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Gantumur Purevjav · Unurjargal Chimedgochoo

Uuriintuya Enkhtaivan

University of Financial and Economics, Mongolia

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# THEORETICAL FRAMEWORK FOR EVALUATION OF EFFECTS OF VAT REFORMS ON HOUSEHOLD WELFARE: CASE OF MONGOLIA

Gantumur Purevjav[1*], Unurjargal Chimedgochoo[2], Uuriintuya Enkhtaivan[3]

[1]*Department of Economics, University of Financial and Economics, Mongolia,*
[2]*Professional School of International Accountancy & Finance, University of Financial and Economics, Mongolia,*
[3]*Institute of Foreign Languages, University of Financial and Economics, Mongolia*

[1]gantumur.p@ufe.edu.mn, [2]unurjargal.ch@ufe.edu.mn, [3]uuriintyua.e@ufe.edu.mn

***Abstract*–** In this study, the impact of VAT reform on household welfare was updated using the QAIDS model based on the 2015-2019 household socio-economic sample survey. Also, we studied the issue of determining the optimal level of VAT by the Armey model. The own-price elasticity of 14 food products and services was calculated using the QAIDS model, and the impact of the VAT reform on welfare was estimated by imposing a 10% VAT. Statistics for 2019 indicate that demand for goods such as meat, seafood, milk, and dairy products, fruits, vegetables, sweets and jams, tea, coffee and beverages, alcoholic beverages, and cigarettes have decreased by over 50 units. The factors influencing the C-efficiency of VAT collections are considered based on the work of Tagkalakis (2014). Some of the C-efficient macro-economic variables impacts of VAT have been enhanced using ARDL model. There are some significant statistical effects on VAT collection of C-efficiency, such as tax reform, GDP growth, population growth, and the proportion of foreign trade in GDP as result of the estimation. As a result of the reduction in consumption consumer welfare deteriorates. The impact of the price change on consumer welfare depends on the price elasticity of demand. Theoretically, if the price of the good is inelastic, demand for the good is not affected, therefore, the price increase reduces the consumption of alternative goods by households due to the substitution effect.

***Keywords*** – Value added tax(VAT), Own-price elasticity, Cross-price elasticity, Income elasticity, Quadratic Almost Ideal Demand System(QAIDS), C-efficiency of VAT collection, Armeycurve

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[*] Corresponding Author: Gantumur Purevjav

# 1. INTRODUCTION

Analysis of demand is one of the most popular research areas in microeconomics. The first empirical research was conducted by Charles Davenant [1699], who studied a table of demand for wheat. Complete demand systems are tools for analyzing the whole structure of consumption. Construction of the demand function can be used to find the relationship that is impossible to discover using single-equation models. In Mongolia literature, some studies use a complete demand system, but only for selected products, such as energy consumption [G. Ganchimeg, 2013].

**Purpose of research work -** To analyze the impact of VAT reform on welfare through the analysis of certain food goods and services sensitivities (own-price elasticity, gross-price elasticity and expenditure elasticity), and to study the effect of some macroeconomic variables on the efficiency of VAT collection.

# 2. THEORETICAL FRAMEWORK

Jing Xi, Ron Mittelhammer, and Thomas Heckelei. A QAIDS model of Japanese meat demand, 2003: Comparing to previous studies relating to Japanese meat demand that employed the more restrictive linear or nonlinear AIDS model, the paper illustrates the substantially increased flexibility of the QAIDS model of consumer demand, providing more meaningful and a priori defensible results, including in particular the ability to more flexibly represent income effects on consumption.

Nelson H.W. Wawire, Determinants of value added tax revenue in Kenya, 2017: - The determinants of VAT include GDP, institutional, demographic, and structural features of the economy. Among the notable ones that seem to have had positive influences on VAT, revenues are the introduction of sales tax in 1973, the coffee and tea booms, the introduction of sales tax on imports in the fiscal year 1984/85, the budget rationalization program, the establishment of KRA in 1995, favorable weather, TMG, and the volume of international trade.

Awudu Abdulai, Household Demand for Food in Switzerland. A Quadratic Almost Ideal Demand System: - In this paper we estimate a complete demand system for Switzerland, with emphasis on food demand, using a recent household expenditure survey. The Quadratic Almost Ideal Demand System (QAIDS) is employed in the analysis of six food commodities and non-food groups. The quadratic terms in the

QAIDS were found to be empirically important in describing household budget behavior in Switzerland. For most food commodity groups, demand is inelastic, with elasticities ranging between -0.64 and -1.02. Cross-price elasticities are very low, suggesting limited possibilities of substitution between food groups. All food groups are found to be necessities, while the non-food group is a luxury. The estimated own-price and expenditure elasticities from the specification on groups segmented by income show that for most food commodities, own-price (absolutely) and expenditure elasticities are consistently higher for the lower income group Leyaro, V., Morrissey, O., & Owens, T. (2010), Food prices, tax reforms and consumer Welfare in Tanzania 1991–2007: The results indicate that real price increases from 1991–2007 have reduced the welfare of the average household by 20 percent of 1991 income, and the loss was fairly evenly distributed between the 1990s and 2000s. The welfare loss was much greater for the poor, especially the rural poor (a 27 percent reduction), compared to the non-poor (in particular the urban non-poor, who suffered a five percent loss). Although we cannot establish explicit links between tax reforms and domestic commodity price changes, to assess the extent to which welfare changes can be explained by tax reforms we simulate the effects of tax changes on domestic price changes.

## 3. QUADRATIC ALMOST IDEAL DEMAND SYSTEM

Lubna Naz, Munir Ahmad, G.M.Arif, Estimating Food Demand System and Rural Household Welfare: A Case Study from Pakistan, Results from expenditure and price elasticities may be used to shed light on the welfare effects of price and income changes. The cereals are own price inelastic (uncompensated and compensated) in the pooled sample (-0.91 and -0.86). This infers that the increase in cereals price is directly proportional to the increase in total expenditure of rural households. The policymakers can use these findings to make well-informed decisions, and use prices as an instrument for stabilizing household welfare. The present study is the pioneer in Mongolia in the application of the QAIDS model in estimating a complete demand system. The estimates of demand parameters are based on secondary data from the household economic-social survey of the National Statistic Committee in Mongolia, conducted in 2014/2015, 2015/2016, 2016/2017, 2017/2018, and 2018/2019.

Deaton and Muellbauer (1980) introduced the Almost Ideal Demand System (AIDS) which is one of the most popular versions of the complete demand system. Deaton and Muellbauer restricted preferences to be linear concerning the logarithm of income.

