Employment and familiar agriculture agribusiness in the Brazilian economy: an interregional Leontief-Miyazawa model approach

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EMPLOYMENT AND FAMILIAR AGRICULTURE AGRIBUSINESS IN THE BRAZILIAN ECONOMY: AN INTERREGIONAL LEONTIEF-MIYAZAWA MODEL APPROACH

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ABSTRACT

The agricultural sector has great importance in the socio-economic development. Its development throughout history has enabled the emergence of other activities and therefore new jobs. Furthermore, the importance of the agribusiness can be evidence for its share of about 30% in the total Brazilian GDP and its importance in generating jobs. To study this sector in more detail, the agricultural sector was broken down into two sectors: Familiar and Non-Familiar Agriculture Agribusiness. The goal of this paper is to study how the productive structure and the income distribution in the Brazilian economy have had an impact over employment generation and income sectors in the Familiar and Non-Familiar Agriculture Agribusiness in 2002. This paper uses as a theoretical basis the Leontief-Miyazawa approach considering the differences between sectors and the 27 Brazilian states.

KEY WORDS: Employment, Leontief-Miyazawa, familiar and agribusiness agriculture

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1. INTRODUCTION

The agricultural sector has great importance in Brazilian socio-economic formation. Its development throughout history has allowed the emergence of other activities and therefore new jobs. More than this it is always remembered for its importance in absorbing the labor force and in producing food, specially direct for the self consume, i.e., it is more directed to a social approach than to an economic one, taking into consideration its low productivity and low use of capital intensive techniques.

However the low productivity and low use of capital intensive techniques are not features of both segments of agricultural sector. In the last years the non-familiar agriculture agribusiness has become more productivity and using more capital intensive techniques.

On the other hand, the familiar agriculture agribusiness consists of small producers that represent the vast majority of rural producers in Brazil. Although the small property does not have the advantages of scale and gains in production, it is crucial in the economy of small towns. There are around 4.5 million establishments which 50% in the Northeast. The segment holds 20% of the land and accounts for 30% of global production. In some basic products of the Brazilian diet such as beans, rice, corn, vegetables, cassava and small animals, the familiar agriculture is responsible for 60% of production. Because of these reasons, the familiar agriculture agribusiness is focus of policies to employment generation the displacement of unemployed in urban areas for work in field.

In this way, taking into consideration the importance of the agricultural sector to Brazil — more than 20% of occupied people at Brazilian economic are in the agriculture sector — and the differences in familiar and non-familiar agriculture agribusiness, this study intent to show the importance of the familiar agribusiness in the employment in the Brazilian regions in 2002 through the Leontief-Miyazawa approach.

This paper is organized in 3 sections, beyond this brief introduction. In the next sections we will be presenting the methodology based on the Leontief-Miyazawa model and in section 3, the results are presented.

2. METHODOLOGY AND DATA BASE

In this section we presented the Leontief-Miyazawa model, the structure of the interregional input-output table and briefly describe the data source for the elaboration of this paper.

2.1. The Leontief-Miyazawa Model

The analysis of the intersetorial structure will be carried through the application of the Leontief-Miyazawa approach. The Leontief-Miyazawa analysis brings information on the structure of production of the economy and the sectoral origin of the generated income and also the sectoral distribution of income to households in different income brackets, and the sectoral allocation of consumption expenditures by households.

In the Leontief model the intersectoral flows of goods and services can be determined by technological and economic factors from the following system of equations:

$$\mathbf{X} = \mathbf{AX} + \mathbf{Y} \tag{1}$$

Where **X** represents a vector ($n \times 1$) with the value of the total production for sector, **Y** is a vector ($n \times 1$) with the values of the sectoral final demand and **A** it is a matrix ($n \times n$) with the technical coefficients of the production. The vector of total production is determined by the vector of final demand, considered exogenous to the system:

$$\mathbf{X} = \mathbf{B} \times \mathbf{Y} \tag{2}$$

Where **B** is the Leontief inverse [$\mathbf{B} = (\mathbf{I} - \mathbf{A})^{-1}$]. The elements in the final demand vector, **Y**, are:

a) household consumption ($\mathbf{Y_f}$); b) exports ($\mathbf{Y_e}$); c) government expenditure ($\mathbf{Y_g}$); d) investment ($\mathbf{Y_k}$). From this pure model, Miyazawa (1976) divided to the final demands in internal demands of consumption and exogenous demands (expense of the government, investment and exportations):

$$\mathbf{Y} = \mathbf{Y}^c \times \mathbf{Y}^e \tag{3}$$

where $\mathbf{Y}^c$ is the (n x 1) vector of consumption demand and $\mathbf{Y}^e$ is the (n x 1) vector of exogenous demand.

