

Purchase Flow of Agricultural Raw Materials in the IX Region, Chile

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Abstract

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The objectives of this study were to evaluate purchase flows of agricultural raw materials and to establish the commercial boundaries of the city of Temuco in the IX Region of Chile in 2002-2003. Local Planning Boards were polled from the districts of the IX Region and in the provinces of Arauco, Biobio and Valdivia were also included. The gravitational determinist model on demarcation of commercial areas was used. According to the results obtained, the city of Temuco, as leader city, attracts expense flow from all of the neighbouring districts in the IX Region and also from border districts in the VIII and X Regions, totalizing 35 districts, north and south of Temuco. There were shared zones of attraction with Valdivia, Concepcion and Los Angeles. The coefficients of the population variables and number of commercial patents used to measure the commercial attraction of the districts of origin on the expense flows were negative. The coefficients for population, number of commercial patents and sales area of the districts of destination of flows were positive, whereas both restriction variables had negative coefficients. The coefficients of the three variables were statistically significant ($p < 0.05$) in the specification of the gravitational model that uses population as an attribute of the district of origin, destination of the commercial flows and travel time as restriction variables. The global adjustment of the model improved when other variables that reflected the commercial attraction of the procurement centers were introduced, i.e. number of business patents of agricultural supply stores and the related commercial area, showing determination coefficients higher than 40%, considered acceptable in this type of research. Notwithstanding, the variable referred to the district of origin of the expense re-routing had statistically non-significant coefficients ($p > 0.05$) and were positive for the commercial area. Therefore, It was determined that movement of raw material acquisitions outside the district where farms were located is done in the interurban commercial centres, that offered the largest variety of products, and the best business conditions and services to farmers.

Key words: Commercial flows, commercial gravitation, raw materials.

Cien. Inv. Agr. 32(3). 177-189. 2005

INTRODUCTION

The economical contribution of the agrarian and forestry sector to the annual gross internal

product (GIP) of the VIII, IX and X Regions of Chile has varied from 7 to 14% between 1996 and 2000. The participation of the business sector to regional GIP represented

8 to 10% approximately for the same period (Central Bank of Chile, 2003). These economic sectors are linked to the agricultural production. The business sector provides seeds, fertilizers, herbicides, insecticides, fungicides and other supplies that are required for annual and permanent crop production. Today, transportation and toll fees are considerably relevant as part of the direct costs of production. Therefore, the acquisitions of most of the supplies are made within the area where farms are located, and very seldom purchases are done in business centers far way from the farm.

The business areas appeared as results of the interregional movement. These areas correspond to rather extended zones where inhabitants of diverse population nuclei gravitate. Usually and preferentially, these zones are located in an urban center that has a large and well-supplied commerce. According to this definition part of the commercial expenditure, pertaining to the total amount consumers allot to retail good acquisition, minus service expenditures, is eluded between locations. In other words, it accounts for the presence of purchase flows or commercial flows. These occur due to the uneven distribution of commercial installations throughout the territory, reflecting the heterogeneous distribution of demand and profitability needs of retail companies. Ultimately, commercial areas exist due to commercial flows that correspond to consumer purchasing transfer required by the lack of adequate commercial product supply, needed to satisfy their demand.

Studying purchase flows, and commercial area development, would enable to solve effectively and efficiently the location problems in the private sector. At the same time, would enable to choose the distribution channels for businesspersons and producers. These can be studied using

analytical models or empiric methods. These methods consist on surveys to determine the buying habits of the consumers and the importance of the corresponding expense flows. These procedures may be oriented to the consumers themselves or, to those familiar with the purchasing habits of the inhabitants of a given area (De Juan, 1998; Casares and Rebollo, 2000).

The analytical or theoretical methods can be used to determine the geographical size and degree of commercial attraction that a specific shopping center exerts. These methods are based on the establishment of consumer behavior models and estimating their corresponding parameters. Such models may be based on normative hypothesis concerning consumer travel practices, using information obtained through behavior analysis or, evaluating consumer usefulness functions using techniques of joint measures (Craig *et al.* 1984).

