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Reorganization of Household Economies to Compensate the Reduction of Coffee Income in the Sierra Norte Region, Mexico

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The households—in the Sierra Norte region of the State of Oaxaca, Mexico—have combined the self-consumption of staple crops (corn and beans) with the commercial production of coffee and sugarcane on a small scale. Until 2014 coffee income accounted for most of the household income budget and the following year the rust epidemic significantly reduced coffee production. In 2017, a considerable decrease in coffee income was detected, although the producer households continued investing in this crop, at the same time, they looked for complementary sources of income. Thus, households assigned more manpower to the labor markets, and invested in small businesses, including the productive chain of sugarcane. Migration stands out as a general strategy to increase the family budget. The decision analysis was carried by means of the household economics model (Reyes-Morales, Gijón-Cruz, & Cruz-Hernández, 2015). The databases of a probabilistic household survey applied in 2014 and 2017 were used to construct the model equations by ordinary least squares. This model allows distinguishing between the fraction of the household income contributing to household wellbeing and that fraction allocated for investment and savings.

Keywords: staple crops, small-scale cash crops, migration, rust epidemic

Introduction

This article analyzes the effects of the fall of coffee income in the household economies in the communities of the Sierra Norte region, State of Oaxaca, Mexico and the actions that the producer households have adopted to generate complementary income. Such adjustments have not implied the abandonment of production of corn and beans but rather households have put more emphasis on market-orientated activities (Van del Ploeg, 1950; Mead & Liedholm, 1998). In this scope it is intended to make a theoretical-methodological contribution that improves the understanding of the functioning of the household economies of small coffee farmers and their actions to compensate for the reduction of their income associated with the rust epidemic. The experiences of small coffe

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farmers from the mountains of Mexico to face the effects of a severe contraction in production could be valuable for coffe producers with similar climatic and economic conditions worldwide.

Problems Facing World Small-Scale Coffee Production

One of the cash crops produced on a small scale is coffee, which worldwide supplies and contributes to the economy of around 125 million people (Martínez, 2012) and in Latin America it represents the most important product after petroleum. In Mexico, coffee represents a source of income for 2.5 million coffee farmers and is a labor-intensive crop during the agricultural cycle and especially in the harvest (Traffano et al., 1948; Najera, 2002). However, the recurrent crisis in coffee prices has affected both large and small producers in recent decades. This problem has its antecedents in the collapse of the International Coffee Agreement signed in 1962 according to Salinas (2000) and other cyclic problems must be added such as: the coffee rust disease (*Hemileia vastatrix*) and the pest of coffee berry borer (*Hypothenemus hampei Ferrari*). In Mexico one of the effects of these crises is seasonal migration of coffee farmers, who have sought additional income in the cities and commercial agricultural fields of central and northern states and in the United States. At the beginning, the fall in coffee prices was attempted to revert through a quota system that was established and regulated by the International Coffee Organization until 1989 when this organization disappeared. After that, the world coffee market was destabilized due to the entry of reserves until then controlled. There was an oversupply without quality specifications that led to the abandonment of plantations due to the growing migration of producers (Escamilla et al., 2005). The production of small farmers was reduced to 20% of the previous volume with a value no higher than 0.1% (Pérez & Echánove, 2006). At the same time, Vietnam and Indonesia began to gain positions in the international market while Colombia and Costa Rica reduced their participation; these adjustments affected the majority of producers (Varagis, Lewis, & Giovannuci, 2002). Due to structural adjustments in Mexico, credit to the coffee producing municipalities was reduced drastically and only 2.5% of the producers were benefited; this situation placed small coffee farmers at a disadvantage compared to large ones (Escamilla et al., 2005). As a result, the vast majority of coffee farmers in the main coffee producing states of Mexico—Oaxaca, Puebla and Veracruz—were immersed in poverty and marginalization.

In the State of Oaxaca, coffee cultivation covers more than 150,000 hectares and involves around 100 thousand households (Torres, 2017). Specifically in the District of Villa Alta located in the Sierra Norte region, coffee production constitutes between 50% and 80% of the income of rural economies (Fuentes, 2012; Chávez-Méndez, 2016). In these conditions, an alternative to reactivate the economy of small producers in rural areas with a temperate humid climate can be the cultivation of organic coffee, which is produced under certified norms, the use of labor and the reduction of chemical fertilizers. This type of coffee could be a strategy that allows producers to insert themselves into fair trade and improve their income (Escamilla et al., 2005; Varagis et al., 2002). In the Villa Alta District, the study area, coffee producers are characterized by having small plantations, communally-owned, whose size is between ¼ and ½ ha; and their production system is labor-intensive and has been adapted to the natural ecosystem during more than one century. Hence, at the present small coffee farmers have conditions to participate in coffee fair trade as way out of poverty.

