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Business cycles on a sub-national level:

Measuring regional industrial cycles by using the leading economic indicators' approach as a way of solving the absence of industrial production indexes' data

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Abstract

Because of its theoretical importance, in order to study how business cycles behave, data referred to the industrial sector is still part of any methodological approach's core. At the same time, industrial production indexes are mostly the indicators that submit this information and that's why they are being used in almost any national monthly composite coincident index around the world.

On the other hand for those who study business cycles on a sub national level, especially in Latin-America, a frequent problem to resolve is that industrial indexes are mostly calculated on a national aggregate level while states and cities rarely produce industrial output indicators.

The following document exposes the methodological bases followed by the authors as a contribution in measuring monthly coincident economic activity on a sub-national level facing the fact that there is not any available indicator which can efficiently resolve the absence of a standard industrial production index.

Our research shows how to capture the industrial cycle's flow by using the economic leading indicators approach upon a group of representative time series creating an industrial monthly indicator that can be used as part of the regional coincident index.

Once the representative group of series is selected, we test two methodologies in order to generate our new industrial indicator: the internationally known one used by The Conference Board (TCB) and one created by Dr. Mario Jorrat at the University of Tucumán, in Argentina.

Finally, we discuss how traditional weights used by industrial production indexes derived from proportions in the total value-added output could not necessary represent the best criteria in order to aggregate series with the purpose of measuring business cycles.

Key Words: Business Fluctuations and Cycles, Regional Economic Activity.

JEL Classification: E32, R11.

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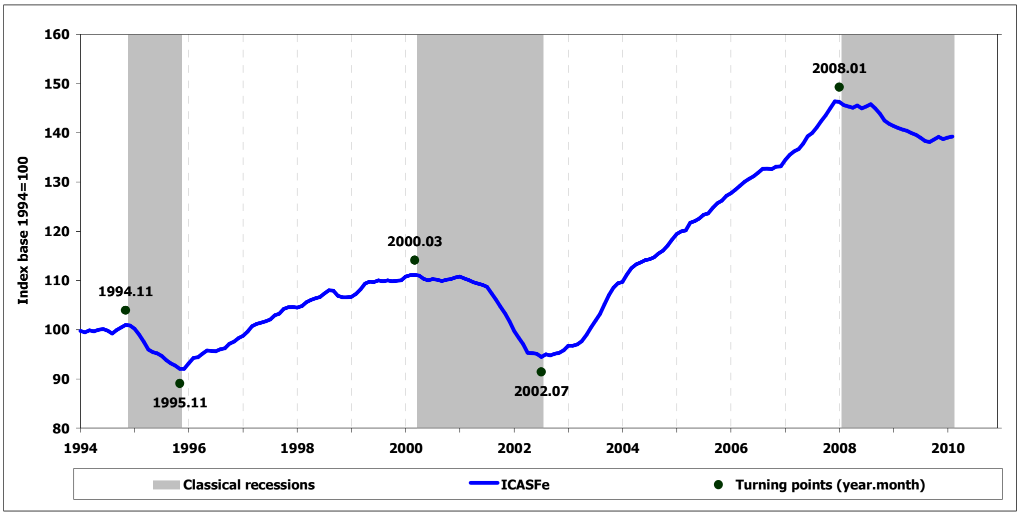
* The BCSF is an Argentinean civil association that can be compared with a "Chamber of Commerce". The authors are also involved with different Universities but this paper is a product of their work as members of BCSF's Institutional Research Center.

1. Introduction

The following paper presents the methodological bases which were adopted by the Research and Services Center of the *Bolsa de Comercio de Santa Fe*, with the aim of capturing industrial cycles' fluctuations on a sub-national level. In fact, this task didn't begin as a purpose itself, but as a singular way of improving the structure of the coincident economic index for the province[1] of Santa Fe[2] (ICASFe). A monthly indicator that has allowed us to examine business cycles experienced by Santa Fe's economy since January 1994 (see Figure 1), and sets up the reference cycle of our research.

Figure 1 Monthly Composite Coincident Index for the province of Santa Fe (Argentina)



Source: Research and Services Center, Bolsa de Comercio de Santa Fe (BCSF).

In order to generate an economic composite index for a sub-national jurisdiction applying the leading economic indicators' approach, we are forced to use time series that make reference, spatially speaking, to the regional studied territory. Our work's initial source was precisely based on the fact that we were not able to follow this basic statement. The province of Santa Fe does not count with any indicator which measures industrial output with a regular frequency lower than one year. In Argentina and all over the world many sub-national divisions share this problem. In some cases this happens due to the lack of a limited domestic statistical system not classified by jurisdiction. In some others, it's just because there isn't any probable improvement by actually presenting data arranged on that bases. Spatial concentration that characterises worldwide industrial activity does not necessarily follow a national or any other political/administrative outline. Moreover, in most cases, industrial spots in space go beyond domestic boundaries.

But the inner reasons that explain the absence of an industrial indicator do not happened to be part of our research. The fact is that the province of Santa Fe has not any particular or equivalent indicator in order to measure industrial cycles directly. Furthermore, in this current paper we describe a procedure which is encouraged by the use of leading economic indicators' methodology as a feasible alternative to capture the industrial cycle's flow in a sub-national space. Therefore, at the same time, we are able to solve the difficulty we had within the structure of our coincident economic index for the province of Santa Fe.

[1] In Argentina a province is a political/administrative division similar to a state in the U.S.

[2] D'Jorge, Cohan, Henderson, Sagua (2007), *Proceso de construcción del Índice Compuesto Coincidente Mensual de Actividad Económica de la provincial de Santa Fe*; Annals of the *Asociación Argentina de Economía Política* (AAEP).

This document's general contents are arranged by the following order. In first place we explain how Industry is one of the most important elements in contemporary business cycles' research. Then, we describe secondary sector's structure in the province of Santa Fe. Afterwards, taken this knowledge into account, we classify and select a group of representative time series which belong to industrial activities and behave with coincident characteristics. Thirdly, we discuss the difficulties we've had to face when trying to include the chosen series into the coincident index. We also suggest a feasible solution in regard to the main problematic by extending the leading economic indicator's approach for measuring industrial cycles. In the last part of the paper, we evaluate cyclical properties upon the industrial indicators we've developed.

1.1 The importance of the industrial sector over business cycles' research: brief description.

In historical terms, mankind has been conceiving cycles since early times. In fact, their significance has been set by many different disciplines and knowledge areas like Philosophy, Biology, Geology, History, Arts, just to mention some of them. However, in the economics field, systematic studies of cycles began recently, as a consubstantial phenomenon of modernity - although this statement probably isn't easy to accept since contemporary society has grown with the solid idea that economy inexorably moves through prosperity to shrinking moments and vice versa -. A possible reason for this lagged interest in the area we duty, is precisely based on the evidence that business cycles have not always shown the intensity they do since after the industrial revolution.

Economic structures shaped by ancient civilisations and during feudalism were mainly sustained on agricultural bases. Their performance was closely connected by the availability of natural resources, climate patterns within seasonal and medium terms, and political or military circumstances, only to mention some of the most representative variables. Gathering and transforming economic goods were mostly aligned to the benefits of a prevailing class and each member's role, in the society, was fundamentally static. In that context, problems such as overproduction, consumers purchasing power, financial bubbles or massive detractions over investment, could hardly be conceived as contemporary economists are accustom to. Thus, economic fluctuations were mainly attached to variables related to the imperative demographic structure, while exogenous factors could accelerate the process. For instance: natural disasters, epidemics, specific technological improvements expressed in better living conditions, wars, to name some of the most meaningful ones. As a result of this reality, complete cyclical reiterations lasted very long periods of time, lapses we should always list within the long term.

It seems to be that economic activity's fluctuations were strongly emphasized by the effects of industrial revolutions which took place in Europe during the 18^{th} and 19^{th} centuries. So, this unknown dimension of progress reached its most significant moment by expressing a tide of relevant periods of economic depressions. Consequently, authors from many different approaches rationalized these increasing downturns in economy as consubstantial crises of industrial capitalism. Ironically, technical development was improving industrial production but was also generating an inexplicable systematic reproduction of sudden breaks in economy. Most important, incoming crises showed a deep influence over social reality. For the first time in human history, cycles began to externalize in short and medium terms. This worrisome situation meant a direct attempt against the idea of unrestricted development supported by positivism. According to our own judgement, the hole problem we just described can be recognised as the intellectual muse that simultaneously encouraged scientists from all over the planet to introduce their individual contributions to the topic. Their goal, as it still is today, was mostly related with the intention of determine causes and establish possible corrective actions. For this reason, business cycles' researches in an academic level have always been, from the beginning, essentially connected with industrial economies with an open market orientation.

1.2 Industry's role within indexes of economic activity produced according to the leading economic indicators' approach.

In accordance with most published bibliography regarding to the leading economic indicators' approach, composite coincident indexes' main structure is usually related to four basic components: (1) employment levels; **(2) industrial production;** (3) retail sales; and (4) household disposable income. This theoretical framework, also supported by decades of experience, has been originally developed to study business cycles in a national extent and requires statistical information almost always available for researchers from developed countries. However, because of structural economic differences between countries and jurisdictions in addition to the lack of suitable statistic indicators, many time series which are included in the coincident indicators are not always exactly the same. First of all, not every country around the world publishes monthly statistics that precisely adjust in order to capture the four structural components' behaviour. At the same time, under particular cases among structural rigidities, certain adjustments upon the main methodological propositions could be justified; especially when these rigidities attempt against free market leanings.

Table 1 shows the internal structure of nine national coincident indexes published by The Conference Board (TCB). We suggest to pay special attention to the total number of time series included in each composite indicator, their sub-indicators' related subjects and the units of measurement they are expressed with.

