FUNDAMENTAL ECONOMIC STRUCTURE AND STRUCTURAL CHANGE IN REGIONAL ECONOMIES: A METHODOLOGICAL APPROACH

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Abstract: *Regional economic structure is defined as the composition and patterns of various components of the regional economy such as: production, employment, consumption, trade, and gross regional product. Structural change is conceptualized as the change in relative importance of the aggregate indicators of the economy. The process of regional development and structural change are intertwined, implying as economic development takes place the strength and direction of intersectoral relationships change leading to shifts in the importance, direction and interaction of economic sectors such as: primary, secondary, tertiary, quaternary and quinary sectors. The fundamental economic structure (FES) concept implies that selected characteristics of an economy will vary predictably with region size. The identification of FES leads to an improved understanding of the space-time evolution of regional economic activities at different geographical scales. The FES based economic activities are predictable, stable and important. This paper reviews selected themes in manifesting an improved understanding of the relationship among intersectoral transactions and economic size leading to the identification of FES. The following four questions are addressed in this paper: (1) What are the relationships among sector composition and structural change in the process of economic development? (2) What are the approaches utilized to study structural change analysis? (3) Can a methodology be developed to identify FES for regional economies? (4) Would the identification of FES manifest an improved conception of the taxonomy of economies?*

Keywords*:* STRUCTURAL CHANGE AND FUNDAMENTAL ECONOMIC STRUCTURE.

JEL Classification: DF7, O11, R11

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1. INTRODUCTION

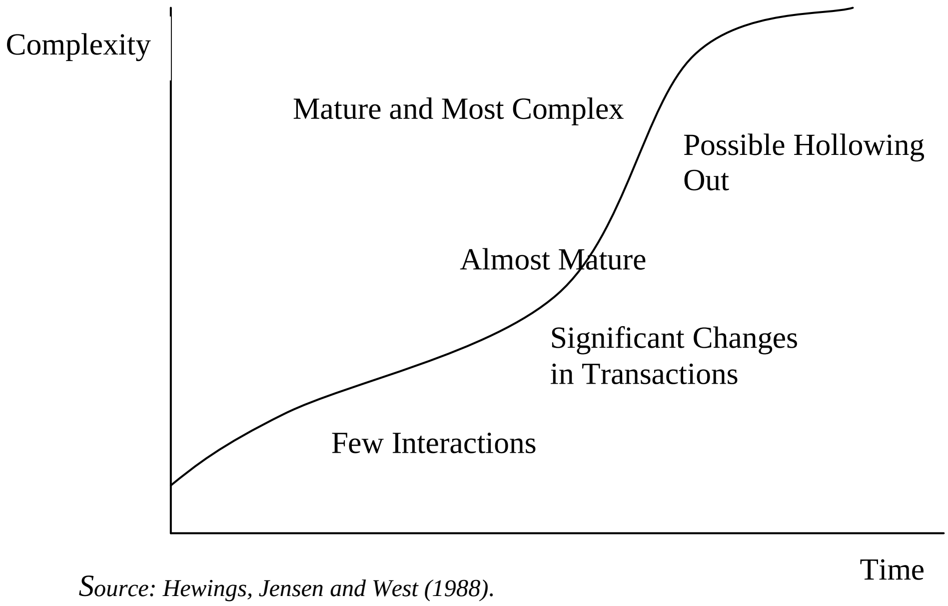
Economic structure is defined as the composition of various components of the macro aggregates, relative change in their size over time, and its relationship with the circular flow of income (Jackson et al., 1990). As regional economies develop from an agricultural, to industrialized and service-sector (quaternary and quinary sectors) based economies there is an explicit transformation among the intersectoral relationships among industries. The initial concentration of economic interaction is among primary sector activities, and matures to secondary and tertiary sector interaction at later stages of development. Given this perspective the overarching question addressed in this paper is whether there are identifiable patterns of relationships among economic transactions and macroeconomic aggregates as revealed by input-output tables. Would identification of such patterns allow regional analysts to predict regional change in a statistical sense? What is the methodology to identify fundamental economic structure (FES)?

Shishido et al. (2000) studied twenty countries from Asian economies and concluded that if the input coefficients in the Leontief table are partitioned into 'principal', 'supporting' and 'primary' groups, then the second and third groups would in all likelihood change as the economy develops. The first group showed no change in pattern with economic development while the latter two showed changes. This suggests the existence of a fundamental component in the regional economic structure. FES represents those economic activities that are consistently present in regional economies of varying size and complexity within a nation. The compilation of input-output table is manpower intensive, expensive and time consuming. If a component of the transaction matrix can be predicted using FES it will save resources in compiling national and regional tables.

A survey of structural change analysis has discovered that studies in the relationship linking technical change and economic growth have gained significance during the 1990s (Silva and Teixeira, 2008). Holland and Cooke (1992) analyzed the regional tables for Washington economy and concluded that changes in output especially in the service sector were driven by international demand. Jensen et al. (1988) and West (2000) utilized a fundamental economic structure (FES) approach to identify predictable cells in the regional tables for Australia. Thakur (2008 and 2010) identified a temporal and a regional FES for the Indian economy. The analysis suggests the existence of FES at different geographical scales. Also, these economic structures are predictable, stable and important. The identification of fundamental cells was based on the assumption that regions exhibited a predictable pattern based on the similarities in regional economies across space and time. The FES approach has been an important milestone in identifying the engines of regional growth. The framework has been utilized to predict the regional tables for economies utilizing times-series and cross-section data on economic structure (West 2000 and 2001).

As economic development takes place the nature of interaction among economic sectors undergoes transformation. Jackson et al. (1989) posit a relationship between stages in economic development associated with sector interaction. They argued that as an economy expands from a primary stage to a more complex stage, the relationship between sector linkages and economic development becomes intricate. In the initial stage, the regional economy's interdependence increases gradually and, later, it increases at faster pace, leading to a strong interaction among sectors. Thus, economies will be strongly dependent on the primary sector and as secondary sector activities are introduced, interaction propagates among the two sectors. The industrial restructuring process introduces service sectors such as: finance, insurance, high technology and trade sectors which predominate. At a mature stage of development, slowing in, the pace of inter-industry interactions are expected, leading to a maximum with the possibility of a decline in interactions known as the process of 'hollowing out' (Figure 1). This process has been observed in the Japanese economy where the employment in the manufacturing sector has significantly declined, and increased in the service-sector, followed by an increase in the share of foreign direct investment by Japanese firms in foreign locations (Prasad, 1997).

Figure 1: Regional Economic Development Process



Source: Hewings, Jensen and West (1988).

Likewise, the Chicago economy has shown a hollowing out as well with the implication that intra-metropolitan dependence in economic interaction has declined and dependence on sources of supply and demand on outside the region has increased (Hewings et al. 1988a; Hewings et al. 1998). Also, the Taiwanese economy has shown a decline in the density of inter-sector linkages since the beginning of the 1980s (West and Brown, 2003). An important aspect of development debate since the early twentieth century has been the identification of regularities, patterns and common trends in the process of development.