But Banks, Blundell, and Lewbel [1997] proved that the linear relation is too strong and investigated a generalized AIDS model that also includes a quadratic logarithmic income term. Their model is known as the Quadratic Almost Ideal Demand System (QAIDS). By imposing particular restrictions on the parameters of this model, QAIDS can be reduced to the Almost Ideal Demand Model.

The QAIDS model is derived from an indirect utility function as follows:

$$ln\psi = \left(\left(lnx - \ln(a(p))/b(p)\right)^{-1} + \lambda(p)\right)^{-1} \quad (1)$$

Where: x is the total expenditure, and p is a vector of prices.

$$lna(p) = a_0 + \sum_{k=1}^{n} a_k lnp_k + \frac{1}{2}\sum_{k=1}^{n}\sum_{l=1}^{n}\gamma_k^* lnp_k lnp_l$$

$$b(p) = \prod_{k=1}^{n} p_k^{\beta_k} = exp\left(\sum_{k=1}^{n}\beta_k lnp_k\right)$$

$$\lambda(p) = \sum_{k=1}^{n}\lambda_k lnp_k \quad (2)$$

Substituting these price indexes into the QAIDS indirect utility function $\psi$ and we receive following function:

$$ln\psi = \left(\left(\frac{lnx - \left(a_0 + \sum_{k=1}^{n} a_k lnp_k + \frac{1}{2}\sum_{k=1}^{n}\sum_{l=1}^{n}\gamma_k^* lnp_k lnp_l\right)}{\prod_{k=1}^{n} p_k^{\beta_k}}\right)^{-1} + \sum_{i=1}^{n}\lambda_k lnp_k\right)^{-1} \quad (3)$$

Which corresponds to the following cost function:

$$lnc = a_0 + \sum_{k=1}^{n} a_k p_k + \frac{1}{2}\sum_{k=1}^{n}\sum_{l=1}^{n}\gamma_k^* lnp_k lnp_l + \frac{u \cdot \prod_{k=1}^{n} p_k^{\beta_k}}{1 - u \cdot \sum_{k=1}^{n}\lambda_k lnp_k}$$

$$lnc = lna(p) + \frac{u \cdot b(p)}{1 - u \cdot \lambda(p)} \quad (4)$$

In the case of all $\lambda_i = 0$, this equation is reduced to the AIDS cost function (Moro, Sckokai, 2000).

By applying Roy's identity to the indirect utility function, one can derive the expenditure share equations:

$$w_i = \alpha_i + \sum_{j=1}^{n}\gamma_j lnp_j + \beta_i\left(\ln\left(\frac{x}{a(p)}\right)\right) + \frac{\lambda_i}{b(p)}\left(\ln\left(\frac{x}{a(p)}\right)\right)^2, \quad (5)$$

where $w_i$ is the share of consumption of each good in total expenditure. The regularity condition resulting from economic theory implies fulfillment of the following constraints on the parameters (De Agostini, 2014):

Adding up,

$$\sum_{i=1}^{n}\alpha_i = 1;\ \sum_{i=1}^{n}\beta_i = 0;\ \sum_{i=1}^{n}\lambda_i = 0;\ \sum_{i=1}^{n}\gamma_{ij} = 0\ j = 1,2,\dots,n$$

Homogeneity requires that

$$\sum_{i=1}^{n}\gamma_{ij} = 0, j = 1,2,\dots,n.$$

The symmetry condition is given by

$$\gamma_{ij} = \gamma_{ji}; i, j = 1,2,\dots,n. \qquad (6)$$

The elasticity coefficient can be calculated with the following formula (Banks, Blundell, Lewbel-1997; De Agostini-2014, Castañon-Herrera, Urzúa-2011):

**Uncompensated own and cross price elasticity:**

$$e_{ij} = \frac{p_j}{q_i}\cdot\frac{\partial g_i(x,p)}{\partial p_j} = -\delta_{ij} + \frac{\mu_{ij}}{w_i} \qquad (7)$$

**Compensated own and cross price elasticity:**

$$\tilde{e}_{ij} = \frac{p_j}{q_i}\cdot\frac{\partial h_i(x,p)}{\partial p_j} = -\delta_{ij} + \frac{\mu_{ij}}{w_i} + w_j\mu_i \qquad (8)$$

**Expenditure elasticity:**

$$e_i = \frac{x}{q_i}\frac{\partial g_i(x,p)}{\partial x} = 1 + \frac{\mu_i}{w_i}$$

$$\mu_{ij} = \gamma_j - \mu_i\left(\alpha_j + \sum_{k=1}^{n}\gamma_k ln p_k\right) - \frac{\lambda_i\beta_j}{b(p)}\left(\ln\left(\frac{I}{a(p)}\right)\right)^2, \qquad (9)$$

where $\delta_{ij}$ is the Kronecker delta.

Stata 16.0 was utilized to do the estimations and Iterative Feasible Generalized Least Squares were applied to obtain the coefficients. The Sum of shares of goods in expenditure equals one (adding up restriction), resulting in the variance-covariance matrix being singular [Gurgul, Wolak 2008]. To circumvent this problem, one equation was deleted, and the remaining coefficients were determined indirectly.

**Elasticity of Demand**

One of the most popular measures of consumer demand is the income elasticity coefficient. The income elasticity of demand measures how quantity demanded of a good response to a change in income, ceteris paribus. The QAIDS model enables us to determine the expenditure elasticity coefficient that shows a relative change in demand for a good or service in response to a one percent increase in all expenditures. Demand indicates total expenditure for a specific group of goods or services.

Table 1. Expenditure elasticity coefficient estimated for a typical household in Mongolia based on the QAIDS results. Standard error values were placed in parenthesis.

(2015-2019 years)

