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Sectoral Shifts and Canadian Unemployment

Janet Neelin

Princeton University

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ABSTRACT

In this paper Lilien's (1982) hypothesis that sectoral shifts in employment raise aggregate unemployment is tested using Canadian quarterly data. Lilien's framework is extended to investigate regional labour market rigidities and to distinguish between industry shifts that are correlated with changes in aggregate activity, and those which are exogenous to the overall level of activity. The robustness of the results to various changes in model specification is also investigated. I find that in Canada exogenous shifts in employment between sectors do not have a significant effect on the aggregate unemployment rate.

INTRODUCTION

In an influential 1982 study, Lilien presents evidence that shifts in the industrial composition of labour demand raise aggregate unemployment. Lilien uses this hypothesis to explain the remarkable increase in U.S. unemployment between the 1960's and the 1970's. According to his analysis, about one half of the observed increase in decadal unemployment rates is attributable to an increase in the volatility of industry specific shocks. Using the same methodology, Samson(1983) finds that sectoral shifts in employment also contribute to Canadian aggregate unemployment. Medoff(1983) shows that in the U.S. shifts in the regional composition of employment can increase aggregate unemployment. In a response to Lilien, Abraham and Katz(1984) show that shifts in the composition of employment may be induced by changes in the level of aggregate activity rather than vice-versa.

In this paper, Lilien's hypothesis will be tested using Canadian quarterly data. His framework is extended to investigate regional labour market rigidities, and to distinguish between industry shifts that are correlated with changes in aggregate activity, and those which are exogenous to the overall level of activity.

CONSTRUCTION OF SHIFT INDICES.

Lilien's insight is that aggregate unemployment will be increased by changes in the composition of labour demand, if workers are slow to adapt to such changes. A worker who loses a job in one sector may remain unemployed for some time even when jobs are available elsewhere since retraining and search take time. Similarly, a regional shift in labour demand will cause unemployment if workers are slow to move from a relatively depressed area to a thriving one.

Lilien uses a weighted sum of the variances of industry employment growth rates as his measure of sectoral shifts:

$$\sigma_{it}(i,0) = \left[\sum_{i=1}^N x_i(t)/X(t) [\log[x_i(t)/x_i(t-1)] - \log[X(t)/X(t-1)]]^2 \right]^{1/2}$$

where x_i is employment in the i th sector and X is total employment .

The notation $\sigma(i,r)$ will be used to denote the variables the shift measure is defined over. "i" stands for industry, "r" stands for region. In the equation above, the "0" shows that the variable is not defined over regions. $\sigma_{it}(i,0)$ is the cross-sectional variance of employment growth rates over industries. σ varies over time, but the time subscript is omitted to avoid clutter. σ is high when there is a great deal of variability in employment growth rates between sectors. One expects labour demand to be high in rapidly growing sectors and vice-versa. Thus, a high value of σ corresponds to a shift in the composition of labour demand towards sectors with rapid growth.

The problem with this index is that σ is not necessarily exogenous to the business cycle. Abraham and Katz argue that if σ measures exogenous sectoral shifts, then vacancies will be positively correlated with σ . On the other hand, if it is aggregate demand shocks that drive σ then one would expect a negative correlation, since vacancies

and real GNP are negatively correlated. They find a negative correlation between σ and a help wanted index in the U.S. data.¹

Aggregate demand shifts may affect different sectors in different ways, so that σ may vary with changes in aggregate demand.

Evidently, it is important to identify the component of σ which is not attributable to aggregate demand shocks. Lilien(1983) approaches the

¹ Attempts to replicate Abraham and Katz's test by regressing a normalized Canadian help wanted index on $\sigma(i,0)$, $\sigma(0,r)$, or $\sigma(i,r)$ produced inconclusive results since the coefficients on the shift indices were not significant. For example, when Abraham and Katz's test is duplicated using the Canadian help wanted index the resulting equation is:

$$\begin{aligned} \text{NHW} = & -.0003 + .0001*\sigma(i,0) - .00002*\text{lag1}(\sigma(i,0)) - .00001*\text{DMR} \\ & -.00003*\text{lag1}(\text{DMR}) - .00006*\text{lag2}(\text{DMR}) + .877*\text{lag1}(\text{NHW}) \\ & + .0000002*\text{TIME} \end{aligned}$$

where NHW is the help wanted index divided by total non-agricultural employment, DMR is unanticipated money, and TIME is a time trend. The corresponding t-statistics are: -1.88, .90, -.30, -.34, -1.09, 2.03, 14.17, and 1.89 respectively. The Canadian help wanted index is defined as the number of column inches of help wanted advertisements in several Canadian newspapers.

problem by estimating a regression equation of the form:

$$\log[x_i(t)/x_i(t-1)] = a_0T + a_1DMR(t) + a_2DMR(t-1) + a_3DMR(t-2) + a_4DMR(t-3) + a_5DMR(t-4) + b_iZ(t) + S_i(t)$$

where T is a time trend, $DMR(t)$ represents a monetary shock in period t , $Z(t)$ is an aggregate effect that Lilien treats as the unobservable component of aggregate demand and $S_i(t)$ is a sector specific component that follows a first order autoregressive process. He then uses the $S_i(t)$ to construct a weighted variance measure similar to the one in Lilien(1982) which is described above. Using this measure he confirms his original finding that sectoral shifts have contributed significantly to aggregate unemployment in the U.S.

