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Trade and Interdependence in Lebanon: An Interregional Input-Output Perspective

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Abstract

The main goal of this paper is to present the recent developments in the construction of an interregional input-output matrix for Lebanon (IIOM-LIBAN), in the context of the development of an interregional computable general equilibrium (ICGE) model for the country – "The ARZ Project". The understanding of the functioning of the Lebanese regional economies within an integrated system is one of the main goals of the ARZ Project. By exploring different methods of comparative structure analysis, it is hoped that this initial exercise will benefit from the complementarity among them, resulting in a better appreciation of the full dimensions of differences and similarities that exist among the governorates in Lebanon. The analysis suggests that there are some important differences in the internal structure of the regional economies in Lebanon and the external interactions among their different agents.

التجارة والاعتماد المتبادل في لبنان: تحليل المدخلات والمخرجات على أساس إقليمي

ادوارد حداد

ملخص

تهدف الورقة إلى عرض التطورات الحديثة في بناء مصفوفة المدخلات والمخرجات على أساس اقليمي في لبنان (IIOM–LIBAN) في إطار وضع نموذج للتوازن العام المحسوب (ICGE) – "مشروع ARZ". ويعتبر إستيعاب أداء اقتصاديات الأقاليم اللبنانية ضمن منظومة متكاملة هو أحد أهم أهداف المشروع، وذلك من خلال استكشاف طرق مختلفة للتحليل الهيكلي المقارن، ومن المأمول أن يؤدي هذا التحليل الأولي إلى الإستفادة من علاقات التكامل بين الأقاليم، مما يؤدي في النهاية إلى تقدير أفضل للأبعاد الكاملة لأوجه الإختلاف والتشابه بين المحافظات اللبنانية. يقترح التحليل أنه توجد بالفعل بعض الإختلافات الهامة في الهيكل الداخلي للاقتصادات الإقليمية في لبنان والتفاعلات الخارجية بين عواملها المختلفة.

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1. Introduction

This paper reports on the recent developments in the construction of an interregional input–output model for Lebanon (IIOM–LIBAN).[1] As part of a project that developed an interregional computable general equilibrium (ICGE) model for the country – "The ARZ Project" – a fully specified interregional input–output database was developed under conditions of limited information. Such database is needed for the calibration of the ICGE model. This project is part of an initiative involving researchers from the Regional and Urban Economics Lab at the University of São Paulo (NEREUS).

As claimed by Hulu and Hewings (1993, p. 135), analysts attempting to build regional models in developing countries are often confronted by the received wisdom that suggests that the task should be abandoned before it is initiated on two grounds. First, it is claimed that there is little interest in spatial development planning and spatial development issues in general, especially for small size countries.[2] Secondly, the quality and quantity of data are such that the end product is likely to be of dubious value.

This wisdom is partially challenged in this paper. The National Physical Plan of the Lebanese Territory (NPMPLT, 2005) reveals the interest by policymakers on regional issues in Lebanon. It defined the principles of developments for various regions as well as the basics of the usage of territory for all areas in the country. It also proposed facilities and sites of planned activities, specifying their objectives, dimensions and locations (NPMPLT, 2005, Introduction, p. 1). Though small, the Lebanese economy is not homogenous internally, presenting variations across sectors and regions. Thus, it is expected that the economic impact of economic policies will vary across different governorates (mohaafazaat). In the context of renewed attention to the spatial aspects of economic development, both from a theoretical perspective (Fujita and Krugman, 2004) and from a policy perspective (World Bank, 2009), there is a growing need for economic and socioeconomic models for bringing new insights into the process of regional planning in the country.

Regular publication of the Lebanon's national accounts since 2002 – starting with 1997 estimates (NEA, 2010) has also provided important inputs for models of the Lebanese economy.[3] To our knowledge, pioneering attempts to model the Lebanese economy are mostly related to accounting-based macro modeling frameworks (e.g. the RMSM-X model used by the World Bank), or national input–output and CGE models (Dessus and Ghaleb, 2006; Berthélemy et al., 2007; Hamade et al., 2011). Given the

challenge of economic development the country faces, simulation exercises are often trying to assess macro and sectoral impacts of competition policies in Lebanon. Using different sorts of national general equilibrium models, it has been shown that Lebanon would largely benefit from the reduction of anti-competitive practices (Dessus and Ghaleb, 2006); that additional GDP growth could be gained through public expenditure, greater domestic competition, and tax harmonization (Berthélemy et al., 2007); and that reductions in domestic trade margins in agricultural commodities are important mechanisms to tackle major agricultural problems Lebanon faces associated with its inefficient marketing channels (Hamade et al., 2011).

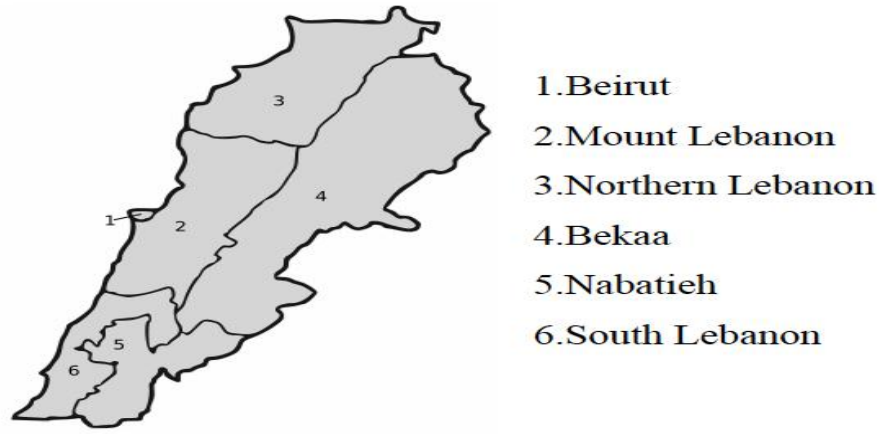
There are other government initiatives in Lebanon to promote competition whose ex ante impacts need to be properly assessed. Both non-spatial (e.g. trade liberalization, TFP-enhancing policies, sectoral policies) and place-based policies (e.g. investments in infrastructure) are expected to have differential regional impacts, as economic structures of regions vary, and the role of infrastructure and of business and community leaders also vary from region to region. There may also exist important trade-offs between efficiency and regional equity. Understanding the nature of these trade-offs requires to take into account the key linkages between regions using appropriate policy tools. In a context where the public administrations experience a stronger and stronger demand on social policy and security, and where budgets tend to be tightened or even scaled back, the economic evaluation – and optimization – of policy actions becomes a recurrent requirement.(4)

We do recognize that, at this stage, there are still data limitations. But do we wait until the data have improved sufficiently, or do we start with existing data, no matter how imperfect, and improve the database gradually? In this project, we have opted for the second alternative, following the advice by Agenor et al. (2007).

The IIOM-LIBAN provides an opportunity to better understand the spatial linkage structure associated with the Lebanese economy in the context of its six governorates (Figure 1). This paper describes the process by which the IIOM-LIBAN was constructed under the conditions of limited information that prevails in Lebanon, and uses this unique dataset to assess some structural features of the Lebanese economy, from a spatial perspective. The next section will describe the main tasks and working hypotheses involved in the treatment of the initial database that was used in the construction process of the system. Section 3 will explore the structural characteristics of the interregional input-output system developed for Lebanon for the year 2005. This

exploratory analysis will be based on the description of structural coefficients and the use of traditional input–output techniques. We further explore the spatial linkage structure by looking at the decomposition of final demand components. It is hoped that this exercise might result in a better appreciation of a broader set of dimensions that might improve our understanding of the integrated interregional economic system in Lebanon.

Figure (1): Governorates in Lebanon



2. Initial Data Treatment

In this section we present the main hypotheses and procedures applied to estimate the interregional input–output matrix for Lebanon. As mentioned before, the IIOM–LIBAN was estimated under conditions of limited information. We used data of the national accounts and regional statistics provided by the Central Administration of Statistics (CAS). National accounts data (NEA, 2010) consist in the Goods and Services Account and the Integrated Economic Accounts at the national level for the year 2005. Sources of regional data are mainly the National Survey of Households Living Conditions 2004, and the Household Expenditure Survey 2004–2005.

2.1. National Input-Output

The first step was to estimate an input–output matrix (Table 1) for the whole country from the goods and services input–output table available in the NEA (2010). The input–output tables for Lebanon are established according to the territorial concept.

Moreover, activities are homogenous in the sense that each activity produces a definite group of products and each group of products is produced only by this activity. The main aspect in the treatment of this piece of information is to transform the economic flows, which are valued at market prices, into economic flows valued at basic prices. The procedure adopted in this work is described as follows.

The initial task consisted in using the information on imports and trade margins to decompose each commodity flow related to a specific user into four components, namely: domestic ⟨BAS DOM⟩ and imported ⟨BAS IMP⟩ commodity flows values at "basic prices" which do not include user–specific trade margins; and the respective trade margin flows on each specific domestic ⟨MAR DOM⟩ and imported ⟨MAR IMP⟩ commodity flow. The initial working hypothesis is that total imports of agriculture and livestock, energy and water, and manufacturing are distributed proportionally to the share of each user in total demand for the respective commodity, generating the estimates for BAS IMP. Similarly, taxes on imports and trade margins were assumed to be proportionally distributed according to specific shares in total demand, giving estimates for TAX IMP ⟨import tariffs on each commodity flow, BAS IMP⟩, and the usage of trade margins for each user of composite imported and domestic goods ⟨MAR IMP + MAR DOM⟩. With that information, domestic commodity flows values at basic prices ⟨BAS DOM⟩ were calculated by residual. Finally, trade margins estimates, MAR DOM + MAR IMP, were further disaggregated proportionally to the specific flows in BAS DOM and BAS IMP. Such procedure generated the national input–output table at basic prices ⟨Table 2⟩ that served as the basis for the interregional input–output system for Lebanon. Notice that the input–output system depicted in Table 2 is fully consistent with the information in Table 1.