| **Items / Years** | **2015** | **2016** | **2017** | **2018** | **2019** |
|---|---|---|---|---|---|
| **Sample size** | **4969** | **6691** | **4597** | **7473** | **4965** |
| Flour products | -0.1172<br>(0.0067) | -0.113<br>(0.009) | -0.072<br>(0.049) | -0.055<br>(0.017) | 0.067<br>(0.034) |
| Meat | -0.0194<br>(0.0054) | -0.086<br>(0.008) | 0.008<br>(0.040) | -0.033<br>(0.017) | -0.014<br>(0.022) |
| Sea food | -0.00004<br>(0.0001) | -0.0003<br>(0.000) | 0.000<br>(0.000) | -0.0003<br>(0.0002) | -7.33E-06<br>(0.0002) |
| Milk and dairy products | -0.00009<br>(0.0036) | -0.032<br>(0.006) | 0.029<br>(0.029) | -0.006<br>(0.019) | -0.019<br>(0.021) |
| Oil and fat | -0.0076<br>(0.0016) | 0.0145<br>(0.002) | -0.001<br>(0.007) | 0.0036<br>(0.0023) | -0.003<br>(0.0036) |
| Fruits | -0.0016<br>(0.0016) | -0.003<br>(0.002) | -0.001<br>(0.007) | -0.001<br>(0.005) | -0.036<br>(0.047) |
| Vegetables | 0.074<br>(0.0095) | 0.039<br>(0.012) | -0.146<br>(0.070) | 0.053<br>(0.027) | -0.0128<br>(0.0405) |
| Leguminous plants | 0.0001<br>(0.000) | -0.0002<br>(0.000) | 0.000<br>(0.000) | -0.0002<br>(0.000) | -0.0007<br>(5.91E-05) |
| Sweets and jams | 0.387<br>(0.0145) | 0.355<br>(0.022) | 0.354<br>(0.108) | 0.150<br>(0.0427) | 0.239<br>(0.0729) |
| Tea, coffee and beverages | -0.3115<br>(0.0101) | -0.202<br>(0.026) | -0.045<br>(0.156) | -0.135<br>(0.056) | -0.342<br>(0.099) |
| Household products | -0.0073<br>(0.001) | -0.003<br>(0.001) | -0.018<br>(0.010) | -0.0039<br>(0.002) | 0.0048<br>(0.0035) |
| Water, soda and fruit juice | -0.0022<br>(0.0018) | 0.012<br>(0.003) | 0.000<br>(0.006) | -0.0005<br>(0.003) | 0.0216<br>(0.0079) |
| Alcoholic beverages | -0.0016<br>(0.0023) | -0.003<br>(0.002) | 0.003<br>(0.007) | -0.003<br>(0.005) | 0.010<br>(0.0086) |
| Cigarettes | 0.0071<br>(0.0102) | 0.021<br>(0.011) | -0.111<br>(0.065) | 0.0315<br>(0.022) | 0.0534<br>(0.0338) |

The estimation stipulates that expenditure elasticity coefficients for most of the groups are relatively small and an increase in expenditure results in lower demand. The most important product group is flour products, and for that, the expenditure elasticity coefficient is estimated negative for each chosen year except for 2019. This indicates that a ten percent increase in all expenditure leads to a decrease in demand for flour by about 0.893 on average between 2015-2018 (ceteris paribus).

But in 2019, a ten percent increase in total expenditure leads to a 0.67 percent increase in demand for flour, on average.

Expenditure elasticity coefficients for “Tea, coffee and beverages” and “Sweets and jams” are higher than other groups of goods. Expenditure elasticity coefficients for “Sweets and jams” are positive for each year, so, it can be said that raise in expenditure increases demand the group. Furthermore, “Sweets and jams” can be interpreted as necessary goods for their expenditure elasticity coefficients are less than 1.

Table 2. Uncompensated cross-price elasticity, 2019

| | Demand for: | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Flour products** | **Meat** | **Sea food** | **Milk and dairy products** | **Oil and fat** | **Fruits** | **Vegetables** | **Leguminous plants** | **Sweets and jams** | **Tea, coffee and beverages** | **Household products** | **Water, soda and fruit juice** | **Alcoholic beverages** | **Cigarettes** |
| **Price of** | | | | | | | | | | | | | | |
| Flour products | 0.001[a] | 0.011[c] | 0 | -0.016 | 0.009[b] | -0.007[c] | -0.183[b] | -0.001 | -0.729[b] | -0.167[a] | 0.016[c] | 0.016[c] | 0.012[b] | 0.066 |
| Meat | 0.009 | -0.650[a] | -0.001 | -0.001 | -0.015 | -0.001 | 0.001[b] | 0 | -0.098 | -0.164[a] | -0.006 | -0.018 | 0.019 | -0.035 |
| Sea food | 0.846 | -0.646 | -0.957 | -0.067 | 0.039 | 0.084 | -0.637 | -0.023 | -0.988 | -0.576 | 0.073 | 0.139 | 0.221 | 0.326 |
| Milk and dairy products | -0.007 | -0.001 | 0 | -0.667[a] | 0.006 | 0 | -0.169[a] | 0 | -0.018 | -0.303[a] | 0.002[b] | 0.005[b] | -0.01 | 0.058[a] |
| Oil and fat | -0.012[b] | -0.119 | 0 | 0.035[b] | -0.540[a] | -0.028 | -0.038[c] | 0.000[b] | 0.034 | -0.100[a] | 0.091[a] | -0.096 | 0.037 | 0.094 |
| Fruits | -0.371 | -0.026 | 0.002 | 0.015 | -0.053 | -0.147[a] | -0.455 | 0.001 | 0.316 | -0.235 | 0.105 | -0.052 | -0.079 | 0.282 |
| Vegetables | 0.456[b] | 0.031[b] | -0.001 | -0.097[a] | 0.003[c] | -0.039 | -1.099[a] | -0.002 | -1.081[c] | -0.834[a] | 0.03 | -0.013[c] | 0.019[b] | 0.169[a] |
| Leguminous plants | -0.133 | -0.074 | -0.027 | -0.154 | 0.002[b] | -0.02 | -0.181 | -0.961[c] | -0.988 | -2.499 | -0.037[a] | -0.026 | 0.046 | -0.158 |
| Sweets and jams | 2.182[b] | 0.095 | -0.001 | -0.142 | 0.04 | -0.045 | -1.495[c] | -0.008 | -5.544[a] | -2.445[a] | 0.087[b] | 0.087 | 0.082 | 0.383[a] |
| Tea, coffee and beverages | -2.136[a] | -0.143[a] | 0.001 | 0.079[a] | -0.047[a] | 0.026 | 1.111[a] | 0.007 | 3.777[a] | 0.972[a] | -0.089[a] | -0.066[a] | -0.065[a] | -0.359[a] |
| Household products | 0.689 | -0.028 | 0.001 | -0.021[b] | 0.119[a] | 0.072 | -0.225 | -0.003[a] | -1.451[b] | -0.362[a] | -0.443[a] | 0.049 | 0.014 | -0.111[c] |
| Water, soda and fruit juice | 5.158 | 0.098[c] | 0 | -0.254 | -0.01 | -0.109 | -3.432[c] | -0.018 | -9.74 | -3.153[a] | 0.242 | -0.448[a] | 0.248 | 0.835[b] |
| Alcoholic beverages | 8.781 | 1.113 | 0.009 | -0.71 | 0.355 | -0.338 | -4.871[b] | -0.028 | -15.96 | -5.473[a] | 0.337 | 0.658[a] | -0.810[a] | 0.631[c] |
| Cigarettes | 1.943 | -0.091[b] | 0.001 | 0.087[a] | 0.101 | 0.1 | -0.344[a] | -0.007 | -3.502[a] | -1.221[a] | -0.044[c] | 0.057[b] | -0.048 | -0.38 |

Source: Own calculus

Note: The F-test used to test the significance levels of the estimated elasticities.

