of covariance tests of this sort is that break-points are known (see Rowley [7]). While it is difficult to pinpoint exactly the mid-60's break identified by many observers, the evidence of the partial correlation coefficients in the present exercise suggests a breakdown, in the 1966-73 period, of the previously strong association of v and u.

[7]Let S equal the sum of squared residuals of the overall relationship with estimated coefficient vector $\hat{B}$: $S = (y-X\hat{B})'(y-X\hat{B})$. Let S_i denote the analogous residuals' sums from regressions using observations of each of the time-periods: $S_i = (Y_i-X_ib_i)'(Y_i-X_ib_i)$, $i = 1, 2, 3$. If there are T observations in the overall period, define T_i as the number of observations in the ith sub-period: $\Sigma_i T_i = T$. Define K as the number of regressors. The rank of each matrix X_i is $K<T_i$ and its dimension is T_i x K. The idea of the test is to contrast the reduction in the residual sum of squares, i.e., $S-\Sigma_i S_i$, with $\Sigma_i S_i$. The ratio $\frac{S-\Sigma_i S_i}{\Sigma_i S_i}$ is the ratio of two chi-square variates and $\frac{(S-\Sigma_i S_i)/K}{\Sigma_i S_i/T-3K} \sim F(K,T-3K)$. The following values are used in computation of the F-statistic:

$S = 0.857394 \times 10^{-4}$
$S_1 = 0.239394 \times 10^{-4}$
$S_2 = 0.105201 \times 10^{-4}$
$S_3 = 0.158468 \times 10^{-4}$

$K = 3$
$T = 84.$

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