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Wage Inflation and the Distribution of Unemployement
L'inflation des salaires et distribution du chômage

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Article abstract

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INTRODUCTION

The disappointing empirical results that investigators have encountered in trying to discover stable Phillips curves have led to a re-examination of the theoretical underpinnings of the aggregate Phillips curve. Although the major effort in recent years has been to take account of the inflationary expectations hypothesis, there has also been a continuing interest in examining more carefully the relations between the regional and national unemployment and inflation rates. Two directions of activity are evident in this regard. On the one hand, some researchers (e.g., Thirsk [7]) are estimating regional Phillips curves (and the relations between them), and on the other, researchers are studying the implications for an aggregate Phillips curve of the existence of regional Phillips curves (e.g., Thirsk [7] and Brechling [2]). Both directions of research recognize that an « aggregate » labour market does not in fact exist, but rather there are a number of interrelated labour markets within any national economy. In this paper we re-examine the question of aggregating regional Phillips curves and suggest some problems with the empirical work to date.

In particular, in the following section we review Lipsey's [6, pp. 17-18] nonlinear aggregation hypothesis, which is that an increased dispersion of unemployment across sectors will shift the macro-Phillips

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curve to the right, yielding a less favourable trade-off between wage inflation and aggregate unemployment. [1] We show that the direction of the dispersion effect is ambiguous when mobility of labour between sectors is permitted. In the last section of the paper we show that even when migration does not occur, a positive dispersion effect (the Lipsey hypothesis) does not necessarily follow when aggregate wage changes are calculated as they have been in recent empirical work. A brief conclusion completes the paper.

THE NONLINEAR AGGREGATION HYPOTHESIS

Lipsey derived his nonlinear aggregation hypothesis by means of the following argument. Suppose there are two labour markets, each having one-half the country's labour force, and each sector initially having the same unemployment rate (equal to OA in Figure 1). Lipsey assumed that the two markets had identical reaction functions (or micro-Phillips curves) so that Figure 1 can be used to represent both sectors. Lipsey then considered changing the distribution of unemployment between the two sectors, while keeping the aggregate unemployment rate constant. With equal-sized labour forces in the two sectors, the aggregate unemployment is simply the average of the two sectoral unemployment rates. Thus, Lipsey considered one unemployment rate falling to OB (in Figure 1) and the other rising to OC, where BA = AC. Lipsey defined the rate of change in the aggregate wage index ($\dot{W}/W$) as simply the average of the two sectoral rates of wage change. Thus, when both sectoral unemployment rates equaled OA, ($\dot{W}/W$) = 0. However, when the sectoral unemployment rates are OB and OC, ($\dot{W}/W$) > 0, since the convexity of the reaction function means that BD is greater than CE. Thus wages increase faster in the low unemployment rate region than wages fall in the high unemployment rate region. Lipsey concluded that as the distribution of unemployment rates between the two sectors is made more unequal, the rate of change in the aggregate wage index must take on larger and larger values. Thus, the terms of the macro trade-off between unemployment and wage inflation are worsened when the dispersion of unemployment rates is greater.

The empirical work that has been undertaken to test Lipsey's hypothesis has defined regions as the different « sectors » of the theory.

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[1] This hypothesis is particularly interesting in the Canadian case since, as Donner [3] has shown, changes in aggregated demand lead to unequal changes in regional unemployment rates.

