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Presentación

Tengo el gusto de presentar *Urbana*, un esfuerzo editorial de la Univerisidad de Monterrey a través del Centro de Análisis Regional y Estudios Aplicados (Centro *AREA*). El objetivo principal de *Urbana* es reunir en una publicación a profesionales competentes y líderes de opinión en materia urbano-regional, a fin de (1) compartir e intercambiar avances y experiencias de investigación, y (2) difundir en nuestra comunidad el trabajo de especialistas propios e invitados.

El contenido de *Urbana* lo constituyen temas urbano-regionales en inglés o español, para respetar los foros que motivaron los escritos y facilitar la participación de especialistas en la comodidad de su lengua.

El Centro *AREA* de la Universidad de Monterrey agradece la colaboración de colegas y personas que hacen posible la existencia de *Urbana*. En este primer número con material en inglés, merece crédito especial Bruce W. Coggin que sugirió correcciones de forma a los artículos de Gustavo Garza V. y Jesús A.Treviño. Es justo aclarar que Coggin no es responsable de los problemas que persistan, sino que deben atribuirse a los autores que tuvieron la decisión final de incluir u omitir las sugerencias de estilo.

El Centro *AREA* espera que *Urbana* sea el foro de sendas que, a fuerza de cruzarse por más de una década, han cultivado un espíritu de amistad y colaboración interdisciplinaria.

Jesús A. Treviño
Coordinador, Centro AREA

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Regional cyclical patterns in Mexico, 1970-88

Jesús A.Treviño

Abstract: This paper focuses on the change of production at state level in Mexico for period 1970-88. The empirical section includes output per capita series for each state to identify regional cycles applying five year rates to register annual changes. This identification allows spatial economic examinations, such as amplitude, volatility and sensitivity in particular states. It also permits some inferences about spatial relations between national and regional fluctuations. First main finding is that high amplitude and volatility in oil producer states reveal the oil prices boom during the second half the seventies. Second finding is that cyclical sensitivity, registered in terms of amplitude and volatility, presents a negative relation with cycles showing high state coherence with the national cycle. Finally, this paper addresses every finding to aspects of spatial policy in Mexico.

I. Introduction

Clearly the process of economic growth is neither smooth nor evenly distributed. Literature related to regional growth and economic fluctuations is recent and presents many conceptual puzzles. Today, an important and unresolved question is how short-term fluctuations influence growth across time and space. Several concepts are used to describe the same characteristics of economic fluctuations. (The same concept often refers to different aspects of regional economic oscillations.) Moreover, although some ideas "correlate with each other quite well, they are usually conceptually different" (MacBean and Nguyen, 1988, pp.95-96). For example, sometimes amplitude, sensitivity, or volatility are applied indiscriminately in reference to the same cyclical behavior. Additionally, they are different when they refer to either their own time path or a bench mark economy. Thus, *the first task in this study* is to classify and clarify concepts on cyclical movements *before* specifying a set of hypotheses for this particular case study.

Brown and Pheasant (1985) claim that the study of economic fluctuations is neglected in the literature on regional

analysis.

> Most approaches to regional economic analysis—input-output tables, impact multiplier models, and shift and share analysis, for example—emphasize growth in employment or income *but do not consider fluctuations in growth rates* (Brown and Pheasant, 1985, p.51, own italics).

The present study emphasizes both economic growth and fluctuations in relation to growth rates, and therefore, flows from previous findings and methodological suggestions from research on spatial cycles. The literature provides some expectations about potential links between economic growth and regional fluctuations. This study finds links by proxy variables through rank correlation coefficients between cycle components and economic growth. Although rank correlations do not define causality or impact between components, correlations are an effort to identify steps in that direction. Once concepts are specified, the *second task of this research* is to recognize possible relations between cycle components and regional economic growth in a case study. Both conceptual specification of cycle components and identification of their potential relations with economic growth are useful for regional forecasting and formulation of spatial policies.

Section II reviews literature related to economic cycles and regional growth. Section III centers on a set of hypotheses about expected spatial cycle patterns and their relations with economic growth in Mexican states for the period 1970-88. Because most of literature on spatial cycles refers to experiences in developed economies, the main task in section III is to provide theoretical support for the set of hypotheses for a developing economy. Additionally, section III identifies the statistical methods that correspond to equivalent concepts within the theoretical framework. They are presented at the end in a Methodological Appendix. Section IV presents an empirical test of previous expectations. Finally, section V presents main findings and future topics for a research agenda.

II. Theoretic issues

1. General context and lessons from developed countries (special reference to the United States).

While there is a vast literature related to national economic fluctuations, literature on spatial cycles within a country is scarce. The pathbreaking work on spatial fluctuations is G. Borts' paper on regional cycles of manufacturing employment in the U.S. (1960). In fact, Borts' paper begins by quoting some studies that show the "recent attention of economists" on the topic. Because of its focus upon employment, it is a supply side study. Kendrick and Jaycox (1965) published a methodology to estimate the *Gross State Product* (GSP).[1] Their contribution was relevant as it supported the scarce academic works on GSP during the seventies (Niemi, 1975). Moreover,

1 The Gross Domestic Product (GDP) is the national equivalent to the GSP, as it is stated by Rensaw, V., E. A. Trott, and H.L. Friedenberg (1988, p.30):

> GSP is the gross market value of the goods and services attributable to labor and property located in a State. *It is the State counterpart of the Nation's gross domestic product (GDP)*

the ideas of Kendrick and Jaycox are present in the first consistent data on GSP more recently published in the *Survey of Current Business* (Renshaw, Trott and Friedenberg, 1988).

After the Borts and Kendrix and Jaycox contributions, scholars produced a varied literature on regional fluctuations during the seventies (Niemi, 1975). Most researchers preferred to study regional personal income. This variable represents the demand-side approach to spatial cycles. The main reason for emphasis on the demand side is not a theoretical but a practical decision: a database is available for regional personal income. In the 1980s, research on regional fluctuations continued to rely on this database. Simultaneously, in the first half the 1980s, there was a renaissance of the supply side approach. Like Borts' study, employment was again the main variable. Analysis of portfolio, suggested by Conroy (1972, 1975), combined with some econometric techniques, was used in this resurgence of the supply-side approach.[2] Since 1988, the supply-side has a new database in the US. Renshaw, Trott, and Friedenberg published an estimation of GSP by industry for the period 1963-86. Until Spring 1992, in the best journals of regional science and economics, there are a few articles using GSP (Niemi, 1985; Connaughton and Madsen, 1990; Munnell and Cook, 1990; Barro, R. and X. Sala-i-Martin, 1992; and Amos, O.M.,1991). The articles by Niemi by and Connaugthon and Madsen compare changing economic structure in US regions. Munnell and Cook study the roll of public infrastructure in regional growth. Finally, the articles by Barro and Sala-i-Martin and by Amos belong to the generation of papers on "catch up" or economic convergence among countries. Most relevant discussion of this literature on catch up has been published in *The American Economic Review* after Maddison's book, *Phases of Capitalist Development* (1982). Articles from Barro and Sala i Martin, and Amos are the first studies using GSP to test convergence across the United States.

Because demand-oriented models have a spatially common interest with supply side models, some Per Capita Income (PCI) findings can be taken as a referent for this GSP analysis.

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[2] One recent application of Portafolio is in Kurre and Weller (1989):

$q_p^2 = \Sigma_i \omega_i^2 \sigma_i^2 + \Sigma_{i \neq j} \Sigma_{j \neq i} \omega_i \omega_j \sigma_{ij}$;

Where:

q_p^2 = The portfolio variance

ω_i and ω_j = each security's weight in the portfolio

σ_{ij} = the covariance between *i*'s and *j*'s returns.

Kurre and Weller's adaptation suggest corrections to previous applications and it recommends specific ways to calculate the regional variances and weights.

> The level of employment in a industry is the 'return' that the region receives from the industry, and the instability of the industry's employment level is its variance or risk (Kurre and Weller, 1989, p. 322).

A reevaluation of measures of diversity as indicators of regional variations demonstrates that portfolio variance is both an effective analytical tool and it provides criteria on spatial fluctuations for policymakers (Wundt, 1992).

Nevertheless, taking PCI results as a referent does not mean equating demand side results with a supply oriented approach based on Gross State Product, GSP, or *Per Capita Output*, PCO. There are three main reasons to think that the two approaches cannot be matched. First, PCI analysis deals with location of markets (demand for products), while the GSP study considers the place of production. Second, PCI regards consumption in a place, while GSP grapples with production to satisfy actual and future demand located anywhere. Third, PCI spatial propositions could differ from those inferred from GSP approaches because their conceptual differences are expressed in their computational basis: "PCI includes transfer payments and is therefore anticyclical and excludes income received by the business, government, and foreign sectors" (Connaughton, J.E. and J.A. Madsen, 1990, p.49). The same argument is also in Niemi, (1985, p.45). Some authors are more specific and state that the main differences between GSP and PCI approaches reside in capital income.

Personal income includes corporate net income only when individuals receive payment as dividends, whereas GSP includes corporate profits and depreciation. (Neither concept includes capital gains.) In addition, GSP attributes capital income to the state in which the business activity occurs, whereas personal income attributes it to the state of the asset holder. Some of these locational considerations apply also to labor income, although — except for a few cities — the location of a business and the residence of the workers are typically in the same state (Barro and Sala-i-Martin, 1990, p.16-17).

Briefly, the previous arguments mean that it requires caution to extend findings from the PCI approach to the GSP approach. Section III specifies concepts and takes feasible hypotheses from literature.

2. Sectorial and spatial aggregation, GSP approach, and period length.

Contemporary theorists on growth and development debate the nature of the spatial cycle (Mutlu, S.,1991, Burns, L., 1987a and 1987b, Higgins, B., 1981). Some of them analyze aggregated variables. Hanink and Cromley (1987, p. 161), for example, argue that "even if all regions had the same industrial structure, there is no reason to assume that all regions would track coincidentally on the same business cycle." They take support from another author: "the same industry might very well mean different things for different places" (Gertler, 1984, in Hanink and Cromley, p.161). They conclude that "the concept of industrial mix is useless in business cycle" (interpretation by Hanink and Cromley, p.161, from Gertler's article).

Referring to the spatial unit of analysis, studies of economic fluctuations within a country (most of studies are about the United States) are diverse. Some of them take activities within a Metropolitan Statistical Area, MSA, (Kurre and Weller, 1989). Other studies analyze activities between or among counties within a state (Brown and Pheasant, 1985, and Jackson, 1984). Finally, there are also analyses among states (Burns 1997a and 1987b) and the census macro-regions (Hanink and Cromley, 1987).

On the other hand, a 15 to 19 year period is long enough to register relevant variations in production, prices, employment, personal income, and many

other aspects of economic life.[3]

3. Main objective, and data sources.

The general purpose of this paper is to determine for us regional cycle patterns and their possible links with the economic performance in the Mexican states. Expectations on cycle patterns and economic growth are based on previous analyses on both the supply and demand side in the US (using employment and family income data). They are summarized in Table 1. The basic database for Mexico is annual estimations of Gross State Product (GSP) or Producto Interno Bruto Estatal (PIB), using peso value of 1980 for the period 1970-88 (Puig and Hernández, 1990). It is assumed that this one-dimensional measure of GSP provides an adequate first approximation to a multi-dimensional concept of economic behavior.[4]

On the other hand, ten year data on population and five year data on sectorial Producto Interno Bruto (PIB) come from the Institute of Statistics, Geography and Information (INEGI).

III. Concepts, specific aims and hypotheses

All concepts and methodological references in this section are cited in the bibliography. Some of them are adaptations or research inferences from previous findings. Nevertheless, quotes are included when concepts deserve special support. The Methodological Appendix presents additional information on statistical procedures.

Regional Coherence: Regional Coherence shows the "closeness" of a regional cycle to the national cycle. The research literature suggests that regional coherence represents "the degree of conformity of the region to the national cycle of similar length" (Cho and McDougall, 1978, p.70). In this study, Regional Coherence is measured by adjusted R squared from regression equations for every state and the country as a whole. As Regional Coherence is calculated for every state in relation to the country, it is not possible to infer any relation with other measures, such as volatility or amplitude, that are based only on the time path growth for single areas. From US experience, it is expected that Regional Coherence will have positive correlation with Economic Growth (parameter ß), and Economic

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3 Burns, L. (1987a) describes the three well-known cycles in economic literature: Kondratieff, Juglar and Kitchin cycles that are fifty, nine, and three-years long, respectively. Maddison, A., (1982) clarifies some confusions about length in these cycles and presents main findings from long-wave analysts after Kondratieff (Kuznets and Schumpeter, and the "revitalists" Rostow and Mandel).
Economic cycle scholars say that in a Juglar cycle, most citizen are affected by the economic variations (changes in occupations, prices, income distribution). On the other side, the Kitchin cycle is too short; its peaks and troughs are only detected by statistical analysis. Finally, the fifty-year Kondratieff cycle can be referred to only by historians or long-wave theorists (Cardoso and Brignoli, 1977, pp.226-28).
This paper uses the term "economic cycle" as a synonym for economic fluctuation without any assumption on periodicity or temporal recurrence in GSP time series. It simply considers that time series 1970-88 for GSP is long enough to test some hypotheses on economic growth and economic fluctuations.

4 Similar studies using the aggregate GDP or its equivalent at state level, GSP, are Maddison (1982), and several studies on convergence or "catch up," mainly in *The American Economic Review* or *Journal of Political Economy.*

Diversification (defined in this section). Negative correlation between Regional Coherence and Risk (ß-1) is also expected.

Amplitude: Amplitude is one of the basic cycle components. This study takes Burns' definition (1987b, p.196).

> [It is] the average range of the swing of the (GSP) growth series . . .[it] is obtained as the sum of differences between each observed values *(sic)* for a state and period and the corresponding national figure.

Previous findings from research suggest that, although there is no theoretical reason, Amplitude has positive correlation with Comparative Volatility (V_3 or Risk). In such case, since both measures are derived from comparative calculations, Risk and Amplitude can be aggregated in a single index of Sensitivity. Both Risk and Amplitude, individually or in a sensitivity index, will have negative correlation with diversification, economic growth, and regional coherence.

Volatility (V_1, V_2, V_3). Besides Amplitude, Volatility is another basic cycle component. There is no agreement in literature to use one concept and measurement for Volatility. This study distinguishes three types of Volatility. Two of them (V_1 and V_2) refer to the time path of growth rates for every state for the period 1970-88. The third type of Volatility describes differences in economic fluctuations for every state in relation to the national fluctuations. Here, it is also called Risk because it is taken from a portfolio approach application to regional analysis (Hanink and Cromley, 1987).

a. Volatility V_1 ._ is the standard deviation in growth rates in every state. It compares observed values to the statistical mean value for the period 1970-88.

b. Volatility V_2._ is the standard error of the "best fit" trend (linear, quadratic or third degree polynomial). This measure relates every observed value to the estimated value.

c. Volatility V_3._ comes from the regression equation for growth rates in every state and the country (ß-1). From now on, V_3 and RISK will be treated as equivalent terms in this paper.

In the Methodological Appendix it is shown that there is no statistical evidence to assume a relation between these three types of Volatility. The first two types of Volatility have different points of reference in their calculations. The first one takes the mean of the observed values, while the second one deals with deviations from estimated values. Both refer to different kinds of dispersion over time for single states. The third type of volatility is the "absolute distance" between the growth rate in a single state and the growth rate in the country as a whole. There exists the possibility of positive correlation between Volatility V_1 and V_2, because they refer to the same concept (temporal volatility). If so, it is worthwhile to consider them as quantitative interpretations of the same idea from different statistical calculations. If there is a relationship between Volatility V_1 (or V_2) and Volatility V_3, since both refer to different concepts, then that constitutes a specific finding to typify cyclical behavior in Mexico. Table 1 exhibits the expected relations for these three types of Volatility.

Diversification. In regional analysis

there is literature available which attempts to tie diversification to the business cycle (Brown and Pheasant, 1985, p.51). Consequently, the possibilities of correlation between diversification, growth, and cycle components are well documented in Burns (1987b), Attaran (1986), and Cho and McDougall (1978). The main expectations are in Table 1. This study assumes that as regions grow in population, their economic base is more diversified. Therefore, "the diversification hypothesis has been tested using population size as a measure of diversification" (Cho and McDougall, 1987, p.72). Thus, Average Population for the period 1970-88 (AVGPOP) is a proxy for economic diversification.

Economic Growth (Average and ß). This study employs two measures of economic growth. The first one is the arithmetic average of the five-year overlapped growth rates in GSP *Per Capita* (AVGTH). The second one is the parameter ß in equations where the state growth rates and the country growth rates are the dependent and independent variables, respectively.

The next set of hypotheses is about Mexico. Expected signs for values are in Table 1.

1. Growth does not occur at same time at all places within a country. The type of activities and economic diversification are different everywhere. Thus, states and regions will respond unequally to periods of expansion and recession, which means that cycle components are different for every state or region. This paper identifies and typifies Mexican states according to their amplitude and volatility as basic cycle components. Since Amplitude and V_3 are expressed in comparative terms and it is expected that both will be correlated, they may be aggregated in a single index of regional sensitivity.[5]

2. Studies referring to Regional Coherence show that the severity of a spatial cycle is higher in regions with economic activity moving with the national cycle (Cho and McDougall, 1978, pp. 70-71).[6] This study tests to see if this assumption of the relation between Regional Coherence and national fluctuations is also true for Mexican states.