Table (1): Good and Services Input-Output Table for Lebanon, 2005
(in current prices)

billion LBP

	Intermediate uses								Final uses				TOTAL
	1	2	3	4	5	6	7	8	Final cons.	GFCF	Exports	Change in inventories	
1. Agriculture and livestock	167	0	1,262	2	0	3	0	0	2,197	20	340	-40	3,951
2. Energy and water	23	1,441	612	25	1,145	429	172	88	1,791	0	10	0	5,736
3. Manufacturing	279	127	3,532	1,810	22	721	307	148	12,073	2,263	3,599	-51	24,830
4. Construction	0	0	0	0	0	0	0	0	0	5,030	0	0	5,030
5. Transport and communication	5	9	84	26	697	758	358	23	2,907	0	203	0	5,070
6. Other services	58	31	413	371	199	355	697	1,371	9,851	0	441	0	13,787
7. Trade	0	0	0	0	0	0	0	0	0	0	917	0	917
8. Administration	0	0	0	0	0	0	0	0	5,029	0	0	0	5,029
Total uses	532	1,608	5,903	2,234	2,063	2,266	1,534	1,630	33,848	7,313	5,510	-91	64,350
Value added	1,675	-263	3,359	2,797	3,007	11,521	7,450	3,399					
Output	2,739	2,953	15,165	7,265	7,133	16,053	10,518	6,659					
Imports	851	3,209	9,577	0	0	0	0	0					
Taxes on imports	101	729	1,812	0	0	0	-2,643	0					
Trade margins	793	453	4,178	0	0	0	-5,425	0					
Total resources	4,484	7,344	30,732	7,265	7,133	16,053	2,450	6,659					

Source: NEA (2010)

Table〈2〉: "Raw" National Input-Output Table for Lebanon, 2005〈in basic prices〉

billion LBP

		Intermediate uses								Final uses					TOTAL
		1	2	3	4	5	6	7	8	Final consumption	GFCF	Exports	Change in inventories	〈-〉 Duty	
BAS DOM	1. Agriculture and livestock	94.0	0.0	710.2	1.1	0.0	1.7	0.0	0.0	1236.4	11.3	191.3	-40.0		2206.0
	2. Energy and water	5.4	337.9	143.5	5.9	268.5	100.6	40.3	20.6	420.0	0.0	2.3	0.0		1345.0
	3. Manufacturing	104.4	47.5	1322.2	677.6	8.2	269.9	114.9	55.4	4519.4	847.1	1347.3	-51.0		9263.0
	4. Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5030.0	0.0	0.0		5030.0
	5. Transport and communication	5.0	9.0	84.0	26.0	697.0	758.0	358.0	23.0	2907.0	0.0	203.0	0.0		5070.0
	6. Other services	58.0	31.0	413.0	371.0	199.0	355.0	697.0	1371.0	9851.0	0.0	441.0	0.0		13787.0
	7. Trade	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	917.0	0.0		917.0
	8. Administration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5029.0	0.0	0.0	0.0		5029.0
BAS IMP	1. Agriculture and livestock	39.8	0.0	301.0	0.5	0.0	0.7	0.0	0.0	524.1	4.8	81.1	0.0	-101.0	952.0
	2. Energy and water	15.8	989.3	420.2	17.2	786.1	294.5	118.1	60.4	1229.6	0.0	6.9	0.0	-729.0	3938.0
	3. Manufacturing	127.7	58.1	1616.7	828.5	10.1	330.0	140.5	67.7	5526.3	1035.9	1647.4	0.0	-1812.0	11389.0
	4. Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5. Transport and communication	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	6. Other services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	7. Trade	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	8. Administration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

continue ....

MAR DOM	1. Agriculture and livestock	23.3	0.0	176.1	0.3	0.0	0.4	0.0	0.0	306.6	2.8	47.4	0.0		556.9
	2. Energy and water	0.5	29.0	12.3	0.5	23.0	8.6	3.5	1.8	36.0	0.0	0.2	0.0		115.3
	3. Manufacturing	21.1	9.6	266.8	136.7	1.7	54.5	23.2	11.2	912.1	171.0	271.9	0.0		1879.6
	4. Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	5. Transport and communication	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	6. Other services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	7. Trade	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	8. Administration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
MAR IMP	1. Agriculture and livestock	9.9	0.0	74.6	0.1	0.0	0.2	0.0	0.0	130.0	1.2	20.1	0.0		236.1
	2. Energy and water	1.4	84.8	36.0	1.5	67.4	25.3	10.1	5.2	105.4	0.0	0.6	0.0		337.7
	3. Manufacturing	25.8	11.7	326.3	167.2	2.0	66.6	28.4	13.7	1115.2	209.0	332.5	0.0		2298.4
	4. Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	5. Transport and communication	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	6. Other services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	7. Trade	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	8. Administration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
VA	Value added	1675.0	−263.0	3359.0	2797.0	3007.0	11521.0	7450.0	3399.0						32945.0
GO	Output	2207.0	1345.0	9262.0	5031.0	5070.0	13787.0	8984.0	5029.0	33848.0	7313.0	5510.0	−91.0	−2642.0	97295.0

Source: Author's calculation

2.2. Regional Accounts

The next step was to disaggregate the national data into the six governorates in Lebanon. This section describes the strategy used to estimate regional aggregates by region, and regional output by sector.

Given the regional macroeconomic identity (1), the components of the Gross Regional Product (GRP) are the usual components of GDP (at the national level) plus the interregional trade balance. In the case of Lebanon, this information is not readily available and needed to be estimated.

$$GRP = C + I + G + \langle X - M \rangle_{ROW} + \langle X - M \rangle_{DOM} \quad (1)$$

where:

C = household consumption
I = investment demand
G = government consumption
$\langle X - M \rangle_{ROW}$ = international trade balance
$\langle X - M \rangle_{DOM}$ = interregional trade balance

We used shares calculated from specific variables to estimate the governorate-level values of the following components of GRP: household consumption, investment demand and government consumption.

Household consumption: estimates of individual expenditures from the Household Expenditure Survey 2004–2005 and total regional population (2004) were combined to obtain total expenditure by governorate. Regional shares in total expenditure were used to disaggregate national household consumption from NEA (2010).

Investment demand: information on regional employment in the construction sector, obtained from the National Survey of Households Living Conditions 2004, was used to disaggregate national investment from NEA (2010).

Government consumption: we have used the information on the regional distribution of labor force in the public sector (National Survey of Households Living Conditions 2004) to disaggregate national government consumption.

The values for international exports by governorate by product were obtained in two steps: i) 50% of the exports by product were allocated to the producing regions based on their respective shares in gross output; ii) the remaining 50% were allocated according to the relative concentration of sectoral production in each region as follows. We have used the regional distribution of sectoral employment in 2004 to calculate the location quotients for each region in comparison to the nation. For a given sector, we divided the region's share of the sector by the similar ratio at the national level. It was assumed that a location quotient greater than one would imply that part of the sector's production would be exported. To estimate gross exports, we assumed a location quotient of unity to imply "self-sufficiency"; any employment above this was allocated to export. Thus, we were able to allocate exports by sector (the remaining 50%) based on the regional allocation of the employment related to exports.

Table 3 presents the estimated shares, including those for international exports by governorate. A general result is the spatial concentration of aggregate demand, which is very likely influenced by the distribution of economic activity and population over the governorates. According to the estimates, the governorate of Mount Lebanon concentrates approximately half of the international exports and more than 40% of the investment demand, household consumption, and government consumption.

As this regional distribution allocation relies heavily on the employment information from the National Survey of Households Living Conditions 2004[5], one note should be made. As the survey responses are based on the households' place of residence, estimates for Beirut may potentially be underestimated. There is evidence of intense commuting flows from the suburbs located in the Mount Lebanon governorate towards the capital city. We decided not to try to correct for that, and to look at the results for both governorates with more cautious. Ideally, we would aggregate both governorates in a single region. However, for the sake of completeness, we kept both governorates as separate regions in the model. When analyzing model outcomes for Beirut and Mount Lebanon, though, it would be wiser to look at them in aggregate terms.

Table (3): Shares used to Estimate the Components of the GRP of Lebanon, 2004

	Investment demand	Housesold consumption	Government consumption	International exports
Beirut	0.043	0.162	0.087	0.106
Mount Lebanon	0.410	0.446	0.413	0.504
Northern Lebanon	0.173	0.129	0.220	0.219
Bekaa	0.082	0.108	0.137	0.067
South Lebanon	0.069	0.048	0.081	0.075
Nabatieh	0.223	0.108	0.062	0.029
TOTAL	1.000	1.000	1.000	1.000

Source: Author's calculation

Table (4): Shares used to Estimate the Regional Allocation of Gross Output in Lebanon, 2004

	Beirut	Mount Lebanon	Northern Lebanon	Bekaa	South Lebanon	Nabatieh	TOTAL
1. Agriculture and livestock	0.000	0.137	0.286	0.293	0.145	0.139	1.000
2. Energy and water	0.000	0.506	0.041	0.224	0.224	0.006	1.000
3. Manufacturing	0.086	0.532	0.166	0.087	0.091	0.037	1.000
4. Construction	0.077	0.396	0.211	0.096	0.131	0.089	1.000
5. Transport and communication	0.128	0.436	0.189	0.109	0.095	0.043	1.000
6. Other services	0.107	0.510	0.162	0.106	0.080	0.036	1.000
7. Trade	0.189	0.464	0.146	0.087	0.076	0.038	1.000
8. Administration	0.264	0.480	0.094	0.070	0.061	0.032	1.000
TOTAL	0.131	0.441	0.175	0.109	0.093	0.051	1.000

Source: Author's calculation based on CAS and Electricité du Liban

2.3. Commodity Trade Matrices

In order to regionalize the national IO table, we have relied on an adapted version of the Chenery-Moses approach (Chenery, 1956; Moses, 1955; Haddad et al., 2010), which assumes, in each region, the same commodity mixes for different users (producers, investors, households and government) as those presented in the national

input–output tables for Lebanon. Trade matrices for each commodity were estimated and used to disaggregate the origin of each commodity in order to capture the structure of the spatial interaction in the Lebanese economy. In order words, for a given user, say agriculture sector, the mix of intermediate inputs will be the same in terms of its composition, but it will differ from the regional sources of supply (considering the six regions of the model and foreign imports).