[a] Significant at the 99 percent level

[b] Significant at the 95 percent level

[c] Significant at the 90 percent level

The estimates indicate that the change in rice and flour products has a weak and statistically significant effect on meat demand, but meat has no significant effect on flour products. If, for example, the price of flour products falls by 10 percent, then the households would decrease their demand for meat by 0.11 percent (table 2). The flour products-to-meat cross elasticity is positive because the price of flour products and demand for meat move in the same direction. The pure effect of this fall in flour products price is a 0.82 percent decrease in meat demand (table 3). Since meat is a normal good, the increase in real income due to the fall in flour products price (the income effect) induces the consumer to increase their meat demand by 0.71 percent (i.e. 0.82-0.11).

Flour products and vegetables have complementary relationships with each other, these relationships (in elasticity form) are statistically significant. A ten percent fall in flour products price would result in a 1.83 percent increased demand for vegetables. The increase in real income due to the lower flour products price is the main indicator (1.25 percent) of this increased demand for vegetables. The cross-price elasticity represents the effect of change in vegetable price on flour demand that a 10 percent fall in vegetable price is associated with a 4.56 percent decrease in flour demand.

Some cross-price elasticities change signs between their uncompensated and compensated forms. For example, the total effect of a change in flour products price on the demand for milk and dairy products suggests that flour products and milk and dairy products are ‘gross” complements (table 2). However, compensated cross-price elasticity is positive indicating flour products and milk and dairy products are “net” substitutes (table 3). Since milk and dairy, products have a relatively high-income elasticity of demand (table 1), an increase in real income due to a fall in flour price results in an increased demand for flour (2019 year).  The income effect, in this case, outweighs the substitution effect, which suggests that the pure price effect of a fall in flour products price is a decrease in demand for milk and dairy products.

Table 3. Compensated cross-price elasticity, 2019

| | Demand for: | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flour products | Meat | Sea food | Milk and dairy products | Oil and fat | Fruits | Vegetables | Leguminous plants | Sweets and jams | Tea, coffee and beverages | Household products | Water, soda and fruit juice | Alcoholic beverages | Cigarettes |
| **Price of:** | | | | | | | | | | | | | | |
| Flour products | 0.169 | 0.082 | 0 | 0.031 | 0.019 | -0.001 | -0.068 | -0.001 | -0.547 | 0.164 | 0.024 | 0.024 | 0.014 | 0.081 |
| Meat | 0.176 | -0.58 | -0.001 | 0.045 | -0.006 | 0.005 | 0.117 | 0 | 0.083 | 0.167 | 0.002 | -0.01 | 0.021 | -0.021 |
| Sea food | 1.221 | -0.488 | -0.956 | 0.037 | 0.06 | 0.097 | -0.378 | -0.023 | -0.581 | 0.166 | 0.091 | 0.157 | 0.225 | 0.36 |
| Milk and dairy products | 0.185 | 0.079 | 0 | -0.614 | 0.017 | 0.007 | -0.036 | 0 | 0.19 | 0.077 | 0.011 | 0.014 | -0.008 | 0.075 |
| Oil and fat | 0.099 | -0.072 | 0.001 | 0.066 | -0.534 | -0.024 | 0.039 | 0 | 0.155 | 0.121 | 0.097 | -0.091 | 0.038 | 0.104 |
| Fruits | -0.249 | 0.025 | 0.002 | 0.049 | -0.046 | -0.143 | -0.37 | 0.001 | 0.448 | 0.006 | 0.111 | -0.046 | -0.077 | 0.293 |
| Vegetables | 0.881 | 0.21 | 0 | 0.021 | 0.026 | -0.024 | -0.805 | -0.001 | -0.62 | 0.007 | 0.051 | 0.008 | 0.024 | 0.207 |
| Leguminous plants | 0.772 | 0.306 | -0.027 | 0.097 | 0.053 | 0.012 | 0.445 | -0.96 | -0.007 | -0.707 | 0.008 | 0.017 | 0.057 | -0.077 |
| Sweets and jams | 3.342 | 0.582 | 0 | 0.18 | 0.105 | -0.005 | -0.693 | -0.008 | -4.287 | -0.149 | 0.144 | 0.143 | 0.096 | 0.487 |
| Tea, coffee and beverages | -2.662 | -0.363 | 0.001 | -0.067 | -0.076 | 0.008 | 0.748 | 0.006 | 3.207 | -0.068 | -0.115 | -0.091 | -0.072 | -0.406 |
| Household products | 0.982 | 0.095 | 0.001 | 0.06 | 0.136 | 0.082 | -0.022 | -0.003 | -1.134 | 0.217 | -0.429 | 0.063 | 0.017 | -0.084 |
| Water, soda and fruit juice | 6.978 | 0.862 | 0.001 | 0.251 | 0.092 | -0.046 | -2.174 | -0.017 | -7.767 | 0.449 | 0.331 | -0.361 | 0.269 | 0.998 |
| Alcoholic beverages | 11.582 | 2.289 | 0.011 | 0.067 | 0.512 | -0.241 | -2.934 | -0.026 | -12.93 | 0.073 | 0.475 | 0.793 | -0.777 | 0.881 |
| Cigarettes | 2.517 | 0.15 | 0.002 | 0.246 | 0.133 | 0.119 | 0.053 | -0.007 | -2.879 | -0.085 | -0.015 | 0.085 | -0.041 | -0.329 |

Source: Own calculus.

**Elasticities**

Elasticities estimation is important for performing an empirical analysis of the impact of VAT reform on household welfare. The result of the elasticity estimation was used to show the characteristics of household welfare. Both own-price elasticity and cross-price elasticity measure the consumer's response to price changes. Therefore, we need to estimate expenditure elasticity, own-price elasticity, and cross-price elasticities in the context of the food products considered in the studies. The result of these estimations is shown in the following table (Table 4).