A significant element in this endeavor has been to understand the relationship between economic development and structural change in the process of modernization.

This paper is organized into five sections: the second section examines selected themes to shed light on the relationships among sector composition, structural change and economic development; the third section discusses the applications of selected methods of structural change followed by the fourth section which outlines the quantitative methodology of the identification of FES; and the last section concludes.

2. ECONOMIC STRUCTURE, STRUCTURAL CHANGE AND DEVELOPMENT

The ‘structural complexity’ of an economic system can be understood by decomposing an economy into three elements: ‘structure’, ‘processes’, and process explaining ‘complexity’ in the economy (Pryor, 1996). Structure is defined as the composition and patterns of components of the macro-economic aggregates. Process involves both description and analysis to identify structural change within economies. A glance at the indicators of structural change will portray a snapshot of the patterns of change occurring in an economy at a given point in time and space. The analytic task is that of exploring the mechanism producing change. Thus, ‘structural changes’ are modifications in relative importance of aggregative indicators of the economy. ‘Structural economic dynamics’ are the processes of time and space dependent changes and the interrelationship between economic aggregates, such as: consumption, savings, investment, and expenditure. Complexity deals with linking particular aspects of the behavior of the economic system with the structural components of the entire economic system (Pryor, 1996).

The process of economic development is explained by the shifting distribution of economic activities in a nation over space and time. To understand the distribution of economic activities three sectors are identified: primary, secondary and tertiary, and a fourth category, quaternary sector can be added (Kenessey, 1987; Malecki, 1991). These sectors correspond to the assemblage of economic activities anchored in various production processes like: ‘extraction’, ‘processing’, ‘delivery’ and ‘information’ (Kenessey, 1987). Kenessey (1987) argues for a *sectoral-structural hypothesis* whereby primary, secondary, tertiary and quaternary activities can be broadly in equilibrium at different rates of growth and economic performance levels for the nation as a whole. To understand the growth momentum of these sectors an understanding of the linkages among these sectors is indispensable. If we assume an economy with three sectors: agriculture, industry and tertiary, there are nine permutations in which three sectors can interact leading to inter-sector interactions. Further, if we abstract from the various linkages and just examine the agriculture and industry linkage, then, this linkage can be traced through the role of agriculture as: (1) supplier of wage goods, mainly food grains to the industry sector, (2) provider of raw materials for agro-based industry, (3) generator of agricultural incomes which creates final demand for the output of the industrial sector, and (4) generator of demand for purchased inputs like fertilizers and pesticides for agricultural production. While the first two linkages represent supply side or backward linkages, the last two represent demand or forward linkage.

The early research by Chenery (1960) and Chenery and Taylor (1968) identified a pattern amongst large countries, small primary-oriented and small industry-oriented countries. They identified uniform patterns of change in the structure of production as the income level of nations rose. Chenery (1960) argued for uniform patterns in industrial growth since demand and supply factors were analogous amongst countries and differences in growth would arise only due to differences in factor prices. In particular the role of technological change in the primary production, chemicals and metal products sectors were reinforced both at the cross-sectional and temporal levels. For instance, in the United States, industries in general shifted to larger consumption of services, electric energy, chemicals and synthetics, thus substituting for coal, wood and metals during the period 1958-62 (Carter, 1967). A cross-sectional study of 26 countries at various income levels have shown that intersectoral relationships have an 'asymmetric dependence' of the service sector upon skill intensive and technologically dependent manufacturing activities (Park and Chan, 1989). In general, development patterns are not invariant over time and especially 'technological change' has a strong role in influencing structural change patterns across countries (Syrquin and Chenery, 1989).

There has been a great deal of interest in linking the association among economic structure, development and structural transformation across intercountry and sub-national economies. The central argument is that nations begin as primary producers, then, resources shift to secondary production and, finally, to service production and these stages identify with the stages of development of economies. Several scholars, such as Chenery (1960), Chenery and Taylor (1968), Chenery (1979), Syrquin and Chenery (1989), identified 'common or universal patterns of development' in their cross-sectional and longitudinal studies across nations and regional economies. The identified development patterns represented an expected milieu of change as economies transform from a low income agricultural economy to a high income urban-industrial economy (Pandit, 1991). This theme has also been investigated to identify shifts in labor shares across sectors as economic development takes place.

Clark (1940) and Fisher (1939) posit with rising levels of economic development, a decline in the share of labor in the agriculture sector is noticed, followed by an initial rise and subsequent decline in the industrial labor share. These two processes are followed by a monotonic increase in the share of labor in the tertiary sector. Pandit (1990a) observed a lacuna in the Fisher (1939), Clark (1940), and Chenery (1975) observations and postulated that the more recent developing countries had a higher share of labor force in the service sector as opposed to the less recently developed countries. A 'hump' is observed in a cross-sectional study of several countries though on an individual basis a rising share of labor in the tertiary sector is observed. Katouzian (1970) suggested that this was true due to aggregation in the service sector since there was a great deal of heterogeneity in the composition of service sector. The tertiary sector constituted three parts: ‘new services’ with high income elasticity of demand, ‘old services’ with low income elasticity of demand and ‘complementary services’ those whose growth was linked with manufacturing sector in addition to government activities.

A tertiary sector hypertrophy (Pandit, 1990b) has been observed, though there is considerable spatial variation among world regions in this phenomenon. Several factors explain this trend. First, a surplus of urban labor supply exists in relation to manufacturing demand in many developing economies; second, rapid urbanization has led to an increasing demand of low-cost services; and third, the government has not operated the labor market efficiently. Pandit et al. (1989) and Pandit (1992) observed a ‘temporal drift’ in sector-shift models among the developed and developing countries, suggesting a lack of regularity in the labor sector allocation as development occurs. Further, Pandit (1986) noted the impact of trading activities upon the labor force transformation among developing economies. In a nutshell, though the Clark-Fisher thesis is theoretically appealing and provides a strong rationale for explaining the allocation of labor force across sectors, but, the notion can be acceptable only by examining its sensitivity to temporal, spatial and contextual validity to shifts of labor force across sectors, and the shift of the sectors themselves (Casetti and Pandit, 1987).

3. METHODS OF STUDYING STRUCTURAL CHANGE

Regional analysts have developed several methodologies to measure, interpret and understand structural change. This section discusses four selected themes of the approaches utilized in measuring structural change. These methodologies manifest an improved understanding of the relationship among sector composition, structural change and economic development. These themes are: ‘identification of key sectors’, ‘sector composition and economic growth’, ‘structural decomposition analyses’, and ‘spatial structural convergence’.