Agriculture and the Development of the Small Rural Production

The efforts of the government and the population of a nation or a municipality lead the development of the economy, which is reflected in the economic growth; the indicators of this process are: the generation of

employment, the increase of welfare levels, the reduction of poverty and inequality. However, if the members of the labor force do not achieve a level of income that will allow them to meet the wellbeing goals of their households, many of them will emigrate in search of higher income or alternatively will intend to increase their local sources of income. The household income should, at least, allow investment in the education of the children so that they can reach one or more levels of schooling above that of their parents. In summary, the purpose of development is to contribute to the improvement of social welfare and the alleviation of poverty. In this sense, development and economic growth can be based on the rational use of available resources associeated to factors that are related and dependent on each other, that is: capital needs technology, investment, application and generation of knowledge to obtain greater production; and these, in turn, require a solid and responsible social policy (Lewis, 1957; 1960). The ultimate goal of development is the satisfaction that provides people with the achievement of goals and objectives. Thus, development through welfare programs seek the elimination of poverty and social inequalities, because opposite conditions would be reflected in a society with famine and social vulnerability (Sen, 1983; Meier, 2002). That is to say, economic development has the purpose of providing population with resources to improve living conditions. However, for this to be possible, it is necessary to generate knowledge, insert the population in technological advances and in the market (Hoff & Stiglitz, 2002; Adelman, 2002; Meier, 2002). Likewise, it will be necessary, on the one hand, to make an economic restructuring that allows access to credit to small businesses and the agricultural sector; in this way, a greater offer of employment and social equality are expected (Ranis, 1974). On the other hand, according to Lucas (1988) and Romer (1986) economic growth would be generated from the accumulation of human capital and the implementation of technology. The human capital trained and endowed with knowledge, the access to technology will allow to elevate the productivity and competitiveness of the productive plant to participate with advantages in the free market economy.

Another way of looking at the development process is through the factors of production—land, capital, and labor—that fulfill determining functions to generate favorable conditions of life for the population such as: the satisfaction of basic needs (health, education, housing, among others). The agriculture from which these factors originally come from plays an important role in economic development as a source of food supply, income from the sale of surpluses, as well as supplying raw material to other economic sectors (Kuznets, 1995). The agricultural sector also provides labor to the urban sector and scarce employment; therefore, there is a reciprocal relationship between the rural sector and the urban sector through the supply of labor and the demand for wages. Unemployed rural labor can be absorbed by non-agricultural activities and this would affect agricultural work (Lewis, 1975; Taylor & Adelman, 1996). In turn, agriculture demands industrial products for production and consumption based on income received through wages or sale of surpluses (Meier, 1995). In this way, the agricultural sector distributes its resources between subsistence production, commercial production, and wage labor. Despite the importance of the agricultural sector, most of its population is marginalized and receives low wages in developing countries. This situation is explained by the lack of investment in prosperous crops, little or null technology application. Under these conditions, the viable strategy to promote agricultural development would be to invest in research and technology, obtaining knowledge, making use of competitive advantages, and recognizing the contribution of the agricultural sector to development (Johnston & Mellor, 1962). This implies the establishment of an agricultural development program that strengthens efficient activities with technical assistance and subsidies for inputs (Otero, 2004). To this, it must be added favorable exchange relations for producers who have to maintain acceptable levels of productivity. At this point, Gómez-Oliver (1995) states that

the agricultural sector should focus its attention on the use of competitive advantages and capital accumulation. Summing up, in the attempt to improve the living conditions and the income of the rural population, adequate strategies could be (Plaza, 2005): the promotion of activities of economic weight, rescue of culture and resources that allow to strengthen the identity of the community or the nation, the promotion to the investment towards small activities (e.g. handicrafts and services), support to the technification and improvement of agricultural production. On this basis, in Mexico the public policies of social assistance for the countryside during neoliberalism from President Carlos Salina de Gortari to President Enrique Peña Nieto, include programs such as: PROSPERA, PRONASOL, OPORTUNIDADES, PROCAMPO, Program 70 years and Over, and Pension Program for Older People, whose overall objective is to counteract poverty through investment in education and support for the low-income households. However, this strategy has been far from eradicating poverty, at the root, since it only combats its effects; consequently, it has been incapable of correcting the inequalities between rich and poor (Ornelas-Delgado, 2006). Thus, the favorable factors could be: the diversification of income sources and the technical advice to producers, whose effects can contribute to the reactivation of and the empowerment of agriculture (Losch, Grech, & White, 2002).

In the study area, it is important to point out the small production of coffee, which has ecological relevance and conforms to the concept of organic coffee or environmentally friendly production; and also contributes greatly to the development of other basic products (Escamilla et al., 2005). However, the coffee farmers' economy has recently been diminished in Mexico by the presence of rust epidemic, which has become an epidemic of coffee plantations on the planet. This disease appeared in East Africa in 1861 and was spread to other parts of the world until it reached the American continent, where it began to affect coffee plantations in Brazil. In Mexico, the rust epidemic affected the plantations of this crop in 1981 and was first detected in the State of Chiapas, from where it was extended to the coffee plantations of other states (Hernández & Velázquez, 2016; Barrera, 2013). Cold and humid climates favor the presence of this disease and viable strategies to control it at acceptable levels may include: production with technical support that considers the elimination of old plants whose vulnerability to rust epidemic is higher and these must be replaced by plants tolerant to this disease. Government programs must support small-scale production of coffee and other crops that may be the basis for the take-off and the fuel for a sustainable rural development process in Mexico; and some clues may emerge from this paper.

Study Area

The communities of Otatitlán de Morelos, San Bartolomé Yatoni, and Santiago Lalopa[1] are representative of the 13 coffee producing municipalities of the Villa Alta District, which is part of the Sierra Norte region in the State of Oaxaca, Mexico. The territory is located in mountains and receives rainfall from June to December (Arrioja Díaz Viruell, 2008) and the previous three months the rainfall is scarce. The economies of these communities are characterized by being based on the subsistence production of basic crops (corn and beans), small commercial production of coffee and, to a lesser extent, sugarcane in communally-owned land. The communities are located at an altitude between 1,200 and 1,600 meters above sea level and between 140 and 161 km away from the city of Oaxaca. People belong to the Zapotec ethnicity, which is one of the 16 pre-Hispanic surviving ethnicities in Oaxaca State. Zapotecs of Villa Alta District are heir of the Zapotec civilization of the

[1] These localities will be named just Otatitlán, Yatoni, and Lalopa hereinafter.

ancient Mesoamerica. In the municipalities of this district the humid temperate climate predominates highly influenced by the Gulf of Mexico and their natural resources are: agricultural land, cloud forests and abundant water.

