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## **EFFECT OF PUBLIC INVESTMENT IN THE POULTRY SECTOR ON HOUSEHOLDS' WELFARE IN TOGO: THE CASE OF DEMAND FOR LOCAL CHICKENS (GALLUS GALLUS)**

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### **ABSTRACT**

The objective of this study is to estimate the effect of public investment in the poultry sector on household welfare in Togo. The AIDS (Almost Ideal Demand System) model was used to estimate the consumption of local chickens in Togo and the Friedman and Levinsohn (2002) compensatory variation method was used to estimate the effect of public investment on household welfare using data from the DSID (Directorate of Agricultural Statistics, Informatics and documentation) SAN (Food and Nutritional Security) survey. The double least square method was used on a sample of 5636 rural and urban households to estimate the AIDS model. According to the results, following an increase in the average purchase price of a local chicken by 10% between 2015 and 2021, households lost on average 4636 FCFA of their income, i.e. a welfare loss of 6.5%. Low-income households (the poor) lost 3115 FCFA of their income, a 7.7% welfare loss. High-income households (the rich) lost 7677 FCFA of their income, a welfare loss of 6.4%.

### **KEY WORDS**

Welfare, chickens, compensatory variation, investment, households.

Welfare economics is an economic theory at the service of the evaluation of social situation and public decision making. Consequently, it is a foundation of public policy. Its study focuses on the means and criteria for judging and comparing the quality of social situations (Baujard, 2016). Historically, the notion of welfare economics has undergone a rich evolution in terms of approaches between economists. The utilitarian legacy weighs heavily on welfare economics, in which social welfare is then studied on the basis of the evaluation of individual utilities. The first welfare economics, whose foundations can be found in Marshall (1890); is well represented by Pigou (1920). This work aims to study the conditions of the market in terms of Paretian optimality.

The «new welfare economics», represented by Bergson (1938) and Lange (1942), makes a clear separation between the study of the conditions of optimality of social situations and the study of the functioning of the market. These normative conditions are reduced to the Pareto criterion alone, to the exclusion of all redistributive issues; as they are deemed to be outside the scope of economics science, interpersonal comparisons of utility must be avoided. At the same time, a particular interpretation of utilities, based on choice, emerged. Arrow, 1951, sound the death knell of social choice by establishing the impossibility of constructing a social choice function on the basis of individual preferences without recourse to interpersonal comparisons.

This led to a clear separation between two disciplines. On the one hand, normative economics, consisting of social choice and voting theory, equity and justice theories, was



born out of a desire to overcome the impossibility of Arrow, by working within or modifying his framework. On the other hand, contemporary welfare economics, represented by public and agency economists and proponents of cost-benefit analysis in general, is a direct descendant of the second welfare economics. It studies the conditions under which an economic optimum can be achieved.

For Hicks, 1939; economic positivism can easily become an excuse to evade real problems, thus contributing considerably to the euthanasia of our science. Considering its main purpose, which is to allow economists to make welfare prescriptions without having to make value judgments, and in particular interpersonal utility comparisons, the new welfare economics must be considered a failure (Chipman and Moore, 1978). Mishan, (1981); considers that welfare economics has reached a dead end. Lacroix, (1994); also looks at its future with pessimism: "*Its rejection could only be final, welfare economics would have lived*". For Hausman and MacPherson, 1996; the welfare economics project has still not even seen the light of day. Mongin, 2002 concludes that welfare economics is dead: Welfare economics is dead, or more exactly, it has gradually disintegrated. However, if we accept that welfare economics is a foundation for public policy, the thesis of the death of welfare economics is initially surprising and disconcerting. It is therefore necessary to understand the causes that have led welfare economics to such an impasse.

According to the World Bank, 2018; an African consumes on average only one egg every 5 or 6 weeks, while a Japanese consumes it almost daily. Same observation for poultry meat. In one year, an African consumes on average only 3.3 kg of poultry meat, compared to 28 kg for a French person and a world average of 14 kg. Poultry is of great importance to the Togolese population, where it plays a key role in animal husbandry. In order to increase the consumption of poultry meat to ensure food self-sufficiency, food security and by extension, the well-being of its population; the Togolese government has initiated several projects in favour of the poultry sector over the past several years. Despite these investments, the average price per kilo of chicken imported (frozen chicken) from Brazil, the USA or countries of the European Union is 800 FCFA (1.20 €) on the markets, while that of a local chicken is 2300 FCFA (3.50 €) per kilo (Journal of Greenpeace 2014). Since 2010, the EU has increased its poultry meat exports to Africa by 182% (Greenpeace Journal 2014).