The multisectoral consumption function is defined as

$$\mathbf{Y^c} = \mathbf{CQ} \tag{4}$$

Where **C** is a (n x r) matrix with the consumption coefficients, and Q is a (r x 1) vector with the total income of each income group. The matrix E is the matrix whose elements e_{ik} represent the total amount of the i^{th} commodity consumed by the k^{th} income group, and c_{ik} be defined as

$$c_{ik} = \frac{e_{ik}}{q_k} \tag{5}$$

And the income-distribution structure can be represented by the simultaneous equations

$$Q = VX \tag{6}$$

where V is a (r x n) matrix with the value-added ratios. The simultaneous equations (6) represent the fact that the productive structure prevailing in a country is associated to a corresponding structure of income distribution.

The matrix R is the matrix whose elements r_{kj} represent the income of the k^{th} group earned from the j^{th} sector. Then, v_{kj} is given by

$$v_{kj} = \frac{r_{kj}}{x_j} \tag{7}$$

To solve static model we start by substituting (3), (4), and (6) into (1), getting

$$X = AX + CVX + Y^e \tag{8}$$

whose solution is

$$X = (I - A - CV)^{-1} Y^e \tag{9}$$

Moreover, it is convenient to express the matrix in (9) as the product of $B = (I - A)^{-1}$ - which reflects the production flows - and another matrix reflecting the endogenous consumption flows, that is,

$$X = B(I - CVB)^{-1} Y^e \qquad (10)$$

Finally, substituting (10) into (6), the multisectoral income multiplier is given by

$$Q = VB(I - CVB)^{-1} Y^e \qquad (11)$$

Which shows that the income for each group (and, of course, the aggregate income) will have different values depending on the sectors' shares in the exogenous final demand (Miyazawa, 1963 and 1976)?

2.2 The interregional input-output table

The interregional input-output model, also called of "Isard Model", due to the application of Isard (1951), requires a mix of data, actual or estimated, mainly on information flows intersectoral and interregional.

In sum, we can submit the model, from the hypothetical example of intersectoral flows and interregional goods to the regions L and M, with two sectors, as follows:

Z_{ij}^{LL} - monetary flow of the sector *i* for the sector *j* of the region L,

Z_{ij}^{ML} - monetary flow of the sector *i* of the region M, for the sector *j* of the region L.

It is possible to structure the matrix:

$$Z = \begin{bmatrix} Z^{LL} & Z^{LM} \\ Z^{ML} & Z^{MM} \end{bmatrix} \qquad (12)$$

where, Z^{LL} and Z^{MM}, they represent matrix of the monetary intra-regional flows, and Z^{LM} e Z^{ML}, they represent matrix of the monetary interregional flows.

Considering the equation of Leontief, (1951) and (1986)

$$X_i = z_{i1} + z_{i2} + \ldots + z_{ii} + \ldots + z_{in} + Y_i$$

(13)

where X_i indicates the total of the production of the sector *i*, z_{in} the monetary flow of the sector *i* for the sector *n*, and Y*i* is a final demand for products of the sector *i*.

It is possible to apply it according to,

$$X_1^L = z_{11}^{LL} + z_{12}^{LL} + z_{11}^{LM} + z_{12}^{LM} + Y_1^L \qquad (14)$$

where X_1^L is the total of the good 1 produced one in the region L.

The intra-regional coefficients:

$$a_{ij}^{LL} = \frac{z_{ij}^{LL}}{X_j^L} \quad \Rightarrow \quad z_{ij}^{LL} = a_{ij}^{LL}.X_j^L$$

(15)

where, it is possible to define a_{ij}^{LL} like technical coefficients of production, and the sector *j* of the region L, it buys from the sector *i* from the region L

$$a_{ij}^{MM} = \frac{z_{ij}^{MM}}{X_j^M} \quad \Rightarrow \quad z_{ij}^{MM} = a_{ij}^{MM}.X_j^M$$

(16)

and it is possible to define a_{ij}^{MM} like technical coefficients of production, which represent the amount that the sector *j* of the region M buys from the sector *i* from the region M.