Table 1 Time series included in coincident indexes for national jurisdictions

Country	Australia		United States		Germany	
Indicator	Coincident Economic Index		Coincident Economic Index		Coincident Economic Index	
Nº	Subindicator	Unit	Subindicator	Unit	Subindicator	Unit
1	Retail Trade (SA)	Mill. Constant A$	Employees on nonagricultural payrolls	thousands	**Industrial Production**	**Index 2000=100**
2	**Industrial Production (SA, Q)**	**Index 1997-98=100**	Personal income less transfer payments	ann. rate, bil. chn. 2000 dol.	Manufacturing Sales	Index 2000=100
3	Employed Persons (SA)	Thousands of Persons	**Industrial production**	**index: 2002=100**	Retail sales	Index 2000=100
4	Household Disposable Income (SA, Q)	Mill. Constant A$	Manufacturing and trade sales	mil. chn. 2000 dol.	Persons Employed	Thousands #

Country	France		Spain		United Kingdom	
Indicator	Coincident Economic Index		Coincident Economic Index		Coincident Economic Index	
Nº	Subindicator	Unit	Subindicator	Unit	Subindicator	Unit
1	**Industrial Production (SA)**	**Index 2000=100**	Final Household Consumption (Q)	sin datos	**Industrial Production**	**Index 2000=100**
2	Personal Consumptions (SA)	Billions of Euros	**Industrial Production, Excluding Construction (3MA)**	**Index 2000=100**	Retail Sales	Index 2000=100
3	Number of Employees (SA, Q)	Thous. Of Employees	Retail Sales Survey (SA)	#	Employment	average, thousands
4	Wage and Salaries (SA, Q)	Millions of Euros	Real Imports (3MA)	millions of Euro, 1995 prices	Real Household Disposable Income (Q)	average, thousands
5			Employment (Q, SA)	Thousands		

Country	Japan		Korea		Mexico	
Indicator	Coincident Economic Index		Coincident Economic Index		Coincident Economic Index	
Nº	Subindicator	Unit	Subindicator	Unit	Subindicator	Unit
1	Number of Employed Persons (SA)	Thousands of persons	**Industrial Production (SA)**	**Index 2005=100**	**Industrial Production (3MA)**	**Index (2003=100)**
2	**Industrial Production (SA)**	**Index 2005=100**	Wholesale and Retail Trade (SA)	Index 2005=100	Retail Sales (3MA)	Index (2000=100)
3	Wage and Salary Income (SA)	Index 2005=100	Employment (SA)	Thousands of Persons	Employment	Nivel
4	Real Retail, Wholesale, and Manufacturin	Billions of 2005 Yen	Monthly Cash Earnings (SA)	Hundres of Won deflated by CPI		

Source: The Conference Board.

As it can be seen, listed composite indexes employ a group of representative sub-indicators chosen specifically to study coincident cyclic fluctuations. We'd like to draw attention to the fact that all enumerated indexes contain at least one sub-indicator directly related to industrial production. Moreover, in order to capture the four basic components, they use a maximum of five sub-indicators.

In our case, the coincident index for the province of Santa Fe has been designed[3] by using a process developed by J. Mario Jorrat, Director of UNT's Program of Research on Economic Fluctuations. His methodology framework shares Burns & Mitchell[4]'s initial approach as well as further main academic contributions on the field. Even though, the procedure for calculating the composite indexes presents some particular differences among TCB's. Leaving a detailed comparison for a later analysis, at this moment the most relevant issue is that both methods internalize the same central components in order to monitor business cycles, and industrial production is one of them. But unfortunately, as we have already mentioned, the province of Santa Fe hasn't got any proper indicator or available statistical information able to measure, monthly, the secondary sector's performance.

[3] Through an agreement of technological transfer signed by *Universidad Nacional de Tucumán (UNT)* and *Bolsa de Comercio de Santa Fe (BCSF).*

[4] Burns, A. F., and W. C. Mitchell (1946), Measuring Business Cycles. New York: National Bureau of Economic Research.

Therefore, we decided to analyse santafesinean industrial activity as a whole. The purpose was learning about its main characteristics but, most important, being able to classify branches in terms of economic activity. This way, we could set a group of time series able to supply monthly data about regional industrial cycles, by adding information from each of the determined sub-sectors.

2. The province of Santa Fe's industrial sector

In order to give answer to the objectives we've set over the previous paragraph, in this section we analyze industry's structure in the province of Santa Fe, integrally. We started by searching potential informational sources which could help us among our task. In this way, once we have examined all available data, we selected two main indicators as reference to our work: The *Producto Bruto Geográfico* (PBG)[5] published by the *Instituto Provincial de Estadísticas y Censos* (IPEC) and the National Economic Census (NEC)[6] prepared by *the Instituto Nacional de Estadísticas y Censos* (INDEC).

Let's have in mind that, in Argentina, the National Industrial Census is performed every ten years together with the National Economic Census. Moreover, the National Institute of Statistics, INDEC, was also in charge of organizing an Annual Industrial Survey. But this important source of information only published results from 1997 until 2002, when the program was cancelled. In any case, this indicator wasn't necessarily useful to our purposes since it didn't provide statistical data classified by province.

2.1 The secondary sector according to the *Producto Bruto Geográfico* (PBG)

Since the PBG is published annually, we began by using this indicator in order to develop a reference time series. This way we could internalize how industry has behaved in the province, in terms of flows. In this case, we analyze data from periods 1993 to 2008.

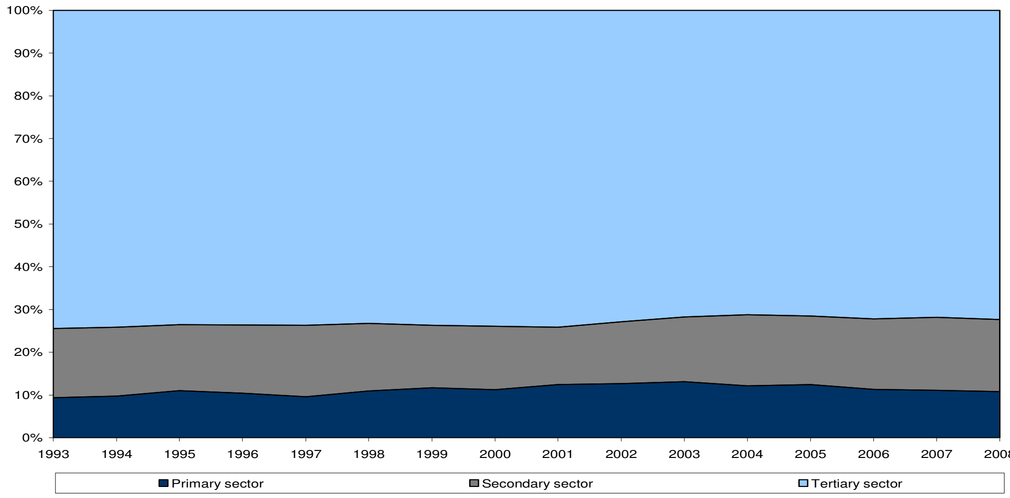
In the province of Santa Fe's economy, the average participation share of goods producer sector[7] (primary and secondary) against services was relatively steady from 1993 to 2002. Afterwards, it slightly increased its relative weight. The different situation was mainly explained by a better performance of industry and its influence over the goods producer sector. Taking account of all the considered years, the value added generated by manufacturing represented an average of 16% of total PBG (See Figure 2).

[5] The "*Producto Bruto Geográfico (PBG)*" it's an indicator similar to the Gross Domestic Product (GDP) by State, published by the U.S. Bureau of Economic Analysis (BEA). However, we must clarify that, in Argentina, PBGs are generated by Provincial Institutes of Statistics and their results have not yet been methodologically homogenized. Hence, Argentinean Gross Domestic Product, calculated by INDEC, is not always equal to the sum of PBGs.

[6] The National Economic Census is arranged by INDEC in collaboration with all Argentinean Provinces' Institutes of Statistics. Its goal is to quantify and portray industry, commerce, mining, finances and services, all over the country.

[7] In order to see a complete list of PBG's components and methodology please click on the following link: http://www.santafe.gov.ar/index.php/web/content/view/full/11319

Figure 2 Value added generated by primary, secondary and tertiary sectors in the province of Santa Fe. Time period: 1993-2008.



Source: *Instituto Provincial de Estadísticas y Censos (IPEC), de Santa Fe*.

During the 90s, in Argentina, services became the most dynamic sector of the economy. But this scenario changed after the devaluation of the local currency (2002), which created better conditions to its foreign trade. At this point, Argentina regained part of its traditional agro-exporter characteristics as a country, and agro-industrial production was significantly pushed forward. The expansion was mainly supported by more competitive domestic prices and an international market that was showing better terms of trade for this kind of products. The phenomenon, with national implications, had a special repercussion over the province of Santa Fe. As it will be proved, this particular province has an industrial structure in straight connection with the alimentary and agro-commodities sectors. Nevertheless, like all over the world, services still are the most representative sector in terms of economic generated value added.

2.1.1 Value added vs. intermediate consumption: industrial sector's cyclical relevance

As an indicator, the PBG tackles all the segments and activities of the province's economy and gives us information about each of them in terms of: generated value added, intermediate consumption (value added created by any sector that is then used as an input in order to develop other activity) and gross output (value added plus intermediate consumption).

As we have explained before, the manufacturing sector is an important element of research in the field of business cycles. However, in gross product terms, industry has been losing relative participation over the last decades due to the importance of services sector. So, why is it still useful to follow the way industrial sector performs? Because of its high degree of connection among most other economic sectors. Focusing the analysis upon the relative value added that each sector produces, is not strictly useful to consider its importance over economic activity; we believe that it's better trying to understand its linkage among other activities. Hopefully, Table 2 will help internalizing the idea we have just explained.

Table 2 2007's santafesinean PBG, by sectors. Constant 1993 billion pesos.

PBG by sectors	Value Added (VA)	Intermediate Consumption (IC)	Gross Output (GO)
Primary and secondary sectors (1)	**9.69**	**20.43**	**30.12**
Agriculture, hunting and forestry	3.04	1.39	4.43
Fishery	0.01	0.00	0.01
Mining and quarrying	0.01	0.00	0.01
Manufacturing	5.07	17.95	23.02
Electricity, gas and water supply	0.91	0.43	1.34
Construction	0.66	0.65	1.32
Service sector (2)	**18.15**	**7.41**	**25.56**
Wholesale and retail trade	4.25	2.00	6.25
Hotels and restaurants	0.23	0.29	0.52
Transport, storage and communications	1.99	1.76	3.75
Financial intermideation	1.03	0.58	1.61
Real estate, renting and business activities	7.33	0.86	8.19
Public administration and social security	0.23	0.40	0.63
Education	1.06	0.10	1.16
Health and social work	1.13	0.84	1.98
Other community, social and personal services	0.58	0.59	1.17
Domestic service	0.31	0.00	0.31
Total (1) + (2)	**27.84**	**27.84**	**55.68**

Source: *Instituto Provincial de Estadísticas y Censos* (IPEC), *de Santa Fe*.