It is therefore important to understand how consumer demand for poultry products is evolving on the welfare of Togolese households following the numerous investments that the sector has received over the past several years. We ask ourselves; what are the effects of public sector investments on households' welfare in Togo? What are the effects of public sector investments on the welfare of low and high income households in Togo following their consumption expenditure on local chickens? This study will attempt to provide answers to these questions.

The objective of this study is to estimate the effects of poultry sector investments on household welfare in Togo. More specifically, it aims to: (i) analyze the effects of poultry sector investments on the welfare of low-income households in Togo as result of their consumption expenditure on local chickens; (ii) analyze the effects of poultry sector investments on the welfare of high-income households in Togo as a result of their consumption expenditure on local chickens. The hypotheses verified in this study are as follows: (i) poultry sector investments in the last five years in Togo have no effect on the welfare of low-income households as a result of their consumption expenditure on local chickens; (ii) poultry sector investments in the last five years in Togo have no effect on the welfare of high-income households as a result of their consumption expenditure on local chickens.

The contribution of this work to the economic literature on the effect of public investments on household welfare is twofold. The first contribution is that consumer expenditure is used in economic studies to measure the reaction of consumers and consumer demand to changes in prices and income and other variables for a given food product. The second contribution is methodological. Unlike previous studies that used the partial general equilibrium model (Agbodji et al., 2013), or that of AIDS (Almost Ideal Demand System) (Deaton and Muellbauer, 1980), to conceptualize the welfare approach; in



this study, we will use the compensatory variation method proposed by Friedman and Levinsohn (2002).

This study aims to use data from the Food and Nutrition Security (FNS) Survey, 2021; of the Directorate of Agricultural Statistics, Informatics and Documentation (DSID), to estimate the effects of investments in the poultry sector on the welfare of households in Togo. The sample consists of 5636 rural and urban households. Finally, the results of this study will allow analysis of the changing structure of the poultry sector and can help measure the impact that changes in economic variables and the policies affecting these variables might have. The study is organized as follows: Section 1 outlines the theoretical and empirical foundations of the effect of investments on welfare. Section 2 presents the methodological approach of this study and Section 3 discusses the results and discussions.

## **THEORETICAL AND EMPIRICAL REVIEW**

The theoretical underpinnings of the welfare effect of investments include the founding approach of welfare economics or old welfare economics, new welfare economics, and contemporary trends in welfare economics.

The founding approach of welfare economics includes utilitarian inheritance, Pareto optimum social welfare, and Arthur Pigou's formalization. The old economics of welfare carried by Jeremy Bentham and John Stuart Mill for whom social well-being is understood as the sum of individual utilities. Utilitarianism is thus based on a theory of cardinal utility which allows interpersonal comparisons of utility. Bentham (1780) defines utilitarianism as the way to maximize collective welfare, which is the sum or average of the welfare of all sentient beings. Mill (1859), defines welfare by happiness, thus departing from a hedonistic utilitarianism.

It should be noted that the utilitarian criterion of Bentham is to be distinguished from the optimum of Pareto. A Pareto optimum is an allocation of resources without alternatives, i.e. all the economic agents are in a situation such that it is impossible to improve the fate of one of them without reducing the satisfaction of another. The Pareto criterion and the utilitarian criterion are compatible, in the sense that if a state A is more efficient than a state B in the Pareto sense, then it is also so in the utilitarian sense.

The new welfare economy appeared in the 1930s and is divided into two streams, namely the British stream and the American stream. The British current, represented by Nicholas Kaldor and John Hicks, is based on the Pareto criterion. A situation is Pareto optimal if it is impossible to improve the welfare of one individual without degrading that of another (Barbe, 2016). Sen (1979) reveals the limits of this approach which prohibits in its evaluation of welfare the consideration of any information external to utility and ignores the problems related to freedoms.