The first theme examined is the key sector analysis. These are those sectors within a regional economy that exercises their influence via sale and purchase relations, and is expected to have a more than average impact on the economy. Rasmussen (1957) proposed two indices that are widely used as measures for the identification of key sectors and these are: ‘power of dispersion’, and ‘sensitivity of dispersion’. The power of dispersion is defined as the ratio of the average direct and indirect coefficient from column j to the average direct and indirect coefficient in the regional table. This implies if the ratio is larger than 1, a unit increase in the final demand for the column industry will translate into a greater than average change in activity in the economy. The sensitivity of dispersion measure is defined as the averages of the direct and indirect coefficients from row i to the average direct and indirect coefficient of the regional table. This implies if the final demand increases by 1 unit, the row will experience a more than an average impact on economic activities (Jackson, 1993). The identification of key sectors can be examined by the application of alternative methodologies such as field of influence and identification of the minimum product matrix (MPM).

Hewings et al. (1989) in their analysis of the Brazilian economy examined the identification of key sectors using the field of influence approach. They decomposed the inter-industry transaction into a hierarchy of flows and the flows associated with the higher levels of hierarchy were identified as key sectors. A new perspective of the identification of key sectors has been proposed by Sonis et al. (2000) based on a minimum information approach. Utilizing the Chinese input-output tables for 1987 and 1990 the regional economic structure has been decomposed into two components. The first component is extracted based upon the row and column multipliers from the Leontief inverse matrix. The second component is compiled from the synergetic interaction among several sectors of the regional economy. A multiplier product matrix (MPM) is then collated which depicts the economic landscape associated with the regional economic structure. However, these measures of economic structure are not devoid of limitations. The development process proposes multiple objectives to attain higher levels of employment, income, output, exports, and foreign exchange; the identification of a few key sectors with a concentrated investment in such sectors cannot achieve the stated multiple objectives (Sonis et al. 1995).

The second theme seeks to identify statistically universal relationships between economic growth and change in economic structure using cross-section data or time-series data for national and sub-national economies. Kuznets (1966) in a sample of 24 countries and Chenery (1975) with a sample of 100 national economies showed how nations shared common patterns of structural change in the process of economic growth, and, thus, attempted to provide a general theory of structural change. This theme attempts to provide an understanding of the process of historical change and experience as economies with similar initial conditions developed in time. Some of the theories used to explain the process of structural change are the dual sector theory, Myint's vent for surplus theory (1958), and Todaro's rural-urban migration (1969). Also, Syrquin (1988) identifies three stages of structural transformation: first, primary production where the economy is characterized by low to moderate rates of capital accumulation, a fast increase in labor force and very low growth in total factor productivity; second, a shift towards the manufacturing sector contributing more to growth, and third, a decline in the share of labor force in manufacturing and an increase in export shares of manufactured goods, with an increase in the service sector. The shift from agriculture to industry sector can be explained by the decline in labor force and operation of Engel's law that leads to the decline of primary sector; a rise in the income elasticity of manufacturing goods; and a subsequent rise of income elasticity in the service sector in the third stage. This stage model is a general model linking sector linkage with economic development which may show discontinuities in different countries with respect to timing and scale.

The third methodology is the application of structural decomposition analysis (SDA) to understand sources of development and change in regional economies. SDA is a comparative static exercise in which sets of coefficients are given a shock in the input-output tables, and the transformed coefficients are compared to a set of initial activity levels. Sonis and Hewings (1998) developed a 'temporal Leontief inverse' method to analyze the trends and tendencies for a time series of input-output tables. This methodology has been applied to examine the 'hollowing out' phenomenon in the Chicago economy for the period 1980-1997. Analysis suggests that the manufacturing sector has experienced a weakening inter-industry relationship, and has become more dependent on inter-regional trade. Further, the services sector demonstrates stability and an increasing dependence on inter-industry relationship within the Chicago region (Okuyama et al. 2006). Jackson and Dzikowski (2002) applied the spatial output decomposition method to five States in the Midwest economy in the US to analyze the regional economic structure. The analysis attributed changes in gross output in the States due to i.e. differences in final demand and inter-industry structure. A spatial SDA approach has been applied to analyze intra and inter-country linkages in the embodied energy demand in Japan and China for 1985 and 1990. The analysis revealed two major implications. First, the effects of the structural changes in the non-competitive inputs in China had a negligible bearing upon primary input requirements in Japan; and secondly, the impact of final demand shifts in Japan on primary energy demand from China was forty times higher than the impact of shifts in final demand in China upon energy requirements in Japan (Kagawa and Inamura, 2004). The sources of growth in the information sector have been analyzed for the Indian economy. The SDA approach was utilized to decompose the determinants of growth during the period 1983-84 and 1989-90. A positive determinant of growth was domestic demand expansion.

The export expansion and technological change factors had a positive effect on information sector but not a significant one. The analysis suggests that supply of technically competent infrastructure would boost growth in the information sector (Roy et al. 2002). The SDA approach has provided insights to the understanding of regional structural changes in many areas of regional analysis. Nevertheless, the SDA methodology lacks a unified theoretical framework. Rose and Casler (1996) suggest that the SDA approach be grounded in the theories of consumer demand and firm behavior.

The fourth theme addressed in this section is the spatial structural convergence analysis. In the past few decades regional economies have been influenced by structural forces such as: liberalization, deregulation and globalization. The process of globalization has various effects on regional economies such as: regional specialization, trade and spatial economic interdependence, new patterns of spread of technologies, and restructuring of the regional mix of industries. Globalization has led to both rapid increases in national economic growth rates as well as economic disparities among nations. A novel approach to examine regional income inequality has been widely discussed and is called the regional convergence. Regional convergence is defined as the decrease of regional income inequality over time and across different regions within a nation. Two concepts of income convergence have been defined namely *Beta-convergence* and *Sigma-convergence* (Sala-I-Martin, 1996). The former is defined as the negative parametric relationship observed between the growth rate of income per capita and the initial level of income. In other words if lagging regions grew faster than prosperous regions then Beta convergence is said to be observed. Further, if the dispersion of real per capita income across a sample of regional economies within a nation tends to decrease over time then Sigma convergence is observed.

A spatial convergence approach has been proposed to examine the evolution of regional income distribution over space and time. This methodological development is a non-parametric approach of studying the dynamics of the spatial distribution of income. It incorporates the integration of spatial statistics into the Markov analysis and is called the 'spatial Markov approach' (Rey, 2001; Le Gallo, 2004). Rey and Montouri (1999) observed that regional income distribution showed a pattern of convergence in the US and this distribution showed co-movements relative to spatial neighbors of individual states in the nation. Rey's (2001) study examined the space-time evolution of income distribution for individual economies in the US and their neighbors for the period 1929-1994. He developed the spatial Markov framework and showed that it contributed greater insights to the role of regional context in shaping the evolution of spatial income distribution. A policy implication of his study is that national government should divert resources to poor regions surrounded by endowed regions rather than poor regions surrounded by other poor regions, although at the outset the latter would seem to need more attention. Also, Le Gallo (2004) examined the evolution of regional disparities in Europe for the period 1980-1995 using the spatial Markov approach. Her study concluded that regional disparities persisted in Europe, with a relative absence of regional mobility in income distribution. The location and physical attributes of regions played a role in the European convergence process.