And, for last, the interregional coefficients:

$$a_{ij}^{ML} = \frac{z_{ij}^{ML}}{X_j^L} \quad \Rightarrow \quad z_{ij}^{ML} = a_{ij}^{ML.}.X_j^L$$

(17)

it is possible to define the $a_{ij}^{ML.}$ like technical coefficients of production that represent how much the sector *j* of the region L buys from the sector *i* from the region M and

$$a_{ij}^{LM} = \frac{z_{ij}^{LM}}{X_j^M} \quad \Rightarrow \quad z_{ij}^{LM} = a_{ij}^{LM} . X_j^L \tag{18}$$

where the a_{ij}^{LM} correspond to technical factors of production which represent the amount that the industry of the region *j*, M purchase of the sector in the region L. These factors may be replaced, obtaining:

$$X_1^L = a_{11}^{LL} X_1^L + a_{12}^{LL} X_2^L + a_{11}^{LM} X_1^M + a_{12}^{LM} X_2^M + Y_1^L \tag{19}$$

The productions for the other sectors are obtained similarly. Isolating Y_1^L and putting in evidence X_1^L:

$$(1 - a_{11}^{LL}) X_1^L - a_{12}^{LL} X_2^L - a_{11}^{LM} X_1^M - a_{12}^{LM} X_2^M = Y_1^L \tag{20}$$

The other final demands can be obtained similarly.

Therefore, according to $A^{LL} = Z^{LL} (\hat{X}^L)^{-1}$ the A^{LL} matrix is built for 2 sectors, where A^{LL} represents the matrix of technical coefficients of intra-regional production.

It should be noted that this formulation worth to A^{LM}, A^{MM}, A^{ML}.

It is defined now the following matrices:

$$A = \begin{bmatrix} A^{LL} & \vdots & A^{LM} \\ \cdots & \cdots & \cdots \\ A^{ML} & \vdots & A^{MM} \end{bmatrix} \tag{21}$$

$$X = \begin{bmatrix} X^L \\ \cdots \\ X^M \end{bmatrix}$$

(22)

$$Y = \begin{bmatrix} Y^L \\ \cdots \\ Y^M \end{bmatrix} \tag{23}$$

The complete system of inter-regional input-output is represented by:

$$(I - A)X = Y, \tag{24}$$

and the matrices can be arranged as follows:

$$\left\{ \begin{bmatrix} I & \vdots & 0 \\ \cdots & \cdots & \cdots \\ 0 & \vdots & I \end{bmatrix} - \begin{bmatrix} A^{LL} & \vdots & A^{LM} \\ \cdots & \cdots & \cdots \\ A^{ML} & \vdots & A^{MM} \end{bmatrix} \right\} \begin{bmatrix} X^L \\ \cdots \\ X^M \end{bmatrix} = \begin{bmatrix} Y^L \\ \cdots \\ Y^M \end{bmatrix} \tag{25}$$

Performing these operations, you get the basic models necessary to review inter-regional proposal by Isard:

$$\begin{aligned} (I - A^{LL})X^L - A^{LM}X^M &= Y^L \\ - A^{ML}X^L + (I - A^{MM})X^M &= Y^M \end{aligned} \tag{26}$$

So the system of interregional Leontief model:

$$X = (I - A)^{-1} Y \tag{27}$$

The model above is only a theoretical description of the interregional model. For the construction of the system here proposed, there will be necessary the use of various techniques for construction of an interregional system from a limited set of information, since there is available all the data needed to build the system produced above.