The American current is carried by Paul Samuelson and Abram Bergson for whom collective welfare is then a function of the individual utilities generated by a given social situation. They thus defined the notion of social welfare function establishing a classification of social situations based on relevant welfare variables.

Welfare economics is brought to an impasse by the research work of Arrow (1951). Faced with this situation, three trends clash and strive to overcome these limits, opening up new horizons of research. The measurement of happiness, the concept of "capability" and the theory of equity. The economy of happiness was born following the paradox of Easterlin (1974). Easterlin's paradox is an economic paradox according to which, beyond a certain threshold, the continuation of the increase in income or gross domestic product per capita does not necessarily translate into an increase in the level of individual happiness declared by individuals (Easterlin, 1974). Indeed, according to the neoclassical hypothesis, the increase in wealth is accompanied by an increase in utility, that is to say welfare.

The concept of capability was introduced by the Indian economist Amartya Sen in 1985 where he reintroduced the possibility of interpersonal comparisons, which were nevertheless no longer based on utility but on "capabilities" (Barbe, 2016). The concept of the idea that interpersonal comparisons aimed at analyzing poverty, inequality, justice or development



should be based on what people are really capable of doing and being, in other words on their capabilities (Sen, 1985).

Aaron and McGuire (1970) used the behavioral approach to show how various distributions would result from various consumer preference structures. Gomance et al. (2003), as well as Mosley et al. (2004) showed that public spending on education, agriculture, housing and economic and social infrastructure (water, sanitation, etc.) has a negative and significant impact on poverty. Janvry and Sadoulet (1995) used the agricultural household model to formulate the poverty reduction strategy for rural households in Mexico. The retained profit function is of generalized Leontief form. The parameters of the system of factor supply and demand functions, for the average farm, are deduced from a reasonable evaluation made from the price elasticities given by Sullivan et al. (1988), after calibration in order to satisfy the constraints of homogeneity and symmetry. Fan et al. (2004) find that rural infrastructure, education and health contribute to increased agricultural production and reduced rural poverty in Uganda.

By reconsidering the infant mortality rate and the human development index (HDI) as indicators of well-being, Gomance et al. (2005) obtain, from quintile regression, that aid can affect welfare through public spending. Frey and Stutzer (2002) showed using Easterlin's paradox that the relationship between increased income and happiness is verified only up to a threshold, which differs depending on the study. Criticisms of Easterlin's paradox come from the work of Stevenson and Wolfers (2008) who find, using richer and more recent data, that happiness is a logarithmic relationship of income, for individuals as well as for countries, to a given moment as in the long term.

Easterlin (2010) criticizes the results of the work of Stevenson and Wolfers, in particular the choice of countries on which the studies focused. Razafindrakoto and Roubaud, 2006; analyzed the factors affecting well-being, and more specifically the role of institutions in Africa on well-being. The study was conducted in eight countries in sub-Saharan Africa (Benin, Burkina Faso, Côte d'Ivoire, Madagascar, Mali, Niger, Senegal and Togo). The result showed that health and education constitute a central component of well-being, which goes well beyond the private returns they provide in terms of income.

In a 2012 report for the United Nations, the authors (Stevenson and Wolfers (2008)) point out that other variables covary with wealth, including social trust, and that it is they, not income, which largely explains the link between GDP and well-being. In 2010, Easterlin published results concerning a sample of 37 countries and reaffirms the Easterlin paradox. A consensus has nevertheless emerged between Frey and Stutzer (2002) and Easterlin (2001, 2010) on the fact that there is a positive correlation between subjective well-being and the level of income but that it is far from to be perfect. Agboji et al. 2013, analyzed the impact of rising food prices (2008-2009) and reform measures implemented by Togo on poverty, vulnerability, inequality and children with an equilibrium model partial general and panel data. The study showed that the price increase has consequences on the well-being of children, and negative effects on net consumers, while farmers, net producers see their standard of living improve.

