STRUCTURE AND ECONOMIC DYNAMICS IN THE INVESTIGATION OF THE REGIONAL CYCLES: PROPOSAL FOR NEW INDEXES IN THE TRADITION OF MITCHELL CLASSICAL APPROACH

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ABSTRACT

The relationship between structure and economic cycles, not on the agenda of regional science, as evidenced by the statement that its disciplinary fields respond to two questions why companies are in a place and not another? and what are the reasons and sources of regional growth? So absent the issue of why regional recessions occur? Mitchell's contribution here is crucial because it defines the economic cycle as a multidimensional phenomenon, so that we can use the concept of diffusion of recessions in the sectorial and regional level and to define new indexes as synchronic and diachronic diffusion indexes and similarity index. The proposed indexes represent an original contribution to regional literature, in which the cyclical dimension of economic phenomena has been neglected.
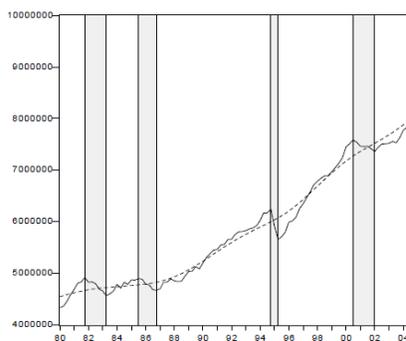
Key words: regional economics, regional business cycles, Mitchel business cycle classical approach

INTRODUCTION

In Figure 1, we see a rising trajectory or trend (dotted line), with their business cycles and their recessions (shaded area).

Figure 1

Mexico, seasonally adjusted GDP and its trend million pesos in 2003

Source: author with data from INEGI

What determines the observed motion into its component parts the trend and cycle, at both national and regional level?

Later it will be Harrod (1939) which summarize the structure-growth link, by an equation in which the

The answer given by the theory can be summed up in "rocking horse" metaphor of Frisch (1933), this indicate that the observed motion can be represented by a simile in which *impulse mechanism* (hammer force) that brings an economy of balance (horse rocker) or *propagation mechanism*, let us sense that given a boost the economy will move describing a path that is the result of the magnitude of the *impulse mechanism* and how the *propagation mechanism* works

On the other hand Samuelson (1939) created by the multiplier-accelerator model an adequate representation of what Frish explained with a metaphor. Thus the structural features of an economy: the propensity to consume and the accelerator, in the presence of different values of the exogenous variables of the model generate a variety of paths: cyclical explosive, damped cyclical, explosive growth and dampened growth.

The link is established between structure, growth and cycles, which is fundamental to imagine the macroeconomic dynamics at national and regional level, object of this paper.

GDP growth rate is predicted by the value of structural parameters of the economy as the savings rate, the

depreciation of capital and the capital product ratio. While years later Thirlwall (1979) would devise a way to incorporate the role of external demand represented by the rate of growth in the rest of the world with effects would be modulated by the elasticity of export demand and the elasticity of demand for imports.

Is there also present the idea that the whole structure: the value of the parameters included in the growth equation of the authors mentioned, would determine the rate of long-term growth of the economy.

But how do you think the relationship structure, growth and cycles in the regional field? Here the contribution of Burns and Mitchell (1946) is fundamental, because they defined business cycles as a simultaneous movement of expansion and recession of a wide range of economic variables. It is therefore possible to distinguish between productive sectors by the depth and duration of recessions in successive cycles. As regional economies can be differentiated by the relative weight of their productive sectors, is expected to be more severe recessions in the regions where predominate national productive sectors showed the most profound and lasting recession. Here again the idea that the structure determine the dynamics of the business cycles.

The paper is then organized around the question ¿What determines the observed motion into its component parts the trend and cycle? The answer given by the theory can be summed up in metaphors like Frish, economic models such as Samuelson, Harrod, Thirlwall and the Mitchell business cycle classical approach. Matters are treated in separate sections and in the conclusions are highlighted our original contribution of new indices in the tradition of Mitchell, useful for the regional analysis of business cycles.

THE ROCKING HORSE METHAPHOR

Was Frish (1933)[1] who established two problems on the relationship between structure and dynamic:

- The problem of the *propagation mechanism* or the internal relations among the variables when the system is in equilibrium.

- The problem of *impulse mechanism* that breaks the balance and move in a cyclic path which is amplified by the nature of the relations chosen as representative of inner working of the economic system, or *propagation mechanism*.