The strategy for estimating the eight trade matrices (one for each commodity in the system) included the following steps:

i. We have initially estimated total supply (output) of each commodity/sector by region, excluding international exports. Thus, for each region, we obtained information for the total sales of each commodity for the domestic markets.

   Supply(c,s) = supply for the domestic markets of commodity c by region s

ii. Following that, we have estimated total demand, in each region, for the aforementioned eight commodities/sectors. To do that, we have assumed the respective users' structure of demand followed the national pattern. With the regional levels of sectoral production, investment demand, household demand and government demand, we have estimated the initial values of total demand for each commodity in each region, from which the demand for imported commodities were deducted. The resulting estimates, which represent the regional total demand for Lebanese goods, were then adjusted so that, for each commodity, demand across regions equals supply across regions.

   Demand(c,d) = demand of commodity c by region d

iii. With the information for Supply(c,s) and Demand(c,d), the next step was to estimate, for each commodity c, matrices of trade (6x6) representing the transactions of each commodity between Lebanese regions. We have fully relied on the methodology described in Dixon e Rimmer (2004). The procedure considered the following steps:

   a) For the diagonal cells, equation (2) was implemented, while for the off-diagonal elements, equation (3) is the relevant one:

$$SHIN(c,d,d) = Min\left\{\frac{Supply(c,d)}{Demand(c,d)},1\right\} * F(c) \quad (2)$$

$$SHIN(c,o,d) = \left\{\frac{1}{Dist(o,d)} \cdot \frac{Supply(c,o)}{\sum_{k=1}^{6} Supply(c,k)}\right\} * \left\{\frac{1 - SHIN(c,d,d)}{\sum_{j=1,j\neq d}^{6}\left[\frac{1}{Dist(j,d)} \cdot \frac{Suply(c,j)}{\sum_{k=1}^{6} Suply(c,k)}\right]}\right\} \quad (3)$$

where c refers to a given commodity, and o and d represent, respectively, origin and destination regions.

The variable Dist〈o,d〉 refers to the distance between two trading regions and was obtained considering the urban hierarchy in the country 〈Verdeil et al., 2007〉. The accessibility focal points were defined as the highest hierarchy city in each governorate, namely: Beirut, Zahleh, Tripoli, Baalbek, Saïda, and Nabatieh. Distances between any two points were calculated using the road distance that provided the minimum travel time by car.(6)

The factor F〈c〉 gives the extent of tradability of a given commodity. For the non-tradables 〈"construction", "transport and communication", and "other services"〉, typically assumed to be locally provided goods, we have used the value of 0.9 for F〈c〉, adopting a usual assumption, while for tradables 〈"agriculture and livestock", "energy and water", and "manufacturing"〉, the value of F〈c〉 was set to 0.5. "Trade" was considered only as a margin commodity, while we have assumed that there is no trade flows associated with "administration".

It can be shown that the column sums in the resulting SHIN matrices add to one. What these matrices show are the supply-adjusted shares of each region in the specific commodity demand by each region of destination. Once these share coefficients were calculated, we then distributed the demand of commodity c by region d 〈Demand〈c,d〉〉 across the corresponding columns of the SHIN matrices. Once we adopted this procedure, we had to further adjust the matrices to make sure that supply and demand balance. This was done through a RAS procedure.

Tables 5 and 6 show the resulting structure of trade in the IIOM-LIBAN (aggregated across commodities). We have also included regional demand for imported commodities (last row), estimated considering the structure of demand according to the national pattern.

Table (5): Estimates of Interregional Trade in Lebanon: Purchases Shares, 2005

		Destination						TOTAL
		Beirut	Mount Lebanon	Northern Lebanon	Bekaa	South Lebanon	Nabatieh	
Origin	Beirut	0.404	0.038	0.027	0.014	0.044	0.076	0.086
	Mount Lebanon	0.192	0.522	0.102	0.302	0.119	0.195	0.336
	Northern Lebanon	0.066	0.046	0.552	0.041	0.028	0.046	0.120
	Bekaa	0.014	0.075	0.023	0.341	0.010	0.016	0.078
	South Lebanon	0.058	0.026	0.016	0.010	0.444	0.164	0.069
	Nabatieh	0.012	0.009	0.005	0.004	0.036	0.235	0.031
	Foreign	0.254	0.284	0.275	0.288	0.318	0.267	0.280
	TOTAL	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Source: Author's calculation

Table (6): Estimates of Interregional Trade in Lebanon: Sales Shares, 2005

		Destination						TOTAL
		Beirut	Mount Lebanon	Northern Lebanon	Bekaa	South Lebanon	Nabatieh	
Origin	Beirut	0.618	0.201	0.046	0.018	0.036	0.082	1.000
	Mount Lebanon	0.075	0.704	0.044	0.098	0.025	0.054	1.000
	Northern Lebanon	0.072	0.171	0.668	0.037	0.016	0.035	1.000
	Bekaa	0.023	0.434	0.043	0.474	0.009	0.018	1.000
	South Lebanon	0.111	0.172	0.034	0.015	0.448	0.219	1.000
	Nabatieh	0.051	0.130	0.025	0.013	0.080	0.700	1.000
	Foreign	0.120	0.459	0.143	0.112	0.079	0.088	1.000
	TOTAL	0.132	0.452	0.145	0.109	0.070	0.092	1.000

Source: Author's calculation

2.4. Value Added Components

Lebanese national accounts only publish total value added by sector. In order to have a first order approximation of disaggregated sectoral value added (labor and capital payments plus other costs), we started with estimates for sectoral labor payments at the national level. Information on the mean of annual salary and distribution of employees by sector from Household Expenditure Survey 2004–2005 was used to estimate labor payments for agriculture and livestock, manufacturing, construction, transport and communication, and trade. For energy and water, total labor payments considered total number of employees in Electricité du Liban multiplied by the mean of annual salary of public employees; for other services and administration, we applied the 1997 labor share in value added to the 2005 value.

At this stage, we needed to estimate sectoral capital payments. We have relied on the sectoral ratios of labor to capital payments from the 1997 input–output system for Lebanon in order to get these estimates. After calibration, we ended up with an overall share of labor payments to value added equal to 0.371, and a share of capital payments to value added equal to 0.443. The remaining 0.186 was residually allocated to other costs.

2.5. The Interregional Input-Output Adjustment System (IIOAS)

To calibrate the interregional CGE model, further adjustments were made in the IIOM–LIBAN. We have opted to internalize the information of changes in inventories in order to generate a structural absorption matrix based on the 2004–2005 information. The process of re–balancing the input–output system ended up with a reconciled national system (Table 7) presenting small deviations from that of the "raw" national input–output table for Lebanon depicted in Table 2.

In the next section, we continue to evaluate the general structure of the IIOM–LIBAN, described in terms of summary indicators. An evaluation of the production linkages follows, based on the intermediate consumption flows, providing a brief comparative analysis of the economic structure of the regions. Traditional input–output methods are used in an attempt to uncover similarities and differences in the structure of the regional economies.

Table (7): "Calibrated" National Input-Output Table for Lebanon, 2004-2005
(in 2005 basic prices)

billion LBP

		INTERMEDIATE USES								FINAL USES				(-) Duty	TOTAL
		1	2	3	4	5	6	7	8	HH CONSUMPTION	GFCF	GOVERNMENT	FOREIGN EXPORTS		
BAS DOM	1. Agriculture and livestock	93.43	0.00	706.10	1.12	0.00	1.68	0.00	0.00	1229.34	11.34	0.00	191.30	0.00	2234.30
	2. Energy and water	5.40	337.87	143.51	5.86	268.48	100.59	40.33	20.65	419.97	0.00	0.00	2.30	0.00	1344.95
	3. Manufacturing	104.09	47.38	1317.39	675.13	8.20	268.91	114.49	55.18	4503.15	855.07	0.00	1347.40	0.00	9296.40
	4. Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5095.45	0.00	0.00	0.00	5095.45
	5. Transport and communication	5.00	9.00	84.00	26.00	696.97	758.00	358.00	23.00	2907.00	0.00	0.00	202.90	0.00	5069.87
	6. Other services	58.00	31.00	412.99	371.00	198.99	355.00	697.00	1371.08	9851.00	0.00	0.00	441.00	0.00	13787.06
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	917.00	0.00	917.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5028.90	0.00	0.00	5028.90
BAS IMP	1. Agriculture and livestock	40.37	0.00	305.08	0.48	0.00	0.72	0.00	0.00	531.16	4.90	0.00	81.10	-101.00	862.81
	2. Energy and water	15.80	989.25	420.18	17.14	786.07	294.51	118.07	60.46	1229.63	0.00	0.00	6.90	-729.00	3209.01
	3. Manufacturing	128.11	58.31	1621.46	830.97	10.10	330.99	140.91	67.92	5542.55	1052.43	0.00	1647.40	-1812.00	9619.16
	4. Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5. Transport and communication	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6. Other services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

continue ....