## **METHODS OF RESEARCH**

Several functional forms are used to model consumer preferences. Flexible functional forms such as the Rotterdam, translog and AIDS (Almost Ideal Demand System) models have been developed to model consumer preferences. Among these, the AIDS model, developed by Deaton and Muellbauer (1980), has become the reference model in demand analysis. The AIDS model is used for the following reasons: (i) the AIDS model is a first-order approximation of any demand system; (ii) the AIDS model is a class of preferences called PIGLOG ("Price independent generalized linear log"); (iii) PIGLOG preferences are represented by a cost or expense function; (iv) the AIDS model is easy to estimate; (v) it is compatible with data collected at the household level and allows perfect aggregation of individual estimates; (vi) the homogeneity and symmetry assumptions can be tested by imposing linear constraints on the model parameters (Allodehou, 2012).



The demand functions of the AIDS model are estimated as functions of the budget share of each good ( $\omega_i$ ) as follows:

$$\frac{p_i q_i}{Y} \equiv \omega_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i + \frac{\ln Y}{P} + \mu_i \quad (1)$$

$$\ln P = \alpha_o + \sum_k \alpha_k \ln p_k + \frac{1}{2} \sum_j \sum_k \gamma_{kj} \ln p_k \ln p_j \quad (2)$$

( $\omega_i$ ) represents the budget share of good  $i$  ( $i=1, \dots, n$ );  $p_j$  the price of good  $j$  ( $j=1, \dots, n$ );  $Y$  the total expenditure,  $P$  translog price index,  $\mu_i$  the error term, and  $\alpha_i, \gamma_{ij}, \beta_i$  are the parameters to be estimated. Using the translog price index can lead to model estimation problems. Deaton and Muellbauer (1980) propose to approximate the value of the translog price index using the Stone index.

The Stone index ( $P^*$ ) is defined by:

$$\ln P^* = \sum_k \omega_k \ln p_k \quad (3)$$

It corresponds to a weighted geometric mean (by budget shares) of the prices of the various goods. The demand functions obtained are valid representations of consumer preferences in the sense of economic theory when the estimated parameters respect the additivity conditions ( $\sum_{i=1}^n \alpha_i = 1$ ;  $\sum_{i=1}^n \beta_i = 0$ ;  $\sum_{i=1}^n \gamma_{ij} = 0 \neq j$ ), of homogeneity ( $\sum_{j=1}^n \gamma_{ij} = 0 \neq i$ ) and symmetry ( $\gamma_{ij} = \gamma_{ji}, i \neq j$ ).

The budget share functions can be rewritten at the household level as follows:

$$\omega_{ih} = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln (Y_h / P * K_h) + \mu_{ih} \quad (4)$$

With  $\omega_{ih}$  the budget share of good  $i$  for household  $h$ ,  $p_j$  the price of good  $j$ ,  $Y_h$  the total household expenditure,  $P$  the price index,  $K_h$  the socio-demographic and economic characteristics of household  $h$ ,  $\mu_{ih}$  the error term at household level  $h$ .

The share of the budget of poultry products ( $\omega_h$ ) is explained by the average purchase price of poultry ( $P_h$ ), the real income of the household ( $Y_h$ ), the socio-demographic and economic characteristics ( $Z_h^k$ ), the region of residence of the household ( $REG_h$ ),  $\mu_h$  Error term, and  $\alpha_i, \gamma_{ij}, \beta_i$  which are the parameters to be estimated according to the equation:

$$\omega_h = \alpha + \gamma \ln(P_h) + \beta \ln(Y_h) + \sum_k \delta_k \ln Z_h^k + \rho REG_h + \mu_h \quad (5)$$

The estimate of consumer welfare can be obtained by estimating a demand or budget share function. The most common measures are the equivalent variation and the compensating variation. The compensating variation measures the variation in income (compared to the new situation) that would allow the consumer to maintain the level of indirect utility of the reference situation. It measures the additional sum that the government should give to the consumer to compensate him exactly for the price change. It is valued at the price of the new situation. The present research uses compensatory variation (CV) to confirm the AIDS model's measure of welfare. The compensating variation is estimated using the approximation proposed by Friedman and Levinsohn (2002):

$$CV^h \approx \sum_i (\omega_i^h * \Delta \ln P_i^h) \quad (6)$$

With  $CV^h$  the compensating variation in the income of household  $h$ ,  $\omega_i^h$  represents the share of the budget of poultry products of household  $h$ ,  $\Delta \ln P_i^h$  the logarithmic variation of the price of good  $i$ . The approximation proposed by Friedman and Levinsohn (2002) allows a simple and rapid calculation of the compensating variation. However, it does not take into account substitution effects between different products.