2.3 Data Source

For the elaboration of this paper we used 3 different databases, all produced by the Brazilian National Statistical Office (IBGE):

• System of National Accounts[3]: Assembly of the Input-Output regional matrices on the basis of the methodology developed by Guilhoto and Sesso-Filho (2005);

• Household consumption: Insertion of the referring data to the consumption of the families on the basis of the Research of Familiar Budgets - POF (IBGE, 2005);

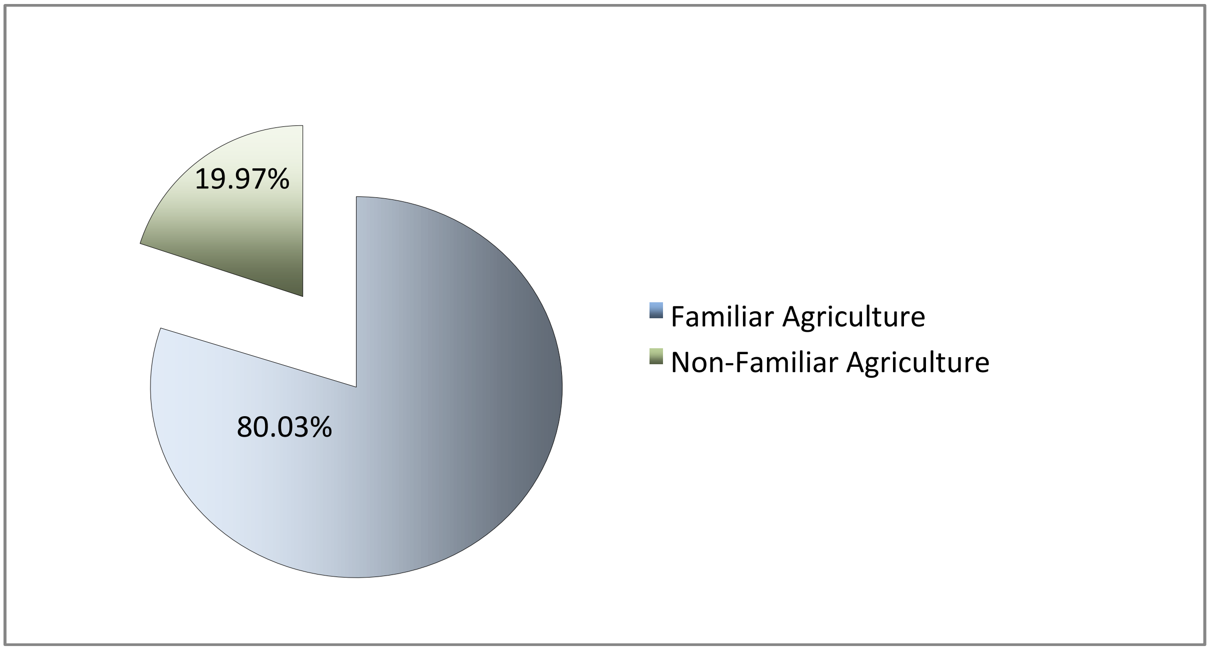
• Income of the families: The information had been tabulated using the Household Survey, PNAD (IBGE, 2004).

3. MAIN RESULTS

This section presents the main results to the Brazilian economy in the year of 2002. Initially we present the estimates of the number of employees in familiar activities in each one of the 27 Brazilian states. Then, will show the results of the estimates in terms of generating employment through the implementation of the methodology to the source of data available. The results from 2002 were brought to the price levels of 2006.

Figure 1 shows the share of employees in the familiar and non-familiar agriculture in the country. The share of the familiar agriculture in Brazil in 2002, amounted to 80% of the employment of the total agricultural sector.

[3] The information uses in this paper refers to the data in the System of National Accounts after revision released in march 2007.



Source: Research data.

Figure 1. Share of the occupied people in familiar and non-familiar agriculture in Brazil (%) – 2002

Table 1 presents the share of employees in the familiar agriculture in each one of the Brazilian states. The results show how expressive is the familiar agriculture in each of the states regarding occupied people in the total of agriculture. Through this table we notice that the familiar agriculture represents more than 50% in all the 27 Brazilian states confirming its importance in generating jobs.

Table 1 – Employment and share of the employees in the familiar agriculture in each one of Brazilian states in 2002 (%)

State	Employment	% State
AC	29,831	71%
AL	465,088	85%
AM	128,863	89%
AP	24,433	72%
BA	1,945,797	85%

CE	627,325	87%
DF	20,504	58%
ES	113,799	66%
GO	426,752	70%
MA	702,213	88%
MG	703,509	65%
MS	378,545	56%
MT	378,024	65%
PA	369,929	72%
PB	466,425	85%
PE	1,257,370	84%
PI	217,890	88%
PR	1,260,360	88%
RJ	81,713	56%
RN	410,110	81%
RO	107,441	78%
RR	13,625	67%
RS	1,068,090	90%
SC	718,452	89%
SE	234,738	88%
SP	1,482,412	70%
TO	102,532	61%

Source: Research data.