Table 4. Expenditure elasticities of all commodity groups

| Obs | Items | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|
| 1 | Flour products | 0.74[a] | 0.86[a] | 1.08 | 1.08[a] | 0.96[b] |
| 2 | Meat | 0.92[a] | 0.17[a] | 0.47 | 0.49[c] | 0.96[b] |
| 3 | Sea food | 1.05 | 2.49[a] | 1.50 | 2.38 | 2.16[a] |
| 4 | Milk and dairy products | 1.02 | 0.52[a] | 1.09 | 1.38 | 1.10[b] |
| 5 | Oil and fat | 0.74[a] | 6.40[a] | 1.19 | 4.44 | 0.64[a] |
| 6 | Fruits | 0.88 | 0.09[c] | 0.55 | 1.72 | 0.70[a] |
| 7 | Vegetables | 1.13[a] | 2.06[a] | 2.01[b] | 2.19[c] | 2.45[c] |
| 8 | Leguminous plants | 3.09[a] | 3.11a | 0.71 | 3.58[a] | 5.21[a] |
| 9 | Sweets and jams | 1.46[a] | 5.02[a] | 5.98[a] | 6.42[a] | 6.67 |
| 10 | Tea, coffee and beverages | 0.82[a] | -2.00[a] | -2.83 | -2.54[b] | -3.02 |
| 11 | Household products (other types of food) | 0.65[a] | 0.80[b] | 7.39[c] | 0.49[c] | 1.68[b] |
| 12 | Water, soda and fruit juice | 0.97 | 8.17[a] | 3.23 | 2.69 | 10.47[a] |
| 13 | Alcoholic beverages | 1.32 | 0.05 | 1.38 | 2.67 | 16.11[a] |
| 14 | Cigarettes (tobacco) | 0.85 | 2.83[c] | 8.34[c] | 6.67 | 3.30[c] |

Source: Own calculus

Note: The F-test used to test the significance levels of the estimated elasticities.

[a] Significant at the 99 percent level

[b] Significant at the 95 percent level

[c] Significant at the 90 percent level

According to the 2019 estimation, the elasticity of expenditure of products such as tea, coffee and leverages is negative, so these products are inferior goods due to income, the rest of the products are normal goods about their income. Meat products and leguminous plants are normal goods, in terms of income, but they are inelastic in income. For products except for tea, coffee, and beverages elasticity of income is elastic.

In the case that the household income involved in this survey increases by one percent products 1, 3, 4, 5, 9, 11, 12, 13, and 14 indicate that consumption of products increases up to more than one percent. The income elasticity of the products such as sweets and jams, other types of food products, water, soda and fruit juice, and cigarettes (tobacco) is comparatively high. And this is seemingly connected to the fact that local / or domestic production is not able to supply the household demands.

## 3.1 THE CHANGES OF VAT IMPACT ON THE WELFARE.

It's been analyzed the impact on the changes of VAT of welfare based on its own-price elasticity assessment coefficient. The results of the analysis are shown in the following table.

Table 5. Impact on the welfare ten percent of VAT standard rate changes

| Products | Units of measurement | Price of products, 2019, tugrugs | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|
| | | | Changes of demand from ten percent of VAT standard rate | | | | |
| Flour products | kilograms | 2808.3 | -13.9 | -12.5 | -54.3 | -33.0 | -49.7 |
| Meat | kilograms | 3850.9 | 6.7 | -163.3 | -111.8 | -65.9 | -51.2 |
| Sea food | kilograms | 3762.9 | 317.2 | -379.4 | -414.8 | -158.2 | -335.3 |
| Milk and dairy products | liter | 2803.7 | -11.1 | -81.0 | -60.9 | -157.7 | -80.5 |
| Oil and fat | kilograms | 3605 | -47.8 | -99.7 | -89.6 | 41.7 | -60.9 |
| Fruits | kilograms | 4256.8 | 103.3 | -95.1 | 16.9 | -443.5 | 352.9 |
| Vegetables | kilograms | 1980.7 | -54.4 | -69.1 | -114.5 | -104.4 | -73.7 |
| Leguminous plants | gram | 5.33 | 0.2 | 0.0 | 0.1 | 0.0 | 0.3 |
| Sweets and jams | gram | 1303.2 | -138.0 | -81.0 | -113.9 | -123.5 | -106.2 |
| Tea, coffee and beverages | gram | 1179 | -39.8 | -41.9 | -57.5 | -102.5 | -87.1 |
| Household products | gram | 11.74 | -0.1 | 0.2 | -0.4 | -0.2 | -0.1 |
| Water, soda and fruit juice | liter | 1617.6 | -44.6 | -76.5 | -59.3 | -24.5 | -26.7 |
| Alcoholic beverages | liter | 10534 | -8.5 | -354.7 | -206.3 | -721.8 | -1168.2 |
| Cigarettes | Box | 2026.4 | -35.0 | -27.1 | -110.3 | -37.4 | -57.4 |

Source: Own calculus

The own-price elasticity was inelastic therefore the changes in the amount of the demand for goods and services (must be) changed less than 10 percent in comparison to price changes (the price of goods is expected to increase by the amount of tax imposed). Statistics for 2019 indicate that demand for goods such as meat, seafood, milk, and dairy products, fruits, vegetables, sweets and jams, tea, coffee and beverages, alcoholic beverages, and cigarettes have decreased by over 50 units.

### 3.2 AN EMPIRICAL MODEL FOR ANALYZING THE IMPACT OF EFFECTIVE VAT COLLECTION TAX REFORM IN MONGOLIA

This study analyzes the impact of effective tax reform on VAT collection in Mongolia. The study uses Keen (2013) and Cnossen's (2015) model (10) to first assess the C-efficiency of VAT revenue.

$$C_{efficiency} = \frac{V_t}{\tau_{St} \cdot C_t^f} \qquad (10)$$

Where: $C_{efficiency}$- C-efficiency of the VAT, $V_t$-The actual VAT revenue, $\tau_{St}$-VAT standard rate, $C_t^f$-Final consumption

After calculating the VAT efficiency of Mongolia, the following analysis was performed by combining C-efficiency with the ANCOVA model proposed by Tagkalakis (2014) to analyze the impact of the VAT revenue collection and its efficiency tax reform.

$$C_{efficiency} = \beta_0 + \beta_1 d1_t + \beta_2 d2_t + \beta_3 GDPG_t + \beta_4 SHDG_t + \beta_5 pop_t + \beta_6 Trade_t + \varepsilon_t \qquad (11)$$

Noted: $C_{efficiency}$-C-efficiency of the VAT, $d1_t$ the initial period of the VAT reform, $d2_t$ the second phase of the VAT reform, the explanatory variables with binary options that get 0 if no reform is made. $GDPG_t$-growth rate of RGDP, $SHDG_t$- The percentage of the shadow economy in GDP, $pop_t$-growth rate of population, $Trade_t$-The percentage growth of the foreign trade in GDP, $\varepsilon_t$-error term

The result of the stationary test showed that there were integrated variables I(0) and I(1) that could not be estimated using OLS from Equation (11).