To analyze the effect of investments on household consumption in Togo; we will use data from the Department of Agricultural Statistics, and Documentation (DSID) relating to the Food and Nutritional Security (SAN) survey for the year 2021. This survey covers a sample of 5636 rural and urban households.

*Definition of variables:*

- Budget share of poultry products ( $\omega_h$ ): Here it designates all the expenses that the household devotes to the purchase of local chickens during the month (Allodehou and Diagne, 2013). This is the dependent variable;
- Average purchase price of poultry ( $P_h$ ): This is the price at which you bought the product from the supplier. The effect of the price of poultry products on the budget share of poultry depends on the value of the elasticity of demand for poultry products with respect to the price of poultry (Fall, 2006). In the case of our study, we expect a negative sign;
- Real household income ( $Y_h$ ): This is the household's real monthly purchasing power. For the Official Journal of the French Senate (1998), real income is used as the basis for calculating social security contributions, a revaluation of the amount of agricultural pensions. Under the assumption that chicken meat is a luxury good, the expected sign of the effect of real income on the budget share of poultry is positive;
- Place of residence of the head of household ( $Z_h^1$ ): This is the place of residence of the head of household. This is a binomial variable indicating whether the head of the household lives in an urban area or a rural area (Lokossou et al., 2011). The sign is not determined;
- Level of education of the head of household ( $Z_h^2$ ): This is the highest level of education of the head of household (Lokossou et al., 2011). The sign is not determined;
- Possession of a chicken coop ( $Z_h^3$ ): This is a binomial variable indicating whether the head of household has a chicken coop or raises local chickens (Babadjide, 2021). The expected sign of the effect of owning a chicken coop is positive;
- Age of head of household ( $Z_h^4$ ): This is the time elapsed by the head of household since birth (Allodehu, 2013). The sign is not determined;
- Household size ( $Z_h^5$ ): This is the number of individuals living in the household. The sign is not determined (Diagne, 2013);
- Region of residence of the household ( $REG_h$ ): This is the territory in which the household resides and which has particular characteristics that give it unity (Jarvis et al, 1998). The sign is not determined (ND).

Table 1 – Description of study variables

Variables	Descriptions	Signs	Sources of variables
$\omega_h$	Share of the budget for poultry products	ND	DSID
$\ln P_h$	Average purchase price of poultry	-	DSID
$\ln Y_h$	Actual household income	+	DSID
$\ln Z_h^1$	Residence of the head of household	ND	DSID
$\ln Z_h^2$	Level of education of the head of the household	ND	DSID
$\ln Z_h^3$	Owning a chicken coop	+	DSID
$\ln Z_h^4$	Age of head of household NA ND		DSID
$\ln Z_h^5$	Size of the head of household	ND	DSID
$REG_h$	Region of residence of the head of household	ND	DSID

Source: Authors; based on DSID data.

The assumption of normality of the dependent variable is verified by the Kurtosis and Skewness test. The positive Kurtosis coefficient (1.38) shows that the distribution of the dependent variable is much more flattened than that of the normal law. That of positive Skewness also (0.21) shows that the distribution of the dependent variable is much more to the right than to the center.

According to the result of the correlation matrix, there is a negative relationship and a strong correlation between the budgetary share in the consumption of local chickens and the purchase price of local chickens (-0.753). This correlation is weaker between the budget share and the household head's income (0.211).



Table 2 – Correlation test between the dependent variable and the independent variables

	(1)	(2)	(3)
(1) $\omega_h$	1.000		
(2) $P_h$	-0.753	1.000	
(3) $Y_h$	0.211	-0.161	1.000

Source: Authors; DSID data, SAN 2021.

## RESULTS AND DISCUSSION

*Socio-demographic characteristics of the respondents.* According to our study, average 82% of respondents are rural compared to 18% who live in urban areas. On average 61.6% of household heads are between 25 and 49 years old, against 2.3% who are over 75 years old. Regarding the level of education of respondents, 48.8% have no level (illiterate); 30.6% have the primary level and only 0.6% have a higher level. In terms of breeding; 77.6% of respondents have a chicken coop against 22.4% who do not have poultry in their households. Finally; 28.7% of respondents live in the Plateau region; 21.9% in the Maritime region; 11.3% in the Central region; 19.6% in the Kara region and 18.5% in the Savane region.