Lilien's interpretation of the $Z(t)$ process as the unobserved portion of GNP is rather narrow. An alternative view is that the $Z(t)$'s also represent variables which are observable but which are not specifically included in the model. The most important variable in this category is

likely to be GNP itself. I try to utilize the information available in the most direct way possible by regressing employment growth rates on actual and lagged growth rates of GNP. Two weighted variance measures are then constructed, one based on the predicted employment growth rates and the other based on the unpredicted employment growth rates. This procedure represents a key departure from Lilien's methodology in that it is a different method of filtering the influence of aggregate demand shocks out of the shift indices. It also allows the sectoral shift measures to be separated into the parts which are attributable to aggregate demand swings and the parts which are not. Another departure from Lilien is the treatment of trends in employment growth rates which vary from sector to sector as part of the "sector specific component".²

² Even if the trend in each sector is anticipated, individual workers may still be unable to foresee when their own jobs will end. In this case workers will not flow smoothly from declining to growing sectors and even anticipated trends will increase aggregate unemployment.

I use the following notation: $\sigma(i,0)$ is Lilien's variance measure as defined above. Here, $N=9$ as there are nine industry sectors. $\sigma(0,r)$ is defined as the square root of the weighted sum of the variances in employment over five regions. $\sigma(i,r)$ includes forty-five employment groups differentiated by both region and sector. Since $\sigma(i,r)$ is based on disaggregated data, it may pick up exogenous variations in employment that cancel out when more highly aggregated data is used. The series that were used to construct these measures are described in Appendix 1.

Some simple two variable vector auto-regressive models were estimated in order to determine whether the σ variables Granger-cause GNP or vice-versa. In a model with eight lags the hypothesis that GNP does not Granger-cause $\sigma(i,0)$ is rejected ($f(8,64)=3.8$) but the hypothesis that $\sigma(i,0)$ does not Granger-cause GNP could not be rejected ($f(8,64)=.6$). In models with $\sigma(0,r)$ and $\sigma(i,r)$ the hypotheses that neither variable caused GNP, (or vice-versa), could

not be rejected. ($f(8,64)=2.5$ for $\sigma(0,r)$ and 1.3 for $\sigma(i,r)$). These results suggest that controlling for GNP is likely to be most important in the case of shifts in employment across industries.

In order to separate out the effects of aggregate demand on the indices of labour demand shifts, each employment growth rate was regressed on the current and four lagged values of the growth rate of real GNP:

$$\log[x_i(t)/x_i(t-1)] = a_0\text{GNP}(t) + a_1\text{GNP}(t-1) + a_2\text{GNP}(t-2) + a_3\text{GNP}(t-3) + a_4\text{GNP}(t-4) + e(t)$$

where $e(t)$ is an error term which represents the portion of sector i 's employment growth rate which is not attributable to GNP.³ The

³ Hausman tests which used US GNP, its growth rate, and the growth rate of seasonally adjusted US unemployment (current values plus four lags) as instruments for the current growth rate of GNP indicated a simultaneity bias in nine out of forty-five cases. Accordingly, the estimated instrumental variable was used instead of current Canadian GNP in the equations for Manufacturing, Transportation, Trade, Maritime Services, Quebec Manufacturing, Quebec Construction, Ontario Trade, British Columbia

adjusted R-squares from these equations are shown in Table 1.

Two indices of sectoral shifts were constructed for each measure that was defined above. One was defined as the square root of the weighted sum of the variances of the predicted growth rates from the employment equations. The other is defined in the same way using the variances of the residuals from the employment growth rate equations. For example, the measures corresponding to the explained (by real GNP) and the unexplained parts of the variance of $\sigma(i,r)$ are:

$$\sigma(i,r,p) = \left[\sum_{i=1}^N x_i(t)/X(t) [x_i^*(t) - X^*(t)]^2 \right]^{1/2}$$

and

$$\sigma(i,r,u) = \left[\sum_{i=1}^N x_i(t)/X(t) [e_i(t) - E(t)]^2 \right]^{1/2}$$

Transportation, and Prairie Transportation.

TABLE 1

ADJUSTED R-SQUARES FROM THE REGRESSION OF EMPLOYMENT GROWTH RATES ON THE LAGGED GROWTH RATE OF GNP. INTERVAL OF ESTIMATION = 1961:2 TO 1983:1.

(A	(F	(F	I	R	(M	(M	(C	(T	(T	(S	(P	A
L	O	I	N	E	I	A	O	R	R	E	U	N
L	R	N	S	A	N	N	N	A	A	R	B	D
	E	A	U	L	I	U	S	N	D	V	L	
I	S	N	R		N	F	T	S	E)	I	I	D
N	T	C	A	E	G)	A	R	P		C	C	E
D	R	E	N	S		C	U	O		E	F	
U	Y)		C	T		T	C	R		S)	A	E
S			E	A		U	T	T)			D	N
T				T		R	I				M	S
R			&	E)		E	O				I	E)
Y)						S)	N)				N	

REGIONS

CANADA	.569	.078	.180	.060	.582	.254	.083	.297	.149	.011
MARITIMES	.286	.064	.107	.028	.192	.087	.216	.136	.095	-.043
QUEBEC	.375	.040	.107	.082	.485	.176	.054	.218	.087	.009
ONTARIO	.455	.050	.047	-.017	.523	.101	.063	.281	.059	-.030
PRAIRIES	.278	.022	.075	.056	.414	.155	.024	.153	.061	-.040
BRITISH COLUMBIA	.290	.002	.001	.072	.074	.130	.126	.162	.192	.011

The industries that show the highest conformity to GNP are Manufacturing, Trade, and Construction. The industry with lowest conformity is Public Administration and Defence. Across regions, conformity is highest in Ontario and Quebec and lowest on the Prairies. The results for the disaggregated data are roughly consistent with these findings except in British Columbia where Services, and Trade exhibit the most conformity and Forestry and Finance Insurance and Real Estate show the least. Detailed regressions available upon request.

respectively, where $x_i(t)$ stands for the sectoral employment growth rate, $X(t)$ represents the aggregate employment growth rate, $x_i^*(t)$ is the predicted growth rate for the i th sector from the employment regressions described above, $X^*(t)$ is the predicted aggregate employment growth rate, the $e_i(t)$ are the residuals from the sectoral employment growth rate equations, and $E(t)$ is the residual from the aggregate employment growth rate equation. Similarly, $\sigma(0,r,p)$ and $\sigma(0,r,u)$ correspond to $\sigma(0,r)$, while $\sigma(i,0,p)$ and $\sigma(i,0,u)$ correspond to $\sigma(i,0)$. Plots of these shift indices are shown in Appendix 1 along with a graph of the unemployment rate.⁴

⁴ An advantage of this filtering procedure is that the elasticities of employment with respect to changes in aggregate activity are allowed to vary from sector to sector. A disadvantage is that these elasticities are assumed to be constant over time. As an alternative, the shift indices could be regressed directly on current and lagged values of GNP and on a full set of interactions between them. One could then use the predicted and residual values from these equations to separate the parts of the shift indices which are attributable to GNP from those which are exogenous to GNP. However, the correlations between indices constructed in this way and the indices used in this paper are less than .85.