3. The literature proposes that diversified regions are more stable (Attaran, 1986, p.52). The theoretical assumption behind this argument is that "highly diversified regions will closely follow the national economy in their cyclical behavior since their relative industrial weights will approximate the national weights" (Cho and McDougall,

5 Two types of Volatility have been identified. One refers to cycle fluctuations for a specific state through time (Time Path Volatility, V_1 and V_2). The second type of volatility refers to cyclical fluctuations in a particular state in comparison to the country (Comparative Volatility, V_3). This hypothesis deals with Comparative Volatility, which is the only one that can be conceptually aggregated to Amplitude.

6 It is said that regional cycles show high coherence "if the region's cycles of small amplitude correspond to the small amplitude national cycles and if large amplitude regional cycles correspond to the large amplitude national cycles .... Thus, the coherence ... shows the degree of conformity of the region to the national cycle" (Cho and McDougall, 1978, p.70). These authors say that "Coherence squared is equivalent to R squared in a time regression line equation (p.68)."

TABLE 1. Relations Between Cyclical Components and Economic Variables. Expectations from Literature. Significant Findings in Brackets

Variable	1 AMPL	2 V_1	3 V_2	4 V_3	5 COHERE	6 AVGTH	7 β	8 AVGPOP
1. Amplitude (AMPL)	1.0	?	?	+	+ (-)	-	-	-
2. Volatility, V_1 (Time Path)		1.0	? (+)	? (-)	?	?	? (+)	-
3. Volatility, V_2 (Time Path)			1.0	? (-)	?	?	? (+)	-
4. Volatility, V_3 or Risk (Comparative measurement, β-1)				1.0	+	-	- (-)	-
5. Regional Coherence (COHERE)					1.0	+	+	+
6. Economic Growth (Average= AVGTH)						1.0	+	+
7. Economic Growth (β)							1.0	+
8. Diversification (AVGPOP)								1.0

1978, p. 72). Thus it is expected that a positive correlation between Diversification and Spatial Coherence exists. Nevertheless, "a 'diversified' set of cyclically unstable industries with similar cyclical timing patterns will not result in a stable local economy" (Kurre and Weller, 1989, p.315). Then the possibility exists that Amplitude, Diversification, and V_3 might follow the same spatial pattern (positive correlation).

4. In the US experience, "high rates of economic expansion are likely to be associated with unstable growth" (Burns, L., 1987a, p.201). Diversification, however, seems positively correlated to Growth and negatively correlated to Volatility (Attaran, 1986). Therefore, Growth would be negatively correlated to Volatility. *Ergo*, since there is no agreement on this respect, at the hypothetical level it is assumed for Mexico that there exists a negative relation between Volatility (V_3) and Economic Growth.

IV. Empirical test

1. Preliminary ideas.

The economic literature distinguishes between horizontal and vertical linkages. In a regional context, interstate trade is an example of horizontal linkage, as interactions between elements of the same hierarchy. On the other hand, mutual connection and dependence of states in the national economy that they constitute is an example of vertical linkage. The

"umbrella" of states respond to the common force which joins them.

> Areas producing agricultural goods, for example, may be expected to respond in much the same way to a change in the demand for food, and hence are integrated through vertical linkages even though they may not have direct trade with each other (Burns 1987a, p.331).

Analysis of spatial linkages in this paper does not consider their vertical or horizontal integration. Instead, it follows Burn's (1987a) suggestions:

> Linkages . . . are proxies by correlations between each pair of states . . . the correlations are meant to be associative rather than causal . . . The point is simple: the more closely the regions' [GSP] growth rates fluctuate with each other, the more balanced is the total system (Burns, 1987a, p.332).

The previous procedure is not the orthodox method to estimate linkages. Nevertheless, the strong assumptions, the cost of collecting and processing data and limited insights into the dynamics of change do not justify the application of standard methods that refer to scale and the composition of linkages *(i.e.*, input-output analysis). Thus, Burns (1987a) concludes,

> Since change is of the essence in the topic under discussion, the cruder longitudinal correlations . . . seem far more appropriate and require fewer heroic assumptions, even though they sacrifice the richness of detail produced by the more standard methodologies (Burns, p.339).

Based on previous suggestions, this paper calculates rank correlations for growth rates in Mexican states (Table A.1). In general, their relation with the national economy corresponds to the "degree of spatial coherence" represented by adjusted R squared (Table A.2). States *not following* the national economy are Sinaloa, Distrito Federal, and Tlaxcala (Table A.1). These results coincide with the lowest values for adjusted R square in Table A.3: Sinaloa (.29694), Distrito Federal (.07191), and Tlaxcala (.22085). Although it is necessary to study the particular economic composition in every state to get reasons for these values, some elements can be considered here. Sinaloa presents low and negative growth rates in the second half of the seventies (1974-80). Sinaloa has had problems recovering from the Mexican crisis in 1976.[7] Distrito Federal encloses the Capital City. It is well known that its economy receives subsidies from the rest of the country (Zaid, Gabriel, 1988, and Garza, G., 1985). The case of Tlaxcala can be inferred from the data base; it is the poorest state in Mexico.

2. Test of the hypotheses.

1. The first hypothesis says that states within a country respond distinctly to national economic fluctuations. Overall, the states that are growing at same rate or faster than the country are Baja California Sur, Tamaulipas, Puebla, Hidalgo, Querétaro, Tabasco, Chiapas, Campeche y Quintana Roo (slope $\beta > 1$ in Table A.2). They follow closely the national economy (adjusted R square in Table

7 In the last 24 years, Mexico has had two crucial economic crisis. Between both crises there is a 6 year gap. Each crisis occurred in the Mexican presidential transition year and three years after the world oil price crisis. Thus, the first Mexican economic crisis of the last two decades occurred in 1976, three years after the world oil price crisis in 1973. The second one occurred in 1982, three years after the world oil price crisis in 1979.

A.2). The exceptions are Tabasco, Chiapas and Quintana Roo. Tabasco is the biggest oil producing state in Mexico. Its comparatively low adjusted R square (0.7739) indicates that its market dependency on the national economy is not as close as to those states growing at the same rate or faster than the country. Chiapas, Campeche and Quintana Roo, with adjusted R^2 of 0.7519, 0.7985, and 0.6249, are states located in the south and southeast of the country; they have a local economic orientation. These states combine negative values of the intercept (that represents comparative regional disadvantage) with high growth rates. Sometimes this high growth is a symptom of small and poorly diversified economies. Therefore, these states deserve deeper and more detailed study.[8] At the same time, among states growing at similar or faster rate than the nation, Tabasco, Hidalgo, Chiapas and Quintana Roo have more volatility (ß-1 as a measure of RISK in Table A.3). The value of adjusted R^2 in Table A.2 represents the proportion of their volatility that is associated with the national cyclicality.

On the other hand, the states that definitively *do not follow* the national economy are Sinaloa, Distrito Federal, and Tlaxcala (they do not present significant coefficients of regression). In particular, Sinaloa reported low or negative growth rates in second half of the 1970s. Distrito Federal has the Capital City and receives subsidies from the rest of the economy. Tlaxcala is the classical small local economy that has a high growth rate that is significant only when it is kept within the local context. The data show that Tlaxcala is the Mexican state with the lowest level of production.

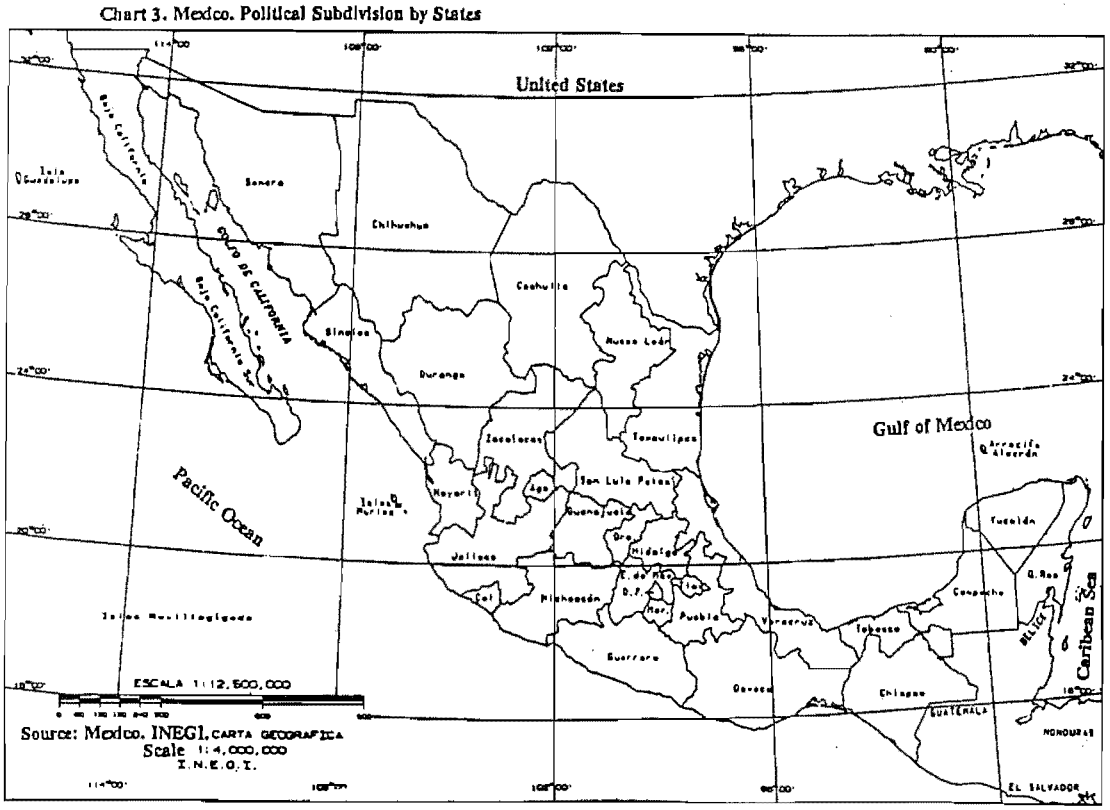
The remainder of the states grow at a rate below the national growth rate. Their rates of growth must be interpreted in terms of difference from national growth or Volatility and their adjusted R^2 value. The following hypothesis develops and tests these potential relationships.

Briefly, the expectation in hypothesis 1 is true: Mexican states respond distinctly to national economic fluctuations. At the same time, Table 1 also shows that we, with the first hypothesis, expect positive correlation between Amplitude and RISK (V_3). This expectation is not confirmed in Table 2 (the correlation coefficient between them is not significant); so, both measures cannot be aggregated into a single index as was proposed in hypothesis 1.

2. The second hypothesis states that, in the US experience (as it is represented in Table 1), regions following the national cycle will present higher economic fluctuations. This study shows that hypothesis 2 is not true in Mexican states. Table 2 shows that in the case study the relationship between Regional Coherence (COHERE) and Amplitude is negative (-.4992, significant at the .01 level). This relation is observed in Charts 1 and 2. Chart 1 reveals that in oil producing states (Tabasco and Chiapas), the small economies of Tlaxcala and Q. Roo, and in the Distrito Federal, Amplitude is high. Their extreme values do not represent the

8 Actually, neoclassical growth models assume that economic growth tends to be inversely related to the initial level of economic growth. Another way around, lower income areas tend to grow faster than rich ones (See Barro, R., 1989 for a cross-country analysis).

Chart 3. Mexico. Political Subdivision by States



01 Aguascalientes, AGS
02 Baja California, BC
03 Baja California Sur, BC
04 Campeche, CAM
05 Coahuila, COH
06 Colima, COL
07 Chiapas, CHIS
08 Chihuahua, CHIH
09 Distrito Federal, DF
10 Durango, DGO
11 Guanajuato, GTO
12 Guerrero, GRO
13 Hidalgo, HGO
14 Jalisco, JAL
15 Mexico, MEX
16 Michoacan, MICH
17 Morelos, MOR
18 Nayarit, NAY
19 Nuevo Leon, NL
20 Oaxaca, OAX
21 Puebla, PUE
22 Queretaro, QRO
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31 Yucatan, YUC
32 Zacatecas, ZAC

Amplitude and Coherence in most Mexican states. Chart 2 excludes these "atypical" states and eliminates the "scale effects." As a result, the spatial pattern is clearer; it depicts more obviously the negative correlation between Amplitude and Coherence. Thus, the results for hypothesis 2 shows that higher cyclical Coherence in the Mexican states does not imply higher Amplitude. On the contrary, they exhibit the opposite tendency, showing that in most Mexican states the national cycle may be less severe. Chart 2 presents evidence of these movements between states and the country. As an example, Nuevo León presents low Amplitude and high Coherence, while Sinaloa has low Coherence and high Amplitude. Briefly, the second hypothesis expectation is neither from nor for a developing economy. Amplitude correlates negatively to Spatial Coherence.

3. The third hypothesis accepts the argument that diversified regions are more stable (negative correlation between V_3 and diversification) and that these states closely follow national fluctuations (positive correlation with adjusted R square). At the same time, the third hypothesis also defines a potential positive correlation for Volatility, Regional Coherence, and Diversification. Let us consider, provisionally that in the US experience, more diversified regions have smaller cyclical amplitude (Chow and McDougall, 1978, p. 72). Since the second hypothesis already tested an inverse relationship between Amplitude and Regional Coherence, expectations in hypothesis 3 of positive correlations between Amplitude, Diversification, and Risk are no longer valid. Thus, the third hypothesis must be reformulated: a) if Regional Coherence is negatively correlated to Amplitude; and b),

TABLE 2. Mexico. Rank Correlation for Amplitude (AMPL), Economic Growth (AVGTH), Standard Deviation of Growth Rates (V_1), Diversification (AVGPOP), Regional Coherence (COHERE), Volatility from Beta Coefficient (V_3), Standard Errors From Estimated Trends (V_2), and Comparative Growth (ß)

	AMPL	AVGTH	V_1	AVGPOP
AMPL	1.0000	-.2036	-.0180	-.3523
AVGTH	-.2036	1.0000	.0024	.1538
V_1	-.0180	.0024	1.0000	-.2289
AVGPOP	-.3523	.1538	-.2289	1.0000
COHERE	-.4992*	-.3046	.0977	.1532
V_3	.3285	.2503	-.7393**	.1068
V_2	-.1914	.1636	.5739**	.1954
ß	-.1302	-.0630	.9567*	-.1913
Correlations: (Continuation)	V_2	ß	COHERE	V_3
AMPL	-.1914	-.1302	-.4992*	.3285
AVGTH	.1636	-.0630	-.3046	.2503
V_1	.5739**	.9567**	.0977	-.7393**
AVGPOP	.1954	-.1913	.1532	.1068
COHERE	.3639	.3215	1.0000	-.3559
V_3	-.4780*	-.7757**	-.3559	1.0000
V_2	1.0000	.6285**	.3639	-.4780*
ß	.6285**	1.0000	.3215	-.7757**

N of cases: 27 1-tailed Signif: * - .01 ** - .001

Source: Own calculations in this paper based on Table A.4.

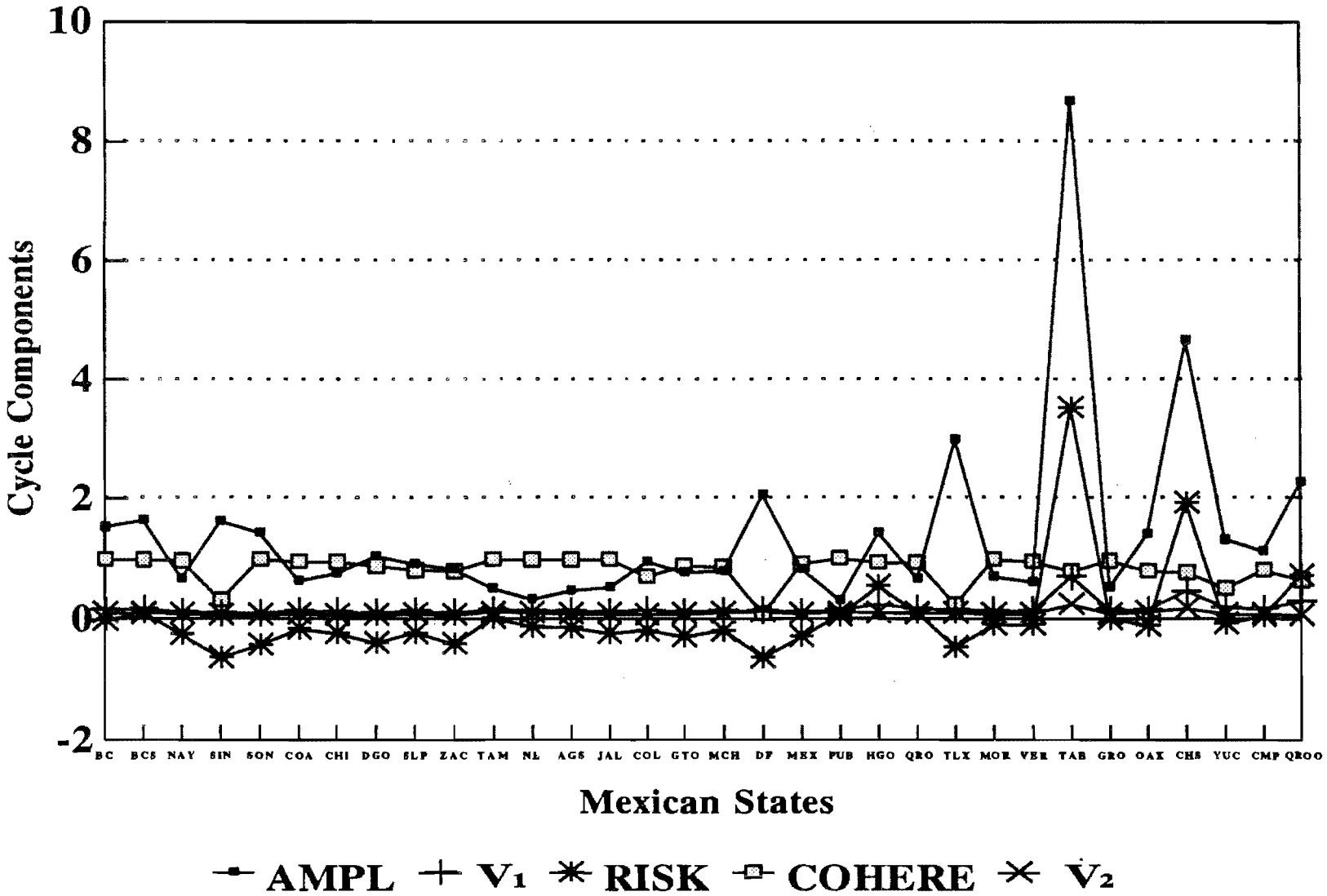
Diversification is negatively correlated to Amplitude (in the US experience); then c), a positive correlation between Diversification and Spatial Coherence is expected (Table 1). So far, the statements in the third hypothesis that "Diversification is negatively correlated to Amplitude" and "there exists positive correlation between Diversification and Coherence" still have to be examined along the following lines. The empirical test for these speculations considers population size as a measure of diversification. The result is that Diversification does not present any significant relation to Amplitude or Regional Coherence in Mexican States (Table 2).[9] Succinctly, the expected relations in hypothesis 3, at this level of analysis, do not have statistical support. An exception in these empirical tests is the negative correlation between Amplitude and Coherence already found in hypothesis 1.