That is, according to the shape and length of rocking horse (*propagation mechanism*) and strength, sequence or timing of the *impulse mechanism* (type of hammer hitting the economy). Will describe a sequence of movements is the mechanical analogy of the cyclical movement of the economy.

What can sense that given a boost the economy will move describing a path that is the result of the magnitude of the *impulse mechanism* and how the *propagation mechanism* work.

Is now linked to the structural (or permanent) that goes into motion (economic dynamics), where an exogenous force out of balance the economic system.

THE MULTIPLIER-ACCELERATOR MODEL

Samuelson (1939), created by the multiplier-accelerator model an adequate representation of what Frisch had explained with a metaphor.

This model describe the structural features of an economy by the propensity to consume and the accelerator, and in the presence of different values of exogenous variables, the solved solution of model generate a variety of paths: cyclical explosive, damped cyclical, explosive growth and dampened growth.

As will be seen, the cyclic paths depend crucially:

- The field of values taken by parameters

- The temporary delays of the relationship between the variables over the time.

Below in Table 1 shows the equations that explain the consumption and investment in the model and the form it takes its reduced equation, in which the level of activity is based on the levels of previous periods, specified by an equation differences whose roots in solution and / or amplitude of time delays define the character of the cyclic path that the model shown in each of the cases identified.

Table 1

1 In Jarsulic (1993)) a discussion of the contribution of Frish. There also notes the importance of Slutsky (1927) who used the random numbers generated by the Russian lottery to produce time series, then with the data constructed several moving averages, and graphing showed its similarity to the cyclical economic series, this involved that any economic variable can be explained by a linear equation in differential form: $X_t = X_{t-1} + e_t$, where e_t is a serially uncorrelated random variable. (Jarsulic, 1993:347).

Multiplier-accelerator model of business cycle

Ecuations	
Identity	$Y_t = C_t + I_t + G_t$
Consumption	
Investment	$I_t = v (C_t - C_{t-1})$
Reduced equation	$Y_t = (b + bv) Y_{t-1} - bv Y_{t-2}$ $+ G_t$
	Ro

ots and trajectories

|	
Monotonic convergent	Región A
Damped cyclical	Región B
Cyclical explosive	Región C
Monotonic explosive	Región D

Source: Samuelson (1939)

So if that solves numerically the Samuelson model, assuming the level of activity figures for the first two periods, and taking values of the parameters "v " (accelerator) and "b " (propensity to consume or multiplier) as regions A, B, C, D of the model[2], the simulation is described in Figure 2, which illustrates what Samuelson speculated about the kind of cyclical paths possible given the combinations of values of "v" and "b "

Figure 2
Multiplier accelerator model of Samuelson
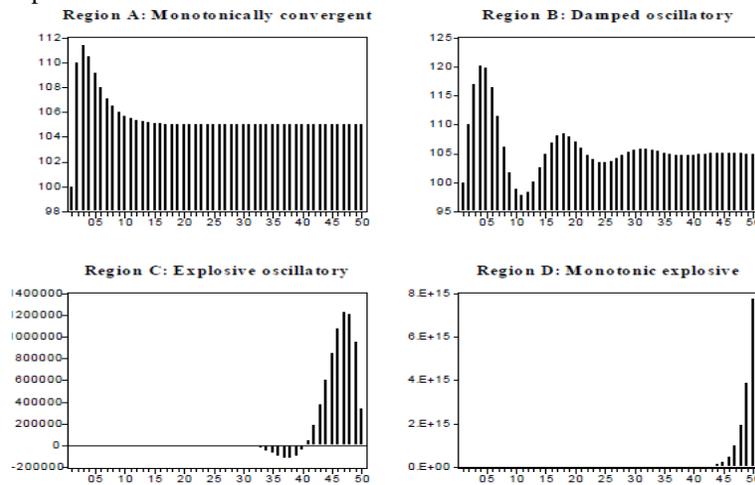
Source: Author

2 With a propensity to consume b = 0.8, for all cases and accelerator values (v) of 0.3, 1, 2 and 3 respectively.

But he notes that none of the cases presented, it seems an adequate approximation of observed cyclic path of the economy because it tends not to stagnation (monotonic convergent path), and fluctuates in a buffered (damped oscillatory path), nor does it an explosively (explosive oscillatory path), or grow exponentially (monotonic explosive path).