RESULTS: SHIFTS IN THE INDUSTRIAL COMPOSITION OF LABOUR DEMAND.

In this section, the measures of sectoral shifts developed above are included in three different unemployment rate models. The first includes the current value and 8 lags of unanticipated money growth along with 8 lags of the unemployment rate in an equation similar to Lilien's (1980) and to Barro's(1977). The derivation of the unanticipated money growth series is described in Appendix 2. To test the robustness of the results to different specifications I also use a model in which unanticipated money growth is replaced with unanticipated GNP, and a model similar to Mishkin(1982) which has long lags of both anticipated and unanticipated money. Unanticipated GNP is defined as the residuals from an AR(2) equation for GNP which is also shown in Appendix 2. The effective interval of estimation is 1962:2 to 1983:1.⁵ Only the sums of coefficients are reported.

⁵ Employment data by industry are available from 1961:1 to 1983:1. After 1983:1 the Establishment Survey was changed and the new

Table 2 displays unemployment rate equations estimated using the measure of the total variance of industry employment growth rates, $\sigma(0,i)$. This measure is statistically significant in each model, which indicates that sectoral shifts do influence the aggregate unemployment rate. Table 2A shows the same equations when the variance measure is divided into the parts which are explained and unexplained by aggregate demand changes, ($\sigma(0,i,p)$ and $\sigma(0,i,u)$ respectively). This table shows that only the part of the sectoral shift variable which is attributable to GNP is significant in the unemployment rate equations. This result implies that in Canada, exogenous shifts in the industrial composition of employment do not appear to lead to aggregate unemployment. Rather, aggregate demand shocks work through shifts in the composition of employment to increase the unemployment rate.⁶

employment data has not yet been spliced to the old. One data point is lost in the construction of the shift indices. Four more are lost when these indices are lagged four quarters.

⁶ The models were tested for first order autocorrelation by regressing the residuals from each equation on their own lagged values and the other variables in the model. The t-statistics on the lagged residuals

TABLE 2

EFFECTS OF CHANGES IN THE VARIANCE OF EMPLOYMENT ACROSS INDUSTRIES
USING THE TOTAL SECTORAL SHIFT VARIABLE

MODEL (1) IS LILIEN'S MODEL WITH CURRENT VALUE AND 8 LAGS OF
UNANTICIPATED MONEY, AND 8 LAGS OF THE UNEMPLOYMENT RATE.

MODEL (2) IS SAME AS ABOVE WITH UNANTICIPATED GNP REPLACING
UNANTICIPATED MONEY.

MODEL (3) IS MISHKIN'S MODEL WITH CURRENT VALUE PLUS 19 LAGS OF
UNANTICIPATED MONEY AS WELL AS 19 LAGS OF THE UNEMPLOYMENT RATE AND
OF ANTICIPATED MONEY.

ALL THREE MODELS HAVE THE CURRENT VALUE PLUS 4 LAGS OF THE SHIFT
VARIABLE.

T-STATISTICS IN ().

VARIABLE NAMES	(1)	(2)	(3)
INTERCEPT	-57.26 (-2.21)	-45.68 (-1.90)	-146.00 (-2.06)
SUM LAGS OF THE UNEMPLOYMENT RATE	.94 (9.01)	.91 (7.97)	.90 (4.17)
SUM OF CURRENT VALUE AND LAGS OF UNANTI- CIPATED MONEY OR GNP	-16.12 (-4.38)	-.0004 (-9.02)	-26.35 (-2.33)
SUM OF LAGS OF ANTICIPATED MONEY	-	-	-17.94 (-1.73)
TIME TREND	.029 (2.23)	.024 (1.93)	.07 (2.07)
SUM OF SEASONAL DUMMY VARIABLES	-3.75 (-10.10)	-3.17 (-2.68)	-2.52 (-3.83)
SUM OF SECTORAL SHIFT VARIABLE	32.81 (3.24)	32.00 (2.95)	58.42 (2.30)
STANDARD ERROR OF ESTIMATES	.091	.098	.132

TABLE 2A

EFFECTS OF CHANGES IN THE VARIANCE OF EMPLOYMENT ACROSS INDUSTRIES,
WHERE THE VARIANCE IS DIVIDED INTO THE PART EXPLAINED BY GNP AND
THE PART UNEXPLAINED BY GNP.

MODEL (1) IS LILIEN'S MODEL WITH CURRENT VALUE AND 8 LAGS OF
UNANTICIPATED MONEY, AND 8 LAGS OF THE UNEMPLOYMENT RATE.

MODEL (2) IS SAME AS ABOVE WITH UNANTICIPATED GNP REPLACING
UNANTICIPATED MONEY.

MODEL (3) IS MISHKIN'S MODEL WITH CURRENT VALUE PLUS 19 LAGS OF
UNANTICIPATED MONEY AS WELL AS 19 LAGS OF THE UNEMPLOYMENT RATE AND
OF ANTICIPATED MONEY.

ALL THREE MODELS HAVE THE CURRENT VALUE PLUS 4 LAGS OF THE SHIFT
VARIABLE.