The ARDL modeling technique by Pesaran and Shin (1999, 2000) is more suitable because it is not a time series in the integration of order I(2). The ARDL model of equation (11) can be transformed as follows.

$$C_{efficiency_t} = \beta_0 + \sum_{i=1}^{K} \beta_1 (E_t^C)_{t-i} + \sum_{i=0}^{K} \beta_2 (d1)_{t-i} + \sum_{i=0}^{K} \beta_3 (d2)_{t-i} + \sum_{i=0}^{K} \beta_4 (GDPG)_{t-i} + \sum_{i=0}^{K} \beta_5 (SHDG)_{t-i} + \sum_{i=0}^{K} \beta_6 (pop)_{t-i} + \sum_{i=0}^{K} \beta_7 (Trade)_{t-i} + \varepsilon_t$$

(12)

Equation (12) provides a short-term ARDL model for use in the assessment of the C-efficiency of VAT. The ARDL model is widely used by researchers because it has many advantages, such as the ability to work with variables in different order integrations, the configuration of a single equation makes it easy to evaluate and interpret parameters, and the ability to consider different variables in a model at different times.

Table 6. Variables used in VAT collection efficiency analysis

| Variables | Definition | Sources |
|---|---|---|
| VAT collection C-efficiency $\left(C_{efficiency_t}\right)$ | The ratio of total actual VAT revenue in the economy to potential VAT revenue in the economy | The actual VAT for each period is measured in proportion to the estimated potential VAT revenue |
| The standard amount of VAT | The level of VAT is imposed on most goods and services. | The values reported by the national statistical office of Mongolia were used. |
| The actual VAT revenue | The cost of total revenue collection by VAT in a given year | The values reported by the national statistical office of Mongolia were used. |
| Final consumption | Cost of goods and services used in the economy | Report of the national statistical office |
| GDP growth rate | Percentage of changes in the cost of goods and services produced in a given period | Report of the national statistical office |
| Population growth rate | Percentage of population growth for each year | Report of the national statistical office |
| The percentage of the shadow economy in GDP | Percentage of the estimated value of the shadow economy in GDP | International Monetary Fund |
| VAT reform | Changes made by the parliament to the VAT rate in order to improve the efficiency of VAT revenue | When reformed 1 will set, for all other periods that have not been reformed will be 0. |

## Data and source

The study used time series data. Information related to household budgets was used by the National Statistical Committee of Mongolia based on household socio-economic surveys.

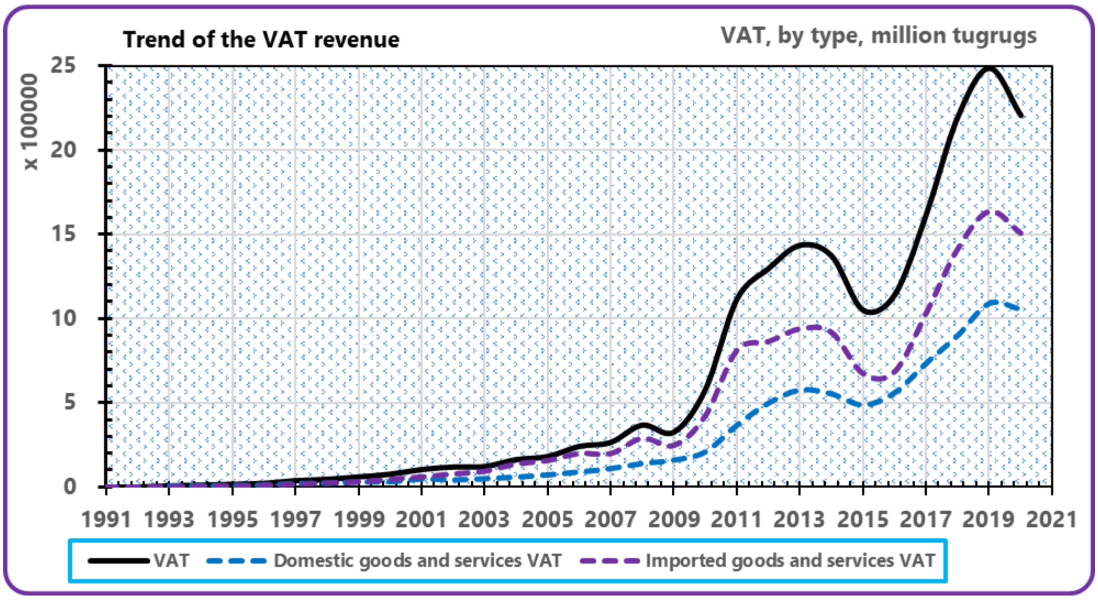
Table 7. Results of the unit root tests of variables in the C-efficiency analysis of VAT.

| **Variables** | **Augmented Dickey Fuller (ADF)** | | **Philip-Perron (PP)** | | Order of Integration |
|---|---|---|---|---|---|
| | P-value at levels | P-value at 1st difference | P-value at levels | P-value at 1st difference | |
| VAT standard rate | 0.5742 | 0.0000[a] | 0.5157 | 0.0000[a] | I(1) |
| GDP growth rate | 0.0049[a] | | 0.0039[a] | | I(0) |
| The percentage of the shadow economy in GDP | 0.4823 | 0.0000* | 0.5539 | 0.0000[a] | I(1) |
| Population growth rate | 0.0001[a] | | 0.2782 | 0.0000[a] | I(0) |
| The percentage growth of the foreign trade in GDP | 0.1017 | 0.000[a] | 0.1053 | 0.0000[a] | I(0) |

Source: Own calculus

[a] Significant at the 99 percent level

Figure 1. VAT revenue, domestic goods and services tax revenue, imported goods and services tax revenue trend.




As can be seen from the figure, VAT revenues and their component revenues all tend to increase. However, VAT revenue on imported goods and services is highly fluctuated, while VAT revenue on domestic goods and services is expected to increase with low fluctuation.

**Short-run ARDL estimation outcome**

The optimal lag level of the ARDL model was selected using the AIC criteria. According to these criteria, the ARDL model was determined as the most suitable. The results of the evaluation are shown in table 8.