Hence, in cycle models had to be made ad hoc considerations to improve their quality approximate to reality. Then dismissed convergent monotonic as exponential growth cases, because the former is not compatible with the growth trend of the capitalist economy and the second because this case more appropriately to the conditions for economic growth.

Thus some theorists as Kalecki (1935).chose the case of damped oscillatory motion, which however, tends to long-term stability which does not correspond to the cyclical dynamics observed in reality, what they considered necessary to add the presence of a mechanism for periodic or random impulse move the economy to trend total damping
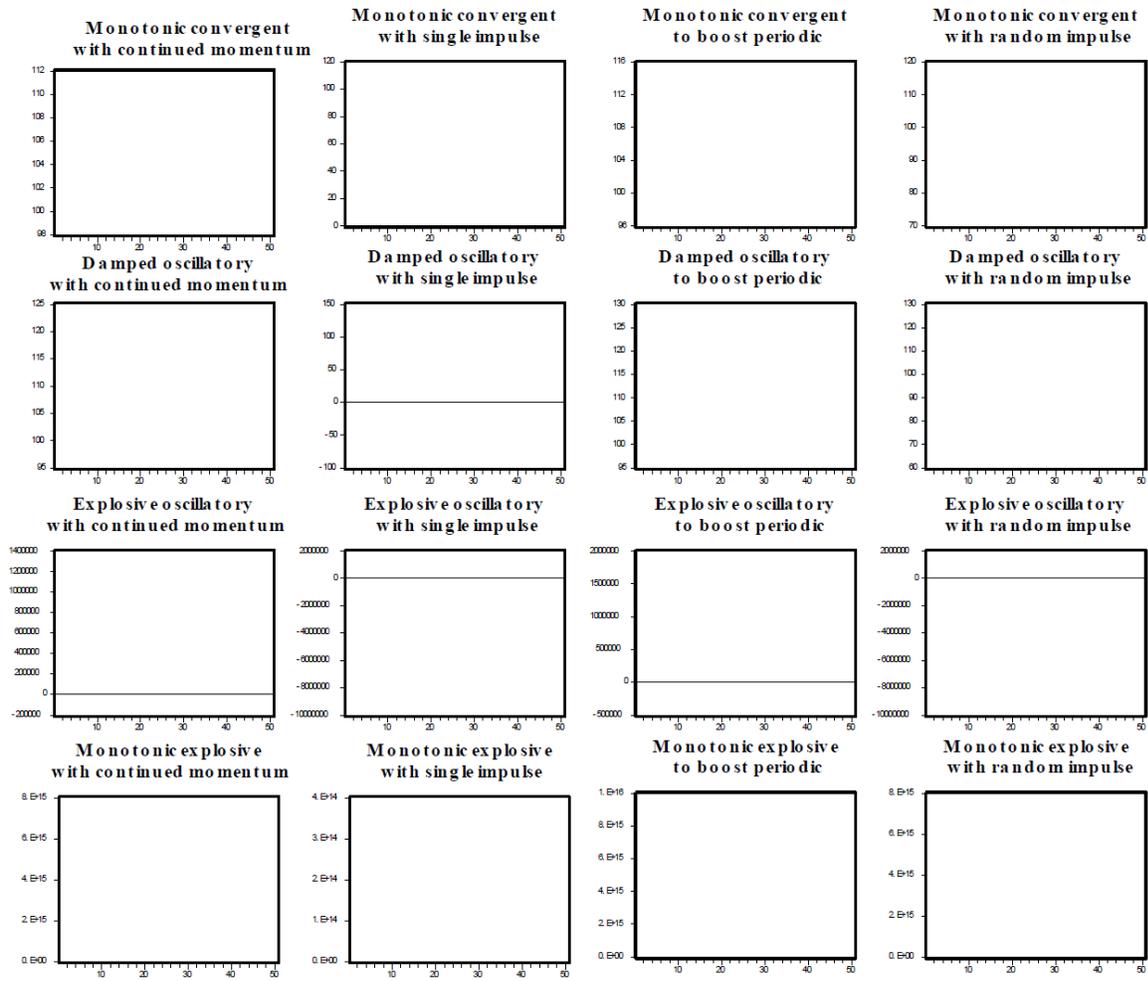
The above solution is not satisfactory, as observed Hicks (1950) - because it is incompatible with the reality of the economy's trend growth, in which case the explosive oscillatory solution is adequate, but given the presence of "floors" (minimum requirements defined by the replacement of physical capital in the economy), and "ceiling" (the latest resource constraints of labor and / or capital given the maximum population growth and general availability of resources)

To understand aspects of the debate is useful to work more Samuelson model simulation, but this time by subjecting it to different exogenous impulses. As one of the changes in the perspective of the modeling cycle from those years was the importance given to the type of exogenous boost the economy required to generate a cyclical pattern.