T-STATISTICS IN ().

VARIABLE NAMES	(1)	(2)	(3)
INTERCEPT	-71.66 (-2.46)	-42.58 (-1.65)	-152.93 (-1.81)
SUM LAGS OF THE UNEMPLOYMENT RATE	.87 (7.16)	.87 (7.13)	.74 (2.30)
SUM OF CURRENT VALUE AND LAGS OF UNANTI- CIPATED MONEY OR GNP	-23.20 (-5.37)	-.0004 (-5.98)	140.37 (8.40)
SUM OF LAGS OF ANTICIPATED MONEY	-	-	-31.65 (-2.31)
TIME TREND	.037 (2.48)	.022 (1.67)	.08 (1.82)
SUM OF SEASONAL DUMMY VARIABLES	-3.57 (9.06)	-3.02 (-7.86)	-2.99 (-3.62)
SUM OF EXPLAINED SHIFT VARIABLE	95.20 (3.49)	83.04 (3.06)	326.70 (3.94)
SUM OF UNEXPLAINED SHIFT VARIABLE	21.27 (1.56)	19.45 (1.55)	-49.75 (-1.31)
STANDARD ERROR OF ESTIMATES	.109	.104	.187

In Table 3 and 3A, the same experiments are performed using the measures of the variance of regional employment growth rates. In contrast to the results described above, exogenous shifts in the regional composition of employment do increase aggregate unemployment,⁷ though as a practical matter, the part of the variance that is explained by GNP is much more important.⁸

are .78, .88, -.62 for the three models in Table 2, and .76, -1.87, -.91 for the three models in Table 2A.

⁷ Although in one instance the coefficient on the exogenous part of the variance is significantly negative. The coefficient on the current value of $\sigma(0,r)$ is close to zero while the coefficients on the four lagged values are large and negative.

⁸ The t-statistics relevant to the test for autocorrelation described above are .64, -3.15, and .328 for Table 3 and 1.07, -1.99, and -.423 for Table 3A. Hence these tests suggest that the residuals of the two models with unanticipated GNP are autocorrelated. However, the estimates of the correlation coefficient are only -.043 and -.083 respectively. The Box-Pierce Q-statistics for the residuals from column two of Tables 3 and 3A are 12.62 and 20.06 at 18 lags, and 26.50 and 38.23 at 24 lags. The first three numbers are well under the critical levels for the Chi-square test at the 95 percent level. (i.e. we cannot reject the hypothesis of white noise residuals with 95 percent confidence.) The last number exceeds the critical value for the Chi-square at the 95 percent level, but not at the 99 percent level. We also regressed the residuals from the two models on their

TABLE 3

EFFECTS OF CHANGES IN THE VARIANCE OF EMPLOYMENT ACROSS REGIONS
USING THE TOTAL SECTORAL SHIFT VARIABLE

MODEL (1) IS LILIEN'S MODEL WITH CURRENT VALUE AND 8 LAGS OF
UNANTICIPATED MONEY, AND 8 LAGS OF THE UNEMPLOYMENT RATE.

MODEL (2) IS SAME AS ABOVE WITH UNANTICIPATED GNP REPLACING
UNANTICIPATED MONEY.

MODEL (3) IS MISHKIN'S MODEL WITH CURRENT VALUE PLUS 19 LAGS OF
UNANTICIPATED MONEY AS WELL AS 19 LAGS OF THE UNEMPLOYMENT RATE AND
OF ANTICIPATED MONEY.

ALL THREE MODELS HAVE THE CURRENT VALUE PLUS 4 LAGS OF THE SHIFT
VARIABLE.

T-STATISTICS IN ().

VARIABLE NAMES	(1)	(2)	(3)
INTERCEPT	-54.25 (-2.04)	-37.91 (-1.65)	-169.27 (-2.20)
SUM LAGS OF THE UNEMPLOYMENT RATE	.92 (7.76)	.87 (7.75)	.96 (3.23)
SUM OF CURRENT VALUE - 9.03 AND LAGS OF UNANTI- (-2.30) CIPATED MONEY OR GNP		-.0006 (-12.48)	114.58 (8.92)
SUM OF LAGS OF ANTICIPATED MONEY	-	-	-35.87 (-3.13)
TIME TREND	.03 (2.07)	.02 (1.70)	.09 (2.21)
SUM OF SEASONAL DUMMY VARIABLES	-3.96 (-9.57)	-3.57 (-9.31)	-3.35 (-3.99)
SUM OF SECTORAL SHIFT VARIABLE	44.83 (2.40)	64.54 (3.58)	-70.75 (-1.42)
STANDARD ERROR OF ESTIMATES	.108	.098	.166

TABLE 3A

EFFECTS OF CHANGES IN THE VARIANCE OF EMPLOYMENT ACROSS REGIONS,
WHERE THE VARIANCE IS DIVIDED INTO THE PART EXPLAINED BY GNP AND
THE PART UNEXPLAINED BY GNP.

MODEL (1) IS LILIEN'S MODEL WITH CURRENT VALUE AND 8 LAGS OF
UNANTICIPATED MONEY, AND 8 LAGS OF THE UNEMPLOYMENT RATE.

MODEL (2) IS SAME AS ABOVE WITH UNANTICIPATED GNP REPLACING
UNANTICIPATED MONEY.

MODEL (3) IS MISHKIN'S MODEL WITH CURRENT VALUE PLUS 19 LAGS OF
UNANTICIPATED MONEY AS WELL AS 19 LAGS OF THE UNEMPLOYMENT RATE AND
OF ANTICIPATED MONEY.

ALL THREE MODELS HAVE THE CURRENT VALUE PLUS 4 LAGS OF THE SHIFT
VARIABLES.