Effects of the Rust Epidemic on the Income of Coffee Producers

The rust epidemic decreased abruptly coffee crop yield and affected the relative prosperity of the household economies of the coffee producing municipalities in Villa Alta District, the last area in Mexico that was affected by this epidemic. Out of these municipalities, the communities of Otatitlán, Yatoni, and Lalopa are considered in this article.[2] The contraction of the average production volume per producer was as follows (Figures 1 and 2): Households of Otatitlán produced 334.4 kg of parchment coffee in 2014 and in 2017 production dropped to 173.4 kg; Yatoni from 427 kg dropped to 128 kg; and the largest reduction was observed in Lalopa that went from 440.7 kg to only 38.5 kg. Additionally, the value of coffee production decreased because the rust epidemic reduced the quality of the cherries. Thus, in 2014 in Otatitlá the average annual value of the coffee harvest per producer was Mex$ 11,554.0 and in 2017 it was reduced to Mex$ 4,535.0, while in Yatoni it went from Mex$ 13,317.0 to Mex$ 3,366.4 and in Lalopa from Mex$ 12,974.0 to only Mex$ 1,023.0. The fall in coffee income was only compensated in Lalopa through the production of *aguardiente*, which is the popular rum in Mexico made from sugarcane[3]; and this product ranked first among the other communities (Figure 2). In contrast, in the other communities there were apparent losses in the production of both sugarcane and basic crops. This was due to an increase in production costs, which raised the unit price of maize and bean harvests consumed by households and sugarcane harvested for manufacturing *panela* and *aguardiente*. In fact, these "losses" affect the household budget just by the reduction of net income from these crops since there was no total loss and the negative net income resulted from valuing the harvest at the market price. On one hand and, producers do not have to pay the amount of the apparent losses, but they do see their net income from sugarcane harvest vanishes to cero and, on the other, its sugarcane harvest goes into the production of *panela* (brown sugar loaf) and *aguardiente*, which produce good gains and specially the later. In the case of staple foods for self-consumption, harvest just became smaller and more expensive. Nonetheless, coffee income continued to be significant in Otatitlán and Yatoni, where the contribution to agricultural net income was between 60% and 80%, in comparison with the rest of the agricultural crops and backyard livestock, while in Lalopa the production of *aguardiente* became the main source of income for various producers in 2017 (Figure 2). The information obtained through interviews with producers indicates that not all households in this community produce *aguardiente* and that coffee continues to be the small-scale commercial crop for most households, as in the rest of Villa Alta District.

The output value of productive chain of sugarcane in la Lolopa exceeded that of coffee in 2017, but it did not eliminate coffee from the income of households that continued to be important. Beans and corn are mainly products of self-consumption, therefore, their income is lower since only small surpluses are sold at prices lower than that of coffee, *panela* and *aguardiente*. Coffee income comes mainly from the commercialization of parchment coffee, which is sold in small quantities in various communities of the Villa Alta District. This information shows the importance of small-scale coffee production in rural peasant economies in mountainous areas of Mexico.

[2] Database of Lalopa is available in 2017 and data are missing in 2014; hence, this community was not included in model 2014.
[3] It is the Mexican version of the Caribbean rum or the South American cachaça and is obtained by distillation from a fermented concentrate of sugarcane juice, which is obtained by evaporation (molasses).