Table 2 shows Santa Fe's PBG for 2007, gathered by economic sectors (2008's results were not included because we didn't consider that year stable enough). During the analyzed period industry generated 18.2% of total value added created in the province, whereas the services sector represented 65.2%. However, if we think about it in terms of intermediate consumption, manufacturing used as input 64.5% (17.9 constant 1993 billion Argentinean pesos) of total value added generated in the province during that year. And, in addition, the sector generated its own value added over its intermediate consumption (intermediate goods, raw materials and services) in approximately other 5 constant 1993 billion Argentinean pesos.

2.1.2 Historical analysis of industrial branches' averages

Based on previous paragraph's contents, we choose to make use of the Gross Output (GO), Value Added (VA) plus Intermediate Consumption (IC), as main indicator for our analysis. In addition, all used information was expressed in constant 1993 billion Argentinean pesos in order to prevent nominal distortions generated by domestic inflation. Between 1993 and 2000, industrial GO reached an annual average of 11.2 constant 1993 billion Argentinean pesos. And 71% of that total amounts, about 8 billions, were spent on intermediate consumption. In the next period, between 2001 and 2007, annual averages of industrial GO and industrial IC were calculated in 16.2 and 12.4 billions, respectively. This means that during last analysed period industry's IC represented an annual average of 77% of its total GO.

Table 3 Gross output and value added classified by branches of the manufacturing sector; province of Santa Fe. Constant 1993 billion Argentinean pesos. Annualized averages. Periods (1993-2000) and (2001-2007).

Branches of manufacturing	Annual average. Period: 1993-2000.				Annual average. Period: 2001-2007.			
	Gross Output (GO)	Proportion (%)	Value Added (VA)	Proportion (%)	Gross Output (GO)	Proportion (%)	Value Added (VA)	Proportion (%)
Meat Products, Fish, Fruits and legumes	3,695	32.8%	372	11.7%	7,053	42.7%	642	16.6%
Dairy products	1,081	9.7%	308	9.6%	1,081	7.1%	292	8.2%
Other food products and brevages	1,024	9.2%	395	12.4%	1,146	7.4%	407	11.3%
Metals industry sector	802	7.2%	207	6.4%	1,027	6.4%	389	10.0%
Machines and equipment	750	6.8%	331	10.3%	1,023	6.2%	408	10.6%
Chemical industry	691	6.2%	173	5.4%	1,136	6.9%	205	5.6%
Automotive industry	498	4.4%	195	6.1%	913	5.4%	177	4.6%
Crude oil refining and petrolium coke	428	3.7%	117	3.6%	626	3.9%	209	5.8%
Metal products, excluding machines	383	3.5%	191	6.0%	318	2.0%	151	4.1%
Furniture and related product manufacturing	292	2.6%	180	5.6%	245	1.5%	137	3.6%
Leathergoods and footwear	287	2.6%	94	2.9%	368	2.4%	94	2.6%
Paper and paper byproducts	212	1.9%	75	2.3%	264	1.7%	104	2.8%
Rubber and plastic products	201	1.8%	95	3.0%	243	1.5%	109	2.9%
Clothing and leather	170	1.5%	105	3.3%	127	0.8%	75	2.0%
Printing and publications	129	1.2%	79	2.5%	130	0.8%	74	2.0%
Wooden products, excluding furniture	123	1.1%	76	2.4%	125	0.8%	85	2.3%
Non-metallic minerals	122	1.1%	71	2.2%	138	0.9%	74	2.0%
Textiles	110	1.0%	46	1.4%	52	0.4%	32	0.9%
Other machines and electronics, not elsewhere classified	108	1.0%	51	1.6%	87	0.6%	43	1.1%
Other transport equipment	52	0.5%	21	0.6%	36	0.2%	13	0.3%
Medical, optics and precision instruments	27	0.2%	14	0.4%	26	0.2%	11	0.3%
Manufacture of radio, television and communication equipment	7	0.1%	3	0.1%	16	0.1%	9	0.2%
Office Equipment	6	0.1%	2	0.1%	4	0.0%	1	0.0%
Tobacco	2	0.0%	1	0.0%	6	0.0%	3	0.1%
TOTAL	**11,198**	**100.0%**	**3,204**	**100.0%**	**16,189**	**100.0%**	**3,746**	**100.0%**

Source: *Instituto Provincial de Estadísticas y Censos* (IPEC), *de Santa Fe*.

As a result of analyzing data from Table 2, under the followed criterion, santafesinean most relevant industrial branches are:

1) *Meat, fish, fruits and legumes processing*. This branch had an annual average GO of 3.7 constant 1993 billion pesos in the period 1993-2000, which reached 7 billions during the period 2001-2007.

2) *Dairy products*. This branch had an annual average GO of 1.1 constant 1993 billion pesos in the period 1993-2000, which reached 1.1 billions during the period 2001-2007.

3) *Other food products and beverages*. This branch had an annual average GO of 1 constant 1993 billion pesos in the period 1993-2000, which reached 1.1 billions during the period 2001-2007.

4) *Metal industry sector*. This branch had an annual average GO of 0.8 constant 1993 billion pesos in the period 1993-2000, which reached 1 billion during the period 2001-2007.

5) *Machines and equipment*. This branch had an annual average GO of 0.7 constant 1993 billion pesos in the period 1993-2000, which reached 1 billion during the period 2001-2007.

6) *Chemical industry*. This branch had an annual average GO of 0.7 constant 1993 billion pesos in the period 1993-2000, which reached 1.1 billions during the period 2001-2007.

7) *Automotive industry*. This branch had an annual average GO of 0.5 constant 1993 billion pesos in the period 1993-2000, which reached 0.9 billions during the period 2001-2007.

8) *Metal products, excluding machines*. This branch had an annual average GO of 0.4 constant 1993 billion pesos in the period 1993-2000, which reached 0.3 billions during the period 2001-2007.

All together, the eight listed industrial branches represent 79% of santafesinean secondary sector's GO, 83% of its IC, and 64% of its VA. In fact, if we only took into account the three branches related to the Alimentary Industry, their relevance over economy would happen to be even more concentrated. This group of manufacturing companies explains 50% of secondary sector's GO. Table 3 shows that their importance was actually emphasised after the province recovered from the national economic and political crisis suffered in 2001/02. *Meat, fish, fruit and legumes manufacturing*'s GO passed from 3.7 constant 1993 billion pesos to 7 billions, between the two time periods. Hence, their participation over industrial activity's GO, raised 10%.

2.2 The secondary sector according to the National Economic Census (NEC)

The second selected source in order to internalize industrial structural information is the National Economic Census (NEC). Its results become available every 10 years and therefore data is presented in terms of stock. The last two publications refer to 1994/95 and 2004/2005. Coincidentally, the first census was taken on same period year where our coincident composite index for the province begins. Let's remember that this indicator, the ICASFe (see Figure 1), is used as the reference cycle of all cyclic time series approached on our research.

Once more, our aim was to identify the relative importance of each industrial branch. It's worth saying that both main indicators, the PBG and the NEC, have exactly the same setting structure in order to classify industrial activities into branches.

1994/95's NEC, indicated that the province of Santa Fe had a total number of *10,488 productive units* related to industrial activities. In that moment, their joint GO was about 8.2 constant 1993 billion pesos, mainly explained by their IC of 6.2 billions, whereas their VA was only 2 billions. In relative terms 2004/05's NEC presented really similar results. Total productive units declined to 9,866 but their joint GO, also measured in constant prices comparable to 1994/95's, grew to 19.7 billions. Their IC reached 13.8 billions and their total generated VA was 5.9 billions. At this point we checked that, as expected, PBG's information (see Table 3) shares those same results.

Under this indicator's results, once more, IC represents the most relevant proportion over industrial GO. By the contrary, in our analysis, the total value added generated by the sector never implied more than 25 or 30% of its GO.

At this point, our main interest is still being able to rank industrial branches in terms of their relevance among economic activity. Thus, we identified those with higher levels of GO over the last two NECs. That is to say that we have considered, not only their capacity of generating VA themselves, but also their particular relationship with IC. By following this parameter, the most relevant groups of branches in Santa Fe's industrial sector are:

1) *Food products and beverages manufacturing*. These activities represent about 50% of total industrial GO.

2) *Common metal manufacturing*. It represents about 7.8% of total industrial GO.

3) *Machinery and equipment manufacturing*. It represents about 7.7% of total industrial GO.

4) *Metal products manufacturing, except machinery and equipment*. It represents 4.4% of total industrial GO.

5) *Automotive, tow and semitow vehicles manufacturing*. It represents the 4.4% of total industrial GO.

6) *Chemical substances manufacturing*. It represents the 4% of total industrial GO.

Although we have recognised six main branches of industrial activity, *food and beverages manufacturing* are related to 50% of total GO and 55% of total IC. On the contrary, non listed branches, individually, don't exceed 2% of total GO. For this reason, we haven't considered them relevant to our purposes.

2.3 Main preliminary results obtained by analyzing PBG and NECs

PBG and NECs' results showed that, in both cases, *the alimentary sector* is the most important industrial branch of the province in terms of economic activity. As we already said, it actually represents about 50% of total Santa Fe's industrial GO. Moreover, considering carefully this group's profile, we must highlight the particular relevance of oilseed milling, dairy production, and meat slaughter industry, from above all the others. It becomes easily visible that most of these spotted sub-branches belong to the agro-industrial sector, in many cases also directly connected with international commerce. Actually, these conclusions turns out to be more than logical; considering santafesinean territory's geographical features, its primary sector's structure and its strategic location which explains why most Argentinean overseas' foreign trade passes trough Santa Fe's ports. Also according to the analysis, *the metal mechanic sector* is the second most important branch together with the *chemical industry.*

Another issue we want to emphasize is that the majority of industrial goods produced in the province do not require high technological complexity. This situation actually made our workload lighter since, precisely, high technological branches are the most problematic areas to approach in order to study business cycles. In fact, there are some exceptional exclusions, like certain companies from the City of Rafaela[8] for example. But if we consider them on a provincial scale, they are not representative at all.