Among the models based on normative hypotheses, the theory of central place development proposed by Christaller (1933) and Lösch (1954) are important. Similarly, the law of retail gravitation (Reilly, 1931), and its derived (Converse, 1949) are also important. Among the models that use information revealed by the consumer, Huff's proposal (1964) for retail attraction is the most frequently used. He establishes a probabilistic and disaggregated model of commercial attraction of establishments, leading to new stochastic models. With the generalization of the previous models, arise the multiplicative models of competitive interaction thus opening a new line of research (Nakanishi and Cooper, 1974). These contributions are the basis of spatial interaction models, among which the most recent ones are those of Fotheringham and O'Kelly (1989); Gil *et al.* (1997); Mas (1999) and O'Kelly (1999).

To select a shopping center, consumer behavior will depend on attraction and dissuasion variables. These may promote and hinder consumer movement back and forth. The restriction variable relates to the distance and time that the consumer must travel for purchasing, while attraction variables relate to the size of the commercial establishments. Retail attraction assessment has been based on the frequency with which people use the shopping centers, and increasingly on the size of the retail store. The reasoning behind this idea is that the larger the size of the store, or a group of stores, the larger the variety of products offered. Thus, the consumer is certain to find the needed items. Therefore, consumers reduce the risk of wasted travel time given that larger shopping centers offer more variety of stores to choose from (La Forge *et al.*, 1984; Medina, 1997). Consequently, the consumer is willing to travel longer distances in order to choose centers that offer lower travel costs, thus making larger shopping centers more attractive.

Numerous researchers have studied in detail distance as to variable of gravitational models. (Mayo *et al.*, 1988). Buying implies traveling and consequently additional costs in terms of time and money. Therefore, longer distances between businesses and consumers have a negative impact on the attraction exerted on them. Distance becomes to determining factor in consumer choice, the impact of which should be considered jointly with other characteristic attributes of points of sales (Fotheringham and O'Kelly, 1989).

Considering the importance of agricultural activity of the IX Region of Chile and those in the neighbor localities, the objective of this study was to establish the commercial boundaries of the city of Temuco for agricultural supply purchasing, and establishing the factors that explain its development.

Materials and methods

The equation proposed by Converse (1949), known as the point of rupture or equivalent attraction (D_{A-C}), was used to obtain the study units for later surveys on purchase flows. This equation establishes the point of indifference for consumers between two cities, and it gives the distance from a point of indifference to city A, being possible obtained the D_{B-C} value. Mathematically was expressed by the following equation:

$$D_{A-C} = \frac{d}{1 + \sqrt{\frac{P_B}{P_A}}} \quad \text{and} \quad D_{B-C} = \frac{d}{1 + \sqrt{\frac{P_A}{P_B}}}$$

Where, D_{A-C} ; D_{B-C} was the point of indifference from city A, to city B; d , was the distance between city A and city B along the main road; P_A was the population of city A, P_B was the population of city B.

The point of indifference was calculated between Temuco and the neighboring cities of Los Angeles (population 166.556, capital of Biobío Province, VIII Region) and Valdivia (140.559 inhabitants, capital of the Province of Valdivia, X Region) in the south. Temuco had 245.347 inhabitants (INE, 2003), located 158.2 and 171.6 km away from Los Angeles and Valdivia, respectively. Thus, the point of indifference to the north was located at 86.7 km from Temuco (Collipulli District, IX Region), and 97.7 km to the south (Lanco District, X Region). However, due to the deterministic character of the model used, the empiric research was extended beyond the limits previously indicated. This included the commercial flows of all 60 Districts of the Region of Araucanía, including the Provincial districts of Arauco and of Biobío in the VIII Region, and of the Provincial districts of Valdivia in the X Region. The cities of Los Angeles, Temuco and Valdivia were excluded as study units.

For the empirical delimitation of commercial areas in a regional or national environment, customarily qualified informants were surveyed (De Juan, 1998; Casares and Rebollo, 2000). Therefore, a personal survey was given to the Planning and Coordination Communal Secretaries (SECPLAC) of the districts previously mentioned.

The SECPLACs were chosen in consideration to the knowledge that they can have of the district reality on demographic, social and economic aspects and familiarity with the general purchasing habits of the residents of their districts. Furthermore, they were told previously that they could request others neighbors of the same district to complete and/or improve the information required.

The survey was performed using a questionnaire that identified the percentage of expenditure in agricultural supplies made within the district of residence and the proportion of this purchase made outside the residential district. Additionally, it was requested to indicate the two most important districts for shopping outside their own district and to point out the percentage of disbursement made in each one. The SECPLACs were interviewed between October 2002 and April 2003.