		INTERMEDIATE USES								FINAL USES				(-) Duty	TOTAL
		1	2	3	4	5	6	7	8	HH CONSUMPTION	GFCF	GOVERNMENT	FOREIGN EXPORTS		
MAR DOM	1. Agriculture and livestock	23.18	0.00	175.13	0.28	0.00	0.42	0.00	0.00	304.80	2.8	0.0	47.40	0.00	554.03
	2. Energy and water	0.46	28.97	12.30	0.51	23.01	8.63	3.46	1.76	36.00	0.00	0.00	0.20	0.00	115.30
	3. Manufacturing	20.98	9.55	265.86	136.23	1.66	54.29	23.13	11.16	908.77	172.56	0.00	271.90	0.00	1876.08
	4. Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5. Transport and communication	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6. Other services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MAR IMP	1. Agriculture and livestock	10.02	0.00	75.67	0.12	0.00	0.18	0.00	0.00	131.70	1.21	0.00	20.10	0.00	239.00
	2. Energy and water	1.34	84.82	36.00	1.49	67.38	25.27	10.14	5.14	105.40	0.00	0.00	0.60	0.00	337.59
	3. Manufacturing	25.82	11.75	327.23	167.67	2.04	66.81	28.47	13.74	1118.53	212.39	0.00	332.50	0.00	2306.95
	4. Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5. Transport and communication	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6. Other services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	LABR Labor paymments	305.00	58.10	1210.50	517.20	905.40	3790.30	1691.00	2827.90						11305.4
	CPTL Capital payments	564.50	27.73	1448.84	621.42	1602.96	4295.92	4909.56	0.00						13470.9
	OCTS Othe costs tickets	832.80	-348.79	734.15	1722.83	498.60	3434.84	-1788.62	570.90						5656.7
	VA Value added	1702.30	-262.95	3393.50	2861.45	3006.97	11521.06	4811.95	3398.80						30433.1
	GO Output	2234.30	1344.95	9296.40	5095.45	5069.87	13787.06	6345.95	5028.90	28819.00	7408.16	5028.90	5510.00	-2642.00	92326.93

Source: Author's calculation

3. Structural Analysis

In this section, some of the main structural features of the economy of Lebanon are revealed through the use of indicators derived from the IIOM–LIBAN. An analysis of output composition, and sales and purchases shares is presented, considering intermediate demand and final demand. To better understand the results of the ICGE model to be developed, a thorough analysis of the structure of the economy is needed. A close inspection of the benchmark database is necessary, conducted not only on the relationships in the input–output data base, but also on the other relevant parameters of the model. In this section, some of the main structural features of the economy are revealed through the use of indicators derived from the IIOM–LIBAN. These indicators draw on the idea developed by Chenery and Watanabe (1958), which states that a hierarchy of sectors can be proposed based on ratios of intermediate purchases to total input, and intermediate sales to total output.

3.1. Output Composition

Table 8 presents the regional output shares for governorates in Lebanon. The economic core Beirut–Mount Lebanon dominates the national production, with an aggregate share of 57.6.0% in total output (12.1% and 45.5%, respectively).

The regional output shares by sectors in Lebanon reveal some evidence of spatial concentration of specific activities: agriculture in Bekaa (29.3% of total output) and Northern Lebanon (28.6%); energy in Mount Lebanon (50.6%) Bekaa (22.4%) and South Lebanon (22.4%); and manufacturing in Mount Lebanon (53.2%).

Table 9 shows the sectoral shares in regional output, revealing the important role of some activities in relatively specialized regions: the dominant role of other services in Beirut (45.4% of total regional output); the relevance of the agriculture sector in Bekaa (12.6%) and Nabatieh (12.4%).

Relative regional specialization can also be assessed by the calculation of the sectoral location quotients, as presented in Table 10. The highlighted cells identify sectors relatively concentrated in specific regions, i.e. sectors for which their share in total regional output is greater than the respective shares in national output (location quotient greater than unit).

Table ⟨8⟩: Regional Structure of Sectoral Output: Lebanon, 2004–2005

	Beirut	Mount Lebanon	Northern Lebanon	Bekaa	South Lebanon	Nabatieh	TOTAL
1. Agriculture and livestock	0.000	0.137	0.286	0.293	0.145	0.139	1.000
2. Energy and water	0.000	0.506	0.041	0.224	0.224	0.006	1.000
3. Manufacturing	0.086	0.532	0.166	0.087	0.091	0.037	1.000
4. Construction	0.078	0.464	0.187	0.086	0.119	0.066	1.000
5. Transport and communication	0.107	0.510	0.162	0.106	0.080	0.036	1.000
6. Other services	0.192	0.465	0.144	0.086	0.076	0.038	1.000
7. Trade	0.160	0.405	0.190	0.093	0.076	0.076	1.000
8. Administration	0.087	0.413	0.220	0.137	0.081	0.062	1.000
TOTAL	0.121	0.455	0.172	0.108	0.092	0.052	1.000

Source: Author's calculation based on IIOM–LIBAN

Table ⟨9⟩: Sectoral Structure of Regional Output: Lebanon, 2004–2005

	Beirut	Mount Lebanon	Northern Lebanon	Bekaa	South Lebanon	Nabatieh	TOTAL
1. Agriculture and livestock	0.000	0.014	0.077	0.126	0.073	0.124	0.046
2. Energy and water	0.000	0.031	0.007	0.058	0.068	0.003	0.028
3. Manufacturing	0.137	0.225	0.186	0.156	0.192	0.138	0.193
4. Construction	0.068	0.108	0.115	0.084	0.138	0.134	0.106
5. Transport and communication	0.093	0.118	0.099	0.103	0.092	0.073	0.105
6. Other services	0.454	0.292	0.239	0.227	0.236	0.208	0.286
7. Trade	0.173	0.117	0.145	0.113	0.109	0.195	0.132
8. Administration	0.075	0.095	0.133	0.133	0.092	0.125	0.104
TOTAL	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Source: Author's calculation based on IIOM–LIBAN

Table (10): Location Quotients: Lebanon, 2004–2005

	Beirut	Mount Lebanon	Northern Lebanon	Bekaa	South Lebanon	Nabatieh
1. Agriculture and livestock	0.000	0.302	1.660	2.716	1.579	2.685
2. Energy and water	0.000	1.112	0.237	2.071	2.441	0.114
3. Manufacturing	0.712	1.168	0.965	0.809	0.995	0.717
4. Construction	0.640	1.020	1.086	0.798	1.301	1.268
5. Transport and communication	0.884	1.120	0.939	0.978	0.872	0.691
6. Other services	1.587	1.021	0.834	0.795	0.825	0.727
7. Trade	1.316	0.890	1.101	0.859	0.831	1.478
8. Administration	0.718	0.907	1.276	1.272	0.883	1.197

Source: Author's calculation based on IIOM–LIBAN

3.2. Sales Shares

For each commodity/sector, the distribution of sales was calculated based on the different destinations of output. Sales–orientation indicators are very important in the discussion of the ICGE model's results, since changes in different markets will have differential impact on producers' decisions. Thus, for instance, an export–oriented sector will be more affected by changes in external demands than a sector that sells all its production locally.

Tables 11 shows the sales structure for each sector in the six governorates. Regional aggregated results, presented at the bottom of each table, reveal important features of the regional economies. For Mount Lebanon, Northern Lebanon and South Lebanon, the relative higher share of sales to intermediate production within the region suggests a higher degree of intraregional linkages, which might generate potentially higher internal multipliers (see section 3.4.1 below). The lower values presented by Nabatieh, Bekaa and Beirut suggest a less integrated regional structure in those regions.

The share of total extra–regional sales (intermediate, capital creation and household) reflects the degree of interregional dependency of each region, from the point of view of demand from the other regions. Thus, the values for the South Lebanon (46.62%), Bekaa (41.64%), Beirut (32.14%), Northern Lebanon (23.86%), Mount Lebanon (23.15%) and Nabatieh (21.15%) establish a hierarchy of interregional dependency within the country. However, when exports to other countries are

considered, the governorates of Nabatieh (15.36%), Bekaa (14.80%) and Northern Lebanon (14.60%) reveal a greater orientation for its sales.

At the sectoral level, sales–orientation varies within the region. Extra–regional markets for manufacturing inputs account for a large share of these sectors' sales in Beirut, for instance. Energy inputs produced in Bekaa and South Lebanon also find a considerable share of their demand outside the respective producing regions. Capital creation within the region tends to be the main user of regional construction. Destination of the regional construction output for capital creation within the respective regions account for 77.96% in Nabatieh, 57.70% in Northern Lebanon, and 54.47% in Mount Lebanon. The main destination of agriculture and livestock produced in Bekaa is outside the region, being for purposes of production (32.07%), household consumption (45.93%) or exports (10.46%).

Regarding the sales to households within the regions, a common pattern appears in that most services are produced locally. Export–oriented commodities in each region include trade services (trade margins are not considered in the calculations) everywhere, and manufacturing goods in Mount Lebanon, and, to a lesser extent, agriculture products in Bekaa and Nabatieh.