T-STATISTICS IN ().	(1)	(2)	(3)
VARIABLE NAMES			
INTERCEPT	-87.01 (-3.25)	-59.93 (-2.41)	-154.23 (-2.00)
SUM LAGS OF THE UNEMPLOYMENT RATE	.88 (7.32)	.85 (7.33)	.98 (3.38)
SUM OF CURRENT VALUE AND LAGS OF UNANTI- CIPATED MONEY OR GNP	-21.90 (-5.91)	-.0006 (-10.12)	163.34 (13.42)
SUM OF LAGS OF ANTICIPATED MONEY	-	-	-5.87 (- .40)
TIME TREND	.04 (3.26)	.03 (2.44)	.08 (2.01)
SUM OF SEASONAL DUMMY VARIABLES	-3.34 (-8.93)	-3.64 (-9.74)	-2.43 (-3.12)
SUM OF EXPLAINED SHIFT VARIABLE	339.07 (5.05)	280.28 (2.49)	528.97 (3.10)
SUM OF UNEXPLAINED SHIFT VARIABLE	37.20 (2.03)	36.66 (2.00)	-320.23 (-5.74)
STANDARD ERROR OF ESTIMATES	.090	.089	.124

Tables 4 and 4A show regressions which are estimated using the variance of employment over the 45 industrial and regional sectors. The results of these experiments are quite similar to those reported in Tables 2 and 2A above.⁹

In his 1982 paper, Lilien suggests that sectoral shifts were a more important cause of aggregate unemployment in the 1970's than in the 1960's. The results discussed above indicate that exogenous shifts in employment were probably not a significant cause of aggregate unemployment in either period. However, it may be true that in the 1970's sectoral shifts became more important as a channel through which

own lagged values and on the other variables in the models except for the lagged values of the shift variables. In these equations the t-statistics on the lagged residuals are -.77 and -.73. The standard errors are also reduced by about 50 percent. These results suggest collinearity between the lagged residuals and the lagged shift variables as a reason why the first test might have produced a spurious reading. On the basis of these further tests I decided not to correct the model for autocorrelation.

⁹ The t-statistics for the autocorrelation test discussed above are 1.54, 1.54, and .16 for Table 4 and 1.60, -.65, -1.24 for Table 4A.

TABLE 4

EFFECTS OF CHANGES IN THE VARIANCE OF EMPLOYMENT ACROSS INDUSTRIES AND REGIONS USING THE TOTAL SECTORAL SHIFT VARIABLE.

MODEL (1) IS LILIEN'S MODEL WITH CURRENT VALUE AND 8 LAGS OF UNANTICIPATED MONEY, AND 8 LAGS OF THE UNEMPLOYMENT RATE.

MODEL (2) IS SAME AS ABOVE WITH UNANTICIPATED GNP REPLACING UNANTICIPATED MONEY.

MODEL (3) IS MISHKIN'S MODEL WITH CURRENT VALUE PLUS 19 LAGS OF UNANTICIPATED MONEY AS WELL AS 19 LAGS OF THE UNEMPLOYMENT RATE AND OF ANTICIPATED MONEY.

ALL THREE MODELS HAVE THE CURRENT VALUE PLUS 4 LAGS OF THE SHIFT VARIABLE.

T-STATISTICS IN ().

VARIABLE NAMES	(1)	(2)	(3)
INTERCEPT	-42.40 (-1.71)	-35.50 (-1.53)	-135.26 (-2.30)
SUM LAGS OF THE UNEMPLOYMENT RATE	.96 (9.25)	.91 (8.14)	.92 (4.09)
SUM OF CURRENT VALUE AND LAGS OF UNANTI- CIPATED MONEY OR GNP	-12.38 (-3.42)	-.0005 (-10.23)	-19.58 (-1.91)
SUM OF LAGS OF ANTICIPATED MONEY	-	-	-28.23 (-2.83)
TIME TREND	.022 (1.73)	.018 (1.55)	.07 (4.72)
SUM OF SEASONAL DUMMY VARIABLES	-3.51 (-9.84)	-3.01 (-8.34)	-2.99 (-4.88)
SUM OF SECTORAL SHIFT VARIABLE	19.87 (2.35)	22.22 (2.53)	29.81 (1.51)
STANDARD ERROR OF ESTIMATES	.089	.094	.118

TABLE 4A

EFFECTS OF CHANGES IN THE VARIANCE OF EMPLOYMENT ACROSS INDUSTRIES AND REGIONS, WHERE THE VARIANCE IS DIVIDED INTO THE PART EXPLAINED BY GNP AND THE PART UNEXPLAINED BY GNP.

MODEL (1) IS LILIEN'S MODEL WITH CURRENT VALUE AND 8 LAGS OF UNANTICIPATED MONEY, 8 LAGS OF THE UNEMPLOYMENT RATE).

MODEL (2) IS SAME AS ABOVE WITH UNANTICIPATED GNP REPLACING UNANTICIPATED MONEY.

MODEL (3) IS MISHKIN'S MODEL WITH CURRENT VALUE PLUS 19 LAGS OF UNANTICIPATED MONEY AS WELL AS 19 LAGS OF THE UNEMPLOYMENT RATE AND OF ANTICIPATED MONEY.

ALL THREE MODELS HAVE THE CURRENT VALUE PLUS 4 LAGS OF THE SHIFT VAR. T-STATISTICS IN ().