With the incorporation of the data from the PNAD and POF (Brazilian National Statistical Office) to the Leontief-Miyazawa model it was possible to get the total jobs generated in each sector, as well as the indirect and induced impacts for the Brazilian economy as a whole.

The values of the direct, indirect and induced employment generation represents the number of jobs to the production monetary value, expressed in the Brazilian currency (Reais in constant prices of 2006). The employment effects are classified into three types:

a) direct employment effect: that determines how many jobs are generated by a given sector when its production is increased;

b) indirect employment effect: that determines how many jobs are generated in all the other sectors when the production of a given sector is increased; and

c) induced employment effect: that determines how many jobs are generated as a result of households consumption, in consequence of the rise in their income, given the increase of direct, indirect and induced jobs.

Table 2 displays, for 2002, the value of the direct, indirect and induced, respectively, employment generated by and increase of R$ 1 million (2006 constant prices) in the final demand of a given sector.

According to these results, is that the effects generators direct, indirect and induced in the industry are higher than in the Non-Family Agricultural. Thus, each unit of production demands of family farming generates a higher value in the economy as a whole, not just in terms of its production chain, but also of their pay to families.

The shares of total generator, it is possible to point that in case of the familiar agriculture, the main effect is direct. The effect induced is especially important for non-familiar agriculture. Such a divergence in these shares results from the differences of the structures of the differences from structures of agricultural sectors. The remuneration represents a larger share of production value for employees, so that the effect induced is more expressive in non-familiar agriculture.

Table 2. Direct, indirect and induced, respectively, employment generated by an increase of R$ 1 million in the final demand of a given sector. - Brazil , 2002.

	Direct	Indirect	Induced	Total
Familiar Agriculture	195	27	119	340
Non-business private services	108	14	77	199
Dairy Industry	8	75	62	144
Animals	5	78	61	144
Apparel	55	23	56	133
The coffee industry	4	63	56	124
Other vegetable products	5	59	54	118
Manufacture of vegetable oils	1	64	52	116
Trade	53	8	54	115
Services to households	40	15	51	106
Other food products	12	43	49	104
Shoes	22	29	49	100
Construction	31	14	51	96
Wood and furniture	26	17	48	91
Textiles	24	21	45	89
Public administration	20	9	56	85
Manufacture of sugar	7	32	45	84
Services to business	26	12	45	83
Transportation	21	13	49	83
Non-familiar agriculture	30	12	39	81
Various industries	22	14	41	76
Non-metallic minerals	17	14	43	74
Other metallurgy	14	10	43	67
Cellulose, paper and printing	8	15	39	62
Mineral extraction (except fuel)	8	12	39	59
Rubber	7	15	37	58
Machinery and equipment	7	12	38	58
All types of vehicles	2	19	37	58
Plastics	9	12	34	56
Pharmaceutical and veterinary	5	14	37	55
Electric material	6	12	36	55
Chemical	3	17	35	54
Parts and other vehicles	5	12	37	54
Communication	4	13	37	54
Financial institutions	4	8	40	53
Various chemicals	4	15	34	52
Petrol and gas	1	15	36	51
Non-ferrous metallurgy	3	12	35	51
Steel	2	13	36	50
Electronic equipment	4	14	32	50
Public utility services	3	7	37	47
Petrol refining	1	13	27	40
Building Rent	3	2	32	36

Source: Research data.

This study also calculated such estimates to generate employment for each one of Brazilian states in 2002. Thus, considering the spatial dimension, however, realizes that there are huge disparities between the effects generators of employment between the major regions of Brazil, as can be seen in table 3 below.

Tabela 3. Direct, indirect and induced employment generated by an increase of R$ 1 million in the final demand of a familiar and non familiar agriculture sectors – Brazilian states, 2002.