Checherita (2008) tested the hypothesis of conditional Beta-convergence in per capital income for US. The analysis controlled the variables public capital stock and human capital endowment and accounted for differences in technological progress and tax burden across the USA for the period 1960-2005. The analysis observed: economic convergence in the US, variations in speed of convergence by decade, and rate of Beta-convergence varied relative to the initial level of income. The impact of structural funds on the regional development process has been examined for the period 1989-1999 in the European Union for a selected set of 145 regions (Dall'erba and Gallo, 2008). A significant proportion of the funds were utilized to finance transportation infrastructure and it was expected that this would induce industrial relocation effects, in turn stimulating regional development, thereby minimizing regional inequality. The analysis suggests lack of any minimization of income inequality or spatial spillover effects. Further Dall'erba et al. (2008) examined the process of regional growth in Europe over the period 1991-2003 for 244 regions with the recent inclusion of new regions. The methodology set out to detect convergence clubs with the inclusion of spatial effects. The study concluded increased regional disparity and a policy implication for investing potential public investments in the new regions. Also, Aroco et al. (2008) analyzed the regional convergence process in

China and found that income distribution has moved away from convergence towards 'polarization'. This is manifested by the fact that income disparities between coastal (core) and inland (periphery) has widened in recent years. Although there are various methodologies to interpret and understand economic structure there is one such approach called the FES which has not received sufficient attention in terms of the refinement of methodology and empirical measurement.

4. FUNDAMENTAL ECONOMIC STRUCTURE (FES): A METHODOLOGICAL APPROACH

4.1. Fundamental Economic Structure: Concept and Approaches

Simpson and Tsukui (1965) developed the notion of *fundamental structure of production* while comparing US and Japanese production structures. This concept was extended and generalized to form the notion of *fundamental economic structure* (FES). The concept of FES encompasses the structure of regional economies and includes more than just the production accounts, such as households, imports and exports (Jensen et al.1987). Jensen et al. (1988) studied the regional economic structure of Queensland economy and established regularities in the regional structure of sub-national economies within Queensland. Similarly, Van der Westhuizen (1992), Imansyah (2000), West (2000 and 2001) and Thakur (2008 and 2010) identified FES for the South African, Indonesian, Australian and Indian economies respectively. These studies claimed that the underlying hypothesis of the FES concept is that regional economic structures are more similar than different at various levels of aggregation. If the basic or core economic structures are similar, then, this information can be utilized to estimate and predict the economic structures of economies at similar levels of development. Traditionally, economic geographers have assumed regions to be unique in their economic characteristics, but this hypothesis refutes that assumption. It suggests the belief that spatial and temporal regularities can be identified in economic structure allowing the nomothetic approach as a viable approach to identify and examine regularity in FES. Thus, if a series of input-output tables for regions within nations or for the nation over time are examined then sets of economic activities represented via cells in regional tables can be identified as fundamental. Although, regional economic structure varies, some economic activities are common to all regions and this common part is called the FES. Thus, FES is conceptualized as those economic activities that are consistently present or inevitably required in national and regional economies at statistically predictable levels. These 'core' sets of economic activities are represented by transactions in national or regional tables and are a function of the economic size of regional economies measured by aggregate economic indicators of the regions.

It is postulated that economic transactions and the size of the economy are related and this functional relationship can be estimated using total sectoral gross output, gross domestic product, and population as independent variables and transactions as dependent variables. An important variant and advance in structural change studies is the taxonomic approach to examine national and regional economic systems. A classification of economic activities can be conceptualized: regional and temporal FES and non-FES (Table 1).

Table 1. Typology of Space-Time Fundamental Economic Structure (FES)

Space-Time FES	FES	Non-FES (NFES)
Regional	Regional FES	Regional NFES
Temporal	Temporal FES	Temporal NFES

Source: Thakur (2008).

The FES cells are the core and remain the same while the non-FES cells vary across regions based on geographic differences in resource endowment. FES cells at the national level will mask and show economic activities at an aggregated level. A regional FES will show the decomposed or disaggregated patterns of FES cells, thereby portraying a more detailed knowledge of the regional economic structure.

The temporal non-FES is the unpredictable component of the FES at the national level. The regional non-FES is the unpredictable component at the regional level due to geographical differences in natural resource endowments such as: agriculture, tourism, and mining activities. It will be interesting to examine the economic activities that constitute regional and temporal FES as well as regional NFES and temporal NFES. The economic activities within each group of the typology could be similar, overlapping, common or different. The set of economic activities in the various FES-NFES categories will manifest an improved understanding of the spatial-temporal evolution of economic activities in regional economies of different sizes and levels of development over time and across various spatial units.

Three approaches have been developed to examine FES: *partitioned*, *tiered* and *temporal* (Jensen et al. 1988; Jensen et al. 1991; and West, 2000 and 2001). Jensen, West and Hewings (1988) developed the conception of a *partitioned approach* in which each cell in an input-output table could be classified as either fundamental or non-fundamental. This classification was derived from the study of the ten region input-output tables of the Queensland economy ranging from less developed rural regions to more developed metropolitan regions. The analysis identified regularities and patterns in cell behavior for the Queensland economy in Australia. The term cell behavior implies change in values, rather than regularity of value relationships. Further empirical regularities in certain cell values pertain to the relationship of region size and cell values. Thus, an identification of expected cell patterns suggested a predictable FES based on the natural ordering of sector along a continuum from primary to tertiary sector classification.

The *tiered approach* is based on the concept that the input-output tables could be partitioned into two tiers of which one is fundamental and the other non-fundamental (Jensen et al. 1991). The fundamental tier is expected to be predictable in an endogenous sense for regions in any economic system while the non-fundamental tier cannot be predicted because it is based on random or exogenous factors that vary across regions. The randomness can be explained by variations in regional resource endowments, such as natural resources, agriculture, fishing, mining and economic activities that have location-based advantages such as scenic-based recreation and tourism. The FES tier is predictable since it comprises those sets of economic activities that are 'similar' in all regions or nation over time and is extracted from the common characteristics of the economic system. Jensen et al. (1991) and West (2000, 2001) have developed the regional analytic framework to explore the impact of final demand on the regional economy by decomposing the final demand into two components-fundamental and non-fundamental. Mathematically, this decomposition can be expressed as (West, 2000, 2001; Jensen et al. 1991):

$$W = (I - A)^{-1}[F_f + F_{nf}] \qquad (1)$$

where the notations refer to the following descriptions:
W = m x 1 vector of industry production levels
F = final demand categories
A = m x m direct requirement or intermediate coefficient matrix
f and nf = fundamental and non-fundamental category of economic activities.