Table 8. Short-Run Dynamic ECT model

| Variables | Elasticities | Std.Error | t-Statistic | Prob. |
|---|---|---|---|---|
| c (constant) | -2.8164* | 1.1476 | -2.4540 | 0.0576 |
| $ECT_{t-1}$ | -3.0082** | 0.8820 | -3.4107 | 0.0190 |
| d1(-1) | -0.9802* | 0.4205 | -2.3305 | 0.0672 |
| d2(-1) | 1.0823* | 0.4780 | 2.2641 | 0.0730 |
| gdpg(-1) | 2.9117** | 1.0551 | 2.7594 | 0.0399 |
| sgdp(-1) | -0.7056* | 0.7745 | -0.9109 | 0.4041 |
| pop(-1) | 83.1168* | 34.7610 | 2.3910 | 0.0623 |
| trade(-1) | 3.5014** | 1.1881 | 2.9469 | 0.0320 |
| d($c_{efficiency}$(-1)) | 0.6889* | 0.3331 | 2.0681 | 0.0935 |
| d(d1) | -0.2785 | 0.2119 | -1.3139 | 0.2459 |
| d(d2) | 0.1431 | 0.3527 | 0.4057 | 0.7017 |
| d(d2(-1)) | -1.1834* | 0.4968 | -2.3819 | 0.0630 |
| d(gdpg) | 0.8430* | 0.3398 | 2.4804 | 0.0558 |
| d(gdpg(-1)) | -1.5336** | 0.5539 | -2.7685 | 0.0394 |
| d(sgdp) | -1.3878* | 0.5806 | -2.3903 | 0.0624 |
| d(sgdp(-1)) | 0.4376 | 0.4623 | 0.9464 | 0.3874 |
| d(pop) | 60.4132* | 25.9904 | 2.3244 | 0.0677 |
| d(trade) | 2.8174** | 0.9527 | 2.9572 | 0.0316 |

**, *-, denote significance at 10%, 5% levels respectively.

**Source:** Author's computation

Table 9. Long-Run Dynamic ECT model and Bounds Test

| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
|---|---|---|---|---|
| d1 | -0.3258*** | 0.0569 | -5.7245 | 0.0023 |
| d2 | 0.3598*** | 0.0729 | 4.9314 | 0.0044 |
| gdpg | 0.9679*** | 0.1562 | 6.1934 | 0.0016 |
| sgdp | -0.2345 | 0.2545 | -0.9213 | 0.3992 |
| pop | 27.6294** | 7.7795 | 3.5515 | 0.0164 |
| trade | 1.1639*** | 0.1217 | 9.5586 | 0.0002 |
| c | -0.9362*** | 0.1956 | -4.7841 | 0.0050 |
| F-Bounds Test | | Null Hypothesis: No levels relationship | | |
| Test Statistic | Value | Signif. | I(0) | I(1) |
| F-statistic | 10.297 | 10% | 2.334 | 3.515 |
| k | 6 | 5% | 2.794 | 4.148 |
| Actual Sample Size | 23 | 1% | 3.976 | 5.691 |

***, **-, denote significance at 1%, 5% levels respectively.

**Source:** Author's computation

The ECT can be obtained as follows:

The long-run Equation is

$$C_{efficiency_t} = -0.9362 - 0.3258d1_t + 0.3598d2_t + 0.9679gdpg_t - 0.2345sgdp_t + 27.6294pop_t + 1.1639trade_t$$

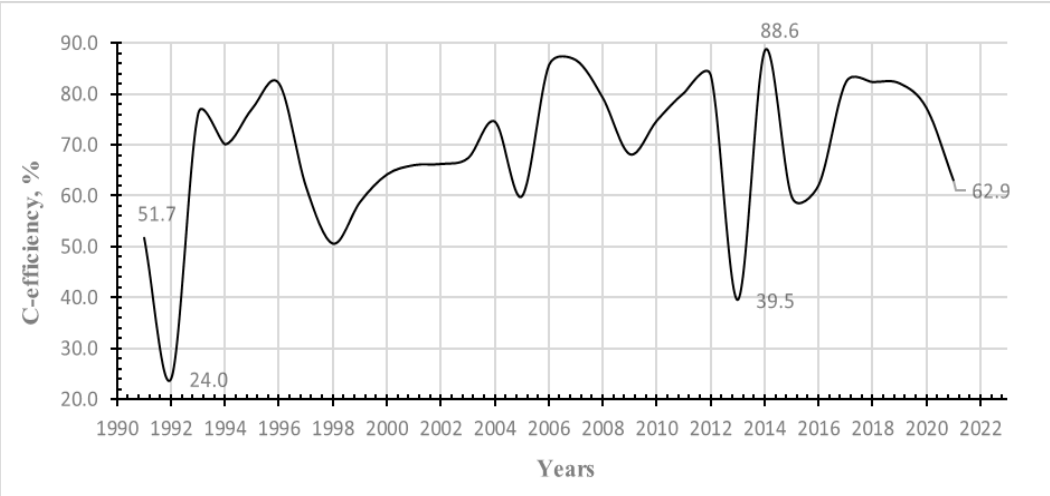
Hence, the ECT equation is

$$ECT = C_{efficiency_t} - (-0.9362 - 0.3258d1_t + 0.3598d2_t + 0.9679gdpg_t - 0.2345sgdp_t + 27.6294pop_t + 1.1639trade_t)$$

This shows that all indicators, except for the proportion of the shadow economy in GDP, have a statistically significant effect on VAT collection C-efficiency. While the first tax reform hurt VAT collection C-efficiency, the standard rate of VAT, which was approved in 2006 and the law came into force in 2007, has helped increase the VAT collection C-efficiency.

The VAT collection efficiency over the 27 years is shown in figure 2.

Figure 2: VAT C-efficiency trend




Source: Constructed from the study data.

Mongolia undertook tax reform in 1998 and 2003, during this period VAT collection C-efficiency decreased, but in 2009 the C-efficiency of VAT collection decreased due to the global financial crisis of 2007-2008. In 2015, the C-efficiency of VAT collection decreased due to the implementation of the transparency law. From this, it can be seen that the VAT collection C-efficiency decreases during most of the period of tax reform. In

1992, after the transfer to a market economy, the VAT collection C-efficiency was 24%, while the was rapid growth in the mining sector at 99.6% in 2014.

### 3.3 OPTIMAL RATE OF VAT

Armey referred to Arthur Laffer, who explained the quadratic relationship between tax rates and total tax revenue and tried to explain with similar logic the relationship between VAT revenue and tax rate.

**Model and Data Set**

Our study aims to calculate the optimal rate of VAT by testing the Armey curve in Mongolia. The analysis in which the time series techniques were used took place based on the following model:

$$VAT_t = \beta_1 tax_t + \beta_2 tax_t^2 + \varepsilon_t \qquad (13)$$

In the model, $VAT_t$-express the rate of VAT revenue, $tax_t$-express the VAT standard rate, and $\varepsilon_t$ – express the error term.

The data set used in the model was obtained from the National Statistical Committee of Mongolia and comprised data belonging to the period 1991-2021. By creating a quadratic equation, the presence of the Armey curve was accepted. The purpose here is to determine the optimal level of VAT rate for Mongolia regarding the preliminary acceptance in which the Armey curve exists. For this to occur first independent variable coefficient is expected to be positive and the second independent variable coefficient is expected to be negative.