VARIABLE NAMES	(1)	(2)	(3)
INTERCEPT	-70.47 (-2.50)	-47.61 (-2.00)	-131.66 (-1.70)
SUM LAGS OF THE UNEMPLOYMENT RATE	.86 (7.70)	.86 (7.41)	.72 (2.11)
SUM OF CURRENT VALUE AND LAGS OF UNANTI- CIPATED MONEY OR GNP	-30.34 (-9.22)	-.0004 (-8.03)	-102.03 (-6.66)
SUM OF LAGS OF ANTICIPATED MONEY	-	-	-13.12 (- .99)
TIME TREND	.036 (2.51)	.024 (2.01)	.07 (1.67)
SUM OF SEASONAL DUMMY VARIABLES	-3.39 (-9.22)	-2.85 (-3.15)	-2.96 (-4.08)
SUM OF EXPLAINED SHIFT VARIABLE	104.64 (3.81)	91.71 (3.15)	255.00 (3.31)
SUM OF UNEXPLAINED SHIFT VARIABLE	15.18 (1.46)	16.81 (1.68)	44.97 (1.65)
STANDARD ERROR OF ESTIMATES	.095	.092	.164

aggregate demand shocks effected unemployment. To test this hypothesis the sample is broken into two periods: 1962:2 to 1969:4 and 1970:1 to 1983:1. Since the sixties sub-sample is small, only models corresponding to columns one and two of Tables 2, 3, and 4 could be estimated. For the sake of brevity, these regressions are not reported. The most interesting result is that the sectoral shift variables are not significant in any of the six regressions. The seventies sub-sample is also too small to allow the Mishkin models to be estimated. Table 5 shows models corresponding to columns one and two of Tables 2, 3, and 4, estimated over the seventies sub-sample. These results are much less dramatic than those presented above. However, in two out of the six cases, the sectoral shift variable is significant. Thus there is some weak evidence here that such shifts were more important in the seventies than in the sixties. Table 5A displays models corresponding to columns one and two of Tables 2A, 3A, and 4A. In three out of six cases, the part of the variance in employment

TABLE 5

EFFECTS OF CHANGES IN THE VARIANCE OF EMPLOYMENT ACROSS INDUSTRIES, REGIONS, AND BOTH INDUSTRIES AND REGIONS USING THE TOTAL SECTORAL SHIFT VARIABLE.

MODEL (1) IS LILIEN'S MODEL WITH CURRENT VALUE AND 8 LAGS OF UNANTICIPATED MONEY, AND 8 LAGS OF THE UNEMPLOYMENT RATE.

MODEL (2) IS SAME AS ABOVE WITH UNANTICIPATED GNP REPLACING UNANTICIPATED MONEY.

T-STATISTICS IN ().

VARIABLE NAMES	(1) ACROSS INDUSTRIES	(2) ACROSS INDUSTRIES	(1) ACROSS REGIONS	(2) ACROSS REGIONS	(1) ACROSS BOTH REGIONS AND INDUSTRIES	(2) ACROSS BOTH REGIONS AND INDUSTRIES
INTERCEPT	-38.65 (-.36)	-83.40 (-.74)	-66.86 (-.60)	-75.91 (-.69)	-27.54 (-.27)	-85.22 (-.79)
SUM LAGS OF THE UNEMPLOYMENT RATE	.96 (5.03)	.79 (3.31)	.93 (4.58)	.76 (3.23)	.98 (5.67)	.77 (3.40)
SUM OF CURRENT VALUE AND LAGS OF UNANTI- CIPATED MONEY OR GNP	-10.86 (-1.60)	-.0004 (-5.49)	- 7.43 (-1.07)	-.0006 (-8.78)	-13.19 (-2.05)	-.0005 (-7.15)
TIME TREND	.02 (.37)	.04 (.75)	.03 (.61)	.04 (.71)	.01 (.28)	.04 (.80)
SUM OF SEASONAL DUMMY VARIABLES	- 4.96 (-6.80)	-3.83 (-5.47)	-4.37 (-6.30)	-4.10 (-6.69)	-3.58 (-5.53)	-3.63 (-5.72)
SUM OF SECTORAL SHIFT VARIABLE	22.10 (1.42)	35.46 (2.42)	-31.30 (-1.23)	49.57 (2.43)	-14.32 (-1.18)	19.89 (1.78)
STANDARD ERROR OF ESTIMATES	.111	.098	.122	.094	.095	.095

TABLE 5A

EFFECTS OF CHANGES IN THE VARIANCE OF EMPLOYMENT ACROSS INDUSTRIES, REGIONS, AND BOTH INDUSTRIES AND REGIONS, WHERE THE VARIANCE IS DIVIDED INTO THE PART EXPLAINED BY GNP AND THE PART UNEXPLAINED BY GNP.

MODEL (1) IS LILIEN'S MODEL WITH CURRENT VALUE AND 8 LAGS OF UNANTICIPATED MONEY, AND 8 LAGS OF THE UNEMPLOYMENT RATE.

MODEL (2) IS SAME AS ABOVE WITH UNANTICIPATED GNP REPLACING UNANTICIPATED MONEY.

T-STATISTICS IN ().

VARIABLE NAMES	(1) ACROSS INDUSTRIES	(2) ACROSS INDUSTRIES	(1) ACROSS REGIONS	(2) ACROSS REGIONS	(1) ACROSS BOTH REGIONS AND INDUSTRIES	(2) ACROSS BOTH REGIONS AND INDUSTRIES
INTERCEPT	-67.71 (- .52)	-196.68 (- 1.47)	-180.35 (-1.44)	10.74 (.11)	-2.62 (-.02)	-71.89 (- .50)
SUM LAGS OF THE UNEMPLOYMENT RATE	.90 (3.84)	.61 (2.16)	.75 (2.93)	.90 (3.61)	1.00 (5.07)	.79 (3.02)
SUM OF CURRENT VALUE AND LAGS OF UNANTI- CIPATED MONEY OR GNP	-16.96 (-2.02)	-.0002 (-2.28)	-41.90 (-6.30)	-.0012 (-13.62)	-43.17 (-6.32)	-.0005 (-6.70)
TIME TREND	.04 (.53)	.10 (1.48)	.09 (4.35)	.01 (.10)	.001 (.02)	.04 (.46)
SUM OF SEASONAL DUMMY VARIABLES	- 5.08 (-5.92)	- 4.44 (-5.27)	-3.33 (-4.35)	-4.91 (-7.15)	-2.61 (-3.45)	-3.50 (-4.34)
SUM OF EXPLAINED SHIFT VARIABLE	100.60 (1.83)	-12.11 (- .25)	386.10 (3.39)	556.59 (2.84)	138.60 (2.98)	66.02 (1.27)
SUM OF UNEXPLAINED SHIFT VARIABLE	-41.59 (-1.65)	1.19 (.05)	-23.76 (-.85)	88.62 (4.01)	10.44 (.62)	15.49 (.98)
STANDARD ERROR OF ESTIMATES	.140	.121	.101	.076	.108	.111