In an input-output table there are several components of final demand and these can be categorized as distinct activities $(F_1, F_2, F_3..F_k)$ such as: private final consumption expenditure, government final consumption expenditure, changes in stocks, capital expenditure and exports. Therefore, equation (1) can be rewritten to incorporate the additional decomposition of final demand into various categories (1...k).

$$W = (I - A)^{-1}[(F_{f1} + F_{nf1}) + (F_{f2} + F_{nf2}) + (F_{f3} + F_{nf3}) + ... + (F_{fk} + F_{nfk}) \qquad (2)$$

The equation 2 implies that a level of output W is attributable to any one final demand or a sum of final demand elements. Also, equation (2) can be written compactly as:

$$W_{fi} = (I - A)^{-1} F_{fi} \qquad (3)$$

where the FES tier corresponds to the final demand category i $(\forall\ i = 1..k)$

Further summing up across the final demand categories, equation (3) can be written as:

$$T_{fi} = A\widehat{W}_{fi} = A diag\{(I - A)^{-1} F_{fi}\} \qquad (4)$$

where the term $\widehat{W}$ denotes a diagonal matrix.

The analogous non-fundamental tier can be succinctly written as:

$$T_{nfi} = A\widehat{W}_{nfi} = Adiag\{(I-A)^{-1}F_{nfi}\} \quad (5)$$

The tiered approach assumed that the input-output table consists of fundamental and non-fundamental components and the economic structure is equivalent to the sum of the two elements. Therefore, summing over the two tiers gives the total FES and NFES tiers and this can be written more parsimoniously in the following equations (6-7):

$$T_f = \sum_{i=1}^{k} T_{fi} \quad (6)$$

$$T_{nf} = \sum_{i=1}^{k} T_{nfi} \quad (7)$$

Adding the FES components ($T_f + T_{nf} = T$), the total transactions table T is derived, fulfilling the assumption of the tiered approach that the transactions matrix in the input-output is composed of the sum of two components, the fundamental and non-fundamental. First, the FES tier has been shown to be satisfactorily estimated in the case of Australia, Indonesia and India (West 2000, 2001; Imansyah, 2000, 2002; Thakur, 2008). The tiered approach is a conceptual improvement in the FES literature (Jensen et al. 1991).

A third category of FES is the *temporal* FES (West, 2000 and 2001) or the non-spatial FES. This component of an economy is predictable over time. This concept is broader and includes a wider array of economic activities. It is possible that in the course of extracting FES of a nation numerous activities can be predictable which were earlier unpredictable in the spatial FES framework. West (2000, 2001) defines temporal FES consisting of fundamental and non-fundamental components. In sum, as the economy progresses in time, the FES will traverse its own evolutionary trajectory. A temporal FES has been identified for Australia (West, 2000 and 2001) using nine national input-output tables and applying the FES methodology to identify economic structure. West (2000 and 2001) identified an economic structure that is holistically predictable for the Australian economy over time. Thakur (2008) utilized the first five input-output tables for the Indian economy to identify the temporal FES and predict the economic structure for the sixth period i.e. 1993-94. The FES methodology can be utilized to measure, interpret understand and predict economic structure and structural changes at various geographical scales. This methodology is a challenge to regional analysts to test, modify, refute, and provide alternative hypotheses and explanations in the study of regional economies.

4.2. Fundamental Economic Structure: Characteristics and Measurement

The FES of an economy has three characteristics: predictability, stability and importance. Predictability is defined as the notion that portions of the FES will be dependent upon aggregate measures of region size such as: gross national product, total sector output, total value added, population, and industrial concentration by sectors and other measures of economic size. The term stability refers to the conception that parts of the FES will be present across a sizable number of samples of regional economies. Importance is defined as that component of the FES that influences significantly the rest of the economic system in terms of overall connectivity. In the subsequent sections these characteristic features are discussed in greater detail along with the quantitative formulation.

The methodology of identifying FES involves the following five steps. First, regression analysis is applied with the cells in the intermediate transactions table as the dependent variable and measures of region size as independent variables to identify those cells that are statistically significant. The variable (region size) that identifies the maximum proportion of significant cells is the best predictor. Second, coefficient of variation is calculated for the sample tables to determine stable cells. Third, field of influence method is used to identify those cells that are important. Fourth, predictable, stable and important cells are collated to determine and compile the intermediate transaction matrix of the target regional economy. Fifth, cell sizes of transaction matrix for the target regional economy are estimated using the best predictor, average of cell sizes of regional economies are calculated to determine the cell sizes of unpredictable cells, and regression estimates are utilized to calculate cell size that are important. The marginal totals of the original table for the regional economy are imposed upon the predicted matrix and Richard A. Stone (RAS) technique is employed to balance the original and projected matrix. Further cross-entropy technique is utilized to improve the parameter estimates since sample regional tables are limited (Thakur, 2008 and 2009). The above steps are elaborated in the following sections.

4.2.1. Predictability

Regional development analysts for over sixty years have been interested in identifying common patterns and regularities in the national and regional structure of economies. The identification of such patterns suggests there is a predictable relationship among levels of development and regional economic structure as revealed, via, the cause and effect relationships among the intermediate transaction component of the input-output tables and measures of region size. A regression analysis has been proposed to identify the common characteristics, cell patterns and a predictable statistical relationship among transaction cell values and region size. Four functional forms commonly utilized in econometric analysis have been proposed to estimate the relation between transaction patterns and region size, determine the largest proportion of predictable cells, and the best predictor (equations 8-11):

Linear Equation

$$Y_{ij}(r) = \alpha + \beta X(r) + \varepsilon \tag{8}$$

Linear Logarithmic Equation

$$Y_{ij}(r) = \alpha + \beta Log X(r) + \varepsilon \tag{9}$$

Logarithmic Linear Equation

$$LogY_{ij}(r) = \alpha + \beta X(r) + \varepsilon \quad (10)$$

Double Logarithmic Equation

$$LogY_{ij}(r) = \alpha + \beta LogX(r) + \varepsilon \quad (11)$$

The notations are expressed as follows:
r = 1.....k region
ij = 1…m
$Y_{ij}(r)$ = cell transactions between sectors i and j in region r, i.e. industry i and industry j
X(r) = the independent variable for the region r denoting independent variables, such as population, gross national product, total value added and total sector output
k = the number of regions
m = the degree of aggregation of sectors.

The rationale for selecting a logarithmic regression model was to approximate the observed non-linear relationship between cell size that varied in magnitude as one progressed from small to large regions and economic size (Jensen et al. 1988). This approach proposed that in the continuum of primary-secondary-tertiary sector activities, the urban based, people-oriented activities were more dominant and constituted the economic core in the distribution of economic activities. This view of urban type and people-oriented activities is contrary to the economic base model, which argues that export activities are the engine of urban and regional growth and are the core of economic activities upon which the non-basic activities are dependent for increments in size. The FES concept lends support to the minimum requirement approach which is based upon the labor force needed to support the internal economic activities of a city (Ullman and Dacey, 1960).