Estimated using the OLS, the results of the estimation are expressed by the following equation. To solve the multicollinearity problem, the estimation was performed with the one lag of the explanatory variable.

$$VAT_t = 17.60tax_t - 76.77tax_t^2 + 0.936VAT_{t-1} + \varepsilon_t$$

From the evaluation, the sign of the independent variables is in line with expectations.

$$R_{adj}^2 = 0.976, DW = 1.89$$

Table 10. The result of a regression to determine the optimal level of VAT.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| tax | 17.60252 | 10.22801 | 1.721012 | 0.0930* |
| $tax^2$ | -76.77146 | 49.63391 | -1.546754 | 0.1369 |
| VAT(-1) | 0.936717 | 0.039429 | 23.75724 | 0.0000*** |

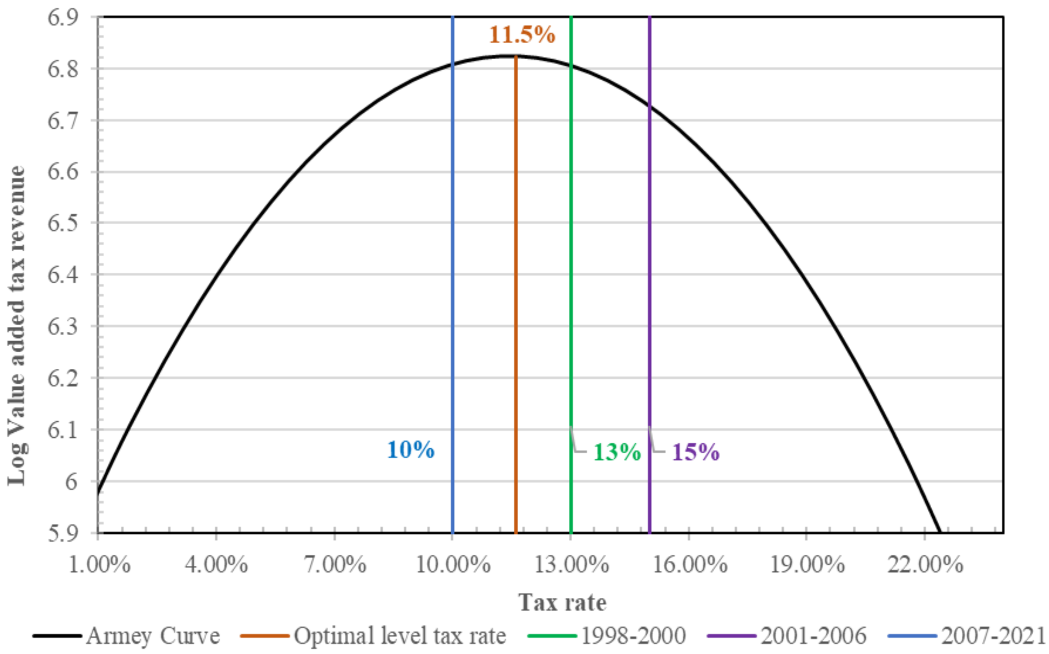
Notes: * and *** express the level of statistical significance at the level of 10%, 1%, respectively.

Based on the above estimation, the optimal standard rate of VAT can be determined unambiguously. In the words, the tax is a quadratic function depending on the tax rate, which solves the problem of finding the maximum value of the function.

$$VAT(tax) = 17.60tax_t - 76.77tax_t^2 + 0.936VAT_{t-1} + \varepsilon_t \rightarrow VAT'(tax) = 0 \rightarrow tax \approx 11.5\%$$

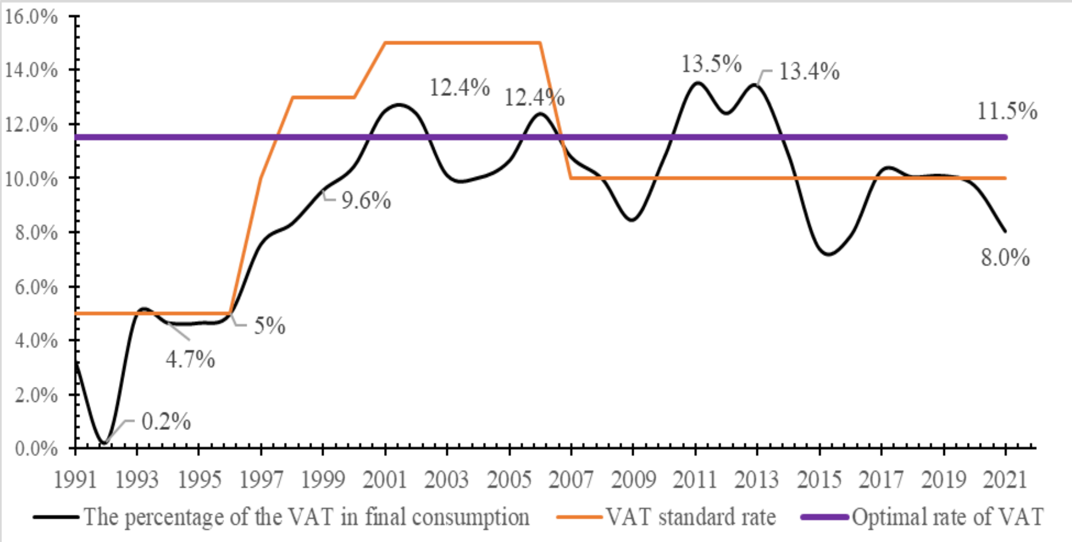
The optimal tax rate of VAT maximizes 11.5% of VAT revenue. This rate was 13% for the years 1998-2000, 15% for the years 2001-2006, and 10% for the years 2007-2021 in Mongolia, and its average value is 12.67%. Based on this, the tax rate of VAT that occurred between the years 2007-2021 was under the optimal level tax rate, while the tax rate of VAT that occurred between 1998-2006 years was above the optimal level tax rate.

Figure 3. The Armey Curve for VAT in Mongolia




The figure above (figure 6) shows the logarithm of the VAT revenue on the vertical axis and the VAT Armey curve on the horizontal axis.

Figure 4. VAT standard rate, VAT performance, and optimal rate of VAT.




In Mongolia, there are many times when the actual amount of VAT collection revenue has not reached the planned rate. However, the tax revenue from final consumption was above the target level and at the target level in 1993-1996, 2001, 2006, and 2017-2020. It shows that the government needs to pay more attention to improving the C-efficiency of VAT collection.

## 4. CONCLUSION

The estimates in this study find tea, coffee, and beverages to have a negative income elasticity of demand, suggesting it is an inferior commodity in Mongolia, regardless of 2015. This attribute makes tea, coffee, and beverages a self-targeting commodity for targeted food intervention programs, and thus has the potential to increase the cost-effectiveness of such programs.

The estimates of cross-price elasticities indicate that substitution effects of price changes are quite strong. Therefore, government price