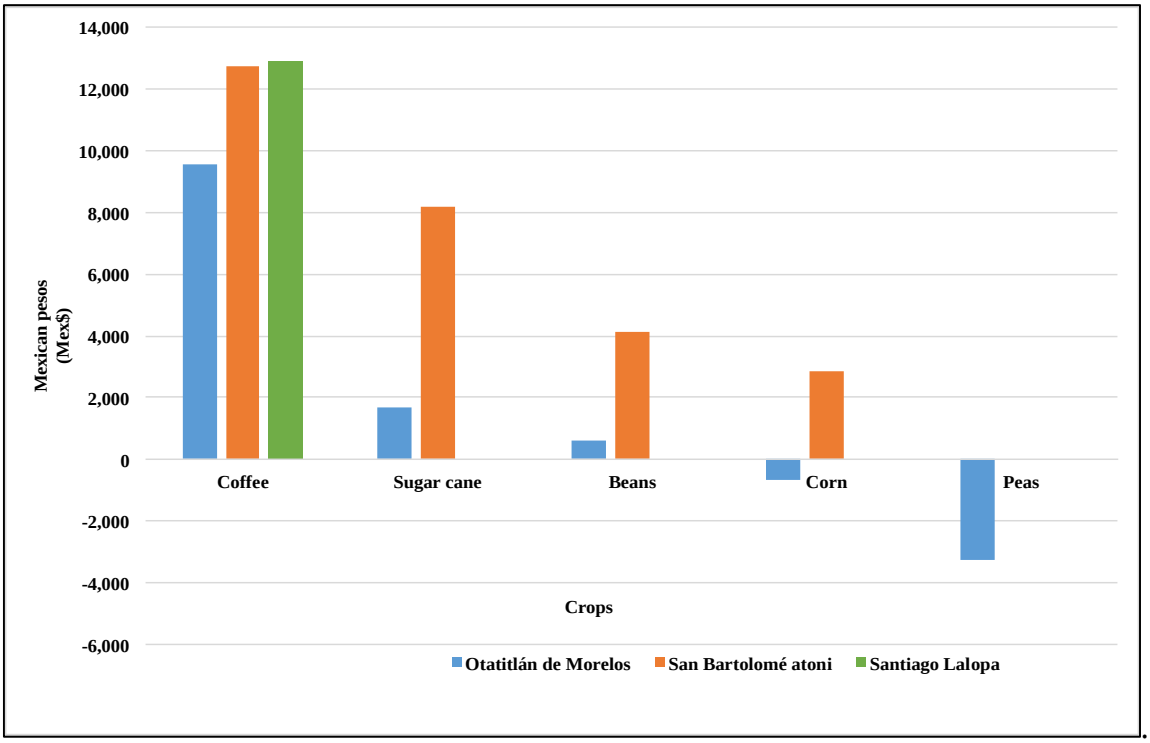

Figure 1. Average net income of the main crops in Otatitlán de Morelos, San Bartolomé Yatoni, and Santiaglo Lalopa, Oax., 2014.

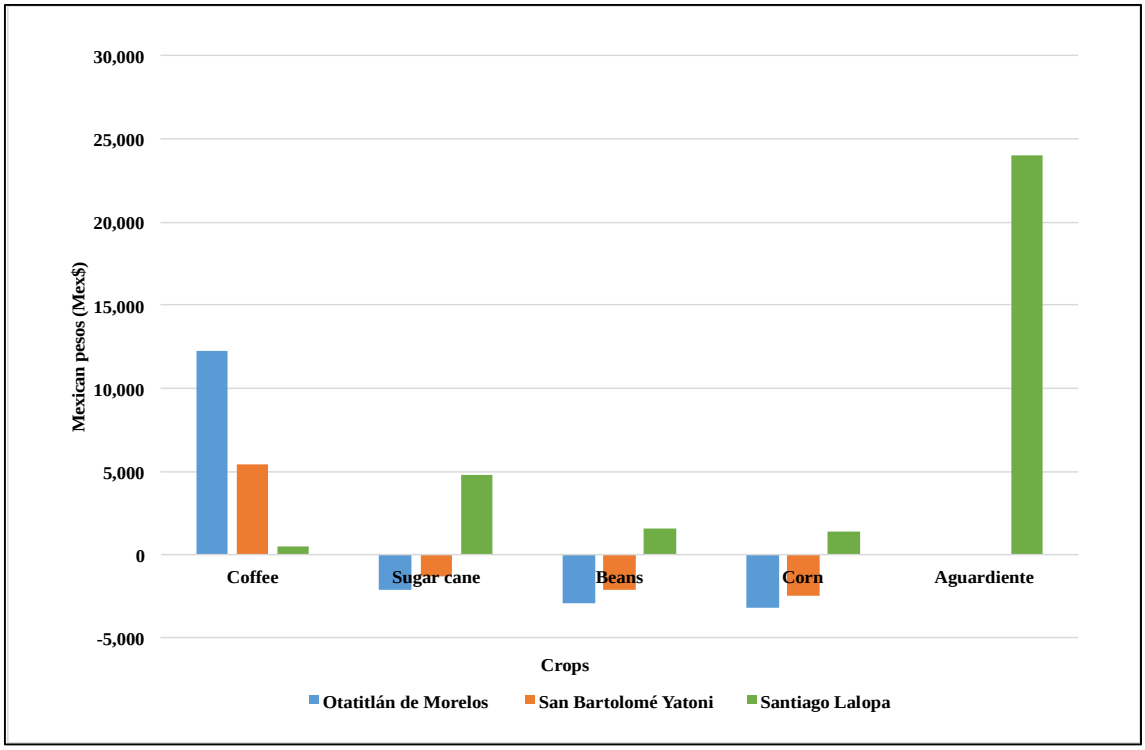

Figure 2. Average income of the main crops in Otatitlán de Morelos, San Bartolomé Yatoni, and Santiago Lalopa, Oaxaca, 2017.

Income in the Household Economies

The selling price of an arroba[4] of parchment coffee ranges between 350 and 380 Mexican pesos (Mex$) and the sale of coffee powder only represents between 5% and 10% of the harvest. The commercialization is carried out through regional middlemen and local merchants who concentrate the coffee production of the Villa Alta District, since the participation of organizations is very limited. In this regard, the information obtained through interviews with producers about the participation of organizations in marketing can be summarized as follows:

> ...We have seen that the price of coffee is low and the work dedicated to the harvest is heavy and takes time. An option to improve the price is to become a member of the organizations already created. In the beginning, organizations' partners were 1000 in the State of Oaxaca. In the communities the coffee production of all the producers was accumulated and sold at a better price through a contract with organizations such as: Michizá, UCIRI, CONDOR and AMSA. These organizations exported coffee to Germany and other countries in Europe, the United States. The advantage of this marketing system consisted of the support received in the harvest and technical assistance. The disadvantage is related to the criteria of production and harvest. The care of the coffee plants is made according to the specifications of the technicians, with whom the production delivery contract is made. It should be noted that the process to deliver a quality product is laborious and must meet certain drying and size requirements. These requirements discouraged most producers who were deserting from the organizations and we remain because discovered that an organization can assure us a good price for coffee. Therefore, we have organized and currently constitute the coffee organizations *Yeni Navan* and *Aroma de Café*. Unfortunately we are small producers and each one can only produce between 200 and 300 kg annually. Therefore, we are at a disadvantage compared to the large producers who have already technified their production system. (Martínez and Velazco, personal interview, 2017)