Table 3 – Socio-demographic characteristics of respondents

Features		Percentage
Residence of the head of household	Urban	0.180
	Rural	0.82
Age of the head of household	18 to 24 years old	0.054
	25 to 49 years old	0.616
	50 to 74 years old	0.307
	75 years and over	0.023
Education level of the head of household	No	0.478
	Primary	0.306
	Secondary_1	0.173
	Secondary_2	0.036
Owning a chicken coop	Superior	0.006
	Yes	0.776
	No	0.224
Region of the head of household	Maritime	0.219
	Plateaux	0.287
	Centrale	0.113
	Kara	0.196
	Savanes	0.185

Source: Authors; DSID data, SAN 2021.

*Socio-economic characteristics of households.* The average monthly budget that a household devotes to local chickens is 2670 FCFA for an average monthly income of 73335 FCFA. In addition, at least 25% of low-income households have a monthly income of less than 40,000 FCFA and devote less than 2,000 FCFA or 5% of their income to the purchase of local chickens. On the other hand, the 25% of high-income households earn at least 120,000 FCFA per month and devote at least 3.125% of their income to the purchase of local chickens. The quartile analysis shows that the lowest income households (poor households) spend more on their consumption of local chickens than high income households (rich households).

Table 4 – Socioeconomic characteristics of households

Variables	Quartile 1	Quartile 2	Quartile 3	Average
Monthly household income	40000	60000	120000	73335
Budget allocated to local chickens	2000	2250	3750	2670
Budget share	5	3.75	3.125	3.958
Purchase price consumption (FCFA)	2500	3000	4000	3170

Source: Authors; DSID data, SAN 2021.



*Estimating demand for poultry products using the 2SLS method.* Suppose that there are other variables  $z$  and  $t$ , capable of explaining the variable "Budget share in local chickens". Then their effects will be captured by the error terms of the model which represent all the information which makes it possible to explain the variable "Budget share in local chickens" which is not in the explanatory variables. The estimation of the model will provide coefficients that will be biased (Frish-Waugh-Lovell theorem, 1933) hence the problem of endogeneity. In the presence of endogeneity, OLS estimation produces non-convergent estimators since the assumption of orthogonality between the regressors and the error terms is not specified. In the case of our study, we suspect the variable "ownership of poultry houses" to be endogenous. To solve the endogeneity problem, the instrumental variable approach will be used to estimate our model. Let  $z$  be this instrumental variable. With  $z$  equal:

$$z \begin{cases} 1 & \text{the head of the household is male} \\ 0 & \text{the head of household is female} \end{cases}$$

The regression will be done by the instrumental variable method and the estimation, by the two-step least squares (2SLS) method.

The probability associated with the Chi2 test is significantly zero (0.0000) \*\*\*. The model is globally significant at the 1% level. This means that all the control variables taken together significantly explain the budget share devoted to local chickens. They explain 23.17% of the variability of the budget share (R-squared=23.17%).

Table 5 – Result of the parameters estimated according to the budget share by 2SLS

Number of obs		5636
Prob> chi2		0.0000
R-squared		0.2317
Adj R-squared		0.42487
Budgetary share of poultry products	Coef	Std. Err
Ownership of poultry houses	- 0.048**	0.021
Average purchase price of local chickens	- 1.125***	0.394
Monthly household income	0.160***	0.009
Age of the head of household	- 0.129***	0.211
Residence of the head of head household	0.466***	0.024
Education level of the head of household (Primary)	- 0.080***	0.135
Level of education of the head of the household (Secondary_1)	- 0.134***	0.016
Education level of the head of household (Secondary_2)	- 0.237***	0.034
Level of education of the head of the household (Higher)	- 0.004	0.083
Proportion of individuals in the household	0.011	0.011
Region of the household	- 0.741***	0.035
Constant	77.72***	3.394

\*\*\*: Significant at 1%; \*\*: Significant at 5%; \*: Significant at 10%. Instrumented: The gender of the head of the household

Source: Authors; based on data from DSID, SAN 2021.