The two approaches taken together strongly support the perception that people related urban-type activities are the engine of urban and regional growth. Since regional population will change, a concomitant transformation will appear in the economic structure and, thus, will change the composition of the urban activities basket. This basket will vary in composition at different points of time and, thus, calls for a temporal comparison of regional economic structures. In sum, the household as a unit is pivotal as opposed to export markets and extra-regional demand in interpreting and analyzing regional economic structures (Jensen et al., 1988).

However, several caveats have been encountered in the process of implementation of this approach. These are: (1) the approach requires a large collection of input-output tables to estimate the FES; (2) the interpretation of the regression coefficient in the presence of an outlier may distort the existing regularity in economic structure; (3) even though cells show lack of regularity, they might conform to some order not amenable to any theory of regional economic structure (Jensen et al., 1991). Subsequent reviews of the FES approach suggested that the partitioned approach required that each cell had to be categorized as either fundamental or non-fundamental. This conceptualization suggested that the partitioned approach could be a special case of a more general notion of FES called the tiered approach.

4.2.2. Stability

A second characteristic of FES is stability. The notion of stability in FES research is defined as transaction cells that are present across a range of input-output tables for a nation over time or across a set of regions (Hewings et al., 1988b). A simple measure of stability is the coefficient of variation:

*Coefficient of Variation = Standard Deviation/Mean *100* (12)

Miller (1989) made a distinction among three terms associated with the concept of stability. First, the term ‘stability’ refers to the examination of technical coefficients or Leontief inverse over space and time from either a demand driven input-output model or a supply driven input-output model. Second, the term ‘joint stability’ refers to the comparison of the various characteristics of the demand and supply driven input-output models. Third, ‘consistency’ refers to the general characteristics that tie the two models together. Thus, if samples of regional input-output table are examined, then the variation of coefficients across the regions will be expected to be minimal, and this can be used to ascertain the stability or minimal change in the technological coefficients. Typically, stable technical coefficients have represented those intersectoral interactions that represent secondary, trade and tertiary sector economic activities for Australia (West, 2000) and primary, secondary and tertiary sector activities for Indonesian and Indian regional economies (Imansyah, 2000; and Thakur, 2010).

4.2.3. Importance

The important cells are those elements in the FES that may be regarded as critically significant. These are cells whose change in size would in all probability create the maximum potential for system-wide changes (Jensen et al., 1987). The important cells are elements within the economic system which has the maximum connectivity with the rest of the system such as the high technology sector or investments in transport infrastructure improvements. Both of these economic activities have a multiplier effect in elevating employment, income and output levels. A region with a large number of important cells signifies that it is highly integrated with the rest of regional system and these activities are spread across the network of intersectoral relationships. Sherman and Morrison (1950) proposed a methodology called the ‘tolerable limits approach’ to measure this relationship. This method measures the impact of a change in the important coefficient that generates a 1 percent change in at least one sector. Tarancon et al. (2008) proposed two approaches namely the elasticity and linear programming approaches for measuring a sector’s importance to the economy. Further, Aroche-Reyes (1996 and 2002) has utilized a qualitative input-output analysis using a graph theoretic approach to identify the important coefficients for Mexico, US, and Canada. The application of this approach allows for the identification of the structural evolution of economies using the important coefficients.

Xu and Madden (1991) made a distinction between the notions of *important coefficient* and *sensitivity*. The term *important coefficient* is defined as the influence of the coefficient change upon a model. The term *sensitivity* is defined as the mode by which a model responds to the existing state of coefficients. Thus, the coefficients are considered important if they are sensitive, since a minuscule change in these elements leads to a large-scale impact on the whole system. The notion of technological change can be analyzed by measuring the extent and magnitude of coefficient change by a method called the 'field of influence'. In a series of research papers: Hewings et al. (1988a), Sonis and Hewings (1989), Hewings et al. (1989), Sonis and Hewings (1992), Sonis et al. (1996) and Okuyama et al. (2002) have developed the mathematical formulation and application of the concept of field of influence. The approach proposes a methodology of measuring the largest field of influence due to a small change in the input-output coefficients. Suppose there is a small change (ε or epsilon) in the direct input coefficients, then, the concomitant change in the components of Leontief inverse can be ascertained by the following formulation (Hewings et al., 1988a):

$$a_{ij} = a_{ij}(t+1) - a_{ij}(t) \qquad (13)$$

The term a_{ij} is the direct input coefficients and the change in the coefficients can be represented by the equation (13). The parameter that generates the transformation from $a_{ij}(t)$ to $a_{ij}(t+1)$ can be expressed as the equation (14):

$$a_{ij}(\varepsilon) = a_{ij}(t) + \varepsilon a_{ij} \qquad (14)$$

where ε is the transfer parameter and the value remains between $0 \leq \varepsilon \leq 1$. Further the matrix A ($\varepsilon$) = $a_{ij}(\varepsilon)$ and the associated Leontief inverse can be written as C (ε) = [I-A (ε)]$^{-1}$. If ε = 0 then, the matrix: A (0) = $a_{ij}(t)$

this is the matrix of direct input coefficients at time t with Leontief inverse expressed as:

$$C(0) = [I-A(t)]^{-1}$$

Also, when $\varepsilon = 1$ then, A (t+1) = $a_{ij}(t+1)$ is the matrix of the direct input coefficients at time (t+1). The associated Leontief Inverse can be expressed as C (t+1) = [I-A (t+1)]$^{-1}$. If the direct input coefficient is changed by perturbing the matrix with a small ε then the field of influence can be measured by the following equation:

$$G(t+1, t) = [C(\varepsilon) - C(0)] / \varepsilon \qquad (15)$$

The outlined approach can be applied to ascertain the most important cells in the intermediate transactions component of the input-output tables.

4.2.4. Predicting Regional Economic Structure Using Cross-Entropy

Often regional analysts encounter the problem of recovering and processing information when the given samples are incorrectly known, limited, partial and incomplete. If a limited sample is used to estimate population characteristics as if the data were complete, this would lead to a problem in statistical inferences since the estimates will be biased and inefficient. This problem can be addressed by a variety of methods, such as one-sample descriptive statistics, two-sample methods, and k-sample methods (Akritas and LaValley, 1997).

In implementing regional analytic approaches, economic geographers encounter data that are unknown and unobserved and, thus, are not amenable to direct measurement. These unknowns need to be imputed by econometric approaches. The cross-entropy is one such approach that regional analysts have utilized to measure how well a distribution approximates another distribution. The problem is thus to recover from an incomplete set of input-output tables, a new matrix that satisfies a number of linear restrictions (Golan et al., 1996). In this problem since the unknowns outnumber the number of data points it is an ill-posed and undetermined problem. The notion of entropy is defined as a measure of the amount of uncertainty in a probability distribution or a system subject to constraints. In economic geography this concept has been used to assess and compare: settlement, population, employment, income and trip distributions patterns and the contained uniformity in distribution patterns.