Although there is a background of coffee organizations in Villa Alta District, these have not prospered as it has occurred in other regions of Oaxaca State due to the apathy of the producers and the lack of leadership to conduct partners towards the successful culmination of projects. In addition, it was detected that the majority of producers do not know the advantages of marketing their product by means of organizations; for this reason, they end up selling their production surplus to the middlemen. However, coffee producers expressed their displeasure with the prices and many of them are interested in improving their commercialization system. The results of the survey and interviews confirm that coffee is the major small-scale commercial crop. Basic crops—corn and beans—besides grains provide corn cobs (*elotes*), *totomoxtle* for *tamales* (corn husks), green beans, and *quelites* of beans.[5] In the specific case of Lalopa, it was observed that coffee is losing weight in household income, although interviews with agricultural producers reported interest in organic coffee cultivation and fair trade. Likewise, it was detected that Lalopa is the only community that has managed to export coffee through the Oaxacan organization known worldwide Union of Communities of the Isthmus Region (UCIRI).

Continuing with the analysis of household economies, it should be underlined that the average budget of households in Yatoni is covered up to 73.7% with endogenous income and in Otatitlán 55.7%. That is, the economies of these communities have the capacity to cover the total consumption of households (household wellbeing) and the productive investment. In contrast, in Lalopa endogenous income represents 36% of the average budget of households, which indicates the dependence of its economy on regional wages (*SR*), internal remittances (*RN*), international remittances (*IR*), and transfers from government (*TG*). The endogenous income corresponds to the net income from agriculture (*INA*), livestock (*ING*), commercial business (*INC*), services business and small-scale manufacturing (*INSyM*), gathering activities (*INR*), local wages (*SL*), and transfers from

[4] 1 arroba = 11.5 kg.

[5] *Quelites* of beans are tender shoots of beans plants and specifically refers to the varieties *delgado* and *cuarentena*.

other households (*TOH*). Information obtained by interviews indicate that net income from family businesses (*INC* and *INSyM*) are used to finance international migration. The major income source corresponds to the *SL* and in some cases to *RN* and *SR* as shown in Figure 3. The *SL* refers to the wages paid to the labor employed during the agricultural cycle of the basic and commercial crops. Households invest to ensure the production of staple foods and cash crops for generating monetary income. Given the importance of coffee in the household budget, households would be expected to invest more in the production of this crop. Nonetheless, the data reveal the first concern is the supply of food in the three communities. Lalopa pays more *SL* while Yatoni resorts to the retention of family labor. Households of Otatitlán are in an intermediate position between these two communities and uses remittances to finance wages, while Lalopa pays it with the net income from production surpluses together with *SR*.

In summary, agriculture in these communities represents the main source of income, basic food and employment. Local labor market created by agriculture reduces labor migration to some degree, as well as the regional one, which offers jobs normally to professionals and teachers. However, as a result of the decline in coffee production associated with the attack of the rust epidemic, households in the study area carried out actions to compensate for the contraction of their income. Thus, in 2014 in Otatitlán agriculture was the most profitable activity and 2017 households with family businesses allocate part of their coffee investment in services-and-commercial businesses, while other households sent family labor to the United States to obtain *RI*. In contrast, households in Yatoni and Lalopa continued to allocate similar amounts of resources to agriculture and to compensate for the reduction in coffee income, they sent labor to the national labor markets to obtain *RN*. Lalopa without abandoning coffee production invested in the production of *aguardiente* from sugarcane and obtained remarkable net income. Family businesses and backyard livestock reported apparent losses (negative net income) like Lalopa. In fact, the households that carry out these activities do not have a capitalist logic, but rather they try to ensure food for self-consumption and other items of daily consumption. In addition, owners of businesses obtain certain social prestige in their communities, which represent the main incentive to invest in this activity. At the current stage of development, the benefit from family businesses may be measured in the field of subjective wellbeing, which goes beyond the scope of this paper. Agriculture is a key economic activity because it provides inputs to the profitable productive chains of coffee and sugarcane whose net income is superior to that of family businesses, backyard livestock, the gathering activities. Additional information about backyard livestock must be underlined and taken into account: this activity can also produce income from rent of working animals to transport harvest and firewood from the mountains to villages. This income is normally not considered in the calculation of the net income of backyard livestock. Chickens, turkeys, pigs, goats, and sheep are mainly for the household feeding, and they are sold only if contingent expenses appear; then household heads do not hesitate to sell part of the livestock. Thus, another function of this activity is a means of saving in kind in peasant economies.