4. The fourth hypothesis expects an inverse relation between Volatility and Economic Growth.[10] The empirical test

9 This result must be considered as a preliminary finding. Further discussion is possible using alternative measures of diversification. Some optional indexes are associated to following names: Theil, Gini, Williamson, Atkinson.

10 This speculation is mainly based on Comparative Volatility, also called V_3 or Risk in this study.

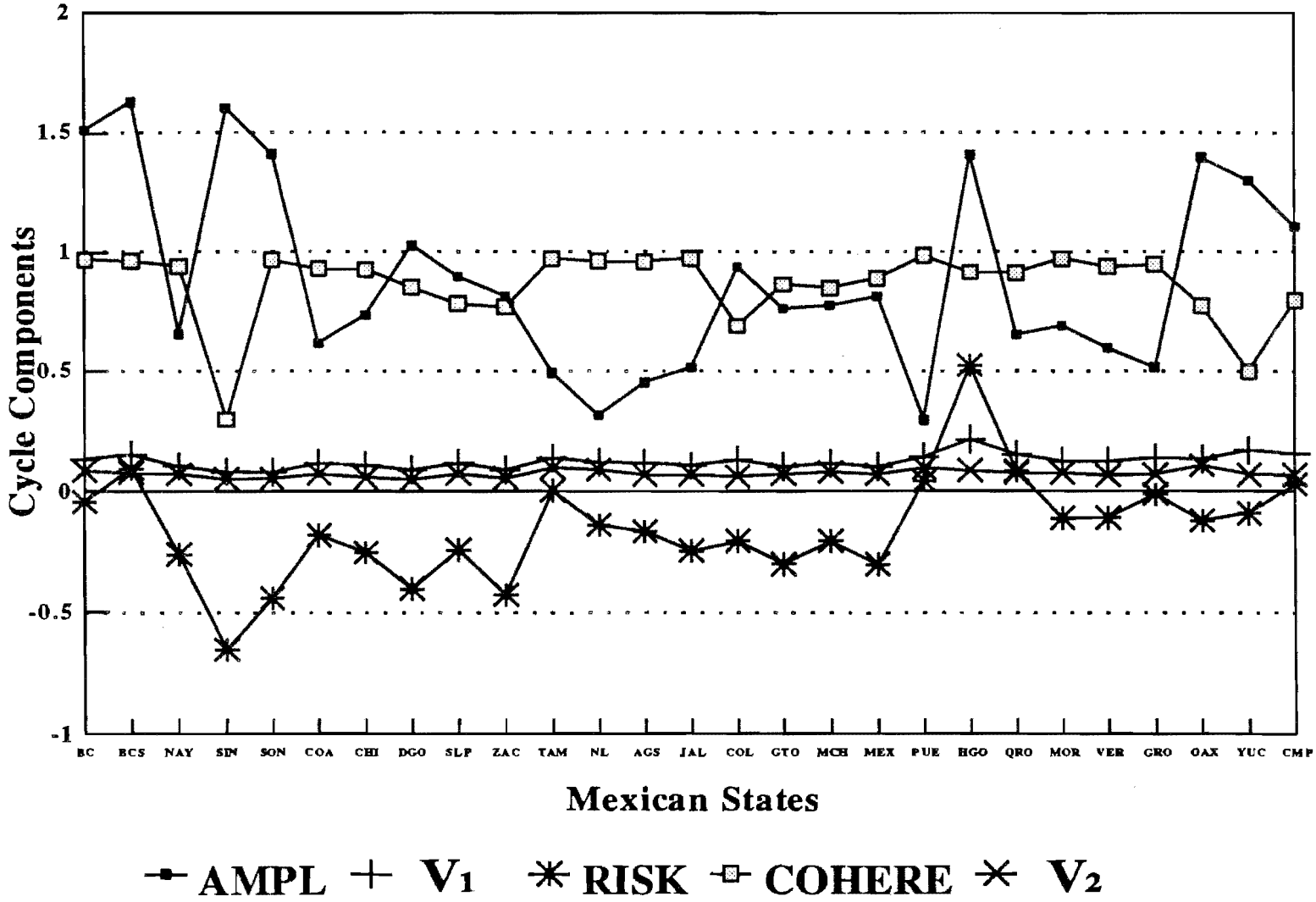
Chart 1. Spatial Cycle in Mexico
Regional Coherence and Cycle Components



Source: Table A.3

Chart 2. Spatial Cycle in Mexico

Regional Coherence and Cycle Components
(Excludes DF, TLX, TAB, CHS, and QROO)



Source: Table A.3

for Mexico uses two measures of Economic Growth. The first one is the arithmetic mean for all overlapped growth rates (period 1970-75 to 1983-88). Data analysis shows that highly volatile states (let us consider Risk that is less uniform among states as it is presented in Chart 2) as Hidalgo or Oaxaca also have high economic growth (Table A.3). Data also show that less volatile states as Durango, Michoacán or Colima present high growth rates. These results are not surprising considering that a measure of growth has different meaning for different states. It is easier for small and poorly diversified economies to present high growth rates than for mature economies. Tlaxcala and Oaxaca are examples of small economies that report high growth rates. At this level of analysis, results do not permit arguments inferring significant relationships between Volatility (V_1, V_2 or V_3) and Economic Growth when this last one is measured in terms of a growth path or trend (AVGTH in Table 2).

The second measure of Economic Growth is a ß coefficient from the regression equation between state and country growth rates. It is a comparative measure. Here, results for Growth (ß) and Comparative Volatility (Risk or ß-1) would seem redundant. The Methodological Appendix shows that such expectation is not true. In fact, for states growing faster than the country (ß>1), higher Growth means higher Volatility (Risk), and vice versa. For states growing less than the country (ß<1), however, higher Growth means less risk, and lower Growth means more Risk. These result confirm that the expectation in the fourth hypothesis is true for Comparative Measures: there is negative correlation between ß-1 (Comparative Volatility) and ß (Comparative Growth). It means that states' growing rates, either above or below the national growth rate, are not far from the growth rates in the country as a whole. Keeping this finding in mind, we also tested a hypothesis that a higher state growth is associated with higher Volatility in each state time path growth (positive correlation for ß with Standard Deviation and Standard Error of growth rates in each state).

Finally, when Growth is measured by the average of single state growth rates through time, the fourth hypothesis remains untested. This option must be reexamined weighting growth rates by the size of economies.[11] Nevertheless, the expectation of an inverse relation between Growth and Volatility is correct when they are expressed as Comparative Measures (ß and ß-1, respectively).

V. Main findings

Overall, the analysis using the first hypothesis permits the identification of several degrees and types of Volatility (V_1, V_2 or V_3) and Amplitude in Mexican

11 An option to calculate economic size weights is to consider factors of production. As an example, Jalan, B (1982) proposes following measure of economic size that could be adapted to state economies:

$Ii = 100/3 * [(Pi/Pmax) + (Ai/Amax) + (Yi/Ymax)]$

Where: Ii= State size index for individual state i, with i running from 1 to 32.

P, A and Y are population, arable area and GSP of each state, respectively (all data are available for Mexican states).

Pmax, *Amax*, and *Ymax* represent the highest values of population, arable area and GSP, respectively.

states. Here, a main inference is that Mexican states respond distinctly to national economic fluctuations.

On the other hand, results of analysis of hypothesis 2 contradict expectations found in the literature about developed countries. Amplitude moves in the opposite direction from Spatial Coherence. On the other hand, all expectations generated in hypothesis 3 on positive correlations for Amplitude, Diver-sification and Spatial Coherence are not accepted for Mexico. Diversification does not present any significant relation with Amplitude or Regional Coherence in Mexican states. Finally, in hypothesis 4 we relate Volatility and Economic Growth. The study uses two economic growth definitions. The first (AVGTH) uses growth in each individual state, while the second (ß) uses state growth in relation to national growth.[12] This research does not detect any significant relation between growth of first kind (growth in each state over time, AVGTH) and the cycle components. On the other hand, growth of the second kind (state economies in relation to the country) has an inverse relation with Comparative Volatility (V_3) and a positive relation with Time Path Volatility (V_1 and V_2).

As with growth, this paper differentiates between two measures of Volatility: Time Path Growth Volatility [Standard Deviation (V_1) and Standard Error (V_2) in individual state growth rates] and Comparative Volatility (ß-1). It is also proposed that the first does not imply the second. This study shows in Table 2 that there exists an inverse relation between Time Path and Comparative Volatility. Rank correlation is significant for V_3 and V_1 (-.7393), and V_3 and V_2 (-.4780).

Findings in this research advise to differentiate and to specify explicitly trend measures (AVGTH, V_1, V_2) from evaluations that describe comparative feature in economic variables or cycle components (ß, V_3).

Case study findings and expectations from the literature suggest further research is necessary on alternative measures of diversification and its relation to economic structure, productive mix, and cycle components. Supplementary empirical evidence at this level of analysis, however, should not substitute for further studies on the behavior of economic agents. Thus, the cyclical behavior analysis of economic aggregates must be a step forward to studies focusing on the economic agents, their relations and business through time and regional space (Nerlove, Grether, and Carvalho, 1979, pp. 20-21).

VI. Methodological Appendix

A.1. Cyclical pattern. The procedure overlaps five-years intervals within period 1970-88 to show a continuous spatial path.

$R7071 = ((GSP_{pc}71 - GSP_{pc}70)/GSP_{pc}70)$;
$R7172 = ((GSP_{pc}72 - GSP_{pc}71)/GSP_{pc}71)$; . . . ;
$R8388 = ((GSP_{pc}88 - GSP_{pc}83)/GSP_{pc}83)$.

Where: R= Growth rate; GSP_{pc}= Gross State Product *per capita* in every year.

12 Similar idea is in Barro and Sala-i-Martin (1990). In their study on Convergence across the United States and across countries, authors differentiate between convergence that refers to tendencies over time from one that refers to a benchmark economy.

Changes in this rate provide the empirical base to measure the cycle movement and, later, analyze its components and associations with growth.

This growth rate method has been used to analyze the economic cyclical behavior at regional and national levels (Burns, 1987a and 1987b, Silvers, A.L. and A.D. Roark, 1988). Actually, it is considered that

> Five-year growth rates reflect changes over a time interval rather than the points of time explicit in annual levels. As such, the series incorporates both future and historical elements to some degree and excludes the large and irksome transitory element inherent in annual income data (Burns, L., 1987a, p.328).

A.2. Regression Analysis. This exercise provides results to use in empirical tests of hypotheses two and three. It relates pairs of regional and national cycles.

$R = a_s + \beta_s Y + e_s$; where,

R= regional five year growth rate.

a_s= is the intercept. It represents a unique advantage in state *s* in relation to the country (it is very similar to Jensen's Alpha in Portfolio Analysis).

β_s= Describes the sensitivity of the state *s* to the national economy. If $\beta_s = 1$, state *s* tracks perfectly and positively with the national GSP per capita. If $\beta_s = 0$, there is no relationship between state *s* and the country. If $\beta_s = -1$, state *s* tracks perfectly, but negatively with the country. If $|\beta_s| < 1$, state *s* is less volatile than those with $|\beta| > 1$. Additionally, values of $|\beta| > 1$ mean greater GSP *per capita* in state *s* than Mexico. The opposite occurs when $|\beta| < 1$. From the relationships can be foreseen opposite relations between economic growth and volatility.

Y= national five year growth rate.

e_s= random term with expected value of zero.

Additionally, the coefficient adjusted R^2 is an indicator that shows the degree of conformity of the region *s* to the national cycle (hypothesis 2).[13]

A.3. Spatial Cycle Components.

1. Amplitude [14]

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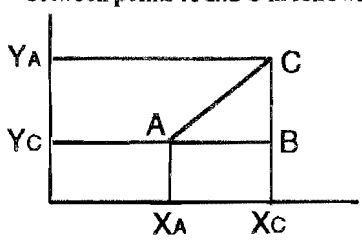
[13] This paper considers 14 observations (five-year overlapped growth rates for period 1970-88) per case. Econometricians suggest several "rules of thumb" to determine the number of observations: a) the number of observations, N, should be equal or greater than some constant, A, (i.e., $N \geq A$); b) to follow a minimum ratio B of observations to predictors ($N \geq Bm$, where m is the number of predictors); c) to follow a combination of previous suggestions ($N \geq A+Bm$). Following this notation, some authors suggest that $N \geq m*20$, or $N \geq m*5$, or $N-m \geq 50$, or, $N/m \geq 10$, or $N \geq 50+8*m$. Green (1991) presents a review and test of these rules of thumb.
Some examples similar to this study are Silvers and Roark (1988) that operate annual growth rates for 25-year period (24 observations); and Hanink and Cromley (1987) employ a 16-year time series. The number of observations in this investigation is restricted to information available. The number of observations in this research (14) can be supported by some rules of thumb (i.e. $N \geq m*5$ or $N/m \geq 10$) and previous case studies. Additionally, preliminary information at state level (rank correlation coefficients) is a point of reference for interpretation of parameters of regression.

[14] Using basic geometry it can be easily tested that amplitude is the total length of the economic fluctuation. General distance between points A and C in following figure is: $AC^2 = AB^2 + BC^2$



Having this figure as a reference,

$d(AC)^2 = (Y_A - Y_C)^2 + (X_A - X_C)^2$

Where,

$Y_A = Y_t$'; $X_A = Y_t$' $- Y_t$; $Y_C = Y_t$; $X_C = Y_{t-1}$' $- Y_{t-1}$

The formula for Amplitude is the sum of this distances for period 1970-75 to 1983-88.

$$A=\sum_t^T \sqrt{(Y_t^s-Y_t)^2+[(Y_t^s-Y_t)-(Y_{t-1}^s-Y_{t-1})]^2}$$

Where: t = time (1= 1970-75, 2=1971-76, . . . , T=1983-88).
Y_t^s = production growth rate of State s.
Y_t = production growth rate of Mexico.

2. Volatility (Time Path and Comparative)

Time Path:
Volatility I (V_1) = $\sqrt{\Sigma(Y_t^s-\bar{Y}^s)/(n-1)}$

Volatility II (V_2) = $\sqrt{\Sigma_t^T(Y_t^s-\hat{Y}_t^s)^2/df}$

Where:

$\hat{Y}_t^s$ = expected GSP *per capita* growth rate of state *s* at time *t*, predicted by a trend equation.
$\bar{Y}^s$ = the arithmetic mean of the growth rates for state *s*.