Figure 1
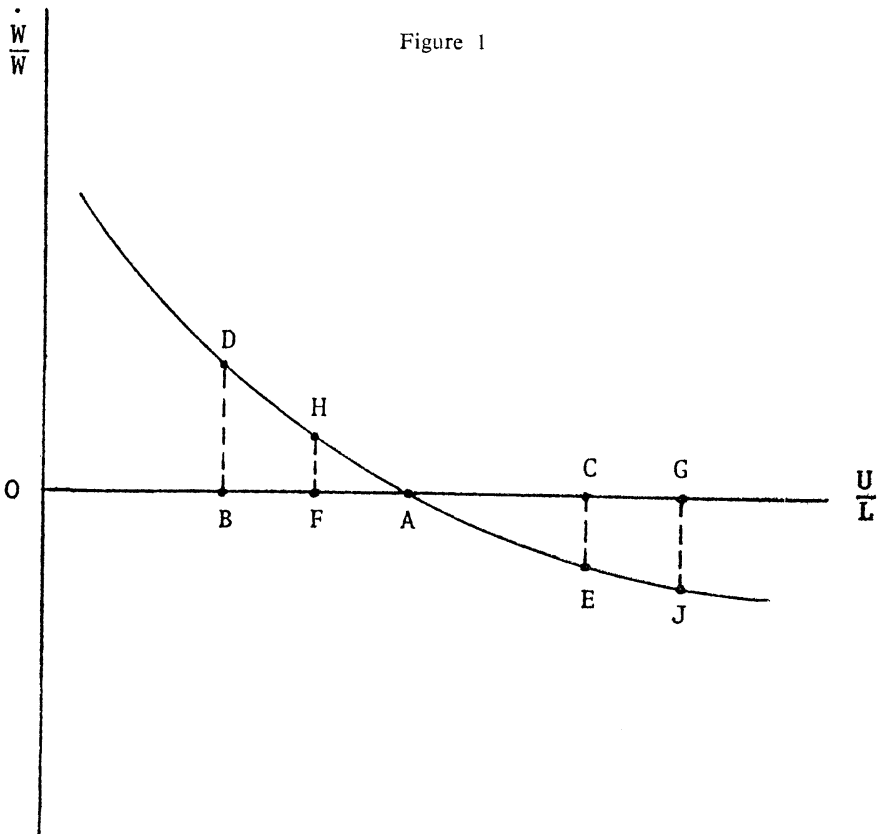
In the Canadian case, then, it is obvious that the theory must be reworked, dropping the assumption of equal-sized labour forces. Intuitively one might think that Lipsey's hypothesis would not follow in this context. For instance, suppose that the change in dispersion of unemployment rates that keeps aggregate unemployment constant comes about by the number of persons fired in the one region equalling to the number of new hires in the other region. With unequaled-sized labour forces, this means that the change in the *percentage* unemployed is larger in the region with the smaller labour force. Let us assume that it is the higher unemployment rate region that has the smaller labour force (a situation which seems reasonable in the Canadian case). Referring to Figure 1, then, the new unemployment rates something like OF and OG, where AG is greater than FA. Even though the Phillips curves are convex, it is quite possible that distance GJ is greater than FH. That is, the decrease in wages in the small-labour-force region may be larger (in absolute value) than the increase in wages in

the other region. One might suspect, then, that the increased dispersion may *not* shift the macro-Phillips curve out to the right.

Archibald [1] has shown, however, that there is no basis for this concern, as long as the rate of change in the aggregate wage index is defined so that the individual rates of wage change are weighted by the proportion of the aggregate labour force that exists in each of the two regions. With this weighting scheme, the effects of the different changes in unemployment *rates* is just cancelled by the different weightings. That is, GJ may be greater than FH, but GJ is weighted less in the definition of aggregate wage changes. The only effect remaining is the convexity effect, so that Lipsey's nonlinear aggregation hypothesis holds, even though the labour forces are of unequal size. Archibald's proof is more general in other dimensions as well, since he did not assume identical micro-Phillips curves, nor equal regional unemployment rates as the initial condition.

The purpose of this part of the paper is to show that Archibald's proof does not follow if there exists any migration between the regions. If the changing dispersion of unemployment rates occurs because of migration of the unemployed from one region to the other, then the labour force proportions change and the perfect cancelling of the differential horizontal shifts in Figure 1, as discussed above, does not occur. Thus, the direction of the dispersion effect is unknown. Since migration of the unemployed from the high unemployment rate regions to the low unemployment rate regions is clearly a well-established phenomenon in Canada and the United States, we argue that our extension of Archibald's analysis may go a long way toward explaining the fact that recent empirical studies have not lent support to the nonlinear aggregation hypothesis. Specifically, the work by Brechling [2, pp. 65-70] for the United States, and by Kaliski [5] and Thirsk [7, pp. 50-52] for Canada, suggests that no dispersion effect on aggregate wage inflation exists. These studies involved several specifications, including Archibald's formulation, and the Taylor series approximation method suggested by Thomas and Stoney [8]. In no case was the coefficient on the regional dispersion measure statistically significant. Indeed, Thirsk consistently obtained the « wrong » sign (which was sometimes nearly significant), implying that increased dispersion of regional unemployment rates would *reduce* the aggregate rate of wage change.

For the remainder of this section of the paper, we prove that the existence of migration makes the direction of the dispersion effect

unknown. Readers who are uninterested in the details of the proof may skip to the last paragraph of this section.