States	Regions	Familiar				Non-familiar			
		Direto	Indireto	Induzido	Total	Direto	Indireto	Induzido	Total
AC	N	186	38	68	292	111	23	73	206
AP	N	333	47	52	432	65	20	51	136
AM	N	121	15	31	167	18	7	31	56
PA	N	93	9	98	199	47	5	96	148
RO	N	89	18	87	195	66	13	84	163
RR	N	173	38	58	270	48	19	58	125
TO	N	344	49	115	508	111	23	114	248
AL	NE	1.099	102	124	1.325	67	24	116	208
BA	NE	515	29	122	665	65	10	118	192
CE	NE	545	56	142	743	124	21	138	283
MA	NE	439	48	138	625	67	16	136	219
PB	NE	597	45	122	765	112	15	94	221
PE	NE	951	43	115	1.109	95	11	105	210
PI	NE	542	60	156	758	83	20	152	255
SE	NE	411	42	94	547	80	16	83	179
RN	NE	690	78	108	876	132	28	103	263
DF	CO	300	84	34	418	21	30	34	85
GO	CO	130	40	59	228	17	17	59	93
MT	CO	148	44	49	241	23	19	46	89
MS	CO	214	35	51	301	43	15	45	102
ES	SE	161	31	50	242	41	15	49	105
MG	SE	155	35	65	255	28	17	62	108
RJ	SE	129	28	50	207	51	14	46	111
SP	SE	151	20	50	221	18	8	46	72
PR	S	122	22	51	196	17	10	48	75
SC	S	116	16	51	183	24	8	49	81
RS	S	81	17	46	144	14	8	39	62

Source: Research data.

The Northeastern region is the one that presents the greatest generation of employment in rural areas, both familiar and non-familiar agriculture. Moreover, analyzing the data only within this region, realizes that the familiar agriculture presents the biggest difference between the generator of employment familiar and non familiar agriculture.

Table 4 – Employment generated at familiar agriculture for each employment generated at non-familiar agriculture - 2002.

States	Regions	Direct	Indirect	Induced	Total
AC	N	1,68	1,68	0,93	1,42
AP	N	5,13	2,37	1,01	3,18
AM	N	6,84	2,21	1,00	3,01
PA	N	1,99	1,98	1,01	1,35
RO	N	1,35	1,42	1,04	1,20
RR	N	3,60	2,02	1,01	2,16
TO	N	3,09	2,09	1,01	2,04
AL	NE	16,35	4,21	1,07	6,38
BA	NE	7,96	3,04	1,03	3,46
CE	NE	4,39	2,68	1,03	2,62
MA	NE	6,51	3,04	1,02	2,85
PB	NE	5,33	3,01	1,31	3,47
PE	NE	10,06	3,97	1,09	5,27
PI	NE	6,49	3,02	1,03	2,97
SE	NE	5,12	2,63	1,13	3,05
RN	NE	5,24	2,78	1,05	3,33
DF	CO	14,43	2,80	1,00	4,91
GO	CO	7,49	2,30	1,00	2,45
MT	CO	6,37	2,28	1,06	2,71
MS	CO	5,04	2,38	1,14	2,94
ES	SE	3,96	2,12	1,02	2,31
MG	SE	5,46	2,08	1,04	2,37
RJ	SE	2,53	1,95	1,09	1,87
SP	SE	8,46	2,38	1,09	3,06
PR	S	7,13	2,18	1,08	2,61
SC	S	4,81	2,00	1,03	2,25
RS	S	5,75	2,18	1,16	2,34

Source: Research data.

The states that more prominently on the effect generator in the familiar agriculture are Alagoas and Pernambuco. For each one million of Reais additional on demand of familiar agriculture in these states, there is a whole generation of employment in their economies, respectively, 1325 and 1,109 jobs.On the other hand, non-familiar agriculture in those states would create 210 and 208 jobs total, so one of the largest disparities between all states evaluated.

Considering the Southeast and South regions, realizes that the potential generator of employment of familiar agriculture is not as expressive as the other regions.

Furthermore, the disparities between the familiar and non-familiar are very small, as shown in table 5. In the Southeast region, the state that gives less difference between the familiar and non-familiar is the Rio de Janeiro, for each job created in the non-familiar agriculture, it would generate 1.87 jobs in the familiar agriculture.

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