Despite the importance of agriculture in the household economies, agricultural income which includes the productive chains of cash crops fail to cover the consumption needs of producer households. Consequently, households began to redirect part of their efforts to new activities to supplement the family budget such as: investment in small family businesses and employment in construction and services in the region (regional wages). One of the most visible consequences of the rust epidemic attack is the increase in migration towards other states of Mexico and Los Angeles, California. As a result, international remittances increased in the last three years; in Otatitlán they went from 6.5% to 8.5% of the household income and in Yantoni from 5.2% to

13.30%. Internal migration was a new outcome and part of the labor force began a circular movement between these communities and the agricultural fields of the States of Sonora and Guanajuato. The effects of this phenomenon can be seen in the decrease in population and in an increase in the demand for waged labor for agriculture and female family labor. Local wages are normally financed with remittances and are also paid in kind with a portion of the harvest of corn and beans. Another kind of payment corresponds to the mutual support between households known as *gozona*, which consists of family labor exchange between households in each one of the cultural labors of these crops; this is: sowing, weeding, fertilization, and harvest. For this reason, in the period 2014-2017 local wages are still significant in the economy of these communities and in general they sustain a labor market in coffee producing communities of the District of Villa Alta.

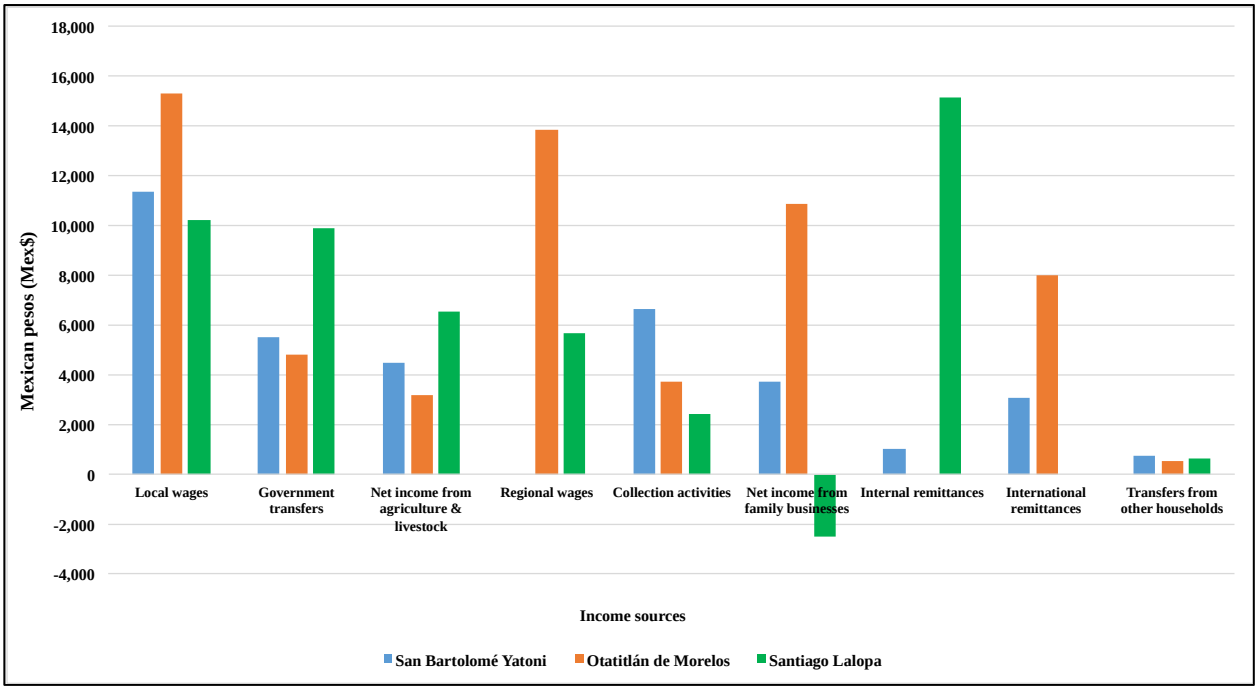

Figure 3. Structure of the household income in Otatitlan de Morelos, San Bartolomé Yatoni, and Santiago Lalopa, 2017 (average values).

It was found that the regional wages in Otatitlán and Lalopa represent 12% and 23% of the household income (*IF*), respectively. Households in Otatitlán have the highest average amount of regional wages (Mex$ 13,829.3) with respect to the other study communities and its waged labor employed in the region has these occupations: primary education teacher, music instructor and office worker. In Lalopa regional wages are related to occupations such as: professionals, service assistant, blue-collar worker, and housekeeper. Government transfers are another source of exogenous income that allows households to have access to health and education services through the OPORTUNIDADES program. These transfers in Yatoni represent 15% of the *IF* and in Lalopa, 20.5%. Finally, transfers between households (*TOH*) represent another source of income that can be both endogenous through the *gozona* and exogenous through remittances. These social practices constitute a mechanism of income redistribution between households, which may characterize Mexican indigenous communities as egalitarian; nevertheless, their weigh in the *IF* is minimal in comparison with wages, net agricultural income and remittances. In fact, *TOH* has more effect on the subjective wellbeing of donor households than on objective wellbeing of the receiving households.

Empirical Model of Household Economies

The results show that the coffee producing communities have characteristics of a peasant economy and adopt strategies and social practices oriented to the satisfaction of basic needs; and the households also present features of an incipient capitalist economy. The climate in such communities is favorable for agriculture and backyard livestock. The abundance of water allows the practice of the *tonamil* system through which support irrigation is provided to the crops during the long rainy season. Thus, agriculture produces basic food for households twice a year, monetary income and wages. However, local wages are not allocated to wellbeing consumption but to savings and investment; for this reason, they appear in equation (1) with a negative sign (Reyes-Morales, Gijón-Cruz, & Cruz-Hernández, 2015).