2.4 Monthly time series related to the province's industrial sector

Having already determined the internal structure of the industrial sector in the province of Santa Fe (along 2.1 and 2.2), we compiled monthly time series related in a sectorial and jurisdictional way to the most relevant secondary activities. Our goal here is to select a group of coincident indicators able to capture industrial cycles and also satisfy general methodological requirements. Therefore, we expect them to show strong coincident features in terms of global economic activity. To this regard, the composite coincident index for Santa Fe was used as reference cycle.

In order to work with analogue time spaces, monthly data was looked for trying to compile it from January 1994 (1994.01) to the present time. Afterwards, nominal or aggregated time series were transformed from raw data to indicators which allow us to test flows in real terms. Then, using U.S. Census Bureau's software X-12-ARIMA, every indicator was filtered from intra-annual frequencies and its extreme values were taking into account. Temporary correspondence[9] was also considered in all cases by comparing each sub-indicator's turning points within the reference cycle. Finally, we choose the most appropriate sub-indicators to our particular needs: measure and capture industrial activity's flow in the province of Santa Fe.

The following list contains all useful time series we managed to gather[10]:

- **SFE-LCT**: monthly fluid milk processed by santafesinean dairy sector.

  Start date: 1991.01.

  Unit of measurement: millions of litres.

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[8] Rafaela is located upon the center/north of the province of Santa Fe, which has become a regional paradigm regarding of economic development.

[9] Each sub-indicator's *temporary correspondence* is calculated by the following method: the sum of specific turning points clearly related with the reference cycle's behaviour (positive signals) are divided by the total number of positive and false signals. As a result, well reported signals are expressed into percentage terms.

[10] Time series' graphs and their specific cyclic characteristics can be downloaded from our site at http://ces.bcsf.com.ar/

Source: *Departamento de Lechería del Ministerio de la Producción de la provincia de Santa Fe*.

- **SFE-OLEO**: monthly oilseeds milling in the province. It considers the quantity of gross soya and sunflower's tons processed by industry. Physical units are expressed in monetary values, according to their relative prices from 2005.

  Start date: 1993.01.

  Unit of measurement: constant 2005 million U.S. dollars.

  Source: *Dirección de Mercados Agroalimentarios del Ministerio de Agricultura de la Nación Argentina*.

- **SFE-FABO**: monthly pieces of cattle slaughtered in the province of Santa Fe.

  Start date: 1993.01.

  Unit of measurement: number of heads.

  Source: O*ficina Nacional de Control Comercial Agropecuario (ONCCA).*

- **SFE-FAPO**: monthly number of pigs slaughtered in the province of Santa Fe.

  Start date: 1993.01.

  Unit of measurement: number of heads.

  Source: *Oficina Nacional de Control Comercial Agropecuario (ONCCA).*

- **SFE-MAQ**: monthly sales of agricultural machinery related to factories which are located in the province. Physical sold units are expressed in monetary values according to their relative prices from 2004.

  Start date: 1995.01.

  Unit of measurement: constant 2004 million Argentinean pesos.

  Source: *Asociación de Fábricas Argentinas de Tractores y Equipamientos Agrícolas (AFAT).*

- **SFE-GICE**: monthly amount of gas delivered to the industrial sector and power stations in the province. Delivered cubic meters are recalculated according to their relationship with petroleum's kilocalories.

  Start date: 1993.01.

  Unit of measurement: thousands metric equivalent tones of petroleum.

  Source: *Ente Nacional Regulador del Gas (ENERGAS).*

- **SFE-EEI**: monthly electricity consumed by industry in the province.

  Start date: 1994.01.

  Unit of measurement: Gig watts per hour (GWh).

  Source*: Empresa Provincial de la Energía (EPE).*

- **SFE-PAUT**: monthly automotive manufacturing in the province of Santa Fe.

  Start date: 1996.01.

  Unit of measurement: number of vehicles.

  Source: *Asociación de Fábricas de Automotores (ADEFA).*

- **SFE-HCL**: direct hydrocarbons' sales to the industrial sector in the province. Same conversion explained in SFE-GICE was applied.

  Start date: 1994.01.

  Unit of measurement: thousands metric equivalent tones of petroleum.

  Source: *Secretaría de Energía de la Nación.*

We must recognise that our selection process was certainly conditioned by the limited amount of available series. This explains the absence of some sub-indicators directly connected with particular industrial sectors which could have also been evaluated. Taking everything into account we decided to include seven specific time series into the composite coincident index for the province of Santa Fe. Their cyclical qualities and industry's structural characteristics were considered, justifying their selection:

(1) **SFE-FAEN**: it monitors cattle and pig slaughter sector. It's measured in constant 2000 Argentinean thousand pesos, taking in consideration that year's relative prices. We consider it a representative series of the food industrial segment; particularly of meat manufacturing.

(2) **SFE-LCT**: it is also considered a representative series of the food industrial segment gradual; particularly related to dairy production.

(3) **SFE-OLEO**: related to the food industrial segment's performance with a particular connection among Argentinean agro-exports.

(4) **SFE-MAQ**: in first place it's related to the metal mechanic sector. And, secondly, it points out general agricultural performance.

(5) **SFE-EEI**: measures main industrial energetic input. It is complemented with SFE-GICE and SFE-HCL.

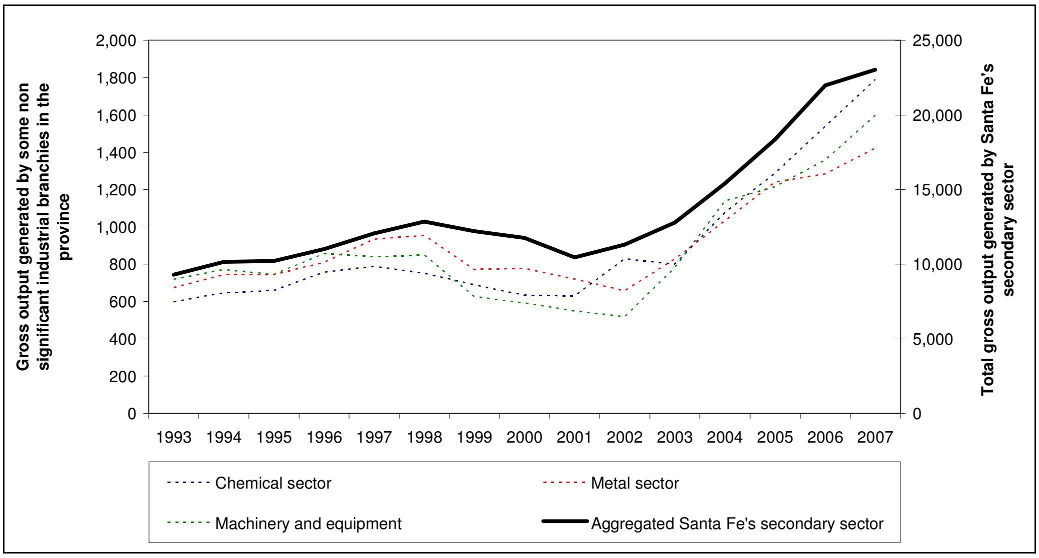
(6) **SFE-GICE**: it complements SFE-EEI. Some industrial companies produce their own electricity, based on gas' consumption.

(7) **SFE-HCL**: it complements SFE-EEI. Some industrial companies produce their own electricity, based on hydrocarbons' consumption; especially, some representative agro-industrial activities.

The first four series make direct reference to the most important branches within the industrial structure in the province. The other three, provide information about the whole secondary sector's performance.

Based on this group of series, we believe that Santa Fe's industrial cycles are being captured in an integral and efficient way. Branches which are not individually represented by series, like chemical substances for example, fluctuate real similarly than the entire manufacturing industry. Figure 3 illustrates this situation within a time period that includes practically all the years tackled by the coincident indicator.

Figure 3 GO generated by the entire industrial sector in the province and GO generated by some non significant branches. Period (1993-2007).



Source: *Instituto Provincial de Estadísticas y Censos (IPEC) de la provincial de Santa Fe.*

This far, we haven't yet strictly proved the capacity of chosen indicators in order to capture the industrial cyclical flows. Having made use of theoretical subjectivities, their consistency is going to be demonstrated over the following parts of the document. Summarising our activity until this point, we choose a total of seven sub-indicators to include in the monthly composite coincident index. This so, because the province does not have a specific indicator to that matters. In order to guide our selection process, we evaluated secondary sector's structural characteristics and detected its most important branches.

3. Implicit relative weights: sub-limitation derived from the initial problem (not having any useful industrial indicator)

In business cycles' research based on interpreting groups of joint time series, being able to determine the total number of sub-indicators and their characteristics it's possibly the most controversial area of the approach. In the past, this subject has already generated many academic discussions over the approach's theoretical framework. But nowadays, there is no doubt the leading economic indicators' approach has gained an international recognition. In fact, none other methodological process allows us to study business cycles in so practical terms. However, it implies a firm responsibility, since it forces the researcher to adopt discretionary positions under the impossibility of systematizing such a complex universe. Of course, these choices must always keep a rational relationship among each other. That is to say, they must be properly grounded, avoiding any arbitrary decision. As we know, there are basic alignments that can be used as a guide. As we have mentioned before, bibliography based on past experience points that coincident economic activity keeps a direct connection with four fundamental elements (see 1.2). And usually, when it is possible, each of those elements is internalized in composite indexes by one specific time series.

Table 4 details the process' main steps in order to generate a coincident index by following two different methodological sets: professor Jorrat's methodology, which whom our coincident index for the province of Santa Fe is calculated with, and The Conference Board's methodology, used by the Institution to calculate its multiple indexes. We suggest the reader to compare both options in terms of the relative weights given to any potential index's sub-indicators.