So considering the Samuelson model four types of impulses: permanent, unique, serially correlated, and random, it is in Figure 3, which allows consider the following:

Figure 3
Multiplier accelerator model of Samuelson expanded

Monotonic convergent with continued momentum	Monotonic convergent with single impulse	Monotonic convergent to boost periodic	Monotonic convergent with random impulse
Damped oscillatory with continued momentum	Damped oscillatory with single impulse	Damped oscillatory to boost periodic	Damped oscillatory with random impulse
Explosive oscillatory with continued momentum	Explosive oscillatory with single impulse	Explosive oscillatory to boost periodic	Explosive oscillatory with random impulse
Monotonic explosive with continued momentum	Monotonic explosive with single impulse	Monotonic explosive to boost periodic	Monotonic explosive with random impulse

Source: Author

- If you want to intuitively choose the cases that best represent the cyclical behavior of real economy, is better the case of the damped oscillations with random impulse (second row, fourth column of Figure 3), and that was the choice he made Kalecki, while Hicks chose the oscillatory explosive with "floor" and "ceilings". And those two were the most accepted forms of modeling cycles in 1950 s.

- Looking at the graphs to weigh the relative importance of the *propagation mechanism* and the *impulse mechanism* in the configuration of the cyclic path, we note that in the case of exponential growth the movement does not seem to depend on the *impulse mechanism*, this type of model is almost purely endogenous, but not generate a cyclical movement.

Remained well established in the modeling business cycle proposed by Samuelson, the link-structure, growth and cycles, which is essential for to display macroeconomic dynamics at regional level, subject of this text.

THE GROWTH MODELS

Harrod (1939) was which summarized the structure-growth link by an equation in which the GDP growth rate is predicted by the value of structural parameters of the economy as the savings rate, the capital - product ratio and depreciation rate of capital. While years later Thirlwall (1979) devised a way to incorporate the role of external demand represented by the rate of growth in the rest of the world whose effects on the growth of national economy are modulated by the elasticity of export demand and the elasticity of demand for imports.

To examine the issues raised in more detail below develops these models.

Thus Harrod asks, What is the rate of growth of gross domestic product (GDP) would ensure that the economy create a demand compatible with the respective supply? This growth rate ensures equality between supply and effective demand.

The demand equation by which the income is spent on consumption (Ct) or saved (St) is:

(1) $Yt = Ct + St$

And the supply equation in which the production is divided into consumer goods (Ct) and investment goods (It)

(2) $Yt = Ct + It$

If no problems in carrying out all the income to purchase the production, such that: (1) = (2)

$Ct + St = Ct + It$

Therefore:

(3) $St = It$ is the dynamic macroeconomic balance equation

Since the investment has two purposes: Increase the capital stock: $\Delta Kt = Kt+1 - Kt$ and replace the capital stock: $d\,Kt$, where d is the depreciation rate of capital stock. Then:

(4) $Kt+1 = Kt - dKt + It$

In economics there are two basic relationships: (5) $s = St / Yt$ which is the propensity to save (6) $v = Kt / Yt$ which is the capital-output ratio.

Substituting in (4) as (3)

(4 ') $Kt +1 = Kt - Kt + d\,St$

But according to (5) $St = s\,Yt$, and according to (6) $Kt = v\,Yt$ And substituting in (4 ') as (5) and (6):

$v\,Yt +1 = v\,Yt - d\,v\,Yt + s\,Yt$

$v\,(Yt +1 - Yt) = - d\,v\,Yt + s\,Yt$

$v\,(Yt +1 - Yt) = (s - d\,v)\,Yt$

$(Yt +1 - Yt) / Yt = (s - d\,v) / v$

$(Yt +1 - Yt) / Yt = (s/v) - d$

That is, growth rate of GDP= $(s / v) - d$, which is the Harrod growth equation.

Thirlwall for their part again worry about demand conditions and their effect on growth, but unlike the reasoning of Harrod, their questions is what is the rate of growth that is compatible with the balance of foreign trade?, a situation in which are dynamically exports equal imports.