Comparative Volatility (V_3)[15]:

$V_3=ß-1$

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15 Relations between V_3 (RISK from ß-1) and ß (Growth) are given as follows:
1. If ß>1
   a) increasing in ß mean increasing in V_3
   b) decreasing " " " decreasing " "
2. If ß<1
   a) increasing in ß mean decreasing in V_3
   b) decreasing " " " increasing " "

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TABLE A.1. Mexico. Rank Correlation for State Growth Rates

Correlations:	BC	BCS	NAY	SIN	SON	COAH
BC	1.0000	.9385**	.9341**	.5214	.9604**	.9297**
BCS	.9385**	1.0000	.9165**	.6319*	.9604**	.9736**
NAY	.9341**	.9165**	1.0000	.5550	.9736**	.9297**
SIN	.5214	.6319*	.5550	1.0000	.5406	.6559*
SON	.9604**	.9604**	.9736**	.5406	1.0000	.9385**
COAH	.9297**	.9736**	.9297**	.6559*	.9385**	1.0000
CHIH	.8989**	.9341**	.9209**	.6223*	.9209**	.9736**
DGO	.8989**	.8066**	.8945**	.3340	.9121**	.7934**
SLP	.8242**	.7319*	.8374**	.3148	.8549**	.7143*
ZAC	.8549**	.7626**	.8593**	.3916	.8769**	.7275*
TAM	.9516**	.8945**	.9341**	.4012	.9648**	.8725**
NL	.9560**	.8857**	.9429**	.4157	.9604**	.8813**
AGS	.9077**	.9473**	.9560**	.6319*	.9516**	.9692**
JAL	.9648**	.9341**	.9692**	.5310	.9736**	.9560**
COL	.8505**	.9385**	.8813**	.7616**	.8769**	.9692**
GTO	.8945**	.8901**	.9121**	.6175*	.8989**	.9429**
MICH	.8725**	.8945**	.8989**	.6607*	.8901**	.9297**
DF	.5077	.3319	.3934	.2042	.4286	.3670
MEX	.8674**	.8385**	.9058**	.5220	.8722**	.8962**
PUE	.9736**	.9121**	.9516**	.4541	.9692**	.9077**
HGO	.8462**	.8154**	.8681**	.2619	.8989**	.7670**
QRO	.8725**	.9341**	.9077**	.7040*	.8945**	.9824**
TLAX	.4242	.4945	.4725	.8193**	.4418	.5868
MOR	.9253**	.9341**	.9868**	.5502	.9736**	.9516**
VER	.9096**	.8213**	.9008**	.3200	.9141**	.8081**
TAB	.7758**	.7670**	.7582**	.2907	.8110**	.7011*
GRO	.8901**	.9473**	.9253**	.6800*	.9165**	.9912**
OAX	.7538**	.7538**	.7978**	.5887	.7802**	.8110**
CHIS	.7934**	.7890**	.7714**	.2619	.8286**	.7143*
YUC	.7802**	.8901**	.8198**	.8049**	.8066**	.9121**
CAMP	.7143*	.8374**	.8242**	.4637	.8110**	.8374**
QROO	.7099*	.8462**	.7758**	.6992*	.7626**	.8505**
COUNTRY	.9560**	.9385**	.9780**	.5214	.9912**	.9385**

Correlations:	CHIH	DGO	SLP	ZAC	TAM	NL
BC	.8989**	.8989**	.8242**	.8549**	.9516**	.9560**
BCS	.9341**	.8066**	.7319*	.7626**	.8945**	.8857**
NAY	.9209**	.8945**	.8374**	.8593**	.9341**	.9429**
SIN	.6223*	.3340	.3148	.3916	.4012	.4157
SON	.9209**	.9121**	.8549**	.8769**	.9648**	.9604**
COAH	.9736**	.7934**	.7143*	.7275*	.8725**	.8813**
CHIH	1.0000	.8110**	.7187*	.7143*	.8813**	.8901**
DGO	.8110**	1.0000	.9692**	.9385**	.9648**	.9692**
SLP	.7187*	.9692**	1.0000	.9341**	.9077**	.9121**
ZAC	.7143*	.9385**	.9341**	1.0000	.9297**	.9341**
TAM	.8813**	.9648**	.9077**	.9297**	1.0000	.9956**
NL	.8901**	.9692**	.9121**	.9341**	.9956**	1.0000
AGS	.9824**	.8374**	.7670**	.7670**	.9033**	.9077**
JAL	.9516**	.9209**	.8593**	.8681**	.9604**	.9736**
COL	.9385**	.6967*	.6132*	.6791*	.7890**	.8022**
GTO	.9209**	.8374**	.7670**	.7890**	.8549**	.8857**
MICH	.8945**	.8198**	.7670**	.7538**	.8154**	.8418**
DF	.3846	.6088	.6923*	.5473	.5165	.5385
MEX	.8722**	.8674**	.8289**	.7616**	.8337**	.8626**
PUE	.9077**	.9560**	.8989**	.9165**	.9912**	.9956**

HGO	.7802**	.9165**	.8505**	.9033**	.9516**	.9341**
QRO	.9736**	.7538**	.6659*	.6923*	.8242**	.8418**
TLAX	.5824	.3363	.3934	.3143	.3363	.3714
MOR	.9560**	.8945**	.8330**	.8418**	.9385**	.9473**
VER	.8081**	.9715**	.9141**	.9494**	.9715**	.9759**
TAB	.7055*	.8198**	.7319*	.8286**	.8725**	.8462**
GRO	.9824**	.7714**	.6879*	.7011*	.8462**	.8593**
OAX	.7714**	.7846**	.8154**	.7275*	.7275*	.7626**
CHIS	.7011*	.8286**	.7451*	.8418**	.8813**	.8549**
YUC	.8813**	.6132*	.5165	.6176*	.7143*	.7231*
CAMP	.8637**	.6659*	.5560	.5868	.7626**	.7451*
QROO	.8462**	.5824	.4681	.5516	.6879*	.6791*
COUNTRY	.9385**	.9341**	.8769**	.8901**	.9736**	.9780**

Correlations:	AGS	JAL	COL	GTO	MICH	DF
BC	.9077**	.9648**	.8505**	.8945**	.8725**	.5077
BCS	.9473**	.9341**	.9385**	.8901**	.8945**	.3319
NAY	.9560**	.9692**	.8813**	.9121**	.8989**	.3934
SIN	.6319*	.5310	.7616**	.6175*	.6607*	.2042
SON	.9516**	.9736**	.8769**	.8989**	.8901**	.4286
COAH	.9692**	.9560**	.9692**	.9429**	.9297**	.3670
CHIH	.9824**	.9516**	.9385**	.9209**	.8945**	.3846
DGO	.8374**	.9209**	.6967*	.8374**	.8198**	.6088
SLP	.7670**	.8593**	.6132*	.7670**	.7670**	.6923*
ZAC	.7670**	.8681**	.6791*	.7890**	.7538**	.5473
TAM	.9033**	.9604**	.7890**	.8549**	.8154**	.5165
NL	.9077**	.9736**	.8022**	.8857**	.8418**	.5385
AGS	1.0000	.9604**	.9341**	.9121**	.8989**	.3670
JAL	.9604**	1.0000	.8945**	.9516**	.9209**	.5033
COL	.9341**	.8945**	1.0000	.9297**	.9165**	.2352
GTO	.9121**	.9516**	.9297**	1.0000	.9780**	.4374
MICH	.8989**	.9209**	.9165**	.9780**	1.0000	.4242
DF	.3670	.5033	.2352	.4374	.4242	1.0000
MEX	.8770**	.9202**	.8385**	.9491**	.9587**	.5214
PUE	.9253**	.9824**	.8286**	.8945**	.8593**	.5341
HGO	.8110**	.8637**	.7011*	.7538**	.7055*	.3451
QRO	.9604**	.9297**	.9868**	.9560**	.9385**	.3055
TLAX	.5868	.5077	.6308*	.5824	.6264*	.4330
MOR	.9780**	.9824**	.9077**	.9341**	.9165**	.4022
VER	.8302**	.9229**	.7330*	.8522**	.8037**	.5122
TAB	.7231*	.7626**	.6659*	.6791*	.6220*	.2615
GRO	.9736**	.9429**	.9780**	.9473**	.9297**	.3275
OAX	.7978**	.8374**	.7802**	.8945**	.9253**	.6000
CHIS	.7231*	.7758**	.6747*	.6923*	.6440*	.2396
YUC	.8769**	.8110**	.9780**	.8637**	.8549**	.1077
CAMP	.8725**	.7802**	.8374**	.7363*	.7143*	.0066
QROO	.8418**	.7407*	.9077**	.7626**	.7538**	-.0022
COUNTRY	.9604**	.9912**	.8769**	.9253**	.9033**	.4725

Correlations:	MEX	PUE	HGO	QRO	TLAX	MOR
BC	.8674**	.9736**	.8462**	.8725**	.4242	.9253**
BCS	.8385**	.9121**	.8154**	.9341**	.4945	.9341**
NAY	.9058**	.9516**	.8681**	.9077**	.4725	.9868**
SIN	.5220	.4541	.2619	.7040*	.8193**	.5502
SON	.8722**	.9692**	.8989**	.8945**	.4418	.9736**
COAH	.8962**	.9077**	.7670**	.9824**	.5868	.9516**
CHIH	.8722**	.9077**	.7802**	.9736**	.5824	.9560**

DGO	.8674**	.9560**	.9165**	.7538**	.3363	.8945**
SLP	.8289**	.8989**	.8505**	.6659*	.3934	.8330**
ZAC	.7616**	.9165**	.9033**	.6923*	.3143	.8418**
TAM	.8337**	.9912**	.9516**	.8242**	.3363	.9385**
NL	.8626**	.9956**	.9341**	.8418**	.3714	.9473**
AGS	.8770**	.9253**	.8110**	.9604**	.5868	.9780**
JAL	.9202**	.9824**	.8637**	.9297**	.5077	.9824**
COL	.8385**	.8286**	.7011*	.9868**	.6308*	.9077**
GTO	.9491**	.8945**	.7538**	.9560**	.5824	.9341**
MICH	.9587**	.8593**	.7055*	.9385**	.6264*	.9165**
DF	.5214	.5341	.3451	.3055	.4330	.4022
MEX	1.0000	.8722**	.7376*	.8914**	.5598	.9106**
PUE	.8722**	1.0000	.9121**	.8637**	.4110	.9560**
HGO	.7376*	.9121**	1.0000	.7275*	.1209	.8681**
QRO	.8914**	.8637**	.7275*	1.0000	.6308*	.9385**
TLAX	.5598	.4110	.1209	.6308*	1.0000	.4989
MOR	.9106**	.9560**	.8681**	.9385**	.4989	1.0000
VER	.8462**	.9582**	.9582**	.7728**	.2385	.8964**
TAB	.6367*	.8198**	.9560**	.6703*	.0462	.7582**
GRO	.8962**	.8813**	.7495*	.9956**	.6176*	.9516**
OAX	.9298**	.7758**	.5912	.8154**	.7275*	.8198**
CHIS	.6511*	.8330**	.9648**	.6747*	.0242	.7714**
YUC	.7616**	.7495*	.6571*	.9473**	.5956	.8374**
CAMP	.7088*	.7495*	.8066**	.8505**	.2967	.8505**
QROO	.6944*	.6967*	.6967*	.8857**	.4462	.7934**
COUNTRY	.8962**	.9824**	.8989**	.9077**	.4681	.9868**

Correlations:	VER	TAB	GRO	OAX	CHIS	YUC
BC	.9096**	.7758**	.8901**	.7538**	.7934**	.7802**
BCS	.8213**	.7670**	.9473**	.7538**	.7890**	.8901**
NAY	.9008**	.7582**	.9253**	.7978**	.7714**	.8198**
SIN	.3200	.2907	.6800*	.5887	.2619	.8049**
SON	.9141**	.8110**	.9165**	.7802**	.8286**	.8066**
COAH	.8081**	.7011*	.9912**	.8110**	.7143*	.9121**
CHIH	.8081**	.7055*	.9824**	.7714**	.7011*	.8813**
DGO	.9715**	.8198**	.7714**	.7846**	.8286**	.6132*
SLP	.9141**	.7319*	.6879*	.8154**	.7451*	.5165
ZAC	.9494**	.8286**	.7011*	.7275*	.8418**	.6176*
TAM	.9715**	.8725**	.8462**	.7275*	.8813**	.7143*
NL	.9759**	.8462**	.8593**	.7626**	.8549**	.7231*
AGS	.8302**	.7231*	.9736**	.7978**	.7231*	.8769**
JAL	.9229**	.7626**	.9429**	.8374**	.7758**	.8110**
COL	.7330*	.6659*	.9780**	.7802**	.6747*	.9780**
GTO	.8522**	.6791*	.9473**	.8945**	.6923*	.8637**
MICH	.8037**	.6220*	.9297**	.9253**	.6440*	.8549**
DF	.5122	.2615	.3275	.6000	.2396	.1077
MEX	.8462**	.6367*	.8962**	.9298**	.6511*	.7616**
PUE	.9582**	.8198**	.8813**	.7758**	.8330**	.7495*
HGO	.9582**	.9560**	.7495*	.5912	.9648**	.6571*
QRO	.7728**	.6703*	.9956**	.8154**	.6747*	.9473**
TLAX	.2385	.0462	.6176*	.7275*	.0242	.5956
MOR	.8964**	.7582**	.9516**	.8198**	.7714**	.8374**
VER	1.0000	.8964**	.7860**	.7286*	.9052**	.6668*
TAB	.8964**	1.0000	.6835*	.4769	.9912**	.6659*
GRO	.7860**	.6835*	1.0000	.8110**	.6879*	.9297**
OAX	.7286*	.4769	.8110**	1.0000	.4945	.6879*
CHIS	.9052**	.9912**	.6879*	.4945	1.0000	.6659*
YUC	.6668*	.6659*	.9297**	.6879*	.6659*	1.0000
CAMP	.7154*	.7846**	.8637**	.5385	.7802**	.8418**

QROO	.6447*	.7363*	.8769**	.5604	.7231*	.9560**
COUNTRY	.9317**	.7978**	.9253**	.8110**	.8110**	.7978**

Correlations:	CAMP	QROO	COUNTRY
BC	.7143*	.7099*	.9560**
BCS	.8374**	.8462**	.9385**
NAY	.8242**	.7758**	.9780**
SIN	.4637	.6992*	.5214
SON	.8110**	.7626**	.9912**
COAH	.8374**	.8505**	.9385**
CHIH	.8637**	.8462**	.9385**
DGO	.6659*	.5824	.9341**
SLP	.5560	.4681	.8769**
ZAC	.5868	.5516	.8901**
TAM	.7626**	.6879*	.9736**
NL	.7451*	.6791*	.9780**
AGS	.8725**	.8418**	.9604**
JAL	.7802**	.7407*	.9912**
COL	.8374**	.9077**	.8769**
GTO	.7363*	.7626**	.9253**
MICH	.7143*	.7538**	.9033**
DF	.0066	-.0022	.4725
MEX	.7088*	.6944*	.8962**
PUE	.7495*	.6967*	.9824**
HGO	.8066**	.6967*	.8989**
QRO	.8505**	.8857**	.9077**
TLAX	.2967	.4462	.4681
MOR	.8505**	.7934**	.9868**
VER	.7154*	.6447*	.9317**
TAB	.7846**	.7363*	.7978**
GRO	.8637**	.8769**	.9253**
OAX	.5385	.5604	.8110**
CHIS	.7802**	.7231*	.8110**
YUC	.8418**	.9560**	.7978**
CAMP	1.0000	.9297**	.8022**
QROO	.9297**	1.0000	.7451*
COUNTRY	.8022**	.7451*	1.0000

N of cases: 14 1-tailed Signif: * - .01 ** - .001

Source: Own calculations in this paper

TABLE A.2 Mexico. Effects of National Cycles and Characteristics of Spatial Fluctuations. Results of Regression Equations For Five Year Growth in Each State and the National Economy

	Intercept (a)	Slope# (b)	Adjusted R Square
I.NORTHWEST			
BC	-.10672	0.95347***	.96977
BCS	-.12628	1.09081***	.96295
NAY	.00661	0.73564***	.94297
SIN	-.01129	.34478*	.29694
SON	-.06792	.55502***	.96736
II. NORTH			
COAH	-.01864	.81465***	.93187
CHIH	-.00577	.74202***	.92911
DGO	.09980	.59321***	.85396
SLP	.06635	.75386***	.78385
ZAC	.05032	.56865***	.76979
III. NORTHEAST			
TAM	-.03194	1.00123***	.97379
NL	.00559	.85721***	.96311
IV. MIDWEST			
AGS	.01691	.82900***	.96110
JAL	.02693	.74828***	.97448
COL	.04646	.79093***	.69174
GTO	.01227	.69498***	.86572
MICH	.03918	.79069***	.84974
V. V. OF MEX			
DF	.13216	.33828	.07191
MEX	.00609	.69339***	.89229
VI. MIDEAST			
PUE	.00639	1.04050***	.98592
HGO	.00375	1.52311***	.91594
QRO	.02834	1.08192***	.91457
TLAX	.24712	.52186	.22085
MOR	-.03691	.88613***	.97416
VII. EAST			
VER	-.03019	.88771***	.93962
TAB	.19031	4.50749***	.77393
VIII. SOUTH			
GRO	-.02306	.98497***	.94906
OAX	.09836	.87561***	.77669
CHIS	-.04606	2.90332***	.75189
IX. P. OF YUC			
YUC	-.02937	.90608*	.49756
CAMP	-.05588	1.02660***	.79846
QROO	-.10396	1.70462***	.62494

Source: Own calculations in this paper.

(#) The significance of the regression coefficients is shown by an *, where:

* = P < 0.05, ** = P < 0.01, and *** = P < 0.001.