which is explained by GNP is statistically significant, while the part of the variance which is exogenous to aggregate demand is only significant in one instance. Once again, the exogenous shift measure is only significant in a model which defines the variance of employment over regions. But even in this case, the coefficient on the part of the variance that is exogenous to GNP is small compared to the coefficient on the part which is explained by GNP.

CONCLUSIONS

These results suggest that in Canada, exogenous shifts in employment demand as measured by the variance of employment across regions and industries, do not have a significant impact on the aggregate unemployment rate. Rather, aggregate demand shocks cause sectoral shifts in employment which influence the unemployment rate. I present some weak evidence that such shifts were a more important channel for aggregate demand shocks during the seventies than during the sixties.

APPENDIX 1

DATA SOURCES

THE FOLLOWING SERIES WERE TAKEN FROM THE CANSIM UNIVERSITY BASE PUBLISHED BY STATISTICS CANADA:

DNUMBER	DEFINITION
D40618	EXPORTS OF GOODS AND SERVICES IN MILLIONS 1971\$ (SA)
D40600	GOVERNMENT CURRENT EXPENDITURES ON GOODS AND SERVICES MILLIONS 1971\$ (SA)
B14006	BANKRATE LAST WED. OF THE MONTH (NSA)
D40593	GROSS NATIONAL EXPENDITURE IN MILLIONS 1971\$ (SA)
B1627	CURRENCY & DEMAND DEPOSITS MILLIONS CURRENT \$ (SA)
B50301	US GNP BILLIONS 1971\$ (SA)
B54409	US 3 MONTH T BILL RATE (SA)
B53106	US UNEMPLOYMENT RATE (SA)
D40551	GROSS NATIONAL EXPENDITURE MILLIONS CURRENT \$ (SA)
B50201	US GNP BILLIONS CURRENT \$ (SA)
D730173	CANADIAN HELP WANTED INDEX (SA) (NOT AVAILABLE AFTER 1982)

(SA) = SEASONALLY ADJUSTED AT ANNUAL RATES, (NSA) = NOT SAAR

THE GROWTH RATE OF THE MONEY SUPPLY IS DEFINED AS $\text{LOG}[M1(T)/M1(T-1)]$

THE DEFINITION OF THE LABOUR FORCE WAS CHANGED IN 1966 TO ELIMINATE THOSE 14 YEARS OF AGE. THE UNEMPLOYMENT RATE USED HERE WAS CONSTRUCTED BY SPLICING PRE 1966 DATA WITH POST 1966 DATA. THE SERIES IS AVAILABLE UPON REQUEST.

MONTHLY DATA WERE CONVERTED TO QUARTERLY BY AVERAGING.

THE DATA USED IN CONSTRUCTION OF THE EMPLOYMENT SHIFT INDICES COMES FROM MATRIX 1715 OF THE 1983 UNIVERSITY BASE. THE NINE INDUSTRY GROUPS ARE FORESTRY, MINING, MANUFACTURING, CONSTRUCTION, TRANSPORTATION, TRADE, FINANCE INSURANCE AND REAL ESTATE, SERVICES, AND PUBLIC ADMINISTRATION AND DEFENCE. THE FIVE REGIONS ARE THE MARITIMES, QUEBEC, ONTARIO THE PRAIRIES AND BRITISH COLUMBIA. THE EMPLOYMENT DATA IS MONTHLY AND IS SEASONALLY ADJUSTED. IT WAS CONVERTED TO QUARTERLY BY AVERAGING. TOTAL NON-AGRICULTURAL EMPLOYMENT WAS DEFINED AS THE SUM OF EMPLOYMENT IN EACH INDUSTRY.

INDUSTRIAL SHIFT INDICES DECOMPOSED

QUARTERLY UNEMPLOYMENT FROM 1961 TO 1984 SMOOTHED USING SEASONAL DUMMIES, DUMMIES FOR THE 66 BREAK, TIME, AND TIME SQUARED

SHIFT INDICES DEFINED OVER REGION AND INDUSTRY: DECOMPOSED

REGIONAL SHIFT INDICES DECOMPOSED

APPENDIX 2

The available evidence suggests that the process generating the Canadian money supply data is quite different than that which underlies the American data. Barro and Saidi replicate Barro's analysis using Canadian annual data from 1950 to 1974. In contrast to Barro they find that the deviation of government expenditure from its trend value is not a significant determinant of the rate of growth of the money supply. This result is not startling in view of the smooth growth in Canadian government expenditures over the post war period. What is more surprising is that they find no evidence of employment stabilization policy: lagged values of the unemployment rate do not help predict money supply growth. Barro and Saidi also find evidence of a structural shift in the forecasting equation in 1962, when Canada switched to a fixed exchange rate regime.

Wogin reproduces Barro's experiment with annual Canadian data from 1926 to 1972. He finds that the lagged level of government spending has a significant positive effect on money growth over this period. He also adds exports to the Barro equation as a proxy for balance of payments effects. Exports are more likely to be exogenous than the balance on current account. Wogin tests for breaks in the sample period corresponding to changes in exchange rate regimes, and is unable to reject the null hypothesis that no breaks occurred. This is not an unreasonable conclusion: Monetary policy in a crawling peg regime may not be very different from the policy observed under a dirty float.