The unrestricted model of spatial interaction (Fotheringham and O'Kelly, 1989; equation 2) was used to determine the factors that explain the commercial flow of agricultural supplies between Districts of the VIII, IX and X Region and the composition of the commercial area of Temuco.

$$F_{ij} = k \cdot V_i^{\beta_1} \cdot W_j^{\beta_2} \cdot c_{ij}^{-\beta_3} \quad (2)$$

where F_{ij} were the flows between origin i and destination j ; V_i were the characteristics of origin i ; W_j were the characteristics of

destination j ; c_{ij} was a variable of spatial separation from origin i at destination j ; k was the gravitational constant; β_1 , β_2 and β_3 were the parameters of the model.

Given that the model was multiplicative potential, it was calculated previously through logarithmic transformations, considering the following functional form:

$$\ln F_{ij} = \ln k - \beta_1 \ln V_i + \beta_2 \ln W_j - \beta_3 \ln c_{ij}$$

The commercial flows constituted to those determined by the survey to SECPLACs. Distance and later travel time was used as restrictive variable of commercial flow. As a measurement of commercial attraction three variables were used successively, the population of the district of origin and destination based on the information provided by the 2002 Census (INE, 2003), the number of commercial patents of agricultural supplies stores, and their corresponding commercial area. Thus, four different conditions of the model were calculated as follows:

$$F_{ij} = k \cdot P_i^{-\beta_1} \cdot P_j^{\beta_2} \cdot d_{ij}^{-\beta_3} \quad (4)$$

$$F_{ij} = k \cdot P_i^{-\beta_1} \cdot P_j^{\beta_2} \cdot t_{ij}^{-\beta_3}$$

$$F_{ij} = k \cdot L_i^{-\beta_1} \cdot L_j^{\beta_2} \cdot c_{ij}^{-\beta_3}$$

$$F_{ij} = k \cdot S_i^{-\beta_1} \cdot S_j^{\beta_2} \cdot c_{ij}^{-\beta_3}$$

P_i was the population of origin i ; P_j was the population of destination j ; L_i was the number of commercial licenses of origin i ; L_j was the number of commercial licenses of destination j ; S_i was the commercial surface (m^2) of origin i ; S_j was the commercial area (m^2) of destination j ; d_{ij} was the distance (km) from origin i to destination j ; t_{ij} was travel time (minutes) from origin i to destination j .

In the model, the two first specifications

were determined for all the districts that responded through SECPLACs. For the two last conditions, only those belonging to the commercial area of Temuco were considered, or those that circumvent expenses towards this city for the provision of agricultural supplies. The two last specifications were estimated using travel time, because better adjustment was achieved with this restrictive variable. Calculation of the model consisted in finding the coefficients of the equation through the multiple regression technique, using as calculation method the ordinary mean squares of the SPSS 11.0 (SPSS.Inc., USA) statistical program.

The list of commercial patents of each district that constitute the commercial area of Temuco was requested directly from each municipality. To calculate the commercial area related to agricultural supply sales establishments, a personal survey was made of a representative sample of business owners (6 establishments in the district of Temuco and 27 businesses belonging to the districts of the commercial area of Temuco, of a universe of 36 and 76 patents, respectively). For this purpose a questionnaire was used that inquired about the total area and the area assigned to sales in each establishment. The sample was obtained using the statistical formula by Scheaffer *et al.* (1996), referred to the stratified random sample, dichotomy variable, with 95% confidence and 5% estimated error with 0.5 p and q. The surveys were performed between July 2003 and February 2004. The total area and sales area corresponding to the universe of patents of each district, was obtained multiplying the means of surveys performed according to the sample and the total patents in each case.

RESULTS

Temuco's commercial agricultural supply provisioning area. Table 1 and 2 show

the results of the commercial flows of 50 districts of the VIII, IX and X Region of Chile, representing 83% of responses. Temuco's commercial area of attraction included 35 districts, one district from Arauco Province, all districts of the IX Region and 4 districts of Valdivia Province.

The mean proportion of agricultural supply purchases within the district where the farm was located reached 37%, the remaining 63% went to other districts, being Temuco the main destination of expenses. The escaped flows fluctuated between 10 and 100%. Eight districts gravitated commercially above Temuco. These were the districts of Cuncó, Lautaro, Nueva Imperial, Padre Las Casas, Vilcún, Villarica, Traiguén and Victoria. The escaped flows varied between 20 and 90%. Within of this group of districts, Villarica, Traiguén and Victoria were far from the regional capital.