TABLE A.3. Mexico. Measures of Amplitude (AMPL), Economic Growth (AVGTH), Standard Deviation of Growth Rates (V_1), Diversification (AVGPOP), Spatial Coherence (COHERE), Volatility from Beta Coefficient (V_3),[1] and Standard Errors of Estimated Trends (V_2).[2]

STATE	AMPL	AVGTH	V_1	V_3	AVGPOP	COHERE	V_2
BC	1.5124	-.0194	.1311	-.0465	1207.0	.9698	.08144
BCS	1.6289	-.0264	.1505	.0908	213.33	.9630	.07430
NAY	.6574	.0739	.1025	-.2644	699.30	.9430	.06908
SIN	1.6041	.0186	.0789	-.6552	1778.5	.2969	.04760[t]
SON	1.4126	-.0171	.0764	-.4450	1464.5	.9674	.04991
COAH	.6189	.0559	.1141	-.1854	1524.5	.9319	.06760
CHIH	.7379	.0621	.1041	-.2580	1980.6	.9291	.05268
DGO	1.0286	.1541	.0865	-.4068	1151.6	.8540	.04529[q]
SLP	.8968	.1354	.1142	-.2461	1639.1	.7839	.06829[q]
ZAC	.8144	.1024	.0869	-.4314	1123.6	.7698	.05221[q]
TAM	.4917	.0597	.1374	.0012	1871.0	.9738	.09360
NL	.3163	.0840	.1182	-.1428	2400.6	.9631	.08610
AGS	.4514	.0928	.1145	-.1710	505.72	.9611	.06254
JAL	.5130	.0954	.1027	-.2517	4262.4	.9745	.06592
COL	.9391	.1189	.1268	-.2091	333.77	.6917	.05860
GTO	.7647	.0759	.1007	-.3050	3021.2	.8657	.06757
MICH	.7800	.1116	.1155	-.2093	2915.4	.8497	.07719
DF	2.0578	.1631	.1211	-.6617	8371.6	.0719	.10055[q]
MEX	.8144	.0696	.0991	-.3066	6977.8	.8923	.06756
PUE	.2956	.1016	.1420	.0405	3269.4	.9859	.09394
HGO	1.4095	.1432	.2150	.5231	1516.5	.9159	.08387[t]
QRO	.6551	.1274	.1528	.0819	729.42	.9146	.07398
TLAX	2.9775	.2949	.1335	-.4781	559.53	.2209	.07788[t]
MOR	.6918	.0442	.1216	-.1139	906.69	.9742	.07227
VER	.6003	.0511	.1238	-.1123	5114.2	.9396	.06286[t]
TAB	8.6782	.6029	.6870	3.5075	1095.6	.7739	.22917[t]
GRO	.5142	.0671	.1368	-.0150	2100.2	.9491	.06700
OAX	1.3989	.1785	.1332	-.1244	2455.5	.7767	.10515
CHIS	4.6607	.2197	.4483	1.9033	2167.0	.7519	.15914[t]
YUC	1.3010	.0536	.1678	-.0939	1033.2	.4976	.06666[q]
CAMP	1.1098	.0381	.1543	.0266	382.63	.7985	.06526
QROO	2.2663	.0521	.2858	.7046	228.23	.6249	.04734[q]

Source: Own calculations in this paper.

[1] V_3 must be interpreted in terms of its Absolute Value. Further Calculations Consider the Absolute Value for RISK.

[2] Trend specifications are linear, quadratic (q), and third degree polynomial (t) forms.

Lin. Trend: $GSP_{\text{Per Capita}} = a + b\ \text{Time} + u.$

Quad. Form: $GSP_{\text{Per Capita}} = a + b\text{Time} + c\ \text{Time}^2 + u.$

Third Deg.Polynml: $GSP_{\text{Per Capita}} = a + b\text{Time} + c\ \text{Time}^2 + d\ \text{Time}^3 + u.$

TABLE A.4. Mexico. Rank of Mexican States in Amplitude (AMPL), Economic Growth (AVGTH), Diversification (AVGPOP), Standard Deviation of Growth Rates (V_1), Spatial Coherence (COHERE), Volatility from Beta Coefficient (V_3),[a] and Standard Errors from estimated trends (V_2), and Comparative Growth (ß)

	AMPL	AVGTH	V_1	AVGPOP	COHERE	V_3	V_2	ß
BC	3	26	10	17	5	23	6	8
BCS	1	27	5	27	8	21	8	2
NAY	18	14	21	23	11	8	11	21
SIN	2	24	26	12	27	1	26	28
SON	4	25	27	16	6	3	25	26
COAH	20	19	18	14	13	14	13	15
CHIH	16	17	19	10	14	9	23	20
DGO	9	2	25	18	19	5	27	24
SLP	11	4	17	13	22	11	12	18
ZAC	12.5	8	24	19	24	4	24	25
TAM	24	18	7	11	4	27	3	6
NL	26	12	14	8	7	16	4	13
AGS	25	11	16	24	9	15	21	14
JAL	23	10	20	3	2	10	18	19
COL	10	6	11	26	25	13	22	16
GTO	15	13	22	5	18	7	14	22
MCH	14	7	15	6	20	12	7	17
MEX	12.5	15	23	1	17	6	15	23
PUE	27	9	6	4	1	24	2	4
HGO	5	3	1	15	15	2	5	1
QRO	19	5	4	22	16	22	9	3
MOR	17	22	13	21	3	18	10	11
VER	21	21	12	2	12	19	20	10
GRO	22	16	8	9	10	26	16	7
OAX	6	1	9	7	23	17	1	12
YUC	7	20	2	20	26	20	17	9
CAMP	8	23	3	25	21	25	19	5

Source: Table A.2, and A.3.

[a] States of TAB, DF, CHIS, QROO, and TLX are omitted.

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Dynamics of Mexican urbanization:
Mexico City emerging megalopolis and metropolitan Monterrey

Gustavo Garza

The rather swift urbanization of Mexico during the Twentieth Century has resulted from the rapid industrialization that took place until 1982, which transformed the nation. It is considered, therefore, that in order to understand the accelerated growth and multiplication of Mexican cities it is necessary to start from their linkage to processes of overall changes brought about by industrialization and economic development. The first objective of this paper is to analyze the main characteristics of the overall process of urbanization in Mexico in the context of its economic development and, secondly, the phenomenon of the emerging megalopolis in Mexico City and the metropolitan consolidation of Monterrey.

I. Economic development and urbanization in Mexico

Mexico's economic development up to 1982 was the result of an import-substitution policy started in the 1930s, which replaced the agro-exporting pattern that had prevailed since the second half of the Nineteenth Century. Nevertheless, the latter pattern continued coexisting subordinate to the industrial model, until it became totally exhausted in the 1950s. The combination of both models was of great importance for the relative success of the import-substitution policy.

The economic growth of the five decades from 1930 to 1980 was important. Between 1930 and 1940 the Gross Internal Product (GIP) increased in real terms by 3.1% annually; 5.9% between 1940 and 1950; 6.2% between 1950 and 1960; and continued advancing until reaching 7.0% per year between 1960 and 1970. The 1970-1980 decade promised greater dynamism in the light of the international rise in oil prices and the expansion in the exploitation of oil fields, but the mid-

decade crisis prevented it, although the economy registered a growth rate of 6.6% a year. The significant growth rate of the country was spurred by the manufacturing industry, which regularly registered higher rates than that of GIP.

A profound economic recession began in 1982 and lasted throughout the eighties. It was caused by the fall in the prices of oil and the vertiginous growth of the external debt. Between 1983-1988 total GIP declined 0.2% annually and 0.4% per year in industry. Since then, the economy has recovered moderately, increasing the GIP by 3.3% in 1989, 4.4% in 1990, 3.6% in 1991 and 2.8% in 1992.

The territorial distribution of national development and rapid population growth enabled a significant growth in a number of cities, characterized by the increasing importance of Mexico City and Monterrey. In general, since the turn of the century, Mexico has been undergoing a constant process of urbanization, although its pace has varied. In 1900, of a total population of 13.6 million people, just 1.4 were living in cities being the degree of urbanization 10.5% (See Table 1). Since then, the urban population increased in numbers at a rate far exceeding that of the total population. In 1940 around 3.9 million Mexicans lived in cities; by 1960, the urban population had almost quadrupled, with 14.4 million living in cities while a process of urbanization of a metropolitan character began (see Table 1). This occurred between 1950 and 1960 when Mexico City changed into a metropolitan area by the expansion of the urban sprawl of the Federal District into the state of Mexico, the neighboring federal state. From 1960 on, to the extent that the metropolitan character of urbanization in Mexico becomes more general, the urban population figures in Table 1 include the emerging population living in metropolitan areas, which are 27 in 1990 (See, Garza and Rivera, 1993).

The foregoing is reflected in a very significant increase in the degree of urbanization, which more than doubled from 20.0% in 1940 to 41.2% in 1960. From this last year onward, the pace of urbanization slackened, going from 49.4% in 1970 to 56.2% in 1980. By 1990 this level was 60.8% (see Table 1).

II. The urban system expansion

During the slow stage of urbanization, that is, from 1900 through 1940, 22 new cities emerged at the rate of 0.5 a year, increasing the urban population by 2.5 million to reach 3.9 million in 1940 (see Table 1). This growth of the urban population stems from three different sources: i) through reclassification of localities from the rural to the urban category upon exceeding the limit of 15,000 inhabitants, thus becoming reclassified as cities; ii) through population increase caused by physical expansion of the cities, a process occurring when non-urban communities are physically integrated with the growth of cities; and iii) through additions to the urban population due to natural increase and migration.

At the start of this process of urbanization in Mexico, the first two components of growth were important, but ceased to be so during the stage of rapid urban growth from 1940 to 1980.

Thus, for example, the five centers which were reclassified between 1900 and 1910 contributed 38.2% of the urban growth in that period. Subsequently, the importance of reclassification fell sharply: between 1940 and 1950, thirty centers were incorporated that contributed 19.2%; from 1960 through 1970 fifty-five reclassified centers contributed only 4.2% (Unikel, 1977:494). Therefore, during the second stage of urbanization, reclassification had little impact on overall urban population growth.

In the half century from 1940 through 1990, 254 new cities grew up, thus constituting a system of 309 urban centers in 1990. Over this span of time, there was an increase of 45.5 million people in the cities to amount to a total urban population of 49.4 million in 1990 (see Table 1). Hence, this period is characterized by having a yearly average of 5.1 new cities and 900 thousand, new inhabitants a year. Of this growth, 80% is explained by the dynamics of existing cities and only 20% by reclassified cities and through the integration of localities caused by the expansion of urbanized areas.

The urban system is usually ranked according to the distribution of the urban population by city size. There is a highly preeminent or "macrocephalic" system when the population of the country's largest city exceeds several times the population of its second largest (conventionally more than three times and it is called index of primacy); and a rank-size rule when the largest city is double the second largest, is triple the third largest, is quadruple the fourth largest, and, in general, is "n" times greater than the city occupying the "n" rank. One could speak of an intermediate urban hierarchy when the distribution of the urban population is in between both possibilities.

Through the end of the Eighteenth and early Nineteenth Centuries, Mexico City did not exhibit a strong predominance over other localities in colonial Mexico, despite being New Spain's most important city. Thus, the index of primacy for 1790 was only 1.3, reflecting the fact that Mexico City exceeded Puebla's population by only 30%, which was the second largest city of the period. By the early Twentieth Century, the index rises to 2.0 conforming perfectly to a system of cities described by the rank-size rule. In Mexico, industrial capitalism as a mode of dominant production became consolidated during the last two decades of the Nineteenth Century; at this period Mexico City initiated rapid growth. Hence, by 1900 the index of primacy rises to 4.4 and continues to increase until it reaches 7.2 in 1950, becoming stabilized at about 6 during the following decades. Nevertheless, formerly depending basically on only one metropolis, population concentration began to disperse relatively toward other growing metropolises, most notably Guadalajara and Monterrey (See Map 1).

Metropolitan urbanization extended toward new population centers, forming new metropolitan areas that in 1980 numbered 26 and 27 in 1990. Thus, Mexico City, Guadalajara and Monterrey are joined by such new metropolitan areas as Puebla, Torreon, Leon, Orizaba, Tampico, Toluca, among other cities, undoubtely imprinting a metropolitan character on Mexico's urbanization (See Map 1).

Given the structural connections between economic development and urbanization, the economic crisis of the eighties produced an abrupt decrease in the rate of urbanization to 0.8 per year between 1980-1990, the lowest of this century (See Table 1).

Nevertheless, from 1980 to 1990 the number of localities increased by 80, reaching an national urban hierarchy of 309 cities in 1990 (see table 1). Until 1980 cities of more than one million people experienced dynamic growth and their urban population share went from 48.9% to 51.3% between 1970-1980. However, in the eighties they reduced significantly their participation to 45.1% of the national urban population (see table 1). The cities with 20-50 thousand inhabitants underwent the highest increase in units, growing from 94 to 132, but the cities between 500-999 thousand people increased their urban population share from 6.8% in 1980 to 15.2% in 1990.

The urban decentralization path of the eighties could be just temporary and return to the traditional concentration process if the main metropolises restart their economic growth in the context of the North America Free Trade Agreement initiated January 1st, 1994.

To the extent that the new economic strategy would involve the rapid growth of producer services activities--corporate services, legal firms, banking, mass media and information, insurance, and so on--they would tend to locate mainly in the Mexico City and Monterrey metropolitan areas. In the case of Mexico City, the new manufacturing firms will tend to locate in the medium size cities around it. Evidence of this is the fast growth during the eighties of Puebla, Toluca and Cuernavaca which already constitute a megalopolitan conglomerate or a polycentric urban region (See Map 1).

In the case of Monterrey, the city could be the link between the Mexican northeast and the main cities in Texas: San Antonio-Houston-Dallas. Finally, Tijuana and Ciudad Juarez, the most important in-bond assembly industry border cities, will be very soon new metropolises with more than one million people (See Map 1).

III. Mexico City: the emerging megalopolis

By the dawn of the Twentieth Century, in 1900, Mexico City reached 345 thousand inhabitants and initiated an accelerated urban growth process that led, in the late 1980s, to its transformation into one of the world's most populated cities. Throughout this process the capital of Mexico has undergone four stages of development.

a. The Central Nucleus Growth Stage (1900-1930). During the first stage of metropolitanism, the population residing in the central area increased in absolute and relative terms, and the number of persons that traveled to the "center" also grew. In the specific case of Mexico City, this stage covers the period 1900-1930, during which the relatively small population of 345 thousand in 1900 expanded to one million in 1930. The urban area itself recorded an annual growth rate of 3.3%, while that of the Federal District was 2.6%.[1] In 1930 the

[1] The Mexico City Urban Area (MCUA) is located within the Federal District, which is divided into 16 "Delegations" (boroughs). The Federal District is partially surrounded by the State of Mexico, one of the 31 states of the Mexican Republic, a state into wich the city expanded after 1950.

Mexico City Urban Area (MCUA) began to expand beyond the four central Delegations which politically defined the city limits. From that year on, growth spread out to the contiguous Delegations of Coyoacan and Azcapotzalco, which accounted for 2% of the population, while 98% remained in the central city. Thus began the city's expansion in the direction of the Delegations bordering on the central area (See Table 2).

b. The Peripheral Expansion Stage (1930-1950). The second stage of Mexico City's territorial expansion dates from the 1930s. This stage is characterized by the higher growth rates of the Delegations that surrounded the city prior to 1930. Thus, while the central city grew at a rate of 3.4% a year between 1930 and 1940, the seven contiguous Delegations registered a rate of 5.4%. During the 1940s, this difference became more marked, with growth rates of 4.3% and 10.3%, respectively. As a corollary, the central city's share in the total population declined rapidly in relation to the Mexico City Urban Area, from 98% in 1930 to 78.3% in 1950 (See Table 2).

This second stage marked the beginning of the decentralization of commerce, services, and population toward the peripheral Delegations. Although this enlargement occurred exclusively within the Federal District territory, by 1950 its northern boundaries reached the neighboring State of Mexico. This year, therefore, marked the end of Mexico City's second growth stage.

c. The Metropolitan Dynamics Stage. (1950-1980). In the third stage, the Mexico City Urban Area spilled out beyond the northern limits of the Federal District, into the municipality of Tlalnepantla in the State of Mexico, giving rise to the Mexico City Metropolitan Area (MCMA). Since then the analysis of Mexico City's growth differentiates the concept of Mexico City Urban Area from that of the Mexico City Metropolitan Area (See Table 2). In 1950 only the folloging municipalities were incorporated: Naucalpan, Chimalhuacan, and Ecatepec (See Map 2). These municipalities of the State of Mexico registered an important population growth due to the increased movement of manufacturing firms from the center to the northern periphery. Therefore, between 1950 and 1960 the population growth rate of these municipalities was 10.3% a year, while that of the central district reached only 2.4%. The accelerated decline of the central city continued; its share in the total population decreased to 57.6% in 1960 (See Table 2).

From 1960 to 1970 seven new municipalities (Netzahualcoyotl, La Paz, Zaragoza, Tultitlan, Coacalco, Cuautitlan, and Huixquilucan) were added to the MCMA. These administrative areas recorded a high annual growth rate of 14.3%, thus strengthening the metropolitan process in the State of Mexico, which in 1970 accounted for the 20.5% of the MCMA total population.

The metropolitan expansion into the State of Mexico proceeded, and in 1980 another eight municipalities were added to the MCMA: Chalco, Chiautla, Chicoloapan, Chiconcuac, Ixtapalapa, Nicolas Romero, Tecamac, and Texcoco. Thus, in 1980 the MCMA comprised all 16 Delegations of the Federal District and 21 municipalities of the State of Mexico

(See Map 2).

d. The Emerging Megalopolis Stage (1980-2010). In the last decades of the Twentieth Century the system of territorial organization has undergone a significant transformation, most notably, the suburbanization of extensive areas and the rapid integration of previously isolated urban communities. This process has determined the emergence of polycentric metropolitan urban networks that concentrate more complex social structures and relations, thus constituting whole sub-systems within highly integrated cities. The most advanced kind of urban interrelation is the so-called megalopolis, created by the fusion or overlapping of two or more metropolitan areas.

A study of the demarcation of the metropolitan areas in the central region of Mexico identified the following: i) Metropolitan Area of Mexico City; ii) Metropolitan Area of Toluca; iii) Metropolitan Area of Puebla; and iv) Metropolitan Area of Cuernavaca (Negrete and Salazar, 1987). Thus, the contiguous cities of the MCMA have experienced significant metropolitan growth, making possible the emergence of a megalopolis. In fact, by 1980, the Metropolitan Areas of Mexico City and Toluca had overlapped, technically constituting a megalopolitan conglomeration, which could be referred to as the Mexico City megalopolis.

In the 1990 the MCMA is made up of the 16 Delegations of the Federal Districts and 27 municipalities of the State of Mexico with a total populations of 15 million. Adding the populations of Puebla, Toluca and Cuernavaca, the megalopolis of Mexico City would have 18 million in 1990. According to forecasts, it is estimated that, toward the year 2010 then urban region will contain at least 31 million inhabitants (G. Garza, 1987:419).