Depending on how many series are included, each alternative also implies different implicit weightings. Implicit, meaning that each element internalized by the index doesn't have an ad-hoc established weight; as it does, openly, in most composite indicators. Here, the relative influence of included series comes from the mathematic construction and from each sub-indicator's own cyclical volatility, taken into account by both methodologies.

Table 4 Comparison between two methodological sets able to be used alternatively in order to calculate composite indexes

Professor Juan M. Jorrat's methodology	The Conference Board's methodology
1) Time series are filtered by seasonality and corrected by extreme outliers. X-12-ARIMA software is used.	1) Time series are filtered by seasonality and corrected by extreme outliers. X-12-ARIMA software is used.
2) Monthly variations for each component are computed. If the component is in percent change form, simple arithmetic differences are calculated. If it is not, logarithmic rates are used. $\hat{x}_{jt} = (x_{jt} - x_{j(t-1)})$ or $\hat{x}_{jt} = \ln\left(\frac{x_{jt}}{x_{j(t-1)}}\right)$	2) Month-to-month changes are computed for each component. If the component is in percent change form, simple arithmetic differences are calculated. If it is not, a symmetric[11] alternative to the conventional percent change formula is used. $\hat{x}_{it} = (x_{it} - x_{i(t-1)})$ or $\hat{x}_{it} = 200 * (x_{it} - x_{i(t-1)})/(x_{it} + x_{i(t-1)})$
3) Averages and standard deviations for each component are calculated to equalize the volatility of each component. $m_j = \frac{1}{(b-a_j)}\sum_{t=a_j}^{b}\hat{x}_{jt} = \ln\left(\frac{x_{jb}}{x_{ja_j}}\right)\Big/(b-a_j)$ $s_j = \sqrt{\frac{1}{(b-a_j-1)}\sum_{t=a_j}^{b}(\hat{x}_{jt} - m_j)^2}$	3) The month-to-month changes are adjusted using standardization factors that equalize the volatility of each component. Standard deviations for each component are calculated (v_i) as well as standardisation factors (w_i). $(w_i) = 1/(v_i)$. Then, all standardized factors are normalized in order to sum to one. Adjusted month to month changes are calculated: $\hat{m}_{it} = \hat{x}_{it} * (w_i : normalized)$
4) First index's monthly relative variations: the average from all component's logarithmic <u>standardized changes</u> is calculated:	4) First index's monthly relative variations (s_t) :

11 $\hat{x}_t = 200 * (x_t - x_{t-1})/(x_t + x_{t-1}) = 100 * \frac{(x_t - x_{t-1})}{(x_t + x_{t-1})/2}$. It deals with the positive and negative changes symmetrically. In case of having an increase of 1% followed by a fall of 1% the variable goes back to its original level. Whereas, the conventional formula $100 * \frac{(x_t - x_{t-1})}{x_{t-1}}$ would end up with a new level, lower than the original one.

$\hat{c}_t^{(1)} = \frac{1}{n}\sum_{j=1}^{n}\left(\frac{\hat{x}_{jt} - m_j}{s_j}\right)$	$s_t = \sum_{i=1_j}^{n} \hat{m}_{it}$
5) Amplitude's adjustment in terms of the referential cycle. For the Argentinean coincident indicator, its GDP's (PIB) amplitude was adopted. $\hat{c}_t^{(2)} = \left(\hat{c}_t^{(1)} - m_{\hat{c}_t^{(1)}}\right) \cdot \frac{s_{PIB}}{s_{\hat{c}_t^{(1)}}} = \frac{\left(\hat{c}_t^{(1)} - m_{\hat{c}_t^{(1)}}\right)}{s_{\hat{c}_t^{(1)}}} \cdot s_{PIB}$ Where $s_{\hat{c}_t^{(1)}}$ is the standard deviation of monthly changes defined in (4); and, $m_{\hat{c}_t^{(1)}}$ is their long-term average. s_{PIB} is GDP's Typical error.	5) The index is calculated recursively starting from an initial value of 100 for the first month of the sample period. Then symmetric formula is used recursively to compute the index levels for each month that data are available $I_1 = 100$ $I_2 = I_1 * \frac{(200 + s_2)}{(200 - s_2)}$ Etc. Finally, growth rates for the leading and lagging indexes are also adjusted each month so that their long-term trends will be equal to that of the coincident index
6) Finally, the index is adjustment by long-term GDP's trend. The same criterion as in the point 5 is followed. $\hat{c}_t^{(3)} = \hat{c}_t^{(2)} + m_{PIB}$ (theoretical equivalence)	

Both methodologies were thought in accordance with the leading economic indicators' approach. In general, compared to other alternative ways of generating composite indexes, their main advantage rests in their capability of aggregating series which can be expressed in different units of measurement. Moreover, both computations equalize each component's volatility and, therefore, the entire cyclical movement is properly identified.

Jorrat's methodology uses a simple average over all the components' monthly logarithmic standardized changes (see Table 4: step 4, column 1). On the other hand, The Conference Board's methodology sums all components' standardized and normalized changes (see Table 4: steps 3 and 4, column 2).

Without considering the standardization effect, the first methodology gives each sub-indicator a relative weight of 1/n, being n the total number of series included in the composite index. We must remember that this methodology is used in order to generate the coincident indexes for Argentina and for the province of Santa Fe. But for the series included in the U.S. Composite Coincident Index, the Conference Board's methodology turns out to be a lot clearer in terms of weights. Somehow, they are reflected on each normalized standardization factor (for the present analysis we've used published data from The Conference Board's 2001 revision). In any case, the important thing here is that both methodologies' relative weights are in fact influenced by the total number of series which are included in the composite index.

At this point, we compare the relative weights related to each component included on three different computed composite indexes. Our goal here is to be able to quantify the problematic situation created around not having an available industrial production index to incorporate in our provincial coincident index. For this reason, Table 5 is especially designed to show up each of the four main elements defined in 1.2, assigning them with a particular colour and letter. We have also added a fifth letter (E) named "structural adjustments". Under this title, we register the complementary series included in order to solve structural differences and particular limitations over some individual sub-indicators. Implicit weights are shown by series and for the entire element (A, B, C, D, and E).

Under this first set up, the seven series chosen in 2.4 are included individually to the composite index (ICASFe). Let's remember that their purpose is to capture the industrial cycles, replacing a unique series able to measure element C. Just to make the comparison easier, we named this first approach as INITIAL METHOD. The main practical consequence of using this particular set up is that the coincident composite index for the province of Santa Fe is computed with a total number of fourteen sub-indicators: ICASFe (14).

Table 5 Implicit relative weights of included sub-indicators, using an INITIAL METHOD approach

Coincident Economic Index for Santa Fe: ICASFe (14).	1/14	by group	Coincident Economic Index for Argentina	1/11	by group	Coincident Economic Index for the U.S.	Standarization factors (2001)	
(1) Number of registered employees (+A)	7.14%	14.3% + extra from E	(1) Number of registered employees (+A)	9.09%	18.2% + extra from E	(A) Employees on nonagricultural payrolls	47.9%	A
(2) Demand for new employees (+A)	7.14%		(2) Demand for new employees (+A)	9.09%				
(3) Personal income (+B)	7.14%	7.1% + extra from E	(3) Personal income (+B)	9.09%	9.1% + extra from (4 & E)	(D) Personal income less transfer payments	28.3%	B
			(4) Real industrial wage index (+B +c)	9.09%				
(4) Electricity used by industry	7.14%	50.0%	(5) Index of industrial production (+C)	9.09%	9.1% + extra from (4)	(C) Index of industrial production	12.9%	C
(5) Gas used by industry and power stations	7.14%							
(6) Hydrocarbons used by agro-industry	7.14%							
(7) Meat slaughter industry	7.14%							
(8) Dairy production	7.14%							
(9) Oilseed milling	7.14%							
(10) Agricultural machinery production	7.14%							
(11) Supermarket retail sales (+D)	7.14%	7.1%	(6) Retail sales (+D)	9.09%	9.1%	(D) Manufacturing and trade sales	10.9%	D
(12) Cement consumption (+A +b)	7.14%	21.4% - (a y B)	(7) Construction index (+A +b)	9.09%	45.5% - (A & B)	E Structural adjustments		
(13) New vehicles' registrations (+B +a)	7.14%		(8) New vehicles' registrations (+B +a)	9.09%				
(14) Tax revenues (+A)	7.14%		(9) Importations (+B)	9.09%				
			(10) GDP at market prices (+A)	9.09%				
			(11) Tax revenues (+A)	9.09%				
implicit weight	100.0%			100.0%			100.0%	

Source: Research and Services Center*, Bolsa de Comercio de Santa Fe (BCSF)*.

As it can be observed in Table 5, ICASFe (14) gives an approximate relative weight of 50% to the entire element C (industry). On the contrary, both national indicators, the Argentinean and the American one, give a significantly lower weight to this element: 9.1 and 12.9%, respectively. Therefore, the INITIAL METHOD overestimates block C, by including industrial series in an individual way. At the same time, it reduces relative significance to the others.

3.1 Using the leading economic indicators' approach to overcome the limitations of the INITIAL METHOD

In this section, we analyse how to include the seven chosen industrial series gathered under one only common sub-indicator, that we named CICI (Cyclical Industrial Composite Index). This second approach implies an AGGREGATION METHOD, and it allows us to compute ICASFe just with eight time series: ICASFe (8). In fact, this situation is basically the same as having an ad-hoc industrial production index, capable of capturing element C by itself. The most important part is that under this method, problems among relative weights, sketched in the previous section, are minimized.