Archibald considered two regions, each with its own convex Phillips curve of the form

$$(1) \qquad \frac{\dot{W}_i}{W_i} = a_i \left(\frac{U_i}{L_i} \right)^{-b_i} + c_i \qquad i = 1,2$$

where U_i is the level of unemployment in region i

$\quad\quad L_i$ is the number of persons in the labour force in region i

$\quad\quad W_i$ is the wage level in region i

$\quad\quad \dot{W}_i/W_i$ is the rate of growth in wages in region i

$\quad\quad a_i$, b_i and c_i are positive constants.

The aggregate unemployment rate then equals

$$(2) \qquad \frac{U}{L} = \alpha \left(\frac{U_1}{L_1} \right) + (1-\alpha) \frac{U_2}{L_2}$$

where $\alpha = \dfrac{L_1}{L}$ and unsubscripted variables refer to aggregate values.

Archibald then considered a *ceteris paribus* reduction in the dispersion of unemployment between the two regions and showed that the condition for the reduction in dispersion to shift the macro-Phillips curve inwards is that the micro-Phillips curve be steeper in the low unemployment rate region than in the high unemployment rate region and that the direction (but not the magnitude) of this dispersion effect was independent of the distribution of the labour force between the two regions.

This result was established by considering the following definition of aggregate wage changes

$$(3) \qquad \frac{\dot{W}}{W} = \alpha \left(\frac{\dot{W}_1}{W_1} \right) + (1-\alpha) \frac{\dot{W}_2}{W_2}$$

Equations (1) were substituted into (3) and $\dfrac{d(\dot{W}/W)}{d(U_2/L_2)}$ was evaluated subject to the constraint that $d(U/L) = 0$ where $U_1/L_1 > U_2/L_2$). The stipulation that the aggregate unemployment rate stay constant in the experiment rules out any movement along the macro-Phillips curve

as we consider changes in dispersion. In addition, it should be noted that the proportion of the total labour force in each region was also kept constant in Archibald's experiment (i.e., $d\alpha = 0$). This additional stipulation implies that the reduced dispersion in unemployment rates comes about simply by employed workers becoming unemployed within region two and the converse in region one. That is, since $d(\dfrac{U}{L}) = 0$ and $dL = 0$, we have $dU_1 = -dU_2$, and since L_1 and L_2 are constant, $dU_1 = -dE_1$ and $dU_2 = -dE_2$, where E_i is the number employed in region (or market) i.

Thus, although Archibald's conclusions appear to allow use of the aggregation hypothesis when the underlying markets are not of the same size, these conclusions are dependent on a special type of change in dispersion that precludes any net migration between the regions. It is instructive to consider the opposite extreme assumption where the changes in dispersion come about solely by migration of the unemployed from one region to the other (with the numbers employed in each region staying the same).

In this case, $dU = dE_1 = dE_2 = 0$, and $dU_1 = -dU_2 = dL_1 = -dL_2$. The analysis is more complicated in that α can no longer be assumed constant. The result is

$$(4)\,\frac{d\,(\dot{W}/W)}{dU_2} = \frac{1}{L}\left\{(S_2 - S_1) - (S_2\,\frac{U_2}{L_2} - S_1\,\frac{U_1}{L_1}) + (\frac{\dot{W}_2}{W_2} - \frac{\dot{W}_1}{W_1})\right\}$$

where $S_i = -a_ib_i\,(U_i/L_i)^{-(+b_i)}$, the slope of the ith Phillips curve. The first term within the braces on the right-hand side of (4) is the difference between the slopes of the two micro-Phillips curves, and is identical to Archibald's result. (See his equation (6).) In this case, however, there are additional terms to consider, so that even if it is assumed that the slope is steeper for the low unemployment rate region (making $|S_2| > |S_1|$ and the first term negative), the overall sign of the dispersion effect cannot be predicted. Specifically, since by assumption $U_2/L_2 < U_1/L_1$, the second term in equation (4) cannot be signed. Thus, in this case (where the unemployed are assumed to migrate) the effect of the changing dispersion depends not only on the relative slopes of the micro-Phillips curves, but also on the initial values of the unemployment rates and rates of wage change in the two markets.