Temuco was the first choice of shopping for farmers that purchased their supplies outside their district of origin. These districts were Carahue, Freire, Galvarino, Gorbea, Loncoche, Melipeuco, Perquenco, Pitrufquén, Pucón, Teodoro Schmidt, Curacautín, Ercilla, Purén, Mariquina, Panguipulli and Tirúa with flow circumvention towards Temuco that fluctuated between 5 and 85%.

Secondary procurement destinations were the city of Villarica that attracted commercial flows from Loncoche, Pitrufquén and Pucón. The city of Victoria exerted attraction on Curacautín and Ercilla. Similarly, Pitrufquén generated travel from Freire and Gorbea. The city of Valdivia in the X Region, attracted buyers from Mariquina and Panguipulli, these last two districts constituted a shared gravitational zone of commercial areas.

Table 1. Commercial flows of agricultural external inputs determined for the districts of the VIII, IX and X Regions of Chile in 2002-2003.

Districts	Purchase, %		Selected districts			
	Inside ¹	Outside ¹	First district ²	%	Second district ²	%
Carahue	70	30	Temuco	21	Imperial	9
Cunco	10	90	Temuco	90		
Curarrehue	0	100	Pucón	100		
Freire	1	99	Temuco	70	Pitrufoquén	29
Galvarino	20	80	Temuco	60	Traiguén	20
Gorbea	30	70	Temuco	50	Pitrufoquén	20
Lautaro	70	30	Temuco	30		
Loncoche	10	90	Temuco	70	Villarrica	20
Melipeuco	30	70	Temuco	50	Cunco	20
Nueva Imperial	70	30	Temuco	30		
Padre Las Casas	30	70	Temuco	70		
Perquenco	30	70	Temuco	65	Lautaro	5
Pitrufoquén	60	40	Temuco	30	Villarrica	10
Pucón	5	95	Temuco	85	Villarrica	10
Puerto Saavedra	80	20	Carahue	20		
Teodoro Schmidt	90	10	Temuco	5	Toltén	5
Toltén	50	50	Teodoro Schmidt	30	Temuco	20
Vilcún	50	50	Temuco	50		
Villarrica	80	20	Temuco	20		
Angol	40	60	Los Angeles	30	Temuco	30
Collipulli	70	30	Los Angeles	20	Temuco	10
Curacautín	60	40	Temuco	38	Victoria	2
Ercilla	0	100	Temuco	50	Victoria	50
Lonquimay	80	20	Curacautín	16	Temuco	4
Los Sauces	10	90	Angol	70	Temuco	20
Lumaco	0	100	Traiguén	50	Temuco	50
Purén	50	50	Temuco	35	Angol	15
Renaico	0	100	Los Angeles	70	Angol	30
Traiguén	20	80	Temuco	80		
Victoria	60	40	Temuco	40		
Corral	5	95	Valdivia	57	Temuco	38
Lanco	40	60	Valdivia	40	Temuco	20
Mariquina	50	50	Temuco	40	Valdivia	10
Panguipulli	30	70	Temuco	42	Valdivia	28
Tirúa	10	90	Temuco	63	Concepción	27

¹Purchased made inside or outside of the district where farms were located.²First and second districts preferred to purchase agricultural supplies outside of the district where the farm is located

Table 2. Districts in the VIII y X Region of Chile that were not attracted commercially by Temuco.

Districts	Purchase, %		Selected districts			
	Inside ¹	Outside ¹	First district ²	%	Second districts ²	%
Los Alamos	0	100	Cañete	60	Concepción	40
Cañete	80	20	Los Álamos	16	Concepción	4
Contulmo	30	70	Cañete	49	Concepción	21
Curanilahue	5	95	Concepción	67	Arauco	28
Laja	10	90	Los Angeles	81	Concepción	9
Nacimiento	10	90	Los Angeles	85	Concepción	5
Negrete	0	100	Los Angeles	80	Nacimiento	20
Quilaco	10	90	Los Angeles	75	Concepción	15
San Rosendo	0	100	Los Angeles	70	Laja	30
Santa Bárbara	20	80	Los Angeles	80		
Yumbel	50	50	Los Angeles	32	Chillán	18
Futrono	50	50	Valdivia	45	Paillaco	5
La Unión	40	60	Osorno	60		
Máfil	70	30	Valdivia	30		

¹Purchased made inside or outside of the district where farms were located.