Table 6 Implicit relative weights of included sub-indicators, using the AGGREGATION METHOD approach

Coincident Economic Index for Santa Fe: ICASFe (8).	1/8	by group	Coincident Economic Index for Argentina	1/11	by group	Coincident Economic Index for the U.S.	Standarization factors (2008)		Standarization factors (2001)
(1) Number of registered employees (+A)	12.50%	25.0% + extra from E	(1) Number of registered employees (+A)	9.09%	18.2% + extra from E	(A) Employees on nonagricultural payrolls	54.4%	A	47.9%
(2) Demand for new employees (+A)	12.50%		(2) Demand for new employees (+A)	9.09%					
(3) Personal income (+B)	12.50%	12.5% + extra from E	(3) Personal income (+B)	9.09%	9.1% + extra from (4 & E)	(B) Personal income less transfer payments	18.7%	B	28.3%
			(4) Real industrial wage index (+B +c)	9.09%					
(4) Composite industrial index (+C)	12.50%								
(this means 1.79% for each of the 7 series)		12.5%	(5) Index of industrial production (+C)	9.09%	9.1% + extra from (4)	(C) Index of industrial production	15.0%	C	12.9%
(5) Supermarket retail sales (+D)	12.50%	12.5%	(6) Ventas minoristas (+D)	9.09%	9.1%	(D) Manufacturing and trade sales	11.9%	D	10.9%
			(7) Construction index (+A +b)	9.09%					
(6) Cement consumption (+A +b)	12.50%	37.5% - (a & B)	(8) New vehicles' registrations (+B +a)	9.09%	45.5% - (A & B)	E Structural adjustments			
(7) New vehicles' registrations (+B +a)	12.50%		(9) Importations (+B)	9.09%					
(8) Tax revenues (+A)	12.50%		(10) GDP at market prices (+A)	9.09%					
			(11) Tax revenues (+A)	9.09%					
implicit weight	100.0%			100.0%			100.0%		

Source: Research and Services Center, *Bolsa de Comercio de Santa Fe (BCSF).*

By incorporating CICI as one over eight sub-indicators of the coincident composite index, we manage to reduce the relative weight of element C to 12.5%. In addition, the other elements simultaneously increase their relative importance. But it is imperative to recognise that each element's relative participation is not expected to be exactly the same in all coincident indexes. However, they should, at least, fluctuate within a similar range; unless studied geographical jurisdiction moves further away from a free open market economy. In order to emphasize this idea, Table 5 includes The Conference Board 2008's recalculated standardization factors.

4. The Cyclical Industrial Composite Index (CICI)'s extent and inclusion method.

Since many decades ago, secondary sector's relevance over economy has been ceding space to services. At this moment, the entire manufacturing sector doesn't explain more than 25% of total GO generated by a standard contemporary market economy. However, as we have observed, industry still owns a very important dragging effect based on its high intermediate consumption. In the province of Santa Fe, industrial inputs worth over 3 times total sector's generated VA. This strong link among other activities, has led us to discuss industrial production indexes' strict extent in order to study business cycles. For that reason, today's most used criterion in order to build up these composite indexes is based on the relative value added generated by industrial branches, as individual included components.

Along with the efforts of standardizing international practices, United Nations' recommendations on industrial production gauges, suggest[12] using Laspeyres' indexes; which are calculated by using physic units and <u>relative weights based on the proportional value added</u> generated by each considered branch. But, as we have shown in section 2, branches which generate a high level of value added don't necessarily demand big amounts of intermediate consumption. Therefore, their connection among economic activity isn't as important as it could. Besides, from a wider point of view, value added shouldn't be considered like a proper parameter of a desirable underlying social ethic. In one of his books titled "Pop Internationalism", Paul Krugman mentions this paradox in a sarcastic way by showing that tobacco industry is one of the top VA generating industrial branches in the US.

[12] See, International Recommendations for Industrial Statistics (IRIS), United Nations.

Anyways, he was actually expressing his critics against the demagogical use of the term "value added". All ideas set, we leave an open discussion for future works insisting on the fact that industrial cycles, in terms of economic activity, may not necessarily be equal to their physic volumes' performance or generated value added. But as we know, industrial production indexes are actually constructed following different purposes.

At this point, we must clarify that CICI doesn't pretend to replace any potential industrial production index for a sub-national jurisdiction. However, we believe it became a proper indicator in order to determine industrial cycles' performance in the province of Santa Fe; which results very important for our work, since we don't have any available alternative.

The seven selected industrial series are melted in one unique indicator, CICI, based on the same methodology aligned to the leading economic indicators' approach. But in this particular case, serving to a different cause: capturing cyclical industrial fluctuations. In fact, since long time ago, the approach has already been used to compute composite indexes that don't refer accurately to business cycles. Geoffrey H. Moore himself, for example, extended the leading economic indicators' approach to the field of prices, at the end of the 80s'. To sum up, he adapted the method in order to study inflation cycles. Nowadays, the methodology is being used to calculate a huge number of indicators related to heterogeneous themes. The Economic Cycle Research Institute (ECRI)'s complete index database[13] constitutes a clear example of the approach's potential. Some listed indicators, for instance, are related to prices, employment, industrial activity, services, among many others.

Being able to test other existing methodologies in order to aggregate series, using the approach upon industrial cycles has the same benefits we described when related to business cycles. After all, it happens to be an efficient mechanism for monitoring any kind of cyclical fluctuations based on groups of time series. Firstly, it allows us to aggregate series expressed with multiple units of measurement; and secondly, it's useful to handle relative weight problems and cyclical amplitude significant differences between sub-indicators.

In practical terms, we have chosen to generate CICI by 3 different alternatives: (1) constructing the indicator by strictly using The Conference Board's methodology (CICI-TCB); (2) calculating it using Jorrat's methodology without including trend adjustments (CICI-J1); and, (3) making use of the latter but adjusting it by the trend of Argentina's Industrial Production Index (IPI)[14] (CICI-J2).

One of the most outstanding observable differences between using either one or the other methodology is related to the composite indexes' amplitude and trend adjustments. The Conference Board's methodology doesn't need to assign any external amplitude, and trend adjustments are considered optional. On the contrary, Jorrat's methodology does require adjustments over its amplitude and the indexes' cyclical movement is computed without any trend. In order to evaluate business cycles (see methodological section), the coincident index for Argentina it's adjusted by GDP's amplitude and trend, mainly to match both indicators' long term growth. In our particular case, with the objective of measuring the province's industrial cycles, CICI-J was computed by using IPI's amplitude and trend, when adjustments were required.

4.1 Irrelevant choice: neutralization.

The first matter we needed to determine was based on the following question: What precise effect does the CICI generate over the coincident index, once it's included as sub-indicator? Taking into account that the ICASFe is produced with Jorrat's methodology, we analyze the effect of

[13] See http://www.businesscycle.com/resources/indexes/

[14] Composite index made by the *Fundación de Investigaciones Económicas Latinoamericanas (FIEL).* It provides monthly information about industrial production performance in a national level.

calculating the CICI by using three different alternatives (1: CICI-TCB; 2: CICI-J1 without trend; 3: CICI-J2 with IPI's trend).

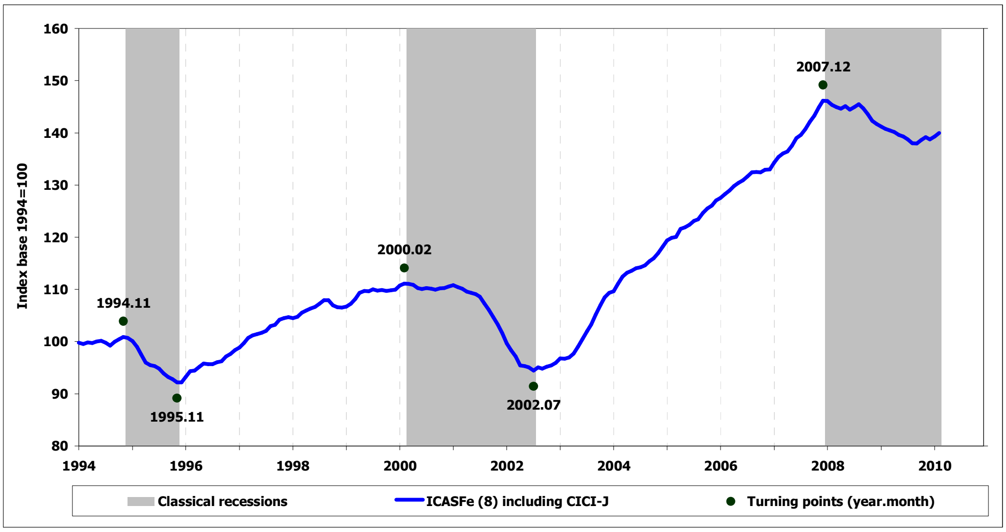
We began by testing the preliminary effects of including the CICI-J1 or the CICI-J2, and the final results were exactly the same. Our first conclusion is that both alternatives produce equal effects over the ICASFe. That's why we called it an irrelevant choice.

Under Jorrat's methodology, coincident indexes are built based on the average of included time series' monthly standardized logarithmic changes. Their trend, understood as the long term monthly relative variations, should always equal zero. In fact, this has to be so by definition. The trend component is isolated in the process. Standardized series present an average equal to 0 and a standard deviation equal to 1. Hence, if we adjust CICI-J1 with IPI's trend (step 6, Table 4) and afterwards we standardize it when ICASFe's calculations are done, in the end, we are neutralizing previous adjustment. In short, it turns to be completely indifferent to include CICI-J1 or CICI-J2 as sub-indicator.

4.2 ICASFe (8) including CICI-J[15] or CICI-TCB

At this point, the remaining alternative to test was the inclusion of CICI-TCB as a component. First of all, during ICASFe's standardization process CICI-TCB's trend is also isolated. However, we must remember that the latter one hasn't been put arbitrarily; it was autogenerated by CICI-TCB's calculation process. On the other hand, each methodology assigns different relative weights to their components. Therefore, using CICI-TCB or CICI-J1/J2 isn't indifferent.