So every year it holds that: XTOTAL= MTOTAL

What can be expressed as: (7) $PX = EP * M$

Whereas: P = Price of exports in pesos X = Volume of Exports E = Exchange rate per dollar P * = price of imports in dollars M = Volume of Imports

If we take natural logarithms to equation (1)

$\log P + \log X = \log E + \log P * + \log M$

Since the logarithm of a variable is at the limit their growth rate, and if they are expressed in lower case, equation (1) becomes:

(8) $p + x = e + p * + m$

Now you must specify the functions Export and Import levels

(9) $X = f (+ Y *, + E (P * / P))$

Whereas Y *= is world demand (10) $M = g (+ Y, - E (P * / P))$

Whereas Y = domestic demand

The growth of exports will depend on how they respond to the growth of external demand and better prices.

(11) $x = (eix) y * + (epx) (e + p * - p)$

Whereas: (eix) is the income elasticity of exports, or in which % exports grow as world demand grows by 1%. (epx) is the price elasticity of exports as % grow or exports when prices rise by 1%.

The growth of imports will depend on how they respond to the growth of domestic demand and prices. (12) $m = (eim) y + (epm) (e + p * - p)$

Whereas: (eim) is the income elasticity of imports, or grow as % imports when domestic demand grows by 1%. (epm) is price elasticity of imports or imports as% fall when prices rise by 1%.

If preserving the trade balance dynamically, then the exports and imports should grow at the same rate: $x = m$

As according to (11) and (12)

(eix) y * + (epx) (e + p * - p) = (eim) and + (epm) (e + p * - p)

Assuming that prices of exports and imports and the exchange rate have long-term growth rates, such that its movement causes: (e + p * - p) is zero.

Therefore: If (e + p * - p) = 0, then (eix) y * + (epx) (0) = (eim) y + (epm) (0) (eix) y* = (eim) y

$y = (eix / eim) y *$

So growth rate of GDP = (eix / eim) y *, which is the Thirlwall growth equation.

It is clear that growth models described, is also present the idea that the structural means the value of the parameters included in the growth equation, determines the rate of long-term growth of the economy.

THE MITCHELL BUSINESS CYCLE HYPOTHESIS

But ¿how do think the relationship structure, growth and cycles in the regional field? The need and feasibility of extending the Mitchell approach to identify and explain the regional cycles was soon raised by Vining (1946 and 1947) and later developed by Siegel (1966), Conroy (1975) and Cho and McDougall (1978) who argues that the diversification of the production structure would explain the instability in the behavior of economic activity in the states of the union, as proposed several measures of diversity. While Kort (1981) and Sherwood (1988), linking both features and includes the relative economic size of the localities under study. Wagner and Deller (1993) incorporate the above indicators of inter-regional ties and Siegel, Johnson and Alwang (1995) adds the local composition of exports as a factor of regional instability. More recently Dissart (2003) and Trendle and Shorney (2004) propose more sophisticated measures of industrial diversity, incorporating techniques of spatial econometrics, respectively, while Kuhlmann, Decker and Wohar (2008) compared the regional cycles with the coincident indicators and explain the duration of recessions using diversity indicators among other variables.

Until 2003, studies of regional cycles were based on employment figures and coincident indexes for some regions and states, but appears Crone (2003) who designs a monthly coincident index for the 50 U.S. states based on figures for nonfarm employment, hours worked in manufacturing, unemployment and real wages, which is calculated by the technique of Stock and Watson (1989), so from that year with a series long that begins in January 1979 and has enabled a study of U.S. state cycles as Owyang, Piger and Wall (2003), Crone (2006) and Novak (2008).

Another branch of this literature is investigating the linkages between regional cycles of a country with respect to a neighboring regions, this is the possibility of bi regional-cycles. So Clark and Shin (1998) review the case of the countries of the European Monetary Union; Brady and Novin (2001) for Canada and the U.S.; Molinari and Volpe (2007) for Brazil and Argentina, Phillips and Cañas (2008) for U.S. and Mexico.

However, research of the regional cycles does not take even the rightful place or in the field of economic cycles or in the field of regional studies.

Thus in a recent balance Capello (2006) notes that the science of the regional economy has two fields: the theory of the location or why companies are located in one place and not another? and the theory of regional growth or "the reasons and sources of growth." The latter in turn is subdivided into regional growth theories that explain basically the GDP growth rates, and other regional development theories dealing with tangible and intangible elements of growth and regional development.