*Instrument validity test.* Our model is said to be "exactly identified", that is to say, the number of endogenous regressors is equal to the number of instrumental variables (Ownership of chicken coop =  $z$ ). The objective of this test is to ensure that the instrument of our model is a good instrument. In this case, the latter should not have too weak an explanatory power on the endogenous regressor. The coefficient of determination  $R^2 = 0.9478$  means that our instrument explains the endogenous regressor at 94.78%. The instrument therefore has a strong explanatory power over the regressor. Moreover, the Fisher statistic (0.0000) \*\*\* which is globally significant at 1% leads us to reject the hypothesis of nullity of our instrument. We conclude that instrument  $z$  is a good instrument.

Table 6 – First stage regression summary statistics

Variable	R-sq	Prob F
Gender of the head of the household	0.9478	0.0000

Source: Authors; based on data from DSID, SAN 2021.



Durbin's and Wu-Hausman's endogeneity tests aim to confirm the endogeneity of the regressor. According to the Durbin test, we have a p-value of 0.2640%; that is, we had a 26.40% risk of being wrong in rejecting the null hypothesis. So we reject the  $H_0$  hypothesis (the exogeneity of the variable owning a chicken coop). Moreover, the Durbin test is confirmed by that of Wu-Hausman.

Table 7 – Augmented regression test

$H_0$ : Variables are exogenous		
Durbin (score) chi2 (1)	=1.24781	(p=0.2640)
Wu-Hausman F (1,5623)	=1.2452	(p=0.2645)

Source: Authors; based on data from DSID, SAN 2021.

Through Table 5, the variables monthly household income and place of residence of the head of household have a positive effect on the budget share that households allocate to the consumption of local chickens and are significant at 1%. Indeed, an increase in monthly household income of 1 point leads to an increase in the budget share that households allocate to the consumption of local chickens by 0.16 point. This is explained by the fact that the increase in household income leads to an increase in the consumption of meat from local chickens. On the other hand, the possession of a henhouse, the average purchase price of local chickens, the age of the household and the level of education have a negative effect on the budget share that households allocate to the consumption of local chickens. They are significant at 5% and 1% respectively. Indeed, the increase in the average purchase price of a local chicken by 1 point leads to a decrease in the consumption of local chicken by 1.125 points.

We can say that public investment policies can affect the welfare of Togolese through the drop in the price of local chickens for consumption. Lower prices for local chickens may be the result of a total increase in the supply of the latter thanks to a public investment policy (economy of scale). In the context of this study, we took the year 2015 as the reference year. We chose 2015 because we estimate that the poultry projects financed this year will have their effect on production and poultry consumption in 2021. In 2015, the average purchase price of a local chicken in Togo is 4050 FCFA (DSID, 2015). According to our study, in (2021), the average purchase price of a chicken is 4500. The effect of public investments on household welfare is obtained following the variation in the purchase price of local chickens from 4050 FCFA to 4500 FCFA, an increase of 10% between 2015 and 2021.

According to our study, to allow low-income households (Quartile\_1) in 2021 to regain their consumption of local chickens from 2015, it would be necessary to add to their income, a sum of 3115 FCFA, i.e. a loss of welfare of 7.7 % for low-income (poor) households between 2015 and 2021. For high-income households (Quartile\_3), an amount of 7677 FCFA should be added to their income to allow them to regain their 2015 consumption, i.e. a loss of welfare of 6.4%. The average loss of welfare is 6.5% between 2015 and 2021 for all households. The loss of welfare is greater among the poorest households (low income) than among rich households (high income).

The difference observed in the effect of the public investment policy on the welfare between poor and rich households is explained by the budget share that the latter devote to the consumption of local chickens. Poor (low income) households have the highest budget shares in local chicken consumption. It is then obvious that an increase in the purchase price of local chickens will have a greater effect on the poorest households than on high-income (rich) households.

Table 8 – Compensating variation in household income

Income Quartiles	Compensatory change in income (CV)
Quartiles_1 (poorest households)	0.077
Quartiles_2 (poor households)	0.053
Quartiles_3 (rich households)	0.064
Average of quartiles	0.065

Source: Authors; DSID data, SAN 2021.