It must be taken into account that in 2017 the community of Lalopa was added to the study which also produces coffee and has similar characteristics to Otatitlán and Yatoni. In the period analyzed, 2014-2017, the five main income sources of these communities were, in order of importance initially: local wages (*SL*), regional wages (*SR*), net income from agriculture which includes net income of the productive chains of coffee and sugarcane (*INA*)[6], government transfers (*TG*), and international remittances (*RI*). The *SL* were generated by coffee and staple crops; the *SR* normally corresponded to family labor with higher schooling. The *TG* did not represent a supplement to the family income that would allow the satisfaction of the household wellbeing goals because it was used for savings or investment. Households allocate in 2017 their surplus of labor force in other activities outside the community; according to equations (3) and (4) these are: international migration (*IR*) and internal migration (*RN*). The *RI* represented for households with migrant members the possibility of improving household conditions, *i.e*., buying a truck; and land for cultivation, investing in the education of their children. On the contrary, in 2014 international remittances represented a reduction in family labor for households and were not enough to cover agricultural wages. Besides, *RI* were utilized for savings or investment. For this reason, this source of income did not have significant effect on the household wellbeing (*BF*) as it can be seen in equations (1) and (2). The *SL* continued to occupy the foreground because they are financed by the net income from coffee and also by exogenous income among which the *IR* and *SR* stand out. In 2017 the *TG* went up and surpassed *SR*, however, they did not have a significant effect on the *BF*. This outcome can be observed in the regression equations (3) and (4). The net income of coffee—included in *INA*—fell to the fifth place due to the rust epidemic and *RN* that were irrelevant in 2014 exceeded the *RI*; this was due to the immigration policies in the United States which reduced both employment opportunities for undocumented Mexican immigrants and remittances flow. However, *RN*—unlike *RI* are used for wellbeing consumption; for this reason, they appear in the regression equations (3) and (4) with positive sign. Net income from family businesses (services businesses, *INS* and commercial businesses, *INC*) remained in the seventh place just below the net income from gathering, *INR* since 2014 and this kind of income was already allocated to wellbeing consumption.

$$BF = \underset{(0.000)}{5{,}126.864\,Espr} + \underset{(0.019)}{374.923 Edpr} + \underset{(0.002)}{0.546 Ah} + \underset{(0.002)}{3.909 INS} + \underset{(0.003)}{1.651 INC} - \underset{(0.021)}{6.013 TOH} - \underset{(0.077)}{0.159 SL} \quad (1)$$

$$BF = \underset{(0.000)}{5{,}290.835\,Espr} + \underset{(0.003)}{4.125\,INS} + \underset{(0.029)}{15{,}271.992 HC} - \underset{(0.005)}{8.281\,TOH} \quad (2)$$

[6] The harvests of cherry coffee and sugarcane are transformed into, the first, in parchment coffee and, the second, in *panela* and *aguardiente* through traditional technological processes that require the use of machinery, equipment, energy and labor.

Table 1

Ordinary Least Squares Multiple Regression Analysis of Household WellBeing Model 2014: Standardized Coefficients, Statistic t and Measures of Multicollinearity

	Equation (1)				
	Standardized coefficients, Beta	Statistic *t*	Multicollinearity measures		
			VIF < 10	Eigenvalues	CI < 10
Average schooling of household members, *Espr*	0.718	6.553	4.989	3.086	1.000
Average age of household members, *Edpr*	0.249	2.438	4.338	1.421	1.474
Savings, *Ah*	0.223	3.242	1.971	0.689	2.116
Net income from business services, *INS*	0.176	3.300	1.187	0.121	5.049
Net income from commercial businesses, *INC*	0.171	3.167	1.214	0.233	3.638
Gifts received (transfers from other households), *TOH*	-0.145	-2.393	1.524	0.479	2.538
Local wages, *SL*	-0.152	-1.812	2.921	0.970	1.784
Coefficient of multiple determination, R^2			0.896		
R^2 correctected, R^2_{corr}			0.880		
Statistic *F*			53.152 ($p < 0.000$)		
Degrees of freedom (regression and total)			7 and 50		
			Equation (2)		
Average schooling of household members, *Espr*	0.741	6.69	4.188	2.435	1.000
Net income from business services, *INS*	0.186	3.178	1.171	0.918	1.629
Households that profess the Catholic religion, *HC*	0.249	2.248	4.188	0.131	4.313
Transfers from other households, *TOH*	-0.2	-2.98	1.531	0.515	2.174
Coefficient of multiple determination, R^2			0.865		
R^2 corrected, R^2_{corr}			0.853		
Statistic *F*			73.766 ($p < 0.000$)		
Degrees of freedom (regression and total)			4 and 50		

Notes. Dependent variable: household wellbeing (*BF*); VIF: variance inflation factor; CI: condition index; Eigen- and CI values do not correspond to the values of the independent variables. Source: Database of a probabilistic household survey in Otatitlán de Morelos and San Bartolomé Yatoni, 2014.