Mishkin argues that any variable in the information set of agents at $(t-1)$ should be included in the money supply equation if it has explanatory power. I followed this approach to the specification of a Canadian money supply equation. The specification that best fit the data is shown in column (1) of the Table. Column (2) displays the same equation estimated using American data. The use of American

INTERVAL OF ESTIMATION
= 1954:3 TO 1984:3

EQUATIONS WITH MONEY GROWTH AS THE DEPENDENT VARIABLE
T-STATISTICS IN ()

		(1) EQUATION USING ALL CANADIAN VARIABLES INTEREST RATE=BANK RATE.		(2) EQUATION USING U.S. GNP, UNEMPLOYMENT AND TREASURY BILLS.	
INDEPENDENT VARIABLE	DATE				
INTERCEPT		-0.446	(-2.331)	-0.257	(-2.031)
MONEY GROWTH	T-1	0.101	(0.906)	0.086	(0.837)
	T-2	-0.554	(-0.488)	-0.135	(-1.237)
	T-3	0.195	(1.989)	0.222	(2.202)
	T-4	-0.343	(-3.244)	-0.356	(-3.617)
	T-5	0.593	(0.590)	-0.057	(-0.553)
	T-6	-0.107	(-1.073)	-0.038	(-0.387)
LOG REAL GNP	T-1	0.506	(3.118)	0.166	(0.768)
	T-2	-0.495	(-2.330)	0.314	(1.146)
	T-3	-0.030	(-0.148)	0.001	(0.003)
	T-4	-0.157	(-0.787)	-0.015	(-0.053)
	T-5	0.375	(1.937)	-0.287	(-1.070)
	T-6	-0.150	(-0.996)	-0.197	(-0.870)
INTEREST RATE	T-1	-0.007	(-4.692)	-0.003	(-2.448)
	T-2	0.004	(1.590)	0.002	(-1.162)
	T-3	0.005	(1.880)	0.001	(0.950)
	T-4	-0.007	(-2.364)	0.000	(0.106)
	T-5	0.001	(0.313)	-0.001	(-0.487)
	T-6	-0.000	(-0.222)	-0.001	(-0.517)
LOG EXPORTS	T-1	-0.073	(-1.833)	-0.000	(0.009)
	T-2	0.071	(1.506)	0.020	(0.377)
	T-3	-0.129	(-2.589)	-0.088	(-1.630)
	T-4	0.102	(1.957)	0.054	(0.970)
	T-5	0.052	(0.974)	0.016	(0.287)
	T-6	-0.028	(-0.615)	0.041	(0.817)
UNEMPLOYMENT RATE	T-1	0.008	(2.327)	0.010	(1.757)
	T-2	-0.009	(-2.003)	0.005	(0.622)
	T-3	0.011	(2.163)	-0.004	(-0.535)
	T-4	-0.013	(-2.385)	-0.004	(-0.497)
	T-5	0.003	(0.434)	-0.009	(-1.169)
	T-6	0.001	(0.181)	0.001	(0.151)
SEASONAL DUMMY VARIABLES	2ND	-0.022	(-1.106)		
	3RD	-0.006	(-0.331)		
	4TH	-0.028	(-1.776)		
SEASONAL DUMMY VARIABLES INTERACTED	2ND	0.004	(0.435)		
	3RD	0.000	(0.031)		
WITH DUMMY FOR CHANGE IN LABOUR FORCE SURVEY IN 1966	4TH	0.011	(01.279)		
ADJ R-SQUARE		.5814		.4536	

variables as proxies for their Canadian counterparts ensures that the explanatory variables are truly exogenous. Also, all the American series are seasonally adjusted, whereas the Canadian bankrate and unemployment rates are not. Hence (2) is my preferred specification. As in Wogin, exports are used as a proxy for the balance on current account. The residuals from the money supply equation will be referred to as unanticipated money.

Exogeneity is purchased at some cost, as equation (2) which uses U.S. interest rates, GNP and unemployment does not fit as well as (1), and some of the coefficients which are significant in (1) are less so in (2). The alternating signs on the coefficients of $\log(\text{GNP})$, $\log(\text{exports})$, and the unemployment rate suggest that it is the growth rates rather than the levels of real GNP, exports and unemployment that affect money growth. Government expenditures and the growth rate of prices were dropped from the model since they were not significant in either version.

In order to run a forecast test, (1) and (2) were estimated over the interval 1953 to 1981. The forecasts were obtained by allowing the equations to generate values for the money growth rate in 1982:1. These values were then used as actual data in the forecasts for 82:3, and so on. The sums of the squared forecast errors are .0105 for (2) and .0068 for (1). In summary, the cost of choosing (2) rather than (1) does not seem to be too great in terms of fit or of predictive power at least in 1982 and 1983.

A dummy variable for the period of fixed exchange rates (from 1962 to 1970) was not significant in either (1) or (2). Chow tests for breaks in the sample period at 1962 and at 1971 were performed using equation (2) as the basic equation. The Chi-square test statistics were .916 when the sub period of estimation was 1962 to 1984, and .859 when the period was 1971-84. Thus the null hypothesis of no structural change could not be rejected.

The Durbin's H statistic for (2) was not computable. However, a regression of the residuals from (2) on their own lagged values and on the explanatory variables from (2), produced an insignificant coefficient on the lagged residual.

A further proxy for unanticipated changes in the economic environment was obtained by taking deviations of real GNP from its AR(2) representation. The estimated equation was:

$$\text{GNP}(t) = 388.01 + 1.37 \text{ GNP}(t-1) - .366 \text{ GNP}(t-2)$$

$$R\text{-square} = .999$$

where the t-statistics for the coefficients were 1.5, 16.1, and -4.3 respectively. The Box-Pierce Q-statistics of 6.59 at six lags and 22.94 at twentyfour lags do not allow rejection of the null hypothesis that the residuals from this equation are white noise. Riddell uses a similar measure of unanticipated shocks to GNP.

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