A THEORETICAL CRITIQUE
OF THE STANDARDIZATION
METHOD OF ESTIMATING REGIONAL EFFECT AND
INDUSTRY STRUCTURE AS SOURCES OF
INTERREGIONAL INCOME VARIATIONS

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Introduction

Cross-sectional analysis of regional variations in income per person have emphasized two strategic factors: differences in regional employment bases, and regional variations in income per employed worker. In turn, sources of regional variation in income per employed worker have frequently been attributed to two factors: interregional variations in industrial structure and interregional variations in pay rates within the same industry.

The methodology involved in studying these two factors is based upon the standardization techniques originally developed by Frank Hanna [8] and Simon Kuznets [9]. Briefly, the method attempts to assess the respective contributions of regional variations in pay rates and industry mix in explaining difference in average income between region and nation.

A number of recent studies utilizing this analytical framework have been based on Canadian regional data, beginning with Chernick's 1966 study for the Economic Council of Canada [2] and, more recently, A.G. Green's work of 1971 [8], the Economic Council's Twelfth Annual Review of 1975 [5], and its 1977 study on regional disparities in Canada entitled Living Together: A Study of Regional Disparities [6]. As well, a current major study utilizing this methodology has been published by the Economic Council entitled Regional Disparities of Productivity and Growth in Canada [1].

This note attempts to demonstrate that Hanna's methodology is theoretically invalid, and that its use may lead to substantive errors in the assessment of the relative importance of interindustry
versus interregional variations in pay rates as sources of regional disparities in income.¹

**Hanna’s Standardization Method**

In order to assess the contribution of industry structure to differences in regional and national average pay rates (termed “reported” state and national earnings) Hanna [9] developed the concept of “rate-constant” earnings.

Significantly, the rate-constant earnings of a region are obtained by imposing the national average wage rate of each industry on the employment weights relevant to that industry in a specific region:

\[
R_{cj} = \frac{\sum (W_{ni} \times E_{ij})}{\Sigma E_j}
\]

where:
- \(R_{cj}\) = rate-constant earnings for region \(j\).
- \(W_{ni}\) = national average wage rate, industry \(i\).
- \(E_{ij}\) = employment level of industry \(i\) in region \(j\).
- \(\Sigma E_j\) = total employment in region \(j\).

If the difference between a region’s rate-constant earnings and reported national earnings is the same as between regional and national reported earnings, it is concluded that industry structure is not a significant factor in explaining earnings differences.

In assessing the effect of pay rates on regional average income, it is significant that the national industrial structure (termed the composition-constant mix)² is imposed on the region’s wage rate in each of its industries:

\[
C_{cj} = \frac{\sum (E_{ni} \times W_{ij})}{\Sigma E_j}
\]

where:
- \(C_{cj}\) = composition-constant earnings for region \(j\).
- \(E_{ni}\) = national average employment level in industry \(i\).

¹ A substantial amount of comment and criticism has occurred in the literature regarding the validity of the empirical results based on Hanna’s method. See Perloff [11:541-551]. There has been little theoretical criticism of the method other than by Denison [4:161-164].

² The composition-constant approach is an extension of Hanna’s original work developed by Denison. Composition-constant and rate-constant earnings additively explain all differences between reported regional and national earnings. See [4:164-174].

If the difference between the region’s composition-constant rates and national reported earnings is the same as between reported regional and national earnings, it is concluded that pay rate differences are not an explanatory factor.

**The Model**

The basic determinants of regional wage rates and industrial structure are factor endowments, consumer taste patterns and production functions. Resulting wage rate differences between regions in a common market may be sustained if long-run factors such as location and climatic conditions vary interregionally. As well, market imperfections such as lagged response to temporary increases in demand for a specific region’s output, or lagged adjustments to changing comparative advantage, may produce short-run factor price differentials.⁴

To illustrate the theoretical shortcomings of Hanna’s standardization technique, assume a two-region model as in the Edgeworth box diagrams and production possibility frontiers contained in Figure 1. Assume that Regions A and B have identical production functions homogeneous of degree 1, and identical consumer tastes, but differ with respect to factor endowments of labour and capital.

Two commodities, X and Y, are produced. Commodity X requires a labour intensive technology, while commodity Y requires a capital intensive technology.