But while the fate of national economies usually examined from the standpoint of traditional economic cycles, for which regular economic processes of expansion or growth is close to crisis and recession events, preparing a new period of expansion, or from the perspective of the growth cycle refers to the relative rise and fall relative to trend GDP. Regional cyclical phenomena within national economies have not received sufficient attention in Latin America, except in the case of Mexico in: Erquizio (2006) and Erquizio (2008) who use Mitchell approach and formulate cycles monthly indexes of several states to identify and compare; Erquizio (2010) and Erquizio (2011) proposed new indices in the tradition of Mitchell for to compare and explain the recessions of 1995, 2001 and 2009; and Mejía Reyes et al (2007) examines the cycle of the State of Mexico in the national context and the environment defined by open NAFTA with monthly data and using the growth cycle approach. Other examples are the papers prepared for Colombia, Zuccardi and Esteban (2002), and Argentina, and Di Garegnani Gresi (1999).

These authors use the vector autoregressive econometric approach and cross-correlations, respectively, to measure the associations of regional cycles and the national cycle.

This relative lack of studies of this kind is taking place despite the regional manifestations of cyclical phenomena may be different, which would add a missing dimension to the study of regional disparities. Is that even today, according to ECLAC (2010) regional analysis just about "the level and evolution of the overall disparity between the incomes and conditions of the inhabitants of different territories and the spatial concentration of economic activity and population"

To account for this, the contribution of Wesley C. Mitchell is fundamental and what is here referred to as "the hypothesis of business cycles", because they defined business cycles as a simultaneous movement of expansion and recession of a wide range of economic variables. It is therefore possible to distinguish between productive sectors by the depth and duration of recessions in successive cycles. As regional economies can be differentiated by the relative weight of their productive sectors, is expected to be more severe recessions in the regions where predominate national productive sectors showed the most profound and lasting recession. Here again the idea that the structure determine the dynamics of the business cycles.

Then the idea is developed, based on Burns and Mitchell (1946: 3) who provided the classic definition of business cycles as: "... A type of fluctuation found in aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions. contractions and revival that which merge into the expansion phase of new cycle, this sequence of changes is recurrent but not periodic; in duration business cycle vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitude approximately their own"

The cycle periods are two:

- expansions of the cycle is the period between the initial valley (Vi) and peak (P).

- recession of cycle is the time lag between the peak (P) and the final valley (Vf) .

Since it tries to establish a methodology to examine and differentiate the regional cycles, this can be done by examining in particular the four main characteristics of the recession of these cycles:

- Chronology, dates for peak and final valley expressed in years, quarters or months.

- Duration, number of years, quarters or months between the peak and final valley.

- Amplitude or depth, difference between the values of cycle indicator in the final valley and peak, which may also be

measured by the negative growth rate average between both values.

Given the simultaneous nature of the cyclical movement of economic activities, each of which will have its specific cycles, so that consideration can define the fourth characteristic of recessions:

- Diffusion, or that so profuse is the downward movement of specific cycles in proportion to the total specific cycles examined.

And is that while economic cycles can be identified with aggregate measures such as GDP, in fact in Mitchell view the cycles are multidimensional movement allowing measure the extent of its spread or diffusion.

The concept of diffusion is crucial and can be understood in two senses. Calculating the diffusion, in one recession or synchronously. If you look at a particular recession, the extreme situation is that it is expressed in all dimensions of the economic sphere. So for example, if a recession down the production in all sectors, the sectorial synchronous diffusion index (SSDI) reached a value of 100%. If this happens in all regions, the regional synchronous diffusion index (RSDI) reached a value of 100%. And if a "perfect storm" as the economy was in recession in all sectors and all regions of the regional sectorial synchronous diffusion index (RSSDI) reached a value of 100%. it is obvious that any recession is a cycle observed so, some come close to these limits, will be the case for more serious recessions, others may be far, and will be the case of the milder recessions.

But there is another way of calculating the diffusion, and is to compare the behavior of national sector output in several recessions, or diachronically. There will be sectors falling into recession in all the years that the national economy is in recession and others who do not, with a sectorial diachronic diffusion index (SDDI) of 100% and 0% respectively.