3.3. Purchases Shares

The analysis of the purchase structure of different users in the six regions is provided in this section, focusing on the regional sources of commodities (regional, rest of the country, foreign). These indicators are useful for the future analysis of regional substitution effects in the ICGE model's results.

Table 12 shows the purchase structure of intermediate inputs used in current production, of inputs used in capital creation, and of household consumption goods, as well as the aggregate consumption. Notice that foreign import coefficients by commodity are assumed to be equal across users. Again, an interregional dependency pattern appears in the analysis of the use of inputs from intraregional and extraregional sources: 49.94% of total intermediate inputs used by industries in the Northern Lebanon (43.95% in Mount Lebanon)

Table 〈11〉: Sales Structure, by User and Destination: Lebanon, 2004-2005
〈in % of total sales〉

		Intermediate		Capital creation		Household		Exports	Government
		Regional	Rest of Lebanon	Regional	Rest of Lebanon	Regional	Rest of Lebanon		
Beirut	1. Agriculture and livestock	-	-	-	-	-	-	-	-
	2. Energy and water	-	-	-	-	-	-	-	-
	3. Manufacturing	7.89	20.45	1.21	7.06	24.15	31.99	7.25	0.00
	4. Construction	0.00	0.00	14.65	85.35	0.00	0.00	0.00	0.00
	5. Transport and communication	29.90	6.30	0.00	0.00	50.61	11.19	2.00	0.00
	6. Other services	12.50	6.07	0.00	0.00	54.95	18.89	7.59	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Mount Lebanon	1. Agriculture and livestock	21.27	16.25	0.25	0.20	29.94	27.81	4.27	0.00
	2. Energy and water	39.10	30.17	0.00	0.00	15.93	14.63	0.18	0.00
	3. Manufacturing	15.01	10.56	4.37	3.66	24.97	20.55	20.88	0.00
	4. Construction	0.00	0.00	54.47	45.53	0.00	0.00	0.00	0.00
	5. Transport and communication	33.12	5.11	0.00	0.00	46.03	9.81	5.93	0.00
	6. Other services	21.47	3.43	0.00	0.00	61.82	10.73	2.56	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Northern Lebanon	1. Agriculture and livestock	15.89	21.46	0.21	0.26	17.36	36.73	8.09	0.00
	2. Energy and water	44.05	23.08	0.00	0.00	21.52	11.17	0.18	0.00
	3. Manufacturing	19.00	13.69	5.97	4.38	23.56	26.15	7.25	0.00
	4. Construction	0.00	0.00	57.70	42.30	0.00	0.00	0.00	0.00
	5. Transport and communication	36.49	6.59	0.00	0.00	43.19	11.73	2.00	0.00
	6. Other services	31.30	2.04	0.00	0.00	58.20	6.85	1.60	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00

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		Intermediate		Capital creation		Household		Exports	Government
		Regional	Rest of Lebanon	Regional	Rest of Lebanon	Regional	Rest of Lebanon		
Bekaa	1. Agriculture and livestock	4.46	32.07	0.05	0.39	6.63	45.93	10.46	0.00
	2. Energy and water	16.72	54.06	0.00	0.00	5.63	23.43	0.17	0.00
	3. Manufacturing	8.48	22.35	2.28	6.80	15.55	37.30	7.25	0.00
	4. Construction	0.00	0.00	25.09	74.91	0.00	0.00	0.00	0.00
	5. Transport and communication	30.39	7.35	0.00	0.00	49.07	11.19	2.00	0.00
	6. Other services	22.07	4.89	0.00	0.00	56.99	14.46	1.60	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
South Lebanon	1. Agriculture and livestock	10.85	24.10	0.11	0.42	8.20	48.49	7.83	0.00
	2. Energy and water	23.34	42.22	0.00	0.00	3.78	30.50	0.17	0.00
	3. Manufacturing	14.25	16.62	3.16	8.86	11.40	38.46	7.25	0.00
	4. Construction	0.00	0.00	26.29	73.71	0.00	0.00	0.00	0.00
	5. Transport and communication	35.66	9.15	0.00	0.00	30.60	22.59	2.00	0.00
	6. Other services	27.50	5.55	0.00	0.00	40.48	24.87	1.60	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Nabatieh	1. Agriculture and livestock	7.73	23.30	0.49	0.26	25.98	31.71	10.53	0.00
	2. Energy and water	18.30	36.66	0.00	0.00	33.12	11.92	0.00	0.00
	3. Manufacturing	9.57	14.15	12.67	3.58	32.55	20.24	7.24	0.00
	4. Construction	0.00	0.00	77.96	22.04	0.00	0.00	0.00	0.00
	5. Transport and communication	17.51	3.66	0.00	0.00	71.85	4.98	1.99	0.00
	6. Other services	14.09	1.86	0.00	0.00	77.90	4.55	1.60	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
	Beirut	11.40	7.35	1.38	8.06	39.40	16.74	6.73	8.95
	Mount Lebanon	16.89	5.77	7.70	6.43	33.66	10.95	7.99	10.61
	Northern Lebanon	17.69	6.02	8.51	6.25	26.35	11.59	8.99	14.60
	Bekaa	12.26	13.96	2.76	8.29	24.08	19.40	4.45	14.80
	South Lebanon	16.21	10.87	4.61	12.93	16.79	22.82	5.73	10.04
	Nabatieh	8.05	6.92	15.08	4.28	35.97	9.95	4.39	15.36

Source: Author's calculation based on IIOM–LIBAN

in current production are provided from regional industries, only 14.17% come from the rest of the country (16.13% in Mount Lebanon), and 35.85% are imported (39.92% in Mount Lebanon). The situation changes completely for Nabatieh, whose industries consume only 22.06% of intermediate inputs from the region, and 42.07% and 35.86% from the rest of the country and from abroad, respectively. Even though Beirut depends relatively less on foreign inputs (33.97% of expenditures on intermediate inputs), that region still has a considerable link with the rest of the country, from where 29.48% of the intermediate inputs are purchased. A similar situation appears in the case of the use of inputs for capital creation.

Results for the regional composition of the consumption bundle of households, by commodity in each region, are also presented. The aggregated regional results, at the bottom of the table, reveal a similar pattern of consumption for families at the less developed region of Nabatieh, in which commodities from the rest of the country have a considerable weight (46.26%). Over 50% of the goods consumed by households in the Mount Lebanon, Northern Lebanon and South Lebanon are produced in the respective regions. However, commodity composition varies across regions, revealing region-specific preferences and regional availability of certain goods. For transport and communication, and other services, a common pattern is observed (except in Nabatieh); for these commodities/sectors over 60% of supply are from within the regions.

Table 〈12〉: Purchases Shares, by Commodity, User and Source: Lebanon, 2004-2005
〈in % of total consumption〉

		Intermediate			Capital creation			Household		Total		
		Regional	Rest of Lebanon	Foreign	Regional	Rest of Lebanon	Foreign	Regional	Foreign	Regional	Rest of Lebanon	Foreign
Beirut	1. Agriculture and livestock	0.00	69.83	30.17	0.00	69.83	30.17	0.00	30.17	-	69.83	30.17
	2. Energy and water	0.00	25.46	74.54	0.00	0.00	0.00	0.00	74.54	-	25.46	74.54
	3. Manufacturing	11.93	32.90	55.17	11.93	32.90	55.17	11.93	55.17	11.93	32.90	55.17
	4. Construction	0.00	0.00	0.00	26.61	73.39	0.00	0.00	0.00	26.61	73.39	0.00
	5. Transport and communication	58.56	41.44	0.00	0.00	0.00	0.00	58.56	0.00	58.56	41.44	0.00
	6. Other services	91.53	8.47	0.00	0.00	0.00	0.00	91.53	0.00	91.53	8.47	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mount Lebanon	1. Agriculture and livestock	11.69	58.14	30.17	11.69	58.14	30.17	11.69	30.17	11.69	58.14	30.17
	2. Energy and water	14.73	10.73	74.54	0.00	0.00	0.00	14.73	74.54	14.73	10.73	74.54
	3. Manufacturing	27.54	17.29	55.17	27.54	17.29	55.17	27.54	55.17	27.54	17.29	55.17
	4. Construction	0.00	0.00	0.00	61.43	38.57	0.00	0.00	0.00	61.43	38.57	0.00
	5. Transport and communication	91.69	8.31	0.00	0.00	0.00	0.00	91.69	0.00	91.69	8.31	0.00
	6. Other services	90.11	9.89	0.00	0.00	0.00	0.00	90.11	0.00	90.11	9.89	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

continue ....