IV. Metropolitan consolidation of Monterrey

Monterrey has increased its importance within the national urban hierarchy in the Twentieth Century. In 1900 it was the fifth city of the Republic, after Mexico City, Guadalajara, Puebla and Leon. In 1910 it displaced Leon, and in 1930 it became larger than Puebla. Since then it has become the third city of country in terms of population, but the second according to its share in the total national GIP. Monterrey, at the same time, decreased the distance that separated it from Mexico City and Guadalajara during the last fifty years. In 1940 the country's capital, Mexico City, was 8.9 times larger than the capital city of the state of Nuevo Leon, but this difference was reduced in 1990 to 5.8. In 1940, Guadalajara, was 1.3 times larger than Monterrey and this difference was reduced to 1.1 in 1990, i.e., it has 10% more inhabitants than Monterrey (See the location of these Cities in Map 1). Monterrey's considerable dynamism, however, came to a halt between 1980 and 1990 as a reflection of the economic crisis it underwent in that period. [2] Since the population grew yearly by 4.6% from 1970 to 1980, it was thought that its population would reach 3 million by 1990. In fact, annual population growth

[2] During the 1960-1980 period, the rate of growth of the GIP of Monterrey was 7.8% per year in real terms, while the same figure for the entire country was 7.0%. Between 1980 and 1988 this rate of growth was reduced, in the case of Monterrey, to 0.1%.

was reduced to 2.5% from 1980 to 1990 resulting in a population of 2.6 million by 1990 (See Table 3). Finally, it is interesting to see the characteristics of the metropolitan expansion of the City.

The metropolization process began in Monterrey in the fifties when it expanded toward to the municipalities of Guadalupe and San Nicolás (See Table 3). The municipality of Monterrey, as a central unit of the growing metropoli, with 399 thousand inhabitants, absorbed 90.5% of of the total population in the Monterrey Metropolitan Area (MMA).The begining of the process is reflected by the fact that the municipality of Guadalupe at the time had only 12.6 thousand inhabitants, i.e. 3% less than the central municipality. Nonetheless, by modern technical conceptualization, Monterrey deserves since 1950 the name of Metropolitan City of our Lady of Monterrey, which it received when founded in 1596.

Between 1950 and 1960 the Monterrey Metropolitan Area (MMA) almost double its population by growing at the highly accelerated rate of 6.6% per year. Garza García was integrated during this decade, bringing the total to four municipalities (See Table 3). The municipality of Monterrey grew 5.9% annually Guadalupe 11.7%, San Nicolas, 14.6% and Garza García, 11.1%. It was evident that the high rates of growth of the last three were due to a reduced population base and obviously because when the central unit became saturated, the growth of the city naturally followed toward the immediate municipalities. Still, by 1960, the Municipality of Monterrey in practical terms continued to be the city, since it represented 84.9% of the total population of the MMA.

In the seventies, three other municipalities joined the MMA: Santa Catarina, Apodaca and General Escobedo (See Map 3). Then the Metropolitan Area was constituted by seven municipalities, among which, Guadalupe and San Nicolás presented very high rates of growth and considerable volumes of population (See Table 3). Monterrey reduced its share of the metropolitan population to 68.0% of the total, while the municipality of Guadalupe, with 170.2 thousand inhabitants, absorbed 13.3% of the stated total. While the demographic growth rate of Monterrey remained below the rest of the metropolitan municipalities, still it was positive (See Table 3).

From 1970 to 1980, the MMA reduced its growth rate to 4.6% per year, integrating only the Municipality of Juárez for a total of eight municipalities, as indicated in Table 3. The rate growth of Monterrey shrank by 2.2%, while those of the other metropolitan municipalities were several times that of Monterrey. The accelerated metropolization process continued, and this was certified by the considerable difference of their rate of growth, since the peripheral municipalities continued to grow at a much greater rate.

The metropolization process suffered a considerable downshift from 1980 to 1990 when the MMA reduced its rate of growth to 2.5% per year. This was the lowest rate since the 1910 - 1921 period, when it grew at 1.1% per year. The most notable part of the eighties was that the municipality of Monterrey now had a negative growth (-.02%) which meant the culmination of the first stage of the metropolization of the City. Also, municipalities constitute the MMA, with the possible incorporation of García in

the nineties, even though in 1990 it had only 13 thousand inhabitants.

Thus, throughout the Twentieth Century, Monterrey went from a small city with a population of 62,000 in 1900 to medium sized metropolis with a population of about 3 million which located the city among the 100 largest urban areas of the planet.

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TABLE 1
Mexico:Urban distribution by city size, 1900 - 1990
(Inhabitants)

Year [a]	Urban Population	15,000 a 19,999	20,000 a 49,999	50,000 a 99,999	100,000 a 499,999	500,000 a 999,999	1,000,000 y más
1900							
Population	1,435	173	536	280	446	—	—
%	100.0	12.1	37.3	19.5	31.1	—	—
Cities	33	10	17	4	2	—	—
Degree	10.5						
1910							
Population	1,783	115	715	363	590	—	—
%	100.0	6.4	40.1	20.4	33.1	—	—
Cities	36	7	22	5	2	—	—
Degree	11.7						
Rate	1.4						
1921							
Population	2,100	201	560	534	143	662	—
%	100.0	9.6	26.7	25.4	6.8	31.5	—
Cities	39	12	17	8	1	1	—
Degree	14.7						
Rate	2.4						
1930							
Population	2,892	275	564	575	429	—	1,049
%	100.0	9.5	19.5	19.9	14.8	—	36.6
Cities	45	16	17	8	3	—	1
Degree	17.5						
Rate	2.7						
1940							
Population	3,928	304	694	589	781	—	1,560
%	100.0	7.7	17.7	15.0	19.9	—	39.7
Cities	55	18	23	8	5	—	1
Degree	20.0						
Rate	1.8						
1950							
Population	7,209	392	1,210	808	1,927	—	2,872
%	100.0	5.5	16.8	11.2	26.7	—	39.8
Cities	84	22	39	12	10	—	1
Degree	28.0						
Rate	3.7						
1960							
Population	14,382	559	1,271	1,956	3,591	1,596	5,409
%	100.0	3.9	8.8	13.6	25.0	11.1	37.6
Cities	119	32	41	26	17	2	1
Degree	41.2						
Rate	3.8						
1970							
Population	23,828	707	1,950	1,510	7,284	732	11,645
%	100.0	3.0	8.2	6.3	30.5	3.1	48.9
Cities	166	41	65	21	35	1	3
Degree	49.4						
Rate	1.8						
1980							
Population	37,584	1,010	2,876	1,633	10,230	2,553	19,282
%	100.0	2.7	7.7	4.3	27.2	6.8	51.3
Cities	229	59	94	24	44	4	4
Degree	56.2						
Rate	1.3						
1990							
Population	49,435	1,386	3,937	2,800	11,456	7,521	22,335
%	100.0	2.8	8.0	5.7	23.2	15.2	45.1
Cities	309	78	132	39	45	11	4
Degree	60.8						
Rate	0.8						

Source: 1900 to 1950 from, Unikel, Ruiz, Garza, EL DESARROLLO URBANO DE MEXICO, El Colegio de México, 1976: 30-31; 1960 to 1980 from, G. Garza, V. Partida, "Hacia la superconcentración espacial", en DEMOS, CARTA SOBRE MEXICO, UNAM, 1988:12. For 1990, INEGI, CENSO GENERAL DE POBLACION Y VIVIENDA (Integración territorial), 1991.

a The urban population is in thousands inhabitants; The Degree of urbanization is the percentage of urban to total population; The rate of urbanization is the mean annual increase in the degree of urbanization. Human Settlements with a population of over 15 thousand are defined as cities.

TABLE 2
Mexico City:Population distribution in basic territorial units, 1900 - 1990

Territorial	1900	1910	1921	1930	1940	1950	1960	1970	1980	1990
a. Central City	344,721	471,066	615,367	1,029,068	1,448,422	2,249,221	2,829,756	3,002,984	2,686,499	1,935,708
b. Federal District	541,516	729,753	903,063	1,220,576	1,757,530	2,329,840	5,178,123	7,327,424	9,165,136	8,261,951
c. Mexico City Urban Area	344,721	421,066	615,367	1,049,000	1,560,000	2,872,000	4,910,000	8,355,000	14,274,746	14,840,831
d. Mexico City Metropolitan Area	—	—	—	—	1,644,821	3,135,673	5,381,153	9,210,853	14,419,454	14,991,281
e. (a)/(d) (%)	—	—	—	—	80.35	71.73	52.59	32.60	18.63	12.71
f. (b)/(d) (%)	—	—	—	—	106.84	103.32	96.23	79.55	63.56	54.65
g. (e)/(d) (%)	—	—	—	—	86.54	91.59	91.24	90.71	99.00	99.00
h. (a)/(b) (%)	63.66	65.36	73.03	83.69	82.39	69 42	54.65	40.98	29.31	23.25
I. (a)/(c) (%)	100.00	100.00	100.00	98.00	92.82	78.32	57.63	35.94	18.82	12.84

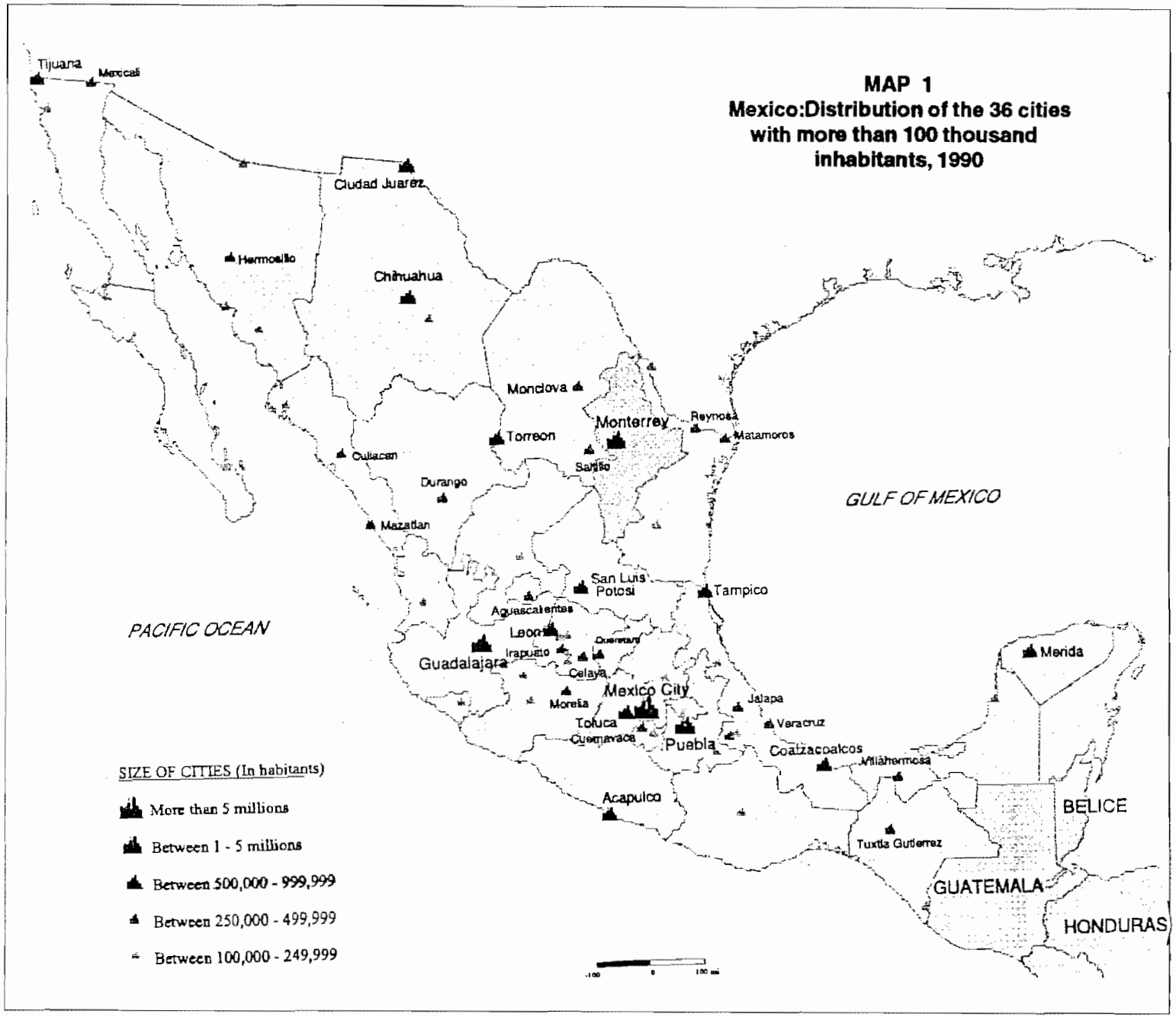
Source: María Eugenia Negrete and Héctor Salazar, "Dinámica de crecimiento de la población de la ciudad de México: 1900-1980", In G. Garza, ET. AL. (Eds), ATLAS DE LA CIUDAD DE MEXICO, Departamento del Distrito Federal y El Colegio de México, México, D.F., 1987: 126.

TABLE 3
Monterrey: Demographic gorwth of the metropolitan municipalities, 1940 - 1990
(Thousands inhabitants)

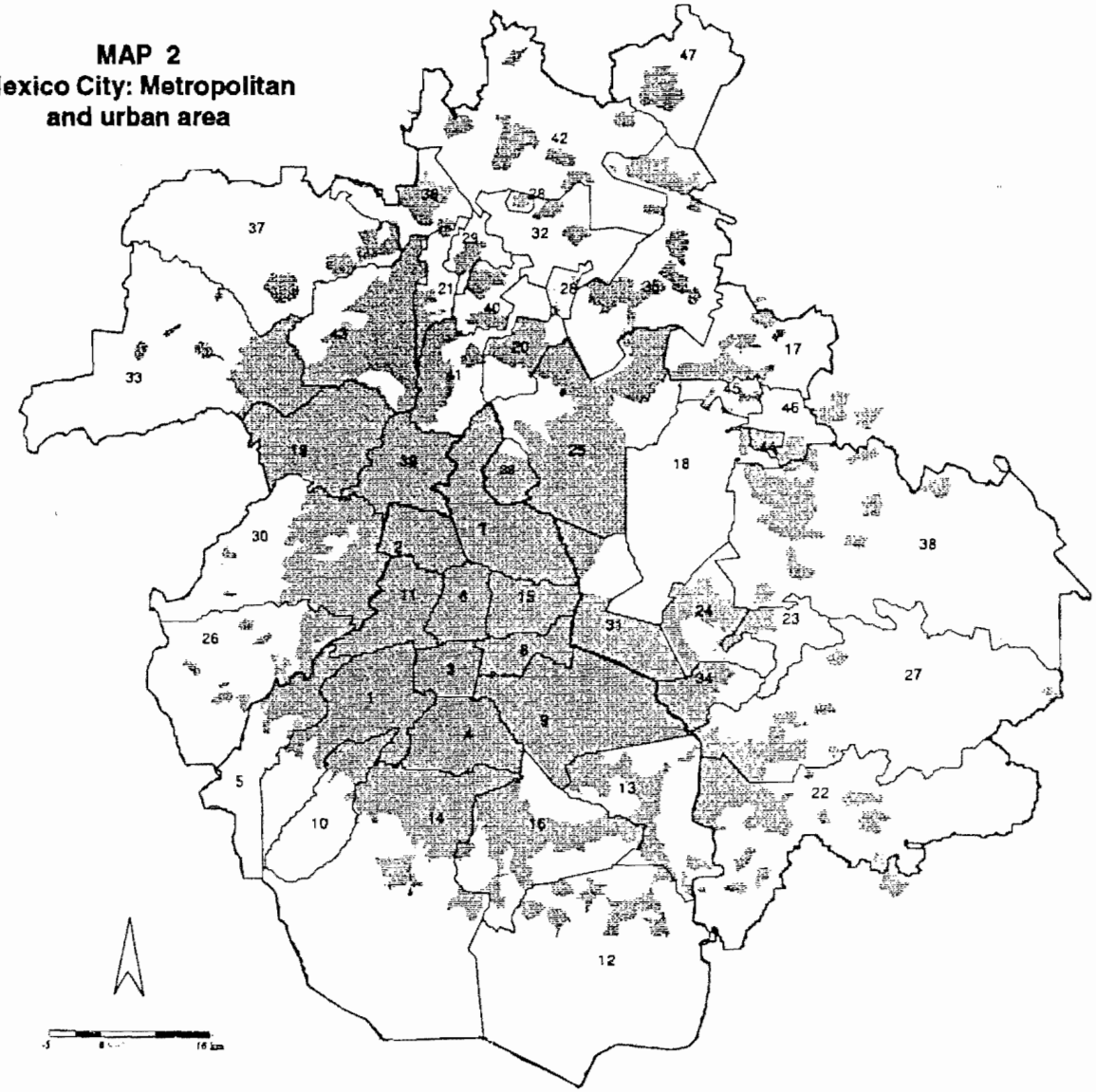
Municipalities	1940	1950	1960	1970	1980	1990
Metropolitan Zone	206.2	375.0	708 3	1,261.0	2,001.5	2,573.5
Monterrey	190.1	339.3	601.1	871.5	1,090.0	1,069 2
Guadalupe	4.4	12.6	38.2	170.2	370.9	535.6
San Nicolás	4.1	10.5	41.2	118.1	280.7	436.6
Garza García	2.8	5.2	14.9	48.3	82.0	113.0
Santa Catarina	4 8	7.4	12.9	38.1	89.5	163.9
Apodaca				18.6	37.1	115.9
General Escobedo				10.5	37.8	98.2
Juárez				5.7	13.5	28.0
García					10.4	13.1
			(Annual rate of growth)			
Metropolitan Zone	6.2	6.6	6.1	4 6	2.5	
Monterrey	6.0	5 9	3.8	2.2	-0.2	
Guadalupe	11.1	11.7	16.1	8.1	3.7	
San Nicolás	9.8	14.6	11.1	9.0	4 5	
Garza García		11.1	12.5	5.4	3.2	
Santa Catarina			11.4	8.9	6.2	
Apodaca				7.1	12.1	
General Escobedo				13.7	10.0	
Juárez					7.6	
García					2.3	

Fuente: 1940 to 1990 from Unikel, Ruiz y Garza, El desarrollo Urbano de México, El Colegio de México, 1976: cuadro IV-2; 1980 from M. E. Negrete and H. Salazar, "Zonas metropolitanas en México, 1980", ESTUDIOS DEMOGRAFICOS Y URBANOS, El Colegio de México, Vol. 1, Núm. 1, january-april, 1986: cuadro 1-A; 1990 from XI CENSO GENE DE POBLACION Y VIVIENDA, Mexico, 1991.