Cross-entropy measures the deviation between one distribution and another. Two other terms associated with the concept of cross-entropy are: ‘maximum entropy’ and ‘generalized maximum entropy’. Maximum entropy is the method of selecting a unique distribution which is closest to uniform from a group of distributions satisfying a particular set of conditions. Generalized maximum entropy is the formalization of the method as a pure inverse problem of recovering estimates from distributions with limited information (Golan et al., 1996). Maximum entropy econometrics has been formulated using information theory developed by Shannon (1948) and later applied by Janes (1957) to the problem of statistical inference and estimation. Theil (1967) integrated this approach in economics.

The cross-entropy method has been recently explored systematically and advocated by Golan et al. (1996) to provide solutions to the problem of recovering and processing information when the underlying sample is incomplete, limited or incorrectly known. In order to cope with the problem of ill-posed data they have suggested a method of maximizing the entropy criterion subject to the limited data that is available. Golan et al. (1994) applied this method to input-output tables with limited and incomplete multi-sector economic data to recover coefficient estimates. The methodology utilized consistency and adding up restrictions and specified the problem in a nonlinear optimization framework. The addition of constraints which is useful information, consistent with the data will decrease the entropy value; but, if the additional information is inconsistent the entropy value will not decrease. The cross-entropy method allows supplementing a measure of uncertainty with each technical coefficient such that greater emphasis is placed on the importance of the estimated coefficients. This method has been applied to estimate activity-specific input allocations when data on aggregate input usage is available but data on activity-specific inputs are not available.

Monte Carlo experiments were run to test the generalized cross-entropy method. The results provided robust estimates of the activity specific inputs (Lence and Miller, 1998). Also, Robinson et al. (2001) applied the method of cross-entropy to estimate a social accounting matrix for Mozambique's economy. All the information utilized for compiling and reconciling the social accounting matrix were available. A Monte Carlo approach was used to compare the cross-entropy approach with the standard RAS approach and evaluate the gains in accuracy in making use of additional information.

In the subsequent section the basic framework of cross-entropy approach is discussed in terms of recovering estimates from limited multi-sector economic data (Golan et al., 1996, pp. 59-63). Let us assume that there are L sectors in an economy producing a single good and purchasing and selling non-negative amounts from each other to use as inputs to produce final goods. The input-output table consists of one or more rows of payments to primary factors of production and one or more columns of final demand categories. Further, a social accounting matrix (SAM) is a more extended system of accounts that maps the factor payments to final demand of goods and services. Thus, a SAM can be represented in matrix form as in equation (16):

$$\text{Z (SAM)} = \begin{bmatrix} S & g \\ u' & 0 \end{bmatrix} \quad (16)$$

In the above equation the term S is a (L x L) matrix of intermediate sales, g is an L dimensional vector of final demands and u is an L dimensional vector of sector value added. A SAM is a square matrix where the row sum is equivalent to the corresponding column sum. Further, it is posited that the intermediate transactions are generated by a fixed coefficient matrix denoted by Z and y denotes the sales to final consumers. Then, the standard Leontief input-output model can be established as represented in equation (17):

$$Zy + g = y \quad (17)$$

$$y - g = c = Zy \quad (18)$$

Let us assume the formulation denoted in equation (18):

$$c = Zy \quad (19)$$

where c and y are L-dimensional vectors of known data and Z is an unknown (L x L) matrix that must satisfy the following consistency and adding up constraints as denoted by equations (20 and 21):

$$\sum_i b_{ij} = 1 \text{ for all j = 1,2,...L} \quad (20)$$

$$\sum_j b_{ij} y_j = y_i \text{ for i= 1,2,...L} \quad (21)$$

in addition to the non-negativity restrictions

$$b_{ij} \geq 0 \text{ for i,j = 1,2,...L} \quad (22)$$

The equation (20) implies that coefficients in each column add up to the value of 1, which is true in the case of SAM, but in the case of input-output tables they will add to known numbers less than 1. The problem can be couched in the following terms.

There are L observed data points on c and y and L adding up constraints and so the objective is to retrieve the matrix Z that includes L(L-1) unknown parameters.

Thus, using the entropy principle the elements of Z matrix i.e. b_{ij} can be recovered using the Shannon formulation in equation (23):

$$H(b) = -\sum_i \sum_j b_{ij} \ln b_{ij} \quad (23)$$

subject to the following constraints

$$\sum_j b_{ij} y_j = c_i \quad (24)$$

$$\sum_i b_{ij} = 1 \quad (25)$$

A Lagrangian function can be written embedding equations (24 and 25) in equation (23) and taking the partial derivatives and write the optimal conditions in equations (28-29)

$$L = -\sum_i \sum_j b_{ij} \ln b_{ij} + \sum_i \lambda_i (c_i - \sum_j b_{ij} y_j) + \sum_j \mu_j (1 - \sum_i b_{ij}) \quad (26)$$

with optimal conditions

$$\frac{\delta L}{\delta b_{ij}} = -\ln \hat{b}_{ij} - 1 - \hat{\lambda}_i y_j - \hat{\mu}_j = 0 \quad \text{for i, j= 1…L} \quad (27)$$

$$\frac{\delta L}{\delta \lambda_i} = c_i - \sum_j \hat{b}_{ij} y_j = 0 \qquad \text{j=1...L} \qquad (28)$$

$$\frac{\delta L}{\delta \mu_j} = 1 - \sum_i \hat{b}_{ij} = 0 \qquad \text{i=1...L} \qquad (29)$$

Solving this system of $L^2 + 2L$ equations and parameters leads to the solution in equation (30):

$$\hat{b}_{ij} = \frac{1}{\Omega_j} \exp[-\hat{\lambda}_i y_j] \qquad (30)$$

where the term,

$$\Omega_j(\hat{\lambda}_i) = \sum_{i=1}^{L} \exp[-\hat{\lambda}_i y_j] \qquad (31)$$

Further the value of the maximum entropy measure which is a function of the data can be written as equation (32):

$$H = \sum_j \ln \hat{\Omega}_j + \sum_i \hat{\lambda}_i c_i \qquad (32)$$

The time series data available on multi-sectoral tables from past periods can be utilized to recover estimates for future periods. The cross-entropy approach can be used to estimate the current or future coefficient estimates based upon past coefficient estimates (Golan et al.,1996). This can be formulated as in equation (33) subject to the consistency and adding up constraints in equations (24 and 25):

$$\min I(b, b^0) = \sum_i \sum_j b_{ij} \ln(b_{ij} / b^0{}_{ij}) = \sum_i \sum_j b_{ij} \ln(b_{ij}) - \sum_i \sum_j b_{ij} \ln(b^0{}_{ij}) \qquad (33)$$

The solution to this cross-entropy is:

$$\hat{b}_{ij}(CE) = \frac{b^0{}_{ij}}{\Omega_j(\tilde{\lambda}_i)} \exp[\tilde{\lambda}_i y_j] \qquad (34)$$

where

$$\Omega_j(\tilde{\lambda}_i) = \sum_{i=1}^{L} b^0{}_{ij} \exp[\tilde{\lambda}_i y_j] \qquad (35)$$

The cross-entropy analysis can be utilized to recover estimates when samples are limited for multi-sector economic data. Thakur (2008) utilized this approach to improve the ordinary least squares (OLS) estimates and FES characteristics for the Indian economy. This approach estimated cell sizes in the intermediate transaction component of the input-output table using cross-entropy approach.