²First and second districts preferred to purchase agricultural supplies outside of the district where the farm is located

Other districts that attracted expense flows secondarily were Nueva Imperial from Carahue, Traiguén from Galvarino, Cunco from Melipeuco, Lautaro from Perquenco, Toltén from Teodoro Schmidt, Angol from Purén and Concepción from Tirúa. The latest district was a gravitational area shared by different districts. The extent of the flows attracted by the secondary procurement destination fluctuated between 2 and 50%.

Eight districts gravitated secondarily but directly on Temuco. Main destinations were Los Angeles and Valdivia in the VIII and X Region, respectively. Los Angeles primarily attracted buyers from Angol and Collipulli, Valdivia exerted attraction on Lanco and Corral. These four districts were shared gravitational zones of commercial disbursement outside the IX Region, the first two and of returns the last ones. Curacautín attracted commercial flows from Lonquimay, Angol from Los Sauces, Traiguén from Lumaco and Teodoro

Schmidt from Toltén, existing between these districts flows back and forth. The flows of expenses attracted by Temuco fluctuated between 4 and 50%. Three districts gravitated indirectly on Temuco, Puerto Saavedra attracted by Carahue, Curarrehue attracted by Pucón and, Renaico that diverted flows primarily towards Los Angeles and secondarily to Angol, creating a shared gravitational zone.

The districts of Los Alamos, Cañete, Contulmo and Curanilahue in the Province of Arauco, the districts of Laja, Nacimiento, Negrete, Quilaco, San Rosendo, Santa Bárbara and Yumbel in Biobío Province and the districts of Futrono, La Unión and Lago Ranco in the Province of Valdivia, did not gravitate commercially on Temuco for the procurement of agricultural supplies (Table 2). In this case, the districts of the Province of Arauco re-routed on average 71.3% of the commercial expenses primarily towards Cañete, Concepción, Los Alamos and Arauco.

The greatest expense circumvention was from the districts of Biobío Province, 85.7% with destination towards Los Angeles in all cases as first choice and, secondarily, towards Concepción, Nacimiento, Laja and Chillán, located in the Province of Ñuble, in the case of Yumbel. The lowest diversion of expenses was from the districts of Valdivia Province that had an average of 60% circumvention towards the cities of Valdivia, Osorno, Río Bueno and Paillaco.

Table 3 shows the number of patents and commercial area of sales establishments of agricultural products in the districts of the commercial area of Temuco. The city of Temuco had the largest number of commercial patents. Considering the sales area, Temuco ranked third after Freire and Curacautín, with a proportion close that of Angol and Traiguén. These results, as expected, reflect that in this type of products the commercial area does not directly increase with the potential level of current demand, estimated by the number of inhabitants. In a high proportion of districts, there was a high proportion of the total area allocated to storage, related to the volume of commercialized products. Twenty-seven percent of the districts lacked this type of commerce.

To certain extent, some of these results reflect how efficient commercial space is used. For instance, in the district of Freire the largest proportion of expenses in agricultural supplies was diverted towards Temuco and Pitrufoquén, despite having the largest commercial surface of the area. This would indicate the inefficient use of commercial space or the development of a commercial mix not congruent with consumer needs. The districts of Cunco, Curarrehue, Angol and Traiguén would be in a similar inefficient situation.

The districts of Carahue, Lautaro, Puerto Saavedra, Toltén, Collipulli, Lonquimay and Victoria showed a highly efficient use of commercial space, since they manage to retain an important proportion of expenses in agricultural supplies with low sales areas. The situation of the districts of Melipeuco, Pucón, Vilcún, Los Sauces and Purén that registered purchases from the district where the property was located without having a commercial area for supply sales, indicates the possible presence of informal commerce or lack of knowledge regarding the procurement patterns.