In three years, the factors that contribute to household wellbeing changed. In 2014, households could use their savings (*Ah*) to sustain their level of *BF*, while the social practice of reciprocal gifts (*TOH*) diminished it. In Oaxaca State *TOH* is called *gozona* or *guelaguetza* and in this practice of mutual support, family members, friends, godfathers, godchildren, or neighbors participate. It helps to preserve the social prestige of the donor households in their community and it may be of a great assistance to the receiving households. The testimonies of people interviewed indicate that *gozona* establishes enduring relationships among households through cronyism (*compadrazgo*), friendship, and good neighborliness; and it has positive effects that manifest through peaceful coexistence and shared wellbeing. Transfers among households include: gifts in cash or in kind to support feeding, health, and education; they are applied, e.g., in family celebrations or represent voluntary labor in the agriculture and construction of houses. However, the negative sign of *TOH* in equation (2) points out that transfers given to other households outweigh the transfers received from them. Likewise, the socio-demographic variables of the household members were the factors that determined the level of *BF*, i.e., average schooling (*Espr*), average age (*Edpr*) *and religion (HC)*. Catholic households had greater wellbeing level than the rest of the households that profess other denominations of christianity. In 2017, *Espr* was the only socio-demographic variable present in linear form in equation (3) and in exponential form in equation (4), while savings and *TOH*

disappeared. An increase in the schooling of the family members continued to represent a resource for households that allowed them to have greater opportunities in the labor markets, especially in the regional ones. Surely the economic crisis that caused the rust epidemic eroded household savings and reduced their capacity to sustain *gozona*. Net income from services businesses (*NIS*) remain but net income from commercial businesses (*NIC*) and *SL* were substituted by *RN* and *RI*. In the new context, the statistical significance of these variables is greater than those of the displaced variables.

$$BF = \underset{(0.000)}{3{,}992.769Espr} + \underset{(0.000)}{6.162INS} + \underset{(0.000)}{0.346RI} - \underset{(0.015)}{0.306RN} \quad (3)$$

$$BF = \underset{(0.000)}{26{,}265.604} + \underset{(0.000)}{6.368INS} + \underset{(0.000)}{0.240e^{1.390Espr}} + \underset{(0.000)}{0.331RI} - \underset{(0.024)}{0.262RN} \quad (4)$$

Conclusions

Table 2

Ordinary Least Squares Multiple Regression Analysis of Household WellBeing Model 2017: Standardized Coefficients, Statistic t and Measures of Multicollinearity

	Equation (3)				
	Standardized coefficients, Beta	Statistic *t*	Multicollinearity measures		
			VIF < 10	Eigenvalues	CI < 10
Average schooling of household members, *Espr*	0.656	14.048	1.200	1.421	1.000
Net income from business services, *INS*	0.546	12.626	1.032	1.003	1.190
International remittances, *RI*	0.172	4.005	1.017	0.980	1.204
Internal remittances, *RN*	-0.114	-2.490	1.148	0.597	1.543
Coefficient of multiple determination, R^2			0.864		
R^2 corrected, R^2_{corr}			0.857		
Statistic *F*			118.978 ($p < 0.000$)		
Degrees of freedom (regression and total)			4 and 79		
			Equation (4)		
Constant		12.161		1.620	1.000
Net income from business services, *INS*	0.791	14.172	1.002	1.014	1.264
Exponential form of average schooling of household members, $e^{(1.390Espr)}$	0.250	4.473	1.009	0.984	1.283
International remittances, *RI*	0.230	4.112	1.008	0.893	1.347
Internal remittances, *RN*	-0.129	-2.299	1.008	0.490	1.818
Coefficient of multiple determination, R^2			0.770		
R^2 corrected, R^2_{corr}			0.758		
Statistic *F*			61.938 ($p < 0.000$)		
Degrees of freedom (regression and total)			4 and 78		

Notes. Dependent variable: household wellbeing (*BF*); VIF: variance inflation factor; CI: condition index. Eigen- and CI values do not correspond to the values of the independent variables. Source: Database of a probabilistic household survey in Otatitlán de Morelos, San Bartolomé Yatoni, and Santiago Lalopa, Oaxaca state, 2017.

The household economies of the coffee producing communities of the northern mountains of Oaxaca State depend mainly on agriculture and present peasant characteristics because the production of staple foods has first priority in the allocation of the family budget. Households also invest in small businesses and small-scale commercial agriculture which includes the value added of coffe and sugarcane to obtain cash and to increase their level of wellbeing. Marketing of coffee is done through regional intermediaries and producers obtain little gain;

however, coffee income is an importat part of the household budget. The rust epidemic in 2017 significantly reduced the income of producer households. As a consequence, their family budget was contracted and this forced them to seek additional income in national and international labor markets. In Sierra Norte region, migration offset the reduction in coffee income to great extent, while in some communities such as Lalopa households invested in the productive chain of sugarcane, which took the place of coffee. The collateral effects of migration are: shortage of labor and, in turn, demand for wage labor and female family labor. In the model of household economies the effects are associated with the average age of the household members and it must be added the reserve of family female labor. Likewise, it was identified that the allocation of part of the household income to the education of children becomes, in the long term, an increase in wellbeing through regional salaries.

It is convenient to highlight the role of the *gozona* in the indigenous Zapotec household economies since this social practice can substitute wages through the exchange of family labor and also constitutes a means of supplying basic foodstuffs. Investment in family business in 2014 was rather a self-consumption activity. In 2017 this activity continued to contribute to the household wellbeing and also represented a means to finance international migration of household members. In short, coffee producer households ensure the production of staple foods and cash through parchment coffee production; afther that, they supplement their family budget with exogenous income such as: internal and international remittances, regional wages and government transfers. They also take advantage of wild natural resources to supplement their daily consumption. As coffee production is a labor-intensive, it requires wage labor for the harvest that is financed by migration remittances and regional wages; migration, in turn, causes shortage of labor and to create further demand of wage labor to produce food stuffs. Thus, Zapotec producers sustain a labor market to satisfy their need of basic food and cash.

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