The downwards line pointed out the municipalities that since 1950 constituted the Metropolitan Area of Monterrey, which are 8 municipalities in 1980 and 9 in 1990 with the incorporation of García.

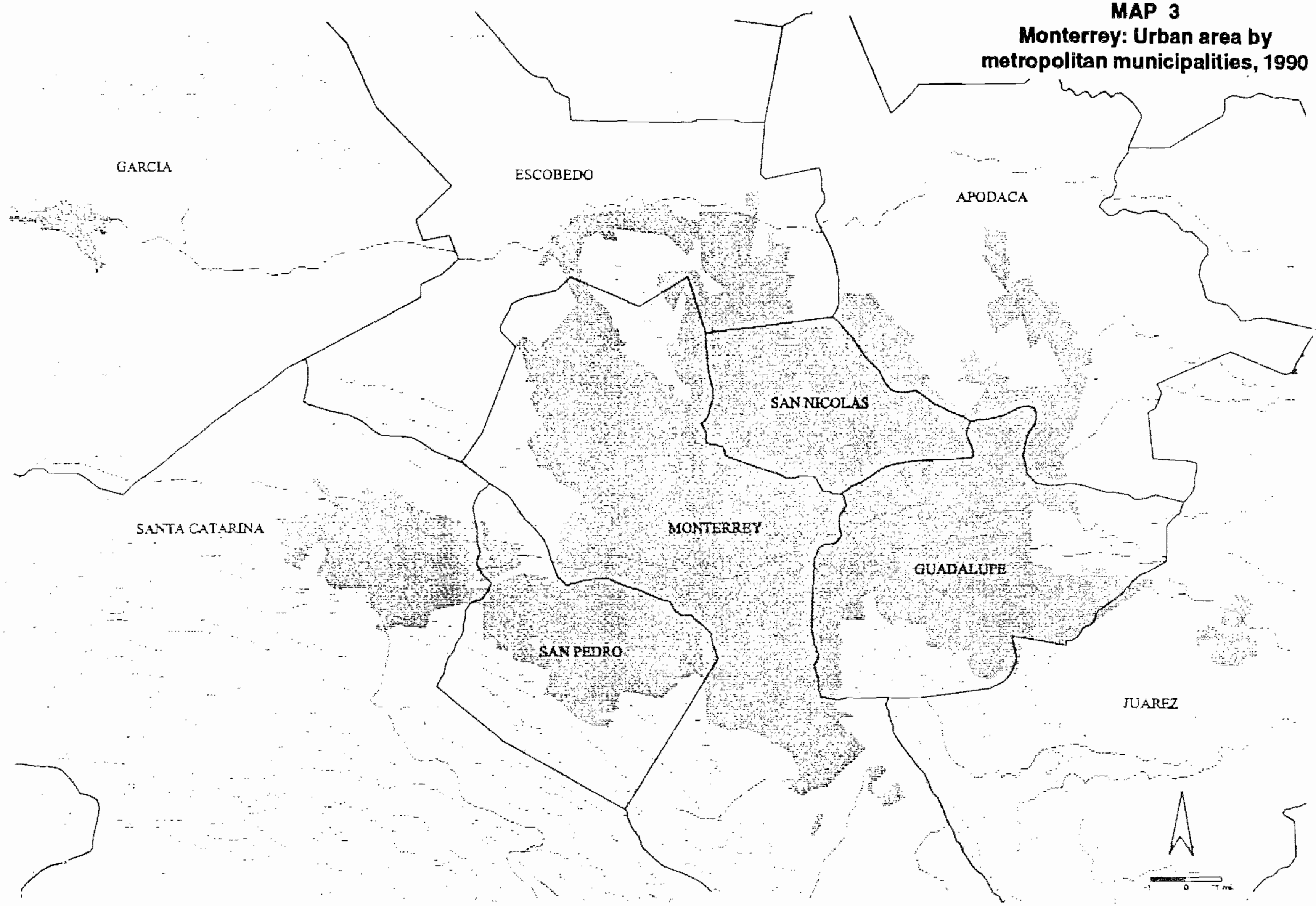

MAP 1
Mexico:Distribution of the 36 cities with more than 100 thousand inhabitants, 1990
Tijuana
Mexicali
Ciudad Juarez
Hermosillo
Chihuahua
Monclova
Monterrey
Reynosa
Matamoros
Torreon
Saltillo
Culiacan
Durango
Mazatlan
GULF OF MEXICO
PACIFIC OCEAN
San Luis Potosi
Tampico
Aguascalientes
Leon
Irapuato
Queretaro
Guadalajara
Celaya
Mexico City
Moreila
Jalapa
Veracruz
Toluca
Cuernavaca
Puebla
Coatzacoalcos
Villahermosa
Merida
Acapulco
BELICE
Tuxtla Gutierrez
GUATEMALA
HONDURAS
SIZE OF CITIES (In habitants)
More than 5 millions
Between 1 - 5 millions
Between 500,000 - 999,999
Between 250,000 - 499,999
Between 100,000 - 249,999

MAP 2
Mexico City: Metropolitan and urban area



DISTRITO FEDERAL		BORDER MUNICIPALITIES	
1	Alvaro Obregón	17	Acolman
2	Azcapotzalco	18	Atenco
3	Benito Juárez	19	Atizapán de Zaragoza
4	Coyoacán	20	Coacalco
5	Cuajimalpa	21	Cuautitlán
6	Cuauhtemoc	22	Chalco
7	G.A.Madero	23	Chicoloapan
8	Iztacalco	24	Chimalhuacán
9	Iztapalapa	25	Ecatepec
10	M.Contreras	26	Huixquilucan
11	Miguel Hidalgo	27	Iztapaluca
12	Milpa Alta	28	Jaltenco
13	Tláhuac	29	Melchor Ocampo
14	Tlalpan	30	Naucalpan
15	V.Carranza	31	Netzahualcoyotl
16	Xochimilco	32	Nextlalpan
		33	Nicolás Romero
		34	La Paz
		35	Tecámac
		36	Teoloyucan
		37	Tepotzotlán
		38	Texcoco
		39	Tlalnepantla
		40	Tultepec
		41	Tultitlán
		42	Zumpango
		43	Cuautitlán Izcalli
		44	Chiconcuac
		45	Tezoyuca
		46	Chiautla
		47	Tizayuca

MAP 3
Monterrey: Urban area by metropolitan municipalities, 1990



Wacah Chan: Visionary Cities Project

The use of architectural metaphor as impetus for urban design

by Jimmie L. King

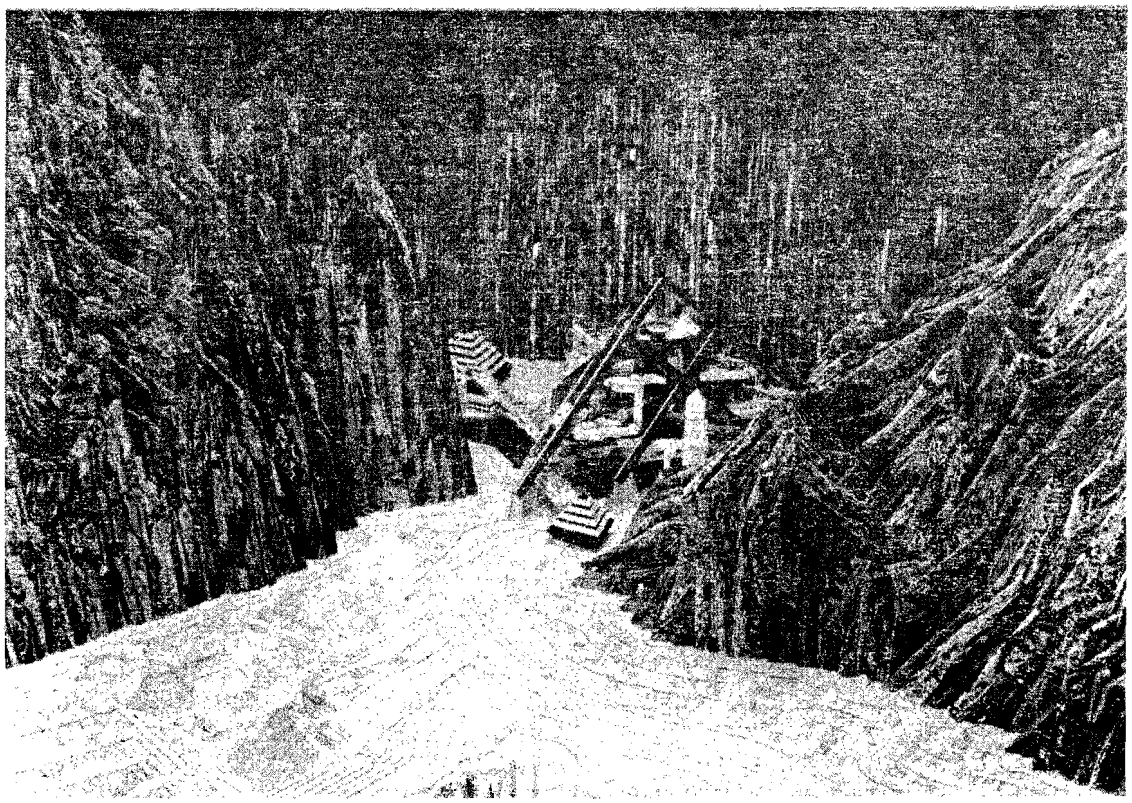
Wacah Chan (Mayan phrase meaning "world tree") is a conceptual urban design project which explores the rational basis for the city as a natural artifact of man. Wacah Chan is intended to serve as a holistic platform from which we are free to "brainstorm" alternative solutions to urban problems in an open ended fashion without limits or constraints.

Using design metaphors which were derived from a study of the physical and spiritual essence of the ancient Maya cities, an empirical model was developed. This model focused upon the question, "what characteristics might a hypothetical Maya city of the future possess?" From this alternative perspective, we are free to ponder the parallel realities of our contemporary urban centers of today and pursue the question, what is possible for the future?

I. The city as an artifact

The progenation of the city as an artifact of man dates from the end of the Ice Age, some 10,000 years ago when small farming villages sprang up in western Asia.[1] Some of these communities eventually evolved into major population centers such as **Jerico** (Israel - 8,000 BC), possibly the oldest city in the world, **Tell Abu Hureyra** (7500 BC - Syria), and **Mehrgarh** (6,000 BC - Pakistan).[2]

Most theories which attempt to explain the developmental history of the city focus upon man's basic survival needs: protection from outside intruders, the construction of dwellings and the production of food stuffs. However, once these primal needs were met many civilizations began searching for spirituality and the realization of that search within the cosmic universe. In any eventuality the city became a social and physical expression of the need and desire to integrate and become part of a larger collective body. The concept of human culture and organized society is so inextricably inter-woven with the metamorphosis of the city that it becomes impossible to discuss one without the other. As a result, perhaps more than any other single artifact, the city has facilitated the advancement of our civilization, ever accommodating and nurturing the spirit of man. In order for this phenomenon to occur, the city has been required to do much more than simply provide shelter



Wacah Chan model with the ancient city looking upon the new.

and meet utilitarian needs. It has, moreover, acted as a dynamic social organism which responds to the collective needs and dreams of its inhabitants.

The city as an institution has survived many epochs and trials yet the city as an individual entity does not possess this same quality of timelessness. Many of the ancient cities functioned for 2,000 years or more. At some point in time all of these cities eventually died and decayed when, for whatever reason, they failed to serve the needs of urbanized man.

Since the Industrial Revolution an ever increasing percentage of the worlds population has moved to large urban centers. At present, greater Tokyo and Mexico City each have a population of some 20 million. The Greater New York City area is not far behind[3] . With this trend toward urbanization virtually every urban complex of this century has experienced problems with regards to social, political, eco-nomic, and environmental issues. The seriousness of these issues have, to varying degrees, compro-mised the cities ability to humanistically serve its inhabitants.

Perhaps the contemporary city is at a crossroad or perhaps we are merely repeating developmental cycles which have reoccurred in slightly different forms throughout several millennia. In either case a study of the city as an artifact can provide a more clear insight into the urban complex of today and the 21st century.

II. Project introduction

Wacah Chan is a conceptual urban design

project which is designed to explore the rational basis for the city as a natural artifact of man. *Wacah Chan* is intended to serve as a holistic platform from which we are free to "brainstorm" alternative solutions to urban problems in a conceptual, open ended fashion without limits or constraints. *Wacah Chan* is offered with the belief that the urban landscape can once again become a city of and for man.

Through the use of metaphor as a design methodology we may, from an alternative perspective, ponder the parallel realities of our contemporary urban centers of today and hopefully pursue an eternal question, what is possible for the future?

In order to accomplish this goal the project first looked to the past in order to see the future. As such, we specifically examined the physical and metaphysical essence of the ancient Maya cities. Based upon this historical/qualitative research, a set of design metaphors were established as a conceptual framework, about which an empirical model was developed. This model focused upon the question, "what characteristics might a hypothetical Maya city of the future possess?" The Maya culture was selected for the study due to certain unique urban and social factors: (1) Sufficient knowledge exists concerning the architectonic and developmental patterns of their cities, (2) the cities were exclusively pedestrian, (3) the Maya were faced with urban problems that are contextually similar to those of contemporary times and (4) a mystery exists as to why the Maya people abandoned their cities, allowing the once great civilization to fade into the obscurity of the jungle.

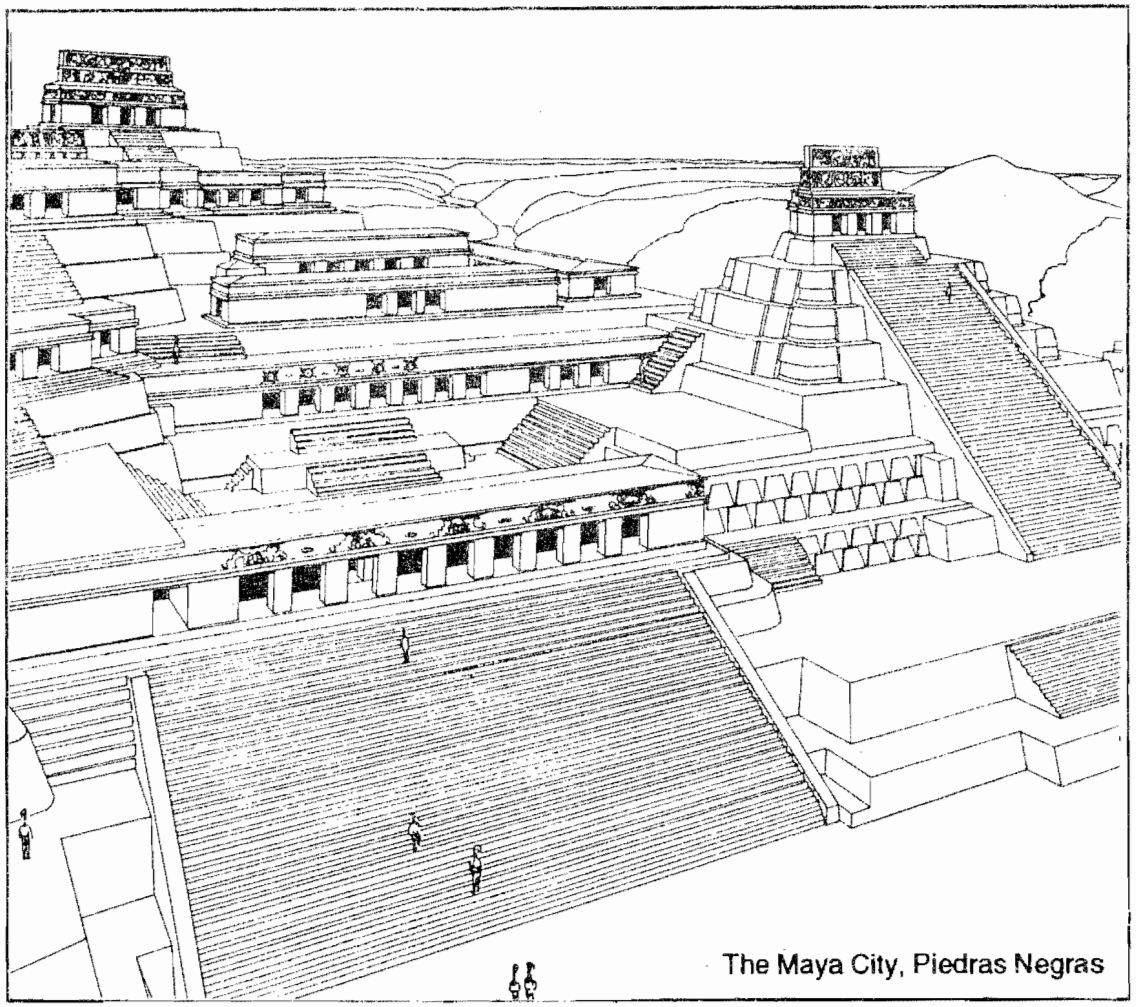
III. A look back to see ahead

The Olmec civilization which flourished along Mexico's Gulf Coast between 1,200 and 400 BC was the mother culture of Meso-america, giving birth to the Maya, Toltecs, and Aztecs.