Modeling of the commercial flows of agricultural supplies. The coefficients of the population variables and number of commercial patents used to measure the commercial attraction of the districts of origin on the expense flows were negative (Table 4). The coefficients for population, number of commercial patents and sales area of the districts of destination of flows were positive, whereas both restriction variables had negative coefficients. The coefficients of the three variables were statistically significant ($p < 0.05$) in the specification of the gravitational model that uses population as an attribute of the district of origin, destination of the commercial flows and travel time as restriction variables. The global adjustment of the model improved when other variables that reflected the commercial attraction of the procurement centers were introduced, i.e. number of business patents of agricultural supply stores and the related commercial area, showing determination coefficients higher than 40%, considered acceptable in this type of research (Medina, 1997). Notwithstanding, the variable referred to the district of origin of the expense re-routing had statistically non-significant coefficients ($p > 0.05$) and were positive for the commercial area. This contrasts the theory of commercial attraction.

Table 3. Licenses and commercial space for selling agricultural products corresponding to the districts that make up Temuco's trade area, IX Region, Chile.

Districts	Commercial licenses	Commercial area (m ²)	Proportion of the total store area (%)	Proportion of the total floor of the trade area (%)
<i>Province of Arauco, VIII Region 37°5' -38° South latitude</i>				
Cañete	5	80	6.9	0.7
Contulmo	0	0	0	0
Tirúa	0	0	0	0
<i>Province of Malleco, IX Region 37°5' -38°5' South latitude</i>				
Angol	4	1,200	46.2	6.4
Collipulli	1	60.0	100	0.5
Curacautín	3	1,500	100	12.6
Ercilla	0	0	0	0
Lonquimay	2	40.0	100	0.3
Los Sauces	0	0	0	0
Lumaco	0	0	0	0
Purén	0	0	0	0
Renaico	0	0	0	0
Traiguén	5	720	100	6.1
Victoria	1	27	19.0	0.2
<i>Province of Cautín, IX Region 38°5' -39°5' South latitude</i>				
Temuco	36	893	14.0	7.5
Carahue	3	75	55.6	0.6
Cunco	3	450	100	3.8
Curarrehue	3	108	100	0.9
Freire	1	4,200	100	35.3
Galvarino	2	200	100	1.7
Gorbea	2	40	25.0	0.3
Lautaro	2	66	6.5	0.6
Loncoche	3	63	8.5	0.5
Melipeuco	0	0	0	0
Nueva Imperial	1	360	60.0	3.0
Padre Las Casas	5	45	1.5	0.4
Perquenco	1	42	45.7	0.4
Pitrufrquén	4	476	3.2	4.0
Pucón	0	0	0	0
Puerto Saavedra	1	60	75.0	0.5
Teodoro Schmidt	5	500	100	4.2
Toltén	2	50	100	0.4
Vilcún	1	0	0	0
Villarrica	7	112	2.4	0.9
<i>Province of Valdivia, X Region 39°5' South latitude</i>				
Lanco	5	280	43.8	2.4
Mariquina	2	108	15.3	0.9
Panguipulli	2	144	16.0	1.2

DISCUSION AND CONCLUSIONS

Because to travel long distances to procure supplies have a direct incremental effect on the production costs, a low incidence of inter-communal procurement travel and a small commercial area around Temuco would be expected in this studied. However, the presence of commercial flows that circumvented the district where the agricultural property was located probably was enhanced by marketing strategies of distributors of agricultural supplies in the region. Mainly those with headquarters in Temuco, that offered a broad range of free services linked to the purchase (soil analysis, advice on how to apply agro-chemicals, professional visits, special containers). Additionally, they provided free delivery over a certain amount.

Within the commercial area of Temuco there was three shared gravitational zones:

1. Four districts of the X Region in the

- border of the IX Region, whose inhabitants also travel to Valdivia to buy;
2. Districts located north of the IX Region that travel to Los Angeles to buy
3. A district of Arauco Province that commercially also depends on the city of Concepción. This situation, together with the large commercial area around Temuco, account for the strong commercial competition existing between agricultural supply businesspersons and distributors, that was reflected both in prices and sales associated services.

The districts of Angol, Villarrica and Victoria created three commercial sub areas within the commercial area of Temuco. These farmers purchased in a main location of a sub area that in turn gravitates around the main attraction pole of the area. The main attraction pole of sub areas had equipment and sufficient commercial attraction capacity to create around it a zone of influence from which to attract an important part of its expense flows (Casares and Rebollo, 2000).