		Intermediate			Capital creation			Household		Total		
		Regional	Rest of Lebanon	Foreign	Regional	Rest of Lebanon	Foreign	Regional	Foreign	Regional	Rest of Lebanon	Foreign
Northern Lebanon	1. Agriculture and livestock	49.01	20.82	30.17	49.01	20.82	30.17	49.01	30.17	49.01	20.82	30.17
	2. Energy and water	5.57	19.89	74.54	0.00	0.00	0.00	5.57	74.54	5.57	19.89	74.54
	3. Manufacturing	28.20	16.63	55.17	28.20	16.63	55.17	28.20	55.17	28.20	16.63	55.17
	4. Construction	0.00	0.00	0.00	62.91	37.09	0.00	0.00	0.00	62.91	37.09	0.00
	5. Transport and communication	94.82	5.18	0.00	0.00	0.00	0.00	94.82	0.00	94.82	5.18	0.00
	6. Other services	91.08	8.92	0.00	0.00	0.00	0.00	91.08	0.00	91.08	8.92	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bekaa	1. Agriculture and livestock	22.88	46.95	30.17	22.88	46.95	30.17	22.88	30.17	22.88	46.95	30.17
	2. Energy and water	9.52	15.94	74.54	0.00	0.00	0.00	9.52	74.54	9.52	15.94	74.54
	3. Manufacturing	11.65	33.18	55.17	11.65	33.18	55.17	11.65	55.17	11.65	33.18	55.17
	4. Construction	0.00	0.00	0.00	25.98	74.02	0.00	0.00	0.00	25.98	74.02	0.00
	5. Transport and communication	83.80	16.20	0.00	0.00	0.00	0.00	83.80	0.00	83.80	16.20	0.00
	6. Other services	63.44	36.56	0.00	0.00	0.00	0.00	63.44	0.00	63.44	36.56	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Lebanon	1. Agriculture and livestock	31.35	38.48	30.17	31.35	38.48	30.17	31.35	30.17	31.35	38.48	30.17
	2. Energy and water	14.33	11.13	74.54	0.00	0.00	0.00	14.33	74.54	14.33	11.13	74.54
	3. Manufacturing	20.02	24.80	55.17	20.02	24.80	55.17	20.02	55.17	20.02	24.80	55.17
	4. Construction	0.00	0.00	0.00	44.67	55.33	0.00	0.00	0.00	44.67	55.33	0.00
	5. Transport and communication	88.71	11.29	0.00	0.00	0.00	0.00	88.71	0.00	88.71	11.29	0.00
	6. Other services	89.15	10.85	0.00	0.00	0.00	0.00	89.15	0.00	89.15	10.85	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

continue ....

		Intermediate			Capital creation			Household		Total		
		Regional	Rest of Lebanon	Foreign	Regional	Rest of Lebanon	Foreign	Regional	Foreign	Regional	Rest of Lebanon	Foreign
Nabatieh	1. Agriculture and livestock	42.59	27.24	30.17	42.59	27.24	30.17	42.59	30.17	42.59	27.24	30.17
	2. Energy and water	1.49	23.97	74.54	0.00	0.00	0.00	1.49	74.54	1.49	23.97	74.54
	3. Manufacturing	10.39	34.43	55.17	10.39	34.43	55.17	10.39	55.17	10.39	34.43	55.17
	4. Construction	0.00	0.00	0.00	23.19	76.81	0.00	0.00	0.00	23.19	76.81	0.00
	5. Transport and communication	41.63	58.37	0.00	0.00	0.00	0.00	41.63	0.00	41.63	58.37	0.00
	6. Other services	38.11	61.89	0.00	0.00	0.00	0.00	38.11	0.00	38.11	61.89	0.00
	7. Trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Beirut	36.55	29.48	33.97	22.56	62.38	15.06	45.46	27.86	42.09	29.15	28.77
	Mount Lebanon	43.95	16.13	39.92	52.10	32.83	15.06	56.29	27.86	51.55	18.16	30.29
	Northern Lebanon	49.97	14.17	35.85	53.44	31.49	15.06	59.19	27.86	54.83	16.48	28.69
	Bekaa	30.88	28.19	40.94	22.08	62.86	15.06	39.73	27.86	34.66	34.30	31.04
	South Lebanon	38.90	17.79	43.31	37.94	46.99	15.06	54.02	27.86	44.30	22.09	33.62
	Nabatieh	22.06	42.07	35.86	19.76	65.18	15.06	25.88	27.86	23.47	51.39	25.14

Source: Author's calculation based on IIOM–LIBAN

3.4. Production and Interregional Linkages

The indicators described above are based on interdependence ratios of the IIOM–LIBAN, which only measure the direct linkages among agents in the economy. In this section, a comparative analysis of regional economic structures is carried out. Production linkages between sectors are considered through the analysis of the intermediate inputs portion of the interregional input–output database. Both the direct and indirect production linkage effects of the economy are captured by the adoption of different methods based on the evaluation of the Leontief inverse matrix. The purpose remains the comparison of economic structures rather than an evaluation of the methods of analysis themselves.

The conventional input–output model is given by the system of matrix equations:

$$x = Ax + f \qquad (4)$$

$$x = (I-A)^{-1}f = Bf \qquad (5)$$

where x and f are respectively the vectors of gross output and final demand; A consists of input coefficients a_{ij} defined as the amount of product i required per unit of product j (in monetary terms), for i, j = 1,…, n; and B is known as the Leontief inverse.

Let us consider systems (4) and (5) in an interregional context, with R different regions, so that:

$$x = \begin{bmatrix} x^1 \\ \vdots \\ x^R \end{bmatrix}; A = \begin{bmatrix} A^{11} & \cdots & A^{1R} \\ \vdots & \ddots & \vdots \\ A^{R1} & \cdots & A^{RR} \end{bmatrix}; f = \begin{bmatrix} f^1 \\ \vdots \\ f^R \end{bmatrix}; \text{ and } B = \begin{bmatrix} B^{11} & \cdots & B^{1R} \\ \vdots & \ddots & \vdots \\ B^{R1} & \cdots & B^{RR} \end{bmatrix} \qquad (6)$$

and

$$x^1 = B^{11}f^1 + \ldots + B^{1R}f^R$$

$$\vdots$$

$$x^R = B^{R1}f^1 + \ldots + B^{RR}f^R \qquad (7)$$

Let us also consider different components of f, which include demands originating in the specific regions, v^{rs}, s = 1,…, R, and abroad, e. We obtain information of final demand from origin s in the IIOM–LIBAN, allowing us to treat v as a matrix which provides the monetary values of final demand expenditures from the domestic regions in Lebanon and from the foreign region.

$$v = \begin{bmatrix} v^{11} & \cdots & v^{1R} \\ \vdots & \ddots & \vdots \\ v^{R1} & \cdots & v^{RR} \end{bmatrix}; \; e = \begin{bmatrix} e^{1} \\ \vdots \\ e^{R} \end{bmatrix}$$

Thus, we can re–write ⟨7⟩ as:

$$x^{1} = B^{11}[\langle V\rangle^{11} + \ldots + v^{R1}+e^{1}\rangle + \ldots+B^{1R}[\langle V]^{1R}+\ldots+V^{RR}+e^{R}\rangle$$

$$\vdots$$

$$x^{R} = B^{R1}[\langle V\rangle^{11} + \ldots + v^{R1}+e^{1}\rangle + \ldots+B^{RR}[\langle V]^{1R}+\ldots+V^{RR}+e^{-}\rangle \qquad \langle 8\rangle$$

With ⟨8⟩, we can then compute the contribution of final demand from different origins on regional output. It is clear from ⟨8⟩ that regional output depends, among others, on demand originating in the region, and, depending on the degree of interregional integration, also on demand from outside the region.

In what follows, interdependence among sectors in different regions is considered through the analysis of the complete intermediate input portion of the interregional input–output table. The Leontief inverse matrix, based on the system ⟨7⟩, will be considered, and some summary interpretations of the structure of the economy derived from it will be provided.

3.4.1. Multiplier Analysis

The column multipliers derived from B were computed ⟨see Miller and Blair, 2009⟩. An output multiplier is defined for each sector j, in each region r, as the total value of production in all sectors and in all regions of the economy that is necessary in order to satisfy a dollar's worth of final demand for sector j's output. The multiplier effect can be decomposed into intraregional ⟨internal multiplier⟩ and interregional ⟨external multiplier⟩ effects, the former representing the impacts on the outputs of sectors within the region where the final demand change was generated, and the latter showing the impacts on the other regions of the system ⟨interregional spillover effects⟩.

Table 13 shows the intraregional and interregional shares for the average total output multipliers in the six governorates in Lebanon as well as the equivalent shares for the direct and indirect effects of a unit change in final demand in each sector in each region net of the initial injection, i.e., the total output multiplier effect net of the initial change. The entries are shown in percentage terms, providing insights into the degree of dependence of each region on the other regions. Three groups of regions emerge. Mount Lebanon, Northern Lebanon and South Lebanon are the most self-sufficient regions; the average flow-on effects from a unit change in sectoral final demand is in excess of 90%. The average net effect almost reaches 70% for Mount Lebanon and is a little above 64% for Northern Lebanon and South Lebanon. For the more specialized governorates of Beirut (services) and Bekaa (agriculture), there is a lower degree of intraregional self-sufficiency: the intraregional share of the net output multiplier is below 50% in both regions. Finaly, Nabatieh is the governorate with the lowest degree of self-sufficiency, as it internalizes, on average, one fourth of the net output multiplier.

Table (13): Regional Percentage Distribution of the Average Total and Net Output Multipliers: Lebanon, 2004-2005

	Total output multiplier		Net output multplier	
	Intraregional share	Interregional share	Intraregional share	Interregional share
Beirut	89.5	10.5	49.9	50.1
Mount Lebanon	93.4	6.6	69.5	30.5
Northern Lebanon	92.1	7.9	64.2	35.8
Bekaa	88.1	11.9	47.0	53.0
South Lebanon	91.9	8.1	64.1	35.9
Nabatieh	83.7	16.3	25.5	74.5

Source: Author's calculation based on IIOM-LIBAN

3.4.2. Output Decomposition

A complementary analysis to the multiplier approach is presented in this section. Regional output is decomposed by taking into account not only the multiplier structure, but also the structure of final demand in the six domestic and the foreign regions (Sonis et al., 1996).

According to equation (8), regional output (for each region) was decomposed, and the contributions of the components of final demand from different areas were calculated. The results are presented in Table 14. On average, the self-generated component of output in each region, i.e., the share of output generated by demand within the region, is dominant (above 50% of total regional output) for all the governorates, with the exception of South Lebanon (38.9%).