To illustrate the calculation of the indices mentioned above is useful to define a matrix of "n" economic sectors, whose behavior is observed in the "j" years in which there is national recession. Each element of the array is recessional indicator IRij is "0" if the sector "i" in recession year "j" the sector "i" showed a positive growth

rate, and is "1" if the sector "i" in recession year "j" the sector

"i" showed a negative growth rate (ie was in recession).

So that in Table 2 shows a matrix as described in 5 x 5 in the formulas used for sectors 1 to 5 in the recession year of 1 to 5, in such a way that for example:

Sectorial Synchronous Diffusion Index in recession 1 is $SSDI1 = [(\Sigma_1^n IR_{ij}) / n] * 100$ and so on until recession 5.

Sectorial Diachronic Diffusion Index in sector 1 is $SDDI1 = [(\Sigma_1^m IR_{ij}) / m] * 100$ and so on until the sector 5.

Table 2
Matrix of Indicator Recessional IR_i^j of (n) economic sectors and (m) recessive years

"n" economic sectors	"m" recessive years when the economy was in recession (j)					$SDDI_1 = [(\Sigma_1^m IR_i^j) / m] * 100$
	Recession 1	Recession 2	Recession 3	Recession 4	Recession 5	
1	1	0	1	1	0	(3/5)*100=60%
2	1	0	1	1	1	80%
3	0	1	0	1	1	60%
4	1	1	1	1	1	100%
5	1	1	1	1	0	80%
$SSDI^1 = [(\Sigma_1^n IR_i^j) / n] * 100$	(4/5)*100=80%	60%	60%	100%	60%	

Source: author

With it you can:

- Compare national recessions by the sectoral distribution of the phenomenon, distinguishing those serious recessions (with sectorial synchronous diffusion index higher) of other less serious recessions (with a sectorial synchronous diffusion index lower).

- Characterize the national economy by the nature of their recessional profile along several recessions, to distinguish between those sectors recessive (with sectorial diachronic diffusion index higher) from other sectors less recessive (with a sectorial diachronic diffusion index lower). And that is characteristic

of the recessions of the national cycles is structural in that it represents a cyclical regularity observed in several recessions.

Just as the manifestations of the recessions of the classical business cycles can be distinguished according to the magnitude of the sectoral distribution of the recession. It is also important to establish the extent to which the profile sectorial national recession is replicated at regional-sectoral level. In this sense there are two extreme possibilities, the Matrix of Indicator Recessional IR_i^j of the national economy coincides cell to cell with Matrix of Indicator Recessional IR_i^j of the regional economy "A", or does not match at all. In the first case will be 100% similar and the second case will be 0% similar.

This making it possible to define:

Recessional Regional Similarity Index = (# of sectorial-regional recessions that coincide with the respective national sectorial recession / # national sectorial recessions) * 100.

As to address the issue of regional manifestations of national cycles there are two important new instruments, which here contribute to the literature of classical business cycles, and are applicable to regional analysis. They are:

- Synchronic and diachronic diffusion index that reveal cycles stylized facts of national sector contrasted with regional sectorial profiles will enable to distinguish between regional recessions.

- Recessional similarity index for comparing the sectorial impact of recessions in a region with what is happening nationwide level.

IMPLICATIONS FOR THE FUTURE

The idea of the relationship between the structural (permanent) and dynamic (or contingent) to resolve the issue of national economic trajectories (trends and cycles) was approached in the history of economic thought, through metaphors and models of Frish, Samuelson, Harrod and Thirlwall, reviewed here. Thinking the problem in terms of regional economies, not on the agenda of regional science, as evidenced by the statement that its disciplinary fields respond to two

questions ¿why companies are located in one place and not another? And ¿what are the reasons and sources of growth? So absent the question of why regional recessions occur? While the cyclical problem referred to this last question is usually answered by the business cycle theories, the problem of differential expression of these cycles at the regional level, has not received sufficient attention in regional science. In this respect, Mitchell's contribution here is crucial because it defines the economic cycle as a multidimensional phenomenon, so that we can use the concept of diffusion of recessions in the sectorial and regional level and to define new indexes as synchronic and diachronic diffusion indexes and similarity index. The proposed indexes represent an original contribution to regional literature, in which the cyclical dimension of economic phenomena has been neglected.

Finally it is worth noting that what is presented is useful for regional analysis of the recession, it proposes new indexes for comparison, to establish a typology and explore causes, which in a subsequent effort could be used to account for the regional impact of the recessions in Mexico and others countries of Latin America.

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