It is, of course, true that during the phases of the business cycle we observe both types of movements by labour force members. That is, there is some variation between the employed and the unemployed groups *within* each region (Archibald's case), as well as some movement of the unemployed between regions (the case considered above). The implication for empirical work is that in some cases increased dispersion in unemployment rates can mean shifts out of the macro-Phillips curve, while in other cases increased dispersion may result in a more favourable short-run trade-off. [2]

THE DEFINITION OF AGGREGATE WAGE CHANGES

However the variations in the dispersion of unemployment rates come about, researchers may still wish to include some dispersion measure in a macro-Phillips curve (on the assumption that the underlying relationships that give rise to the changes in dispersion are stable over time). We simply have no *a priori* prediction as to the sign of this variable in the regression. The problem with this procedure, however, is that it requires that aggregate wage change data be constructed where the weights used in aggregating are labour force proportions. In fact, the empirical studies of the dispersion effect (e.g., Archibald [1], Brechling [2], Kaliski [5], and Thirsk [7]) have derived their aggregate wage change variable by taking first differences of the aggregate wage level index, and dividing by that level. This means that their weights in the definition of aggregate wage changes are *earnings* proportions, not labour force proportions. In this section we explain this assertion and examine its implications. [3]

The aggregate wage level index is constructed by adding up the wage bill for each establishment, and by dividing this total wage bill by the number of employed persons. This procedure amounts to taking a weighted average of the individual wage levels, where the weights

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[2] Our analysis suggests that the more the changes in dispersion arise from migration, the less likely the original aggregation hypothesis will be confirmed in the data. It would be useful to test whether or not the difference between the apparently « correct » results for the United Kingdom (see Archibald [1] and Thomas and Stoney [8]), and the apparently « incorrect » results for North America stems from differences in mobility patterns.

[3] Holt [4] has also raised this point, although he regards it as a minor theoretical slip that the equivalent to our equation (3) is inappropriately defined. The point is not that equation (3) is theoretically incorrect, but that the *testing* of the overall theory is incorrect if the data on aggregate wage changes is not

derived according to whatever definition is used in the theory. We recognize, of course, that it may be possible to *construct* aggregate wage change data using labour force proportions for sectoral weighting, as defined in equation (3). For instance, in Canada the labour force survey reports quarterly data disaggregated by five major industrial classes, five major occupational classes, and ten regions (provinces), that would allow construction of labour force weights. None of the empirical studies of which we are aware have defined the dependent variable in this way, however.

in the average are employment proportions. In a two-region example, the aggregate wage level (W) is defined as

(5) $W = \gamma W_1 + (1-\gamma)W_2$

where

$$\gamma = \frac{E_1}{E_1 + E_2} \quad \text{and} \quad (1-\gamma) = \frac{E_2}{E_1 + E_2}$$

To see what relationship is implied for percentage rates of wage change, we differentiate (5) with respect to time and divide both sides by W. The result is

(6) $\dfrac{\dot{W}}{W} = \gamma^* \dfrac{\dot{W}_1}{W_1} + (1-\gamma^*) \dfrac{\dot{W}_2}{W_2}$

where the weights are

$$\gamma^* = \frac{E_1 W_1}{E_1 W_1 + E_2 W_2} \qquad (1-\gamma^*) = \frac{E_2 W_2}{E_1 W_1 + E_2 W_2}$$

The weights that are used in constructing aggregate wage *changes* are, in fact, *earnings* proportions, not labour force proportions. These are the same as the labour force weights used by Archibald and considered above, in the case in which the *wage levels* are identical in the two market *and* the employment distribution is the same as the labour force distribution. In practice these weights can differ significantly and, moreover the weights stay constant during shift in the dispersion of unemployment must be reconsidered.

   Above we considered two types of changes in unemployment dispersion that left the aggregate unemployment rate constant : a case in which there were variations between the unemployment and employed within each region (referred to as the Archibald case) and a case in which the unemployed migrated from one region to the other (our case). In the first of these, the earnings weights outlined above must be allowed to vary, while in the second, the earnings weights remain constant because

employment is unchanged. Since the general results are the same in both cases, we report a formal analysis for the migration case only (where the mathematics is simpler).

In the migration case $dE_1 = dE_2 = 0$ and $dU_1 = -dU_2 = dL_1 = -dL_2$. Combining equations (1), (2) and (6), totally differentiating and substituting, we have

$$(7) \qquad \frac{d(\dot{W}/W)}{dU_2} = \frac{\gamma^* S_1}{L_1} \left(\frac{U_1}{L_1} - 1\right) + \frac{(\gamma^*-1)S_2}{L_2} \left(\frac{U_2}{L_2} - 1\right)$$

The first term in (7) is positive, while the second term is negative. Even if we assume (as did Archibald) that the Phillips curve in the low unemployment rate region has the steeper slope, making $S_2 \left(\frac{U_2}{L_2}\right) -1) > S_1 \left(\frac{U_1}{L_1} -1\right)$, the sign of the dispersion effect will still depend on the absolute *size* of the initial labour forces and the *wage levels* in each region. Even in the case originally considered by Lipsey of initially identical labour forces and unemployment rates, expression (7) is still not signable and depends on the initial wage levels.