The demand for foreign exports is more relevant for Mount Lebanon (10.2%) and Northern Lebanon (11.8%). Their contribution to regional output is below the national average (9.6%) in the other governorates.[7]

Noteworthy is the prominent role played by the demand originating in the more dynamic area of Mount Lebanon, with a relevant contribution to the output of other governorates ranging from 9.4% (Nabatieh) to 32.1% (Bekaa).

It is worthwhile examining Table 14 in more detail in order to unravel spatial patterns of interactions in Lebanon. Inspection of the results in the columns suggests strong influence of regions at higher hierarchical levels on their immediate neighbors. In addition to the role played by demand from Mount Lebanon for output generation in all regions, we can also note the influence of Nabatieh on South Lebanon: 25.0% of the output of South Lebanon depends on final demand from Nabatieh.

A closer look at the final demand composition of Nabatieh, which generates not only a considerable share of the regional output (73.7%) but also of South Lebanon's output (25.0%), reveals that it is dominated by expenditures in investment demand, as the region was the second main recipient of investments (after Beirut–Mount Lebanon) in the benchmark year (2004–2005). Expenditures in the local construction sector of Nabatieh are responsible for the high share of contribution to the region's output.

One can also look at the results from equation (8) from a perspective of the relative relevance of regional final demand. That is, one may be interested in evaluating the distribution of the effects of each source of demand on the output of a specific region. For instance, while over 75% of the impact of final demand originating in Mount Lebanon

remains in the region, less than one-third (31.9%) of the impact of final demand from Nabatieh is internalized by the governorate, suggesting strong interregional leakages.

Table (14): Contribution of the Sources of Final Demand to Regional/National Output: Lebanon, 2004-2005
((in % of total contribution to regional/national output))

	Regional sources of final demand						
	Beirut	Mount Lebanon	Northern Lebanon	Bekaa	South Lebanon	Nabatieh	Exports
Beirut	57.7	16.4	4.0	1.8	2.7	9.2	8.2
Mount Lebanon	5.4	64.7	3.9	7.4	1.7	6.7	10.2
Northern Lebanon	5.1	13.4	61.1	2.9	1.2	4.4	11.8
Bekaa	2.8	32.1	3.9	50.1	0.8	3.0	7.3
South Lebanon	8.5	14.5	3.2	1.6	38.9	25.0	8.3
Nabatieh	3.7	9.4	2.0	1.2	4.4	73.7	5.7
LEBANON	11.2	39.1	13.9	9.8	5.3	11.1	9.6

Source: Author's calculation based on IIOM-LIBAN

Table (15): Contribution of the Sources of Final Demand to National Output: Lebanon, 2004-2005 (in % of total contribution to national output)

	Regional sources of final demand						
	Beirut	Mount Lebanon	Northern Lebanon	Bekaa	South Lebanon	Nabatieh	Exports
Beirut	58.6	4.8	3.3	2.1	5.7	9.4	9.8
Mount Lebanon	21.8	75.5	12.7	34.5	15.0	27.4	48.8
Northern Lebanon	8.1	6.1	78.1	5.3	4.1	7.1	22.0
Bekaa	2.7	8.9	3.0	55.9	1.7	3.0	8.3
South Lebanon	7.2	3.5	2.2	1.6	69.4	21.2	8.2
Nabatieh	1.6	1.2	0.7	0.6	4.0	31.9	2.9
LEBANON	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Author's calculation based on IIOM-LIBAN

3.4.3. Key Sector Analysis

An attempt to identify key sectors in the regional economies of Lebanon is made in this subsection. Traditional complementary approaches are used in order to reveal particular regional production features. They include the Hirschman–Rasmussen indices and the pure linkage indices. While the familiar Hirschman–Rasmussen indices measure the importance of a sector in the economy in terms of its purchases (backward) or sales (forward) of inputs from/to other sectors, the pure linkage approach also takes into consideration the total production value of each sector in the economy, i.e., the size of the sector. The sectors indicated as the most important inside the economy, using the pure linkage approach, in general are sectors with not only relevant interactions with the other sectors, but also with a significant level of production. The presentation of each of these techniques, accompanied by the empirical results, follows.

Hirschman- Rasmussen Indices

Rasmussen (1956) and Hirschman (1958) proposed the use of two indices to capture the effects of backward and forward linkages in an economy through the use of input–output tables. Let b_{ij} be a typical element in the Leontief inverse, B. Define $b_{.j}$, $b_{i.}$, and $b_{..}$ as the column, row, and total sums of B, respectively. Further, define $B^* = b_{..}/n^2$ as the average value of all elements in the same matrix. Then, the backward linkage index, U_j, and the forward linkage index, U_i, can be calculated by:

$$U_j = \frac{b_{.j}/n}{B^*} \qquad (9)$$

$$U_i = \frac{b_{i.}/n}{B^*} \qquad (10)$$

where n is the number of sectors. In U_j, the numerator is the average value of the elements in column j, while in U_i, the numerator is the average value of the elements in row i. Thus, interpretation of both indices is straightforward: $U_j > 1$ indicates that a unit change in final demand of sector j creates an above–average increase in the economy, i.e., sector j generates above–average response in other sectors; $U_i > 1$ indicates that a unit change in all sector's final demand creates an above–average increase in sector i, i.e., sector i displays above–average dependence on the output of other sectors. Sectors that have both $U_j > 1$ and $U_i > 1$ are considered key sectors in the economy.

Pure Linkage Indices

As presented in Guilhoto, Sonis and Hewings (2005), the pure linkage approach can be used to measure the importance of the sectors in terms of production generation in the economy.

Consider a two-region input-output system represented by the following block matrix, A, of direct inputs:

$$A = \begin{bmatrix} A^{jj} & A^{jr} \\ A^{rj} & A^{rr} \end{bmatrix} = \begin{bmatrix} A^{jj} & A^{jr} \\ A^{rj} & \mathbf{0} \end{bmatrix} + \begin{bmatrix} \mathbf{0} & \mathbf{0} \\ \mathbf{0} & A^{rr} \end{bmatrix} = A^{j} + A^{r} \qquad (11)$$

Where A^{jj} and A^{rr} are the square matrices of direct inputs within the first and second region, and A^{jr} and A^{rj} are the rectangular matrices showing the direct inputs purchased by the second region, and vice-versa.

From (11), one can generate the following expression:

$$B = (\mathbf{I} - A)^{-1} = \begin{pmatrix} B^{jj} & B^{jr} \\ B^{rj} & B^{rr} \end{pmatrix} = \begin{pmatrix} \Delta^{jj} & \mathbf{0} \\ \mathbf{0} & \Delta^{rr} \end{pmatrix} \begin{pmatrix} \Delta^{j} & \mathbf{0} \\ \mathbf{0} & \Delta^{r} \end{pmatrix} \begin{pmatrix} I & A^{jr}\Delta^{r} \\ A^{rj}\Delta^{j} & I \end{pmatrix} \qquad (12)$$

where:

$$\Delta^{j} = \left(I - A^{jj}\right)^{-1}$$
$$\Delta^{r} = \left(I - A^{rr}\right)^{-1}$$
$$\Delta^{jj} = \left(I - \Delta^{j} A^{jr} \Delta^{r} A^{rj}\right)^{-1}$$
$$\Delta^{rr} = \left(I - \Delta^{j} A^{rj} \Delta^{j} A^{jr}\right)^{-1}$$

From equation (12) it is possible to reveal the process of production in an economy as well as to derive the Pure Backward Linkage (PBL) and the Pure Forward Linkage (PFL), i.e.,

$$PBL = \Delta^{r} A^{rj} \Delta^{j} x^{j} \qquad (13)$$

$$PFL = \Delta^{j} A^{jr} \Delta^{r} x^{r} \qquad (14)$$

The following interpretation of the indices may be provided: the PBL will give the pure impact on the economy of the value of the total production in sector j, i.e., the impact that is free from the demand of inputs that sector j makes from sector j, and the feedback from the economy to sector j, and vice–versa; the PFL will give the pure impact on sector j of the total production in the rest of the economy. Furthermore, the definition of pure total linkage 〈PTL〉 is given by the addition of the PBL to the PFL. Hence, in this approach, key sectors are considered as those with the largest values of PTL.

$$PTL = PBL + PFL \qquad (15)$$

To facilitate a comparative analysis of the pure linkage indices with the Hirschman–Rasmussen indices, one can proceed with a normalization of the pure linkage indices. This normalization is done by dividing the pure linkage index in each sector by the average value of the pure linkage indices for the whole economy, in such a way that the normalized pure linkage indices are given by the following equations for the backward 〈NPBL〉, forward 〈NPFL〉 and total 〈NPTL〉 linkages:

$$PBLN_i = PBL_i \Big/ \left(\sum_{i=1}^{n} PBL_i \Big/ n \right) \qquad (16)$$

$$PFLN_i = PFL_i \Big/ \left(\sum_{i=1}^{n} PFL_i \Big/ n \right) \qquad (17)$$

$$PTLN_i = PTL_i \Big/ \left(\sum_{i=1}^{n} PTL_i \Big/ n \right) \qquad (18)$$

Key Sectors in Lebanon

Backward and forward Hirschman–Rasmussen linkage indices were calculated for each of the eight sectors in each governorate in Lebanon 〈Table 16〉. Key sectors for each region are highlighted in the table. Ten key sectors were identified: manufacturing in Beirut; energy and water, manufacturing, and transport and communication in Mount Lebanon; manufacturing, and transport and communication in Northern Lebanon; energy and water in Bekaa; and energy and water, manufacturing, and transport and communication in South Lebanon.