5. CONCLUSION

The overarching problem addressed in this study is whether there are identifiable patterns of relations between various macro aggregates of regional economies and economic transactions as revealed via input-output tables. Would identification of such patterns allow regional analysts to predict economic change? More specifically, this paper provides a discussion of four questions. The first question deals with understanding the relationship among sector composition and structural change. The process of regional development and structural change are intertwined and as regional economies develop the direction and importance of intersectoral interactions undergoes a change from primary, to secondary and tertiary sector activities followed by quaternary and quinary activities. The second question addresses the discussion of selected approaches to analyze structural changes in regional economies. Four themes have been discussed to analyze structural change. The key sector approach identifies those activities that have a more than an average impact on the rest of the economy; sector composition and economic growth theme identifies the commonalities among economies across space and time using statistical analysis; structural decomposition approach identifies the sources of development and change in regional economies; and spatial convergence approach is the non-parametric approach of analyzing the dynamics of the regional distribution of income.

A particular approach to study regional economic structure that has gained importance is the FES methodology. The FES is conceptualized as those economic activities that are consistently present or required in regional economies at statistically predictable levels. It is further postulated that region size and economic transactions are functionally related and this relationship can be estimated using macro economic aggregates (total sector output, population, industrial output, and gross regional domestic product) as independent variable and economic transactions as dependent variable. Given a large sample of national or regional input-output tables the economic structure can be decomposed into a fundamental predictable component and non-fundamental unpredictable component at various spatial scales. The FES can identify the engines of regional growth both at the temporal and regional scales. Thus, the set of economic activities for the FES and non-FES categories at the temporal and regional scales can provide an improved understanding of the patterns of spatial-temporal evolution of economic activities in regional economies of different sizes and levels of development.

The FES is characterized by three attributes: predictability, stability and importance. Predictability is defined as the notion that portions of the FES will be dependent upon aggregate economic size of the regional economy, such as gross national product, total sector output, total value added, population, industrial concentration by sectors and other indicators of economic size. Stability refers to the conception that parts of the FES will be present across a sizable number of samples of regional economies. Importance refers to that part of the FES that influences significantly the rest of the economic system in terms of overall connectivity.

The third question addressed in this paper deals with the discussion of the FES methodology in terms of the quantitative formulation. First, regression analysis is applied with the cells in the intermediate transactions table as the dependent variable and economic size as independent variable to identify those cells that are statistically significant. The variable (economic size) that identifies the maximum proportion of significant cells is the best predictor. Second, coefficient of variation is calculated for the sample tables to determine stable cells. Third, field of influence method is used to identify those cells that are important. Fourth, predictable, stable and important cells are collated to determine and compile the intermediate transaction matrix of the target regional economy. Fifth, cell sizes of transaction matrix for the target regional economy is estimated using the best predictor, average of cell sizes of regional economies are calculated to ascertain the cell sizes of unpredictable cells, and regression estimates are utilized to calculate cell size that are important. The marginal totals of the original table for the regional economy are imposed upon the predicted matrix and Richard A. Stone (RAS) technique is used to iteratively balance the matrix. Further, cross-entropy technique can be utilized to improve the ordinary least square (OLS) estimates for the target regional economy when sample regional tables are limited in numbers (Thakur, 2008 and 2009).

The fourth question deals with the importance of FES in manifesting an improved understanding of economic structure and structural changes of regional and national economies. The FES methodology can be utilized to measure, interpret understand and predict economic structure and structural changes at various geographical scales. This methodology is a challenge to regional analysts to test, modify, refute, provide alternative hypotheses and explanations in the study of regional economies and strengthen the notion of a proposed general theory of FES.

Regional analysts have emphasized on the compiling of input-output tables using hybrid and synthetic procedures. There are several directions in which future work can be advanced in the area of FES. The first, direction lies in developing the FES methodology for projecting and compiling input-output tables for national and regional economies when data are limited, not available or ill-posed (ill-posed data refers to lack of information on variables such that desired parameter estimates cannot be recovered using traditional statistical methods) (Golan et al., 1996). Analysts will always be limited by time, money and manpower resources and thus, methodologies other than full survey can be used to compile national and regional tables. A second, direction is to use the FES approach to identify economic structure for inter-country input-output tables for nations and regions at similar levels of development. An interesting dimension to examine will be to identify inter-country FES and use this information to compile input-output tables for countries for which such tables do not exist (for example Asian FES, European FES, African FES, US FES). A third, direction would be to examine the sensitivity of various measures of dispersion to the inclusion or exclusion of information on economic activities and ascertain if the distribution is normal. A fourth, direction could be to make a holistic comparison of the tables by examining the output, income or employment multipliers. In validating FES methodology and results, actual and expected tables have been compared using measures of error deviations as a first-level comparison. One could compare system-level multipliers as a second-level comparison of actual and predicted tables for ascertaining holistic accuracy of tables.

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STRUCTURES ÉCONOMIQUES FONDAMENTALES ET CHANGEMENT STRUCTUREL EN ÉCONOMIE RÉGIONALE : UNE APPROCHE MÉTHODOLOGIQUE

***Résumé** - Une structure économique fondamentale (SEF) est définie comme un ensemble de caractéristiques dont l’évolution dépend de la taille économique d’une région. Le changement structurel, qui est associé au concept de développement économique régional, implique des mutations sectorielles et une modification des indicateurs tels que les niveaux de production et de consommation, l’emploi, le volume des échanges, le PIB. Cet article propose de revisiter un ensemble de travaux sur les liens entre évolution des indicateurs macroéconomiques et taille régionale, permettant de mieux saisir l'intérêt de l'approche en termes de SEF. Plus particulièrement, quatre questions sont examinées : (1) quelle est la relation entre l’évolution des structures sectorielles et le développement régional ? (2) quelles approches permettent d’analyser les changements structurels ? (3) quelle méthodologie doit-on privilégier pour identifier les SEF ? (4) Est-ce que l'identification des SEF permet une meilleure typologie des économies régionales ?*