Public investment policies in favor of the poultry sector will have a greater effect on the welfare of the poorest households than on the richest households. The analysis by quartile shows that the compensating variation decreases from the poorest households (7.7%) to the richest households (6.4%). The 10% increase in the purchase price of local chickens between 2015 and 2021 caused the poorest households to lose 7.7% of their income compared to 6.4% for the richest households, a difference of 1.3 %. Investments in the poultry sector have no effect on the welfare of poor (low income) and rich (high income) households. This confirms our assumptions made above.

Table 9 – Welfare effect following public investments

Income quartiles	CV	Income	Effect of welfare
Quartiles_1 (poorest households)	3115	40000	7.7%
Quartiles_2 (poor households)	3155	60000	5.3%
Quartiles_3 (rich households)	7677	120000	6.4%
Average quartiles	4636	73334	6.5%

Source: Authors; DSID data, SAN 2021.

Contrary to our study, other researchers like Behrman and Deolalikar, 1990 estimate that the price and wage elasticities of consumption are in most cases substantially and significantly lower for women than for men. Thus, for some foods, women and girls bear a disproportionate share of the adjustment resulting from higher food prices. Haddad, 1993 finds that in Brazil, income in the hands of men does not have the same consequences on the demand for household goods as income in the hands of women. The latter apparently spend more of the budget they control on goods related to human capital or leisure.

Haddad and Kanbur, 1994 examine the effects of growth on internal household inequality. They result, under certain conditions, in the possibility of a Kuznetz curve at the microeconomic level: a general improvement in household resources initially leads to an accentuation of internal inequality and then a decrease in this inequality. They naturally demonstrate that the growth of total household resources decreases internal inequality if all the other parameters are constant. However, this clause is not often respected insofar as the threat points of the various actors are variously affected by the modification of the income.

Chabe-Ferret (2005), showed that the rise in the prices of rice, corn, dairy products and beef would in the short term have an unfavorable impact on the welfare of the poorest households (especially urban ones) while the wealthiest rural households would be the main beneficiaries. Similarly, Leyaro (2009) found that the compensating variation expressed as a percentage of household income decreases from the poorest quintile to the richest quintile in Tanzania. Poor households (particularly rural) are more affected by the rise in food prices than non-poor households (particularly urban). Allodehu et al. ,2012; have shown through the ex-ante analysis study of the impact of the national strategy for the development of rice growing on rice production and on the income of rice producers in Benin that public policy measures can affect the welfare of rice consumers through lower consumer rice prices. According to their study, subsidizing consumer rice prices is more favorable to poor households than to rich households. The analysis by income quartile shows that the compensating variation decreases when moving from the poorest households (0.038) to the richest households (0.011). A 10% drop in the consumer price of rice would allow the poorest households to save 3.8% of their income compared to 1.1% for the richest households.

## CONCLUSION

This study estimated the effect of public investment on household welfare in Togo. Microeconomic data with the AIDS (Almost Ideal Demand System) model proposed by Deaton (1988) were used to first estimate the determinants of local household chicken consumption and then the compensating variation method of Friedman and Levinsohn (2002) was used to assess the effect of public investments on the well-being of households through data from the SAN (Food and Nutritional Security) survey of the DSID (Directorate of



Agricultural Statistics, Informatics and documentation). The regression was done by the two-stage least squares (2SLS) method to solve the possible problem of endogeneity of the model. The sample of these data covers 5,636 rural and urban households in Togo. The results of our study reveal that following the variation in the average purchase price of a local chicken from 4050 FCFA to 4500 FCFA, an increase of 10% between 2015 and 2021, households lost an average of 4636 FCFA of their income or a welfare loss of 6.5%. The poorest households (low income) lost 3115 FCFA of their income, i.e. a loss of 7.7% in welfare. The richest households lost 7,677 FCFA of their income, representing a loss of 6.4% in welfare. This study could be used to measure the impact of various economic policies (fiscal reforms, trade restrictions, regulations, etc.) that could lead to higher prices for poultry products. Our study recommends support for the poultry sector to ensure the food security of poor households who are the big losers in the increase in the price of local chickens.

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