In addition to the estimates of U_j and U_i, Table 16 also shows the results from the computation of the pure linkage indices. From the values obtained for the PTL, a hierarchy of the sectors can be established, from which the key sectors are selected (see also Figure 2). Manufacturing, and other services in Mount Lebanon are the sectors with the largest PTLs. Other sectors with large PTL include other services in Beirut; construction, transport and communication, and administration in Mount Lebanon; and manufacturing and other services in Northern Lebanon. These are the dominant sectors in the sense that they contribute significantly to changes in the level of the national output of the Lebanese economy.

Finally, Table 16 presents the results for the normalized pure linkage indices. As noticed, the pure linkage indices adds to the Hirschman–Rasmussen indices in that they also take into consideration the importance of the values supplied and demanded by each economic sector. Thus, the hierarchy of key sectors based on the normalized pure linkage indices changes slightly: while some sectors with strong backward and forward linkages but with relatively low levels of output leave the list (e.g. energy and water in Mount Lebanon; transport and communication in Northern Lebanon energy and water in Bekaa; and energy and water, and transport and communication in south Lebanon), other sectors with higher levels of output become part of the list (e.g. other services in Beirut; other services in Mount Lebanon; and manufacturing in Bekaa).

Figure (2): Pure Total Linkage for the Lebanese Interregional System

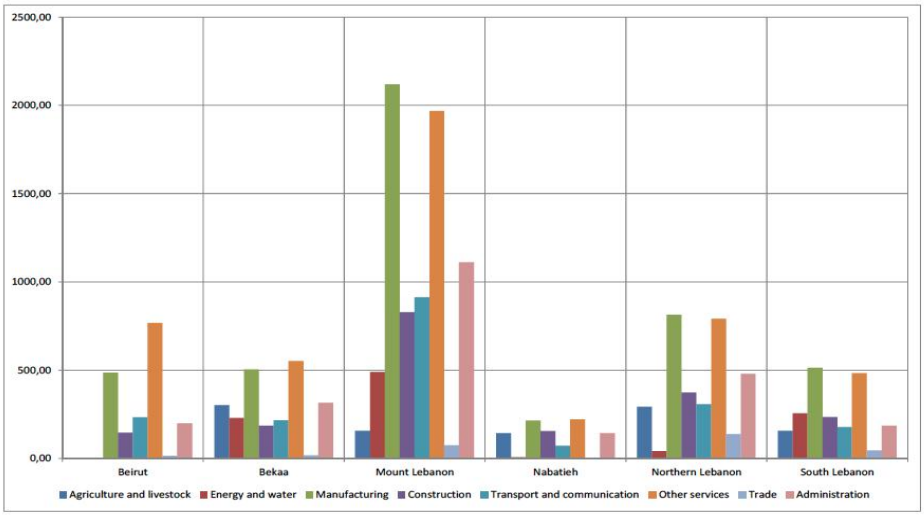

Table (16): Hirschman–Rasmussen, Pure Linkage and Normalized Pure Linkage Indices for the Lebanese Interregional System

		Hirschman-Rasmussen		Pure Linkage			Pure Linkage (normalized)		
		Backward	Forward	Backward	Forward	Total	Backward	Forward	Total
Beirut	1. Agriculture and livestock	-	-	-	-	-	-	-	-
	2. Energy and water	-	-	-	-	-	-	-	-
	3. Manufacturing	1.075	1.006	245.86	240.41	486.26	1.188	1.291	1.237
	4. Construction	1.001	-	145.62	0.00	145.62	0.704	0.000	0.370
	5. Transport and communication	1.025	0.981	97.64	135.96	233.60	0.472	0.730	0.594
	6. Other services	0.896	1.390	280.61	487.57	768.18	1.356	2.618	1.954
	7. Trade	0.934	-	14.47	0.00	14.47	0.070	0.000	0.037
	8. Administration	1.053	-	199.55	0.00	199.55	0.964	0.000	0.508
Mount Lebanon	1. Agriculture and livestock	0.903	0.882	37.27	119.02	156.29	0.180	0.639	0.398
	2. Energy and water	1.139	1.733	67.98	422.46	490.44	0.329	2.268	1.247
	3. Manufacturing	1.075	1.847	1172.40	946.98	2119.38	5.666	5.085	5.391
	4. Construction	0.970	-	827.31	0.00	827.31	3.998	0.000	2.104
	5. Transport and communication	1.025	1.297	359.92	553.03	912.95	1.739	2.970	2.322
	6. Other services	0.896	1.654	687.25	1281.61	1968.86	3.321	6.882	5.008
	7. Trade	0.984	-	75.41	0.00	75.41	0.364	0.000	0.192
	8. Administration	1.053	-	1111.50	0.00	1111.50	5.372	0.000	2.827
Northern Lebanon	1. Agriculture and livestock	0.903	1.002	59.66	232.95	292.61	0.288	1.251	0.744
	2. Energy and water	1.138	0.884	8.90	32.54	41.44	0.043	0.175	0.105
	3. Manufacturing	1.075	1.236	348.42	465.46	813.87	1.684	2.499	2.070
	4. Construction	1.029	-	372.97	0.00	372.97	1.802	0.000	0.949
	5. Transport and communication	1.025	1.127	91.45	215.89	307.34	0.442	1.159	0.782
	6. Other services	0.896	1.331	168.07	623.33	791.41	0.812	3.347	2.013
	7. Trade	0.969	-	138.31	0.00	138.31	0.668	0.000	0.352
	8. Administration	1.053	-	480.17	0.00	480.17	2.321	0.000	1.221

continue ....

		Hirschman-Rasmussen		Pure Linkage			Pure Linkage (normalized)		
		Backward	Forward	Backward	Forward	Total	Backward	Forward	Total
Bekaa	1. Agriculture and livestock	0.903	0.943	73.57	228.37	301.94	0.356	1.226	0.768
	2. Energy and water	1.139	1.196	40.37	188.99	229.36	0.195	1.015	0.583
	3. Manufacturing	1.075	0.988	247.42	256.47	503.89	1.196	1.377	1.282
	4. Construction	1.027	-	186.20	0.00	186.20	0.900	0.000	0.474
	5. Transport and communication	1.025	1.053	76.23	140.66	216.88	0.368	0.755	0.552
	6. Other services	0.896	1.171	125.93	425.79	551.73	0.609	2.286	1.403
	7. Trade	1.002	-	17.62	0.00	17.62	0.085	0.000	0.045
	8. Administration	1.053	-	315.90	0.00	315.90	1.527	0.000	0.803
South Lebanon	1. Agriculture and livestock	0.903	0.923	33.94	123.56	157.50	0.164	0.663	0.401
	2. Energy and water	1.139	1.402	37.91	218.00	255.91	0.183	1.171	0.651
	3. Manufacturing	1.075	1.148	218.15	295.08	513.23	1.054	1.584	1.305
	4. Construction	1.023	-	234.35	0.00	234.35	1.133	0.000	0.596
	5. Transport and communication	1.025	1.126	48.65	129.37	178.02	0.235	0.695	0.453
	6. Other services	0.896	1.402	89.70	393.05	482.75	0.433	2.111	1.228
	7. Trade	1.017	-	45.65	0.00	45.65	0.221	0.000	0.116
	8. Administration	1.053	-	186.36	0.00	186.36	0.901	0.000	0.474
Nabatieh	1. Agriculture and livestock	0.903	0.928	32.24	110.61	142.85	0.156	0.594	0.363
	2. Energy and water	1.138	0.812	1.85	5.29	7.13	0.009	0.028	0.018
	3. Manufacturing	1.075	0.925	107.18	107.28	214.46	0.518	0.576	0.545
	4. Construction	1.078	-	155.46	0.00	155.46	0.751	0.000	0.395
	5. Transport and communication	1.025	0.888	42.05	30.37	72.42	0.203	0.163	0.184
	6. Other services	0.896	0.982	65.29	156.64	221.93	0.316	0.841	0.564
	7. Trade	0.889	-	3.19	0.00	3.19	0.015	0.000	0.008
	8. Administration	1.053	-	142.62	0.00	142.62	0.689	0.000	0.363

4. Final Remarks

The main goal of this paper was to present the recent developments in the construction of an interregional input–output matrix for Lebanon (IIOM–LIBAN). The understanding of the functioning of the Lebanese regional economies within an integrated system is one of the main goals of the ARZ Project. By exploring different methods of comparative structure analysis, it is hoped that this initial exercise benefited from the complementarity among them, resulting in a better appreciation of the full dimensions of differences and similarities that exist among the governorates in Lebanon.

The analysis suggests that there are some important differences in the internal structure of the regional economies in Lebanon and the external interactions among their different agents. As the absorption matrix used throughout the structural analysis will serve as the basis for the calibration of the ICGE model, understanding of the relationships underlying it is fundamental for a better understanding of the forthcoming model's results.

Footnotes

(1) The complete dataset is available at www.usp.br/nereus.
(2) With less than 11,000 km2, Lebanon is the second smallest country in the Middle East and the Arab World (after Bahrain). Its territory represents 1/1000th that of large countries such as the USA and Canada and 1/100th that of Egypt (NPMPLT, 2005, ch. 1, p. 1).
(3) To our knowledge, other sources of data are seldom incorporated in the existing modeling efforts for Lebanon (e.g. demographic and social statistics such as population, labor force and household expenditure surveys).
(4) See World Road Association (2003) for a discussion in the context of transport policies.
(5) For the energy and water sector, we used information related to the regional distribution of total capacity of thermal and hydraulic plants, from Electricité du Liban.
(6) Distances were calculated using Google Maps.
(7) Re–exports were not considered in the calculations.

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