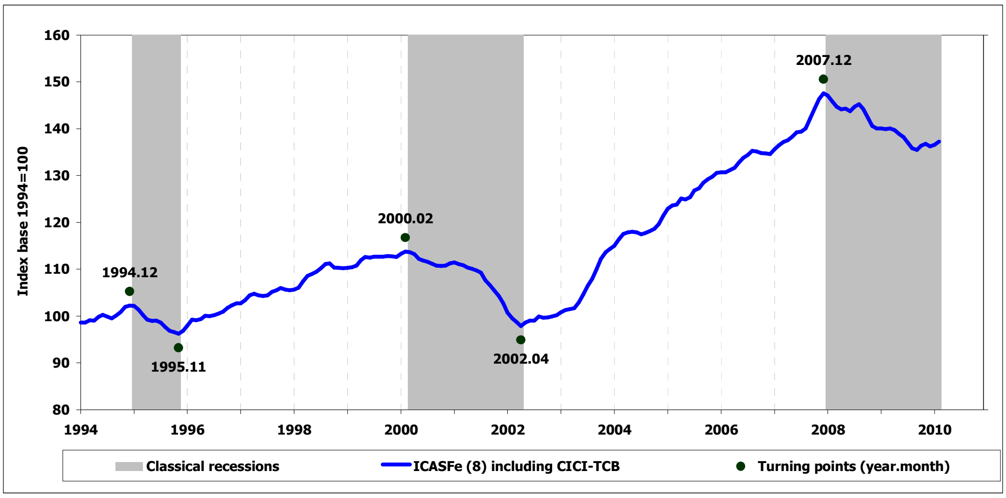
Figure 4 ICASFe (8) including CICI-J. Index base 1994=100.



Source: Research and Services Center, *Bolsa de Comercio de Santa Fe (BCSF).*

[15] Taking into account that including CICI-J1 or CICI-J2 is indifferent, from now on we use CICI-J in order to make reference to any of them.

Figure 5 ICASFe (8) including CICI-TCB. Index base 1994=100.



Source: Research and Services Center, *Bolsa de Comercio de Santa Fe (BCSF).*

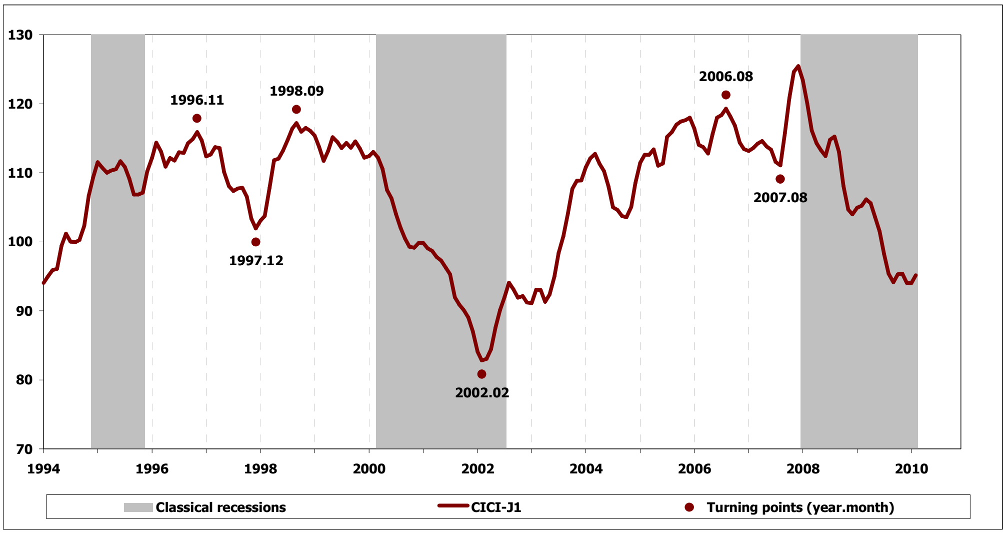
According to Figures 4 and 5, we list some observable differences between both indicators: (1) using CICI-TCB relocates ICASFe(8)'s fourth turning point, from 2002.07 to 2002.04. (2) Secondly, ICASFe(8) constructed with CICI-TCB turns to be rougher, but its cyclical phases acquire a more pronounced amplitude; which is very convenient to distinguish between turns and false signals. To our opinion, this particular property linked to TCB's methodology is extremely useful in order to study growth cycles. Especially, in countries where long term growth doesn't present significant deviations from trend since observable cycles are emphasised. In our case, those benefits are certainly minimal since, even though we work both approaches, the classical one still shows a better performance than growth cycles'. To tell the truth, Santa Fe's classical cycles are still clearly observable and, besides, since the indicator is too short (it begins about 15 years ago), it's really hard to calculate a stable trend in order to date deviations.

4.3 CICI-J and CICI-TCB as coincident series

In this last section we analyze CICI-J and CICI-TCB individually, as coincident time series. To this matter, we start by showing their graphic representation juxtaposed to the reference cycle (santafesinean classical expansions and recessions). Afterwards, we present a summary of statistics related to coincident cyclic properties, and finally, some correlations between the new industrial indicators and ICASFe are shown.

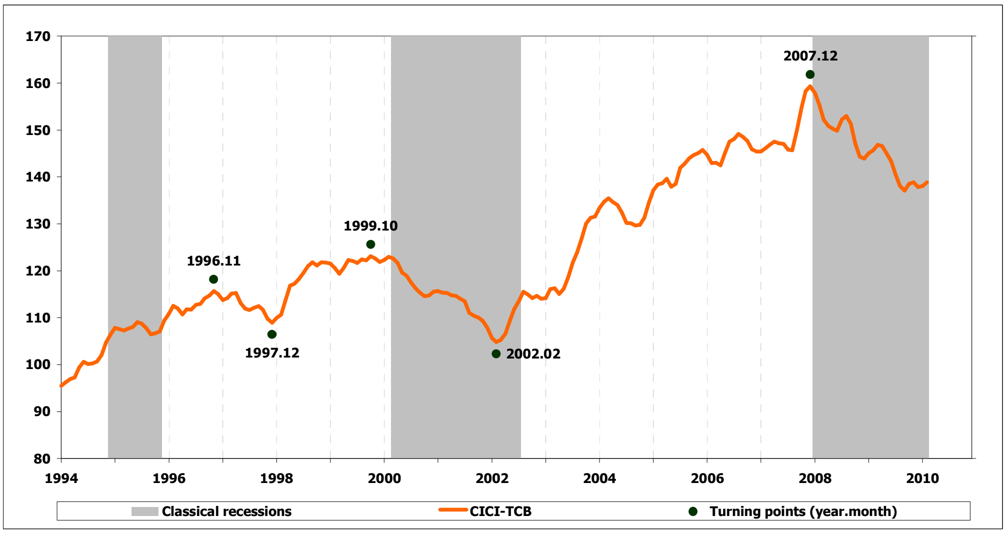
For all this set of comparisons, we decided to use only CICI-J's computation without trend. This is so, in order to avoid having to justify the selection of IPI during trend adjustments; which, after all, happens to be discretional. Anyway, as we've already explained, it finishes being neutralized because of standardization.

Figure 6 CICI-J1 (no trend). Index base 1994=100. Classical turning points.



Source: Research and Services Center, *Bolsa de Comercio de Santa Fe (BCSF).*

Figure 7 CICI-TCB. Index base 1994=100. Classical turning points.



Source: Research and Services Center, *Bolsa de Comercio de Santa Fe (BCSF).*

Considering that both composite indexes have been generated with the same components, Figures 6 and 7 show two industrial indicators with significant differences. The areas painted in grey represent santafesinean classical recessions (ICASFe's contraction phases). On the contrary, white areas represent its classical expansions. Both series' turning points, troughs and peaks, were established by using the Turning Point Determination (TPD) software.

CICI-J1, Figure 6, shows a total number of six turning points with two false signals. Temporally compared with ICASFe's turning points CICI-J1's have significant differences. Especially on the first three cases: 1996.11 (lagged), 1997.12 (lagged), 1998.09 (leaded). Misinformation is also a product of no trends adjustments. If so, the whole graphic would slightly rotate anticlockwise pivoting on its origin point (1994.01), and improving turning points location in terms of ICASFe's.

Figure 7 shows that TCB's methodology is more reliable than Jorrat's in terms of assigning proper turning points. This means that CICI-TCB, as an industrial indicator, allows a clearer visualization of manufacturing cycles in the province. It maximizes turning points' temporal correspondence and minimizes false signals. In this case, five turning points were determined without the presence of any false signal. Two of them also point out a lagged industrial phase (1996.11-1997.12), compared to general economic activity. In addition, by using this methodology no amplitude or trend adjustments need to be tested.

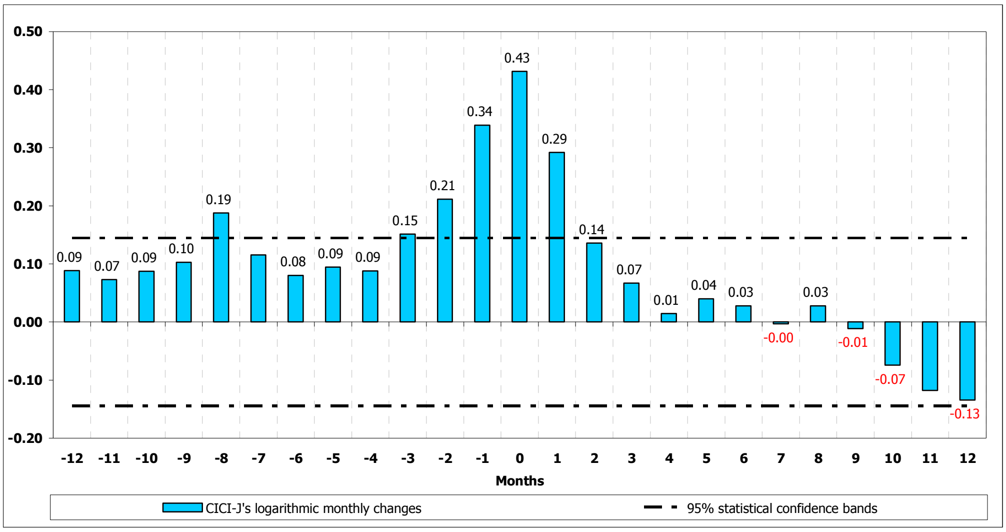
Table 7 CICI-J and CICI-TCB's turning points compared to ICASFe(8)'s. Leads and lags.