CONCLUSION

In summary, recognizing that the unemployed do migrate between regions in Canada, and that data on the agregate wage change variable is constructed using the fraction of earnings for sectoral weighting, it is not at all surprising that the existing empirical studies have trouble detecting a positive dispersion effect. We conclude by noting that an implication of this ambiguity is that a stable *aggregate* Phillips curve may not be found, so that attempts to incorporate an expected price change variable in such a relationship may be a totally inappropriate test of the accelerationist hypothesis.

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L'inflation des salaires et distribution du chômage

Les résultats décevants que les recherchistes ont obtenus en essayant de découvrir des courbes de Phillips stables obligent à en examiner de nouveau les fondements théoriques. Même si l'on a fait en ces dernières années beaucoup d'effort pour tenir compte de l'hypothèse de prévisions inflationnistes, on a aussi considéré attentivement les relations entre les taux d'inflation et les taux de chômage nationaux et régionaux. Quelles que soient les directions dans lesquelles les recherches se sont orientées, on est arrivé à la conclusion qu'il n'existe pas de marché du travail « global », mais qu'il y a, à l'intérieur d'une économie nationale, plusieurs marchés du travail interreliés. Dans leur article, les auteurs ont analysé le problème des courbes de Phillips régionales « globales » et quelques-uns des problèmes qu'elles soulèvent.

À partir d'études théoriques récentes faites sur le sujet en Grande-Bretagne et en Amérique du Nord, ils ont essayé de montrer que plus la dispersion du chômage à travers différents secteurs de l'économie est marquée plus la courbe de Phillips a tendance à glisser vers la droite, que la direction de l'effet de dispersion est ambiguë lorsqu'il y a mobilité de la main-d'oeuvre d'une région à l'autre et, enfin, que, même quand il n'y a pas migration de la main-d'oeuvre, il ne s'ensuit pas nécessairement un effet de dispersion.

L'étude de Lipsey a considéré l'hypothèse de l'existence d'une économie divisée en deux marchés du travail en supposant un taux de chômage différent de l'un à l'autre alors que le taux de chômage global demeure constant. Il en résulte que les salaires augmentent plus rapidement dans la région où le taux de chômage est bas qu'ils ne baissent dans celle où le taux de chômage est le plus élevé. Lipsey en conclut donc que plus la différence entre les taux de chômage est grande entre les deux secteurs, plus l'indice des taux de salaire a tendance à s'accroître.

Dans le cas du Canada, il devient évident qu'il faut repenser la théorie de Lipsey. Un autre auteur, Archibald, a montré qu'il n'y a pas lieu de s'en préoccuper en autant que le taux de changement de l'indice global des salaires est construit de telle sorte que les taux individuels de salaire soient pondérés en tenant compte de la main-d'oeuvre existant dans chacune des deux régions. Le but de l'article est de démontrer que le raisonnement apporté par Archibald à l'appui de la théorie de Lipsey ne vaut plus s'il y a migration de la main-d'oeuvre d'une région à l'autre. Or, comme la migration des sans-travail des régions à haut taux de chômage aux régions à taux de chômage bas est un phénomène bien établi au Canada et aux États-Unis, les auteurs expriment l'opinion que l'analyse d'Archibald n'a pas tellement de signification, car, comme le laissent voir les études de Brechling pour les États-Unis et celles de Kaliski et de Thirsk pour le Canada, il n'existe pas d'effet de dispersion.

Cependant, lorsqu'il y a dispersion des taux de chômage, les recherchistes peuvent également vouloir mesurer le degré de dispersion dans la courbe de Phillips « globale ». Pour ce faire, il faut que les changements globaux dans les données relatives aux salaires soient construites de façon que la pondération de l'ensemble tienne compte des proportions de main-d'oeuvre.

En résumé, si l'on considère que les sans-travail émigrent d'une région du Canada à l'autre, il n'est aucunement surprenant que les études empiriques existantes soient impuissantes à détecter un effet de dispersion positif. La conséquence de cette ambiguité signifie qu'on ne peut découvrir une courbe de Phillips d'ensemble stable d'où il résulte que les tentatives en vue d'incorporer la variable d'un changement des taux auquel on s'attend s'avèrent un test nullement approprié de l'hypothèse de l'accélération.