Table 4. Determination of the commercial gravitation model of agricultural raw materials using different variables of attraction and restriction in Southern Chile

Variables of commercial attraction	Lk	β_1	β_2	β_3	R ² (%)	F-Snedecor
Población/distancia	2.662 (1.724)	-0.276 (-1.915)	0.368 * (3.432)	-0.232 * (-2.184)	13.7	4.330 *
Population/travel time	3.023 (1.968)	-0.318 * (-2.188)	0.427 * (3.738)	-0.398 * (-2.595)	15.6	5.046 *
Commercial licenses/travel time	3.304 * (6.548)	-0.096 (-0.497)	0.532 * (5.096)	-0.414 * (-2.783)	41.8	8.847 *
Commercial floor/travel time	0.399 (0.431)	0.02988 (0.368)	0.632 * (5.413)	-0.368 * (-2.407)	45.2	9.911 *

The Lk value designates the natural logarithm of the variable k. and the values β_1 , β_2 y β_3 the coefficients of the variables of each specification. Numbers between parenthesis correspond to the value of the t student. *: statistically significant ($p < 0.05$).

The coefficients that resulted from the estimate of the commercial gravitation model coincided with those of Medina (1997) for Spain. The coefficients with negative sign for the size of the district of origin variable demonstrated an inverse relation between it and the circumvented flow of expense. This would imply that the size of the district acted as a restrictive factor in the flows of commercial expenditure. The coefficients of the size of the district of destination variable with positive sign indicate that the larger the commercial supply of the district of destination, the greater was the flow of expenditure exchanged with the district of origin. The coefficients of the distance and travel time variable with negative sign would indicate that the distance or travel time towards the larger interurban procurement centers, acted as a flow-restricting factor.

The three variables were statistically significant only in the specification of the model that uses population and travel time as explanatory variables of the phenomenon of commercial attraction. However, the territorial distribution of the commercial availability of agricultural supplies was very relevant in explaining interurban travel to purchase these products. This was noticeably concentrated in certain places and scarce or nonexistent in others. According to these results, farmers were willing to acquire the supplies required for production in procurement centers far from their property because the market offers better commercial conditions reflected in lower transaction costs.

Therefore, Temuco as an attraction pole of the commercial area of this zone attracted directly or indirectly commercial flows for agricultural supplies from all the districts of the IX Region. Indirectly, it attracted commercial flow from neighboring districts

of the provinces of Arauco and Valdivia in the VIII and X Region, respectively. The districts of Angol, Villarrica and Victoria were attraction pole of commercial sub areas attracting part of the expenses circumvented from neighboring districts.

Regarding the southern zone of Chile, it was possible to validate the gravitational model of agricultural supplies using the population of the districts of origin and destination of expense flows, and travel time as explanatory variables of commercial flows. The model's adjustment improved by using the number of business patents and the commercial area as variables that reflect the commercial attraction exerted by a procurement center on its environment.

Travel, to buy agricultural supplies outside the district where the property was located, was made choosing interurban procurement centers that offered the largest variety of products, and the best business conditions and services to farmers.

RESUMEN

Para evaluar la existencia de flujos de compra de insumos agrícolas atraídos por Temuco y delimitar su área comercial, se encuestó a los Secretarios Comunales de Planificación de las comunas de la IX Región y de las provincias de Arauco, Biobío y Valdivia, definidas como unidades de estudio por el modelo gravitacional determinista de delimitación de áreas comerciales. Temuco, como cabecera comercial del área, atrajo flujos de gasto de todas las comunas de la IX Región y de comunas limítrofes de la VIII y X Región de Chile, totalizando 35 comunas atraídas comercialmente. Se observaron zonas de gravitación compartida con las áreas comerciales de las ciudades de Valdivia, Concepción y Los Angeles. Mediante la

estimación del modelo de gravitación comercial tradicional, se determinó que los desplazamientos de compra fuera de la comuna de ubicación del predio para las adquisiciones de insumos agrícolas, se realizaron seleccionando los centros de compra interurbanos de mayor oferta comercial, que ofrecen mejores condiciones comerciales y de servicios a los productores agrícolas, actuando la distancia o el tiempo de desplazamiento como factores de restricción a los desplazamientos de compra.

Palabras clave: flujos comerciales, gravitación comercial, insumos agrícolas.

ACKNOWLEDGEMENTS

The author wants to thank FORD Foundation for contributions made through the TEFE Project 150204 of the Research and Development Department and The Local and Regional Development Institute of the Universidad de la Frontera, Temuco, Chile.

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