While the ancient civilizations of Mesoamerica were not faced with the problems of traffic congestion and fluctuating mort-gage rates they were concerned with urban developmental problems associated with a rapidly expanding infrastructure, political and religious strife, ecology, and the environment. It is important to consider that the Mesoamerica cultures produced such great cities such as Tenochtitlan, Cholula, Cempoala, Tikal, Copan, and Dzibilchaltun. These urban complex-es were perhaps the largest cities in the world at the time, serving hundreds of thousands of people for more than 2,500 years[4]. However, except for the Aztecs, all of these cities and organized civilizations vanished prior the Spanish conquest of the Yucatan in 1519, leaving only building ruins and symbolic pictographs as mysterious testimony to their existence and achievements. Historians and archaeologists have posed a series of possible explanations for the demise of the civilization Including:

A. Political strife and civil war. A sharply defined social order existed where the priests and a selected few were the absolute holders of written knowledge, power and wealth.

B. Plague. Perhaps the cities became too large and the infra-structure was



The Maya City, Piedras Negras

insufficient to accommodate health requirements.

C. Environmental practices which resulted in massive erosion of the land, flooding, and failing crops.

IV. The mythology of place

Wacah Chan is the Mayan phrase which means the **"world tree"** or **"raised up sky."** The world tree was the central axis of the Maya universe which was comprised of three layered domains; **the heavens** or place for the gods, **the middleworld** of earth which was meant to bear fruit by the blood of human sacrifice, and the dark waters of **the underworld** below. This central axis ran through the center of existence and was not located in any one place, but rather could be fixed at any place in the natural or man-made environment through ritual ceremony. *Wacah Chan* thus becomes the linkage between the natural and supernatural worlds; places in which there is no distinction between animate and inanimate objects since for the Maya, the world and all its contents was alive and embodied with sacred qualities.

The Maya conceived the middleworld of man as a region floating in a

primordial sea with the four cardinal directions being used to establishing an axial grid formation for the layout of the Maya commun-ity. The principal axis of the middle-world and heavens was represented by the path of the sun as it eternally traversed the sky from east to west.

V. The project site

The site for the *Wacah Chan* project is a fictional place which was inspired by the power and majesty of the *Sierra Madre* mountains of Mexico. As the vertical plates of the mountains stretch from the ground plane to the heavens above, they create a dramatic sensation of penetration and volumetric tension and shear with the narrow, flat terrain of the canyon floor (membrane) maintaining a delicate topographic balance.

The new city establishes an axial linkage to the primary temples of the ancient city, but in response to a spiritual awakening on the part of the urban designers, the structure stretches upon the basin of the canyon, transcending the element of time and scale. A pyramid is juxtaposed within the aperture of the three mountains, embracing mother earth, seeking an implied base. Yet, physical contact with the soil is minimized in order to lessen the impact upon the fragile dessert ecology.

This naturalistic approach to urban design and site planning reflects man's broader understand-ing of the harmonic balance between man and nature. As the landscape architect, Dan Kiley said, "Man is nature, therefore, everything he produces is natural(istic)." The cities which will serve future generations must reflect this philosophy if they are to overcome the chaos and uncertainty of todays urban environment.

VI. Design ideology

The "mythology of place" coupled with a design ideology utilized by the ancient Maya established a tapestry which behaved as metaphors which interweaving themselves and forming the philo-sophical and generative essence of the Wacah Chan project. The fibers of this fabric include:

1. **Layering:** Increments of time and shifting plates that become transparent for a period and later re-emerge.

2. **Life cycle**: Everything is cyclical. People are ephemeral.

3. **Ceremonial Center**: Larger than life the focal point around which other temples, buildings, and dwellings were built.

4. **God - Nature - Man**: Searching for God and questioning the spiritual and physical struggle between man an nature. Searching for purpose and one's place.

5. **The plaza as a people place:** A place for gathering and social exchange.

6. **A pedestrian city**. The Maya did not use carts or animals.

7. **The transcendence of time and scale.**

Through the use of progressive realization the terrain reveals the city as a successive series of visual fields.

VII. Architectonic forms. Science fiction or plausible alternatives for the future

Wacah Chan is a vertical city with a population capacity of approximately 50,000 persons. The urban field is composed of a ground plan and three separate, but inter-connected community levels (platforms) which are linked about a central axis. The platforms are contained within an open, three sided, pyramidal space frame. A brief description of the design components and features include:

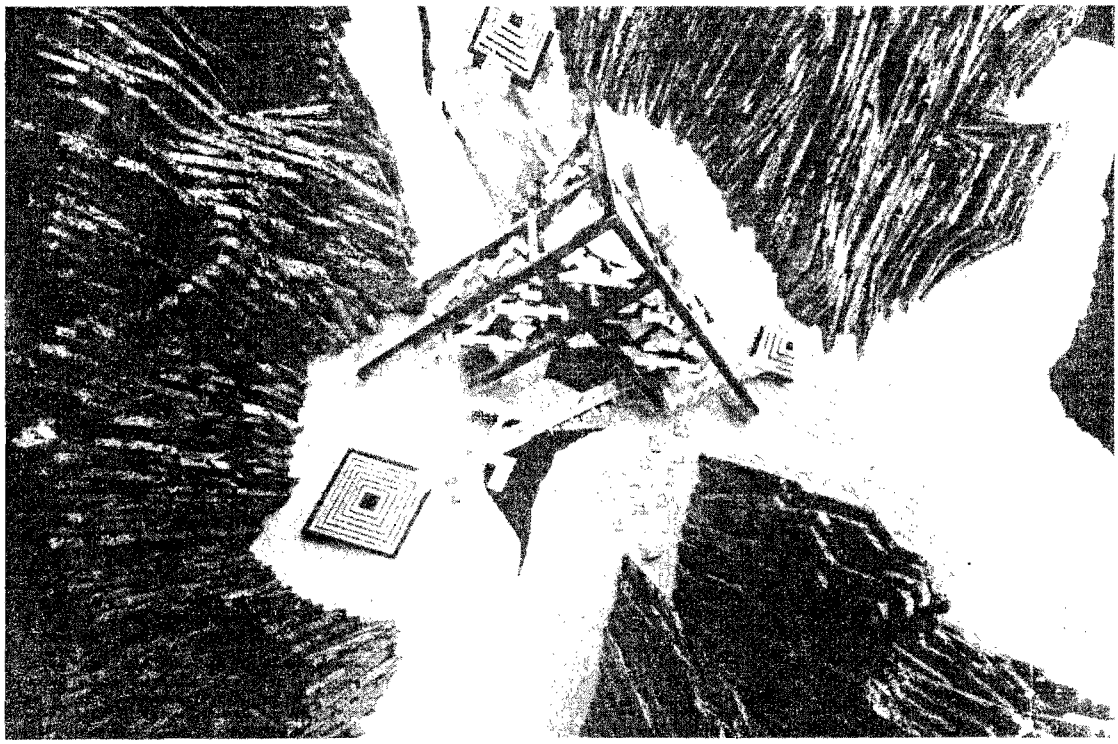
• The open sided structure allows for the free movement of air, thus capturing the cool mountain breezes which pass through the canyon. Panoramic fields of vision are also left unobstructed.

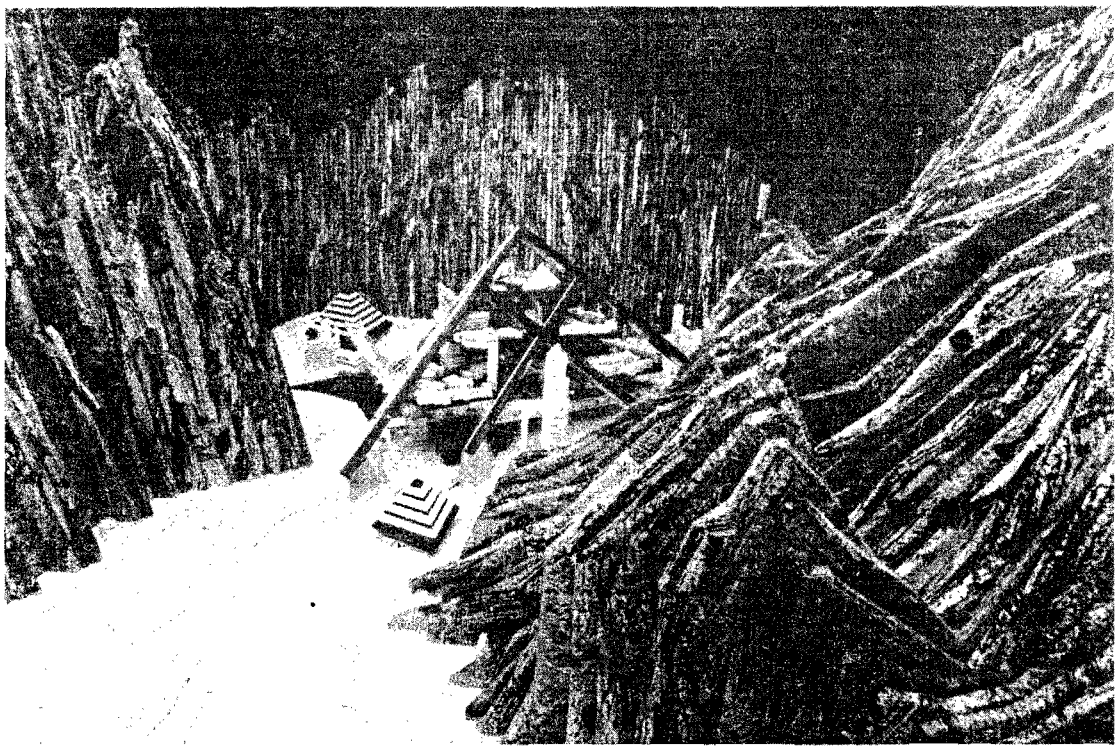
• Because of the vertical arrangement of the community levels, greater densities can be accomplished while at the same time the walking radius is sufficiently short to make it a pedestrian space. Electric powered horizontal and vertical conveyance networks assist the physically challenged, as well as, they who either want to get from one point or one level to another faster than can be accomplished by walking.

• Most zones within the lower platforms receive natural light from the sun, but it becomes necessary to refract sunlight to the more central spaces. This refraction of light is accomplished through the use of quartz plates which are placed in the ceilings overhead. However, due to the arid, solar intense nature of the site, filtered sunlight can be viewed as an advantage.

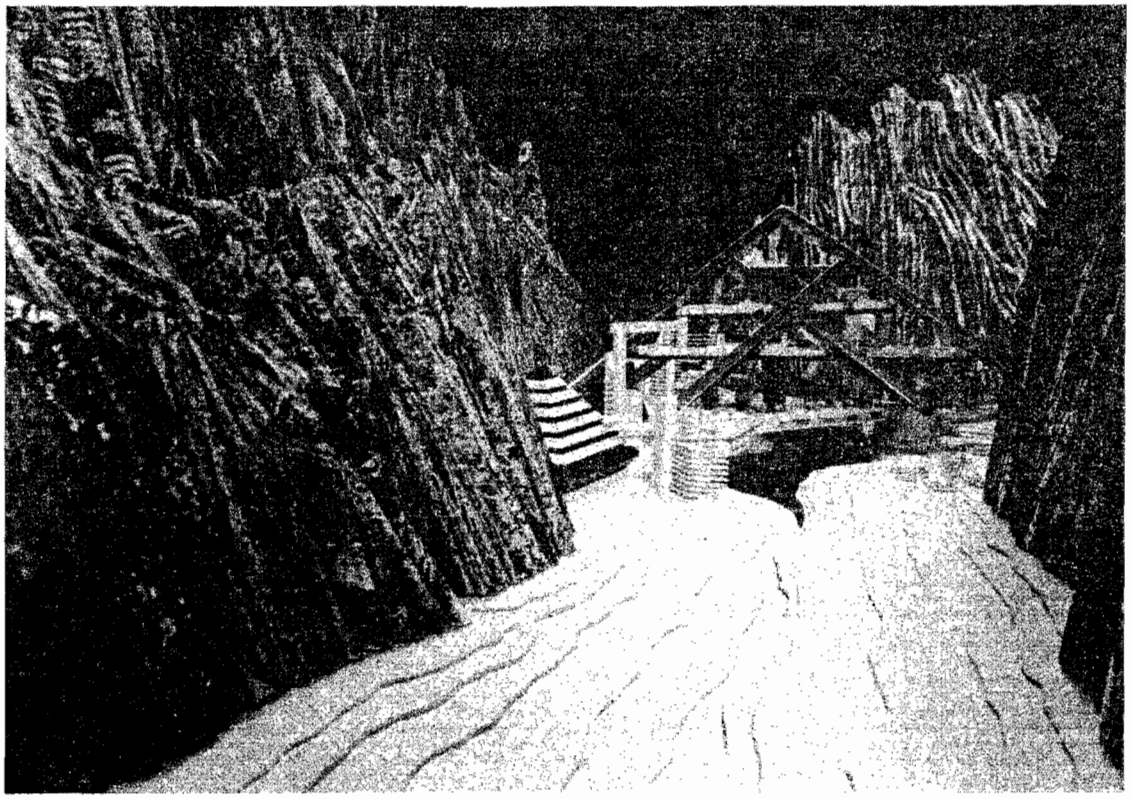
• Power for the city is accom-plished through an integrated network of hydroelectric, solar and wind powered energy sources.

• The lower platforms are self sufficient communities which are mixed-use developments. People live, work, and play within their community. In many cases the people actually work from an office or studio in the home. Government and other public buildings are minimal in number. Libraries and private concerts are electronically available in each home. Plazas are found within each cluster of buildings so as to provide a place for social and cultural gatherings. The upper platform is relegated solely for the purpose of spiritual reflection. This level provides a place to think and to contemplate or to simply look upon the ancient city and the





Top: Plan view.
Bottom: View from the principal gateway to the city.



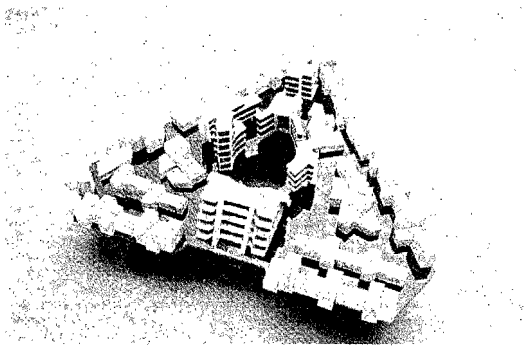
Δ An elevational view of the city looking down one of the three canyons. A lake is shown below the pyramid from which fresh water reserves are drawn.

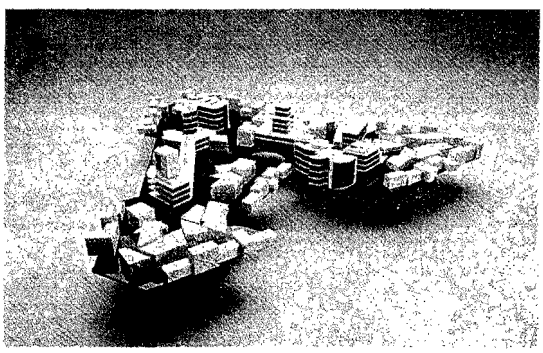
mountains.

• Industrial spaces are contained within underground chambers beneath the city.

• The Mayanic geometric form of the buildings, themselves, are comprised of a series of plates which unfold continuously through acreation. This revolution establishes a continuous interplay between negative (building mass) and positive forms (open spaces). The volumetric forms are intended to envelop and involve the urban participant completely in their spatial animation. As the person moves through the space, there is a continuity of perceptual experience. Simultaneously, variety in the theme, direction of visual movement, and volumetric divergence allows for a more diverse spatial composition and experience.

Elevated view showing the community structures near the ground plane and the individual platforms framed within the pyramid.





Volumetric Models of Platforms two and and three.

VIII. Closure

The ancient Maya believed that the city was a living entity. Though valid for different reasons, this urban concept of existence is equally true today, but only when the city is imbued with the spirit and vitality of the people who inhabit it. A city is a complex social, economic, and political organism that is comprised of many layers and parts. The city is constantly searching for order and unity, yet there are invariably communities and sectors within most cities which have become unnatural and even life threatening habitats. Rather than nurturing man they have come to insulate people from one another, making it possible for one to feel alone and isolated within a city of several million, thus the sense of community is lost. Without the social and cultural linkages that can be facilitated by the city no sense of cohesion is possible, creating an untenable quality of life within the urban areas. Cities possessing this linkage have flourished and have done so through a recognition of this facet.

We must reunify the city propelling it toward the achieve-ment of a more egalitarian and humanistic environment. We can achieve this end through a re-evaluation of urban growth trends and the establishment of new patterns within the urban field. Patterns which challenge the interplay between established spatial, social, and cultural boundaries. Patterns which refresh and stimulate the human spirit.

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