Reference cycle: ICASFe				CICI-J1						CICI-TCB					
Trough		Peak		Trough		Peak		Lead (-) or lag (+) months		Trough		Peak		Lead (-) or lag (+) months	
Year	Month	Year	Month	Year	Month	Year	Month	Trough	Peak	Year	Month	Year	Month	Trough	Peak
		1994	11			1996	11		24			1996	11		24
1995	11			1997	12			25		1997	12			25	
		2000	2			1998	9		-17			1999	10		-4
2002	7			2002	2			-5		2002	2			-5	
						2006	9		false signal						
				2007	8			false signal							
		2007	12									2007	12		0
Median (months)								10.0	3.5					10.0	0.0
Median of both, troughs and peaks								9.5						0.0	
Average (months)								10.0	3.5					10.0	6.7
Average of both, troughs and peaks								6.8						8.0	
Standard deviation (months)								21.2	29.0					21.2	15.1
Standard deviation of both								21.1						15.2	
Corresponding turs (%)								67%	67%					100%	100%
Average correspondence								67%						100%	

Source: Research and Services Center, *Bolsa de Comercio de Santa Fe (BCSF).*

Table 7 summarizes some comparative statistics between the reference cycle's turning points and both industrial indicators'. Based on these numerical results, CICI-TCB also presents better conditions than CICI-J in order to signal properly the province's industrial cycles.

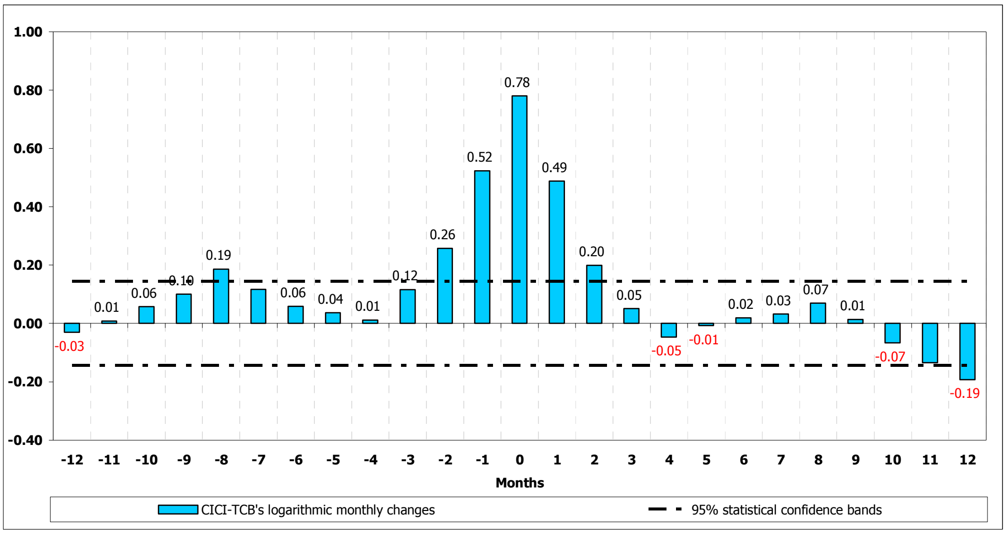
Figure 8 Correlations[16] between ICASFe(8) and CICI-J [12 lags and 12 leads].



Source: Research and Services Center, *Bolsa de Comercio de Santa Fe (BCSF).*

[16] CICI-J's monthly logarithmic changes were correlated against ICASFe(8)'s. Statistical bands refer to coefficients' significance. CICI-J was lagged (+) and leaded (-) 12 months in order to generate 25 variables. For Figure 8's calculations, ICASFe(8) was constructed using CICI-J. For Figure 9, ICASFe(8) was constructed with CICI-TCB.

Figure 9 Correlations between ICASFe(8) and CICI-TCB [12 lags and 12 leads].



Source: Research and Services Center, *Bolsa de Comercio de Santa Fe (BCSF).*

Figures 8 and 9 summarize the results of different correlations which were made to classify technically CICI-J and CICI-TCB, as cyclical indicators. The first set of correlations, shown in Figure 8, were calculated using ICASFe(8)'s monthly changes and CICI-J's. Figure 9 points out the same idea, but using ICASFe(8) and CICI-TCB. Statistically, most significant coefficients were determined on a range of (-2;+2 months), leaded/lagged variables. This implies that CICI-J and CICI-TCB are classified as extremely coincident indicators, in respect to the selected reference cycle. However, CICI-TCB has higher levels of significance over relevant coefficients.

5. Conclusions

The manufacturing sector is an important element in business cycles' research, especially when studies are headed by the leading economic indicators' approach. Generally, this element is internalised through an industrial production composite index. Most of them are built using the relative value added of included branches as main criterion in order to aggregate component series. However, other analogous indicators could be used.

Our work is linked to a regional environment, Santa Fe, a sub-national Argentinean jurisdiction which doesn't have any available industrial indicator published on monthly bases. This absence is shared with many others sub-national spaces all over the world, and generates an important practical problem in order to measure economic activity. In other terms, to monitor the province's business cycles by using a standard coincident composite index we needed to be able, somehow, to capture regional industrial cycles' flows.

Using the *Producto Bruto Geográfico* (PBG) and the National Economic Census (NEC) as main sources of information, we studied the santafesinean secondary sector's structure. Both indicators signal that most relevant industrial branches in the province are connected to the alimentary manufacturing sector. It actually generates about 50% of total industrial value added and 55% of all its intermediate consumption. Santa Fe is deeply connected to its agricultural sector and, therefore, industry logically takes possession of the possibilities that the surrounding resources offer. Finally, we determined a group of seven monthly sectorial series that proved to be representative of Santa Fe's industrial activity.

As a sub-product derived from studying the province's manufacturing activities, data suggested us an interesting idea. Using value added as parameter for relative weight assignations over components included into industrial indexes, doesn't seem to be the best choice for generating an industrial gauge to be incorporated into coincident economic indexes; at least, if external fixed weights are to be used to generate it. We believe that industry's cyclical movements in terms of economic activity are more connected to subjacent intermediate consumption than to each branches' generated value added. That's why despite the fact that services sector became the most important value added generator in contemporaneous economies; Industry still represents business cycles' main factor. Therefore, using gross output as parameter, presents a better connection between each industrial branch and general economic activity. Nevertheless, since this topic wasn't really part of our main objectives, we left the problem open for further investigations.

During the next section, the seven industrial representative series are included individually into the santafesinean coincident composite index (INITIAL METHOD). But this first way of capturing industrial flows implies a double disadvantage to its elements' implicit relative weights: it overestimates the relative importance of the manufacturing sector while damaging the others'. As a consequence, we resolved to include only one indicator by aggregating the seven representative series (AGGREGATIONAL METHOD). As a result, the coincident index can be calculated with only 8 sub-indicators instead of 14; and, what is more important, the problem among relative weights is resolved.

Although multiple aggregation methods could help us out with our purposes, we decided to use the leading economic indicators' approach. This is so, because: (1) using series expressed in different units of measurement is allowed; and, (2) implicit relative weights are determined in inverse accordance with the components' cyclical volatility. In order to compute practically the industrial indicator, we tested two alternatives. One, using the same methodology required to calculate ICASFe, shaped by an Argentinean professor, and the other, the internationally known methodology from The Conference Board. Moreover, we generated three different possibilities of a Cyclical Industrial Composite Index (CICI); (1) computing the indicator following strictly The Conference Board's methodology (CICI-TCB); (2) calculating it using Jorrat's methodology without adjustments (CICI-J1-No Trend); and, (3) adjusting CICI-J1 to IPI's trend (CICI-J2).

We started by comparing the implication of including either CICI-J1 or CICI-J2 into the coincident index. But choosing between these two options turned out to be completely irrelevant because their differences are neutralized during ICASFe's computation. Section 4.1 gives a detailed explanation in this matter.

Afterwards, we tested TCB's methodology generating CICI-TCB. As an ad-hoc industrial indicator, it allows a clearer visualization of manufacturing cycles in the province; spotting turning points' temporal correspondence more efficiently than CICI-J's. Besides, correlations' coefficients showed higher levels of significance than CICI-J, in reference to the coincident index. In addition, by using this methodology no amplitude or trend adjustments need to be tested. However, when included into the composite index CICI-TCB happens to generate more rugosity.

For the moment, we monthly upgrade both: CICI-J1 (no trend) and CICI-TCB. CICI-J1 is used as an individual component of ICASFe; which now enjoys the benefits of a better distribution over its elements' relative weights. CICI-TCB is used as gauge for monitoring industrial santafesinean cycles. At least until no other analogous indicator is produced. Nevertheless and, fortunately, all tests we've done signal that CICI-TCB is a consistent indicator in order to date industrial cycles.

Finally, it is important to recognise that we didn't have enough time to examine comparative bibliography in detailed. Doing that would have surely enriched our knowledge and opinions about our preliminary problems. Tests among intermediate consumption as parameter to assign relative weights during aggregation, also remains undone; and, it could lead to another set of results. The truth is that, this document was based on our experiences from daily work among the coincident composite index for Santa Fe, and for this reason, it wasn't strictly aligned with academic research. Overcoming these limitations sets us a challenge to fulfil in for further investigations.

References

Philip A. Klein (1990), Analyzing Modern Business Cycles, Armonk, N.Y: M.E. Sharpe.

Kajal Lahiri and Geoffrey H. Moore (1991), Leading economic indicators, Cambridge University Press.

Hernán Ortiz Molina (1996). *Linimientos generales para el diseño de un indicador del nivel de actividad industrial. FIEL*.

Martin Lucero (2000). *Los ciclos Industriales en Argentina: 1980-1999. Universidad de San Andres*.

The Conference Board (2001), Bussines Cycle Indicators Handbook.

Martín Lucero (2001). *Documento de Trabajo Nº 70, Reseña: Índice de Producción Industrial y sus ciclos. FIEL.*

Lakshman Achuthan and Anirvan Banerji (2004), Beating the Business Cycle, Currency Doubleday.

Juan Mario Jorrat (2005), *Construcción de índices compuestos mensuales coincidente y líder de Argentina*, *Progresos en econometría, Asociación Argentina de Economía Política (AAEP)*, p. 43-101.

D´Jorge, Cohan, Henderson and Sagua (2007). *Proceso de construcción del Índice Compuesto Coincidente Mensual de Actividad Económica de la Provincia de Santa Fe (ICASFe)". Centro de Estudios y Servicios de la Bolsa de Comercio de Santa Fe, AAEP.*

Ricardo Martínez and Fernando Medina (2007). *Metodología y estimación del índice de producción industrial de Jujuy. Publicación de Naciones Unidas.*