Under conditions of perfect competitive markets and with similar consumption patterns, Figure 1 indicates that an efficient equilibrium occurs at points A and B in each region’s commodity markets.⁵

These regional effects are in contrast to differences in industrial pay rates which are attributable to variations in age, race and sexual composition of the labour force in industries and, in particular, to variations in skill levels required by different industries. Differences in pay rates between industries may be viewed as originating from market imperfections in product or factor markets, or based upon a sustained competitive advantage held by a specific subset of industries. Industries which are notably low-paying or high-paying, when appearing preferentially in a region are then viewed as a possible factor in explaining its average earnings ranking. See Cullen [3].

For a detailed examination of long-and short-run obstacles to interregional wage-rate equalization, see Goldfarb and Yezer [7].

Equilibrium conditions also exist in consumption space (not shown in Figure 1), where

\[
\text{MRS} = \frac{X}{Y} = \frac{P_X}{P_Y}
\]

where \(\text{MRS}\) is the marginal rate of substitution.
\[
\text{MRT} \frac{X}{Y} = \frac{X}{P} \quad (3)
\]

where: \( \text{MRT} \frac{X}{Y} \) = marginal rate of transformation, commodity \( X \) for \( Y \).

\( \frac{X}{P} \) = ratio, price of commodity \( X \) to price of commodity \( Y \).

Simultaneously, an efficient equilibrium in production takes place \( A' \) and \( B' \) in both regions' production markets:

\[
\frac{L}{K} = \frac{MPP}{MPP} \quad (4)
\]

where: \( \frac{L}{K} \) = marginal rate of technical substitution of labour for capital.

\( \frac{MPP}{L} \) = ratio, marginal physical product of labour and capital.

Given these assumptions, there is a difference in industrial structure in the two regions; Region A emphasizing the production of the labour intensive commodity \( X \) (distance \( OX_a > OY_a \)), and Region B that of the capital intensive commodity \( Y \) (distance \( OY_b > OX_a \)). Differing demand patterns in relation to the factor endowments in the two regions results in uniquely determined but differing factor and commodity price ratios.

The \( \frac{L}{K} \) ratio in producing commodities \( X \) and \( Y \) is greater in Region B (as indicated by the slope of \( \frac{L}{K} > \frac{L}{K} \), Figure 1) so that a higher wage rate prevails in Region B. Differences in commodity price ratios in the two regions can be ascertained in Figure 1 by comparing the slopes of the functions \( a' \ a'' \) and \( b' \ b'' \) on the production frontiers of each region.
Figure 1

EDG EWORTH BOXES AND PRODUCTION POSSIBILITY FRONTIERS
The Critique

The analytic implications of Hanna's procedure can be evaluated in Figure 1. For purposes of clarity, but without loss in generality, substitute Region B's industrial structure OY_b, OX_b and as given at B' onto Regions A's production space as shown at A''. This attempt to assess regional pay rate effects in Region A introduces inefficiency into the region's production and commodity markets.

In Region A's production market:

\[
\frac{L}{MPP} \text{ at } A' > \frac{L}{MRTS} \text{ at } A''.
\]

(5)

In Region A's commodity market:

\[
\frac{X}{MRS} > \frac{X}{MRT}.
\]

(6)

In order to assess industry structure effects, Hanna's technique imposes Region B's factor price ratios (given as B_l/B_k at B' in Figure 1) onto Region A's industrial structure at A'. This procedure does not produce an efficient equilibrium because in Region A's production markets:

\[
\frac{L}{MPP} > \frac{L}{MRTS} \text{ at } A'.
\]

(7)

In Region A's commodity markets:

\[
\frac{L}{MPP} > \frac{X}{MRT}.
\]

(8)

Conclusions

Under conditions of perfectly competitive markets, the imposition of this standardization method must lead to reduced efficiency in both production and commodity markets. This result occurs because the method distorts the analytic relationship that establishes factor price ratios which are in efficient equilibrium with the region's industrial structure and patterns of consumer tastes.

If factor endowments and consumer taste patterns vary between regions, Hanna's method cannot correctly measure structural and pay rate effects. Imposition of the national average pay rate in order to estimate structural effects has no validity because the imposed structural has no analytical relationship to the existing pay rates in the region.

References


\[\text{In the context of the model, attempts to assess pay rate effects by application of Hanna's composition-constant method result in existing wage rates in Region A being too high to be consistent with the industrial structure imposed from Region B. Similarly, attempts to assess industry structure effects impose wage rates from Region B on the existing industrial structure of Region A, which is then incorrectly biased in favour of commodity output from the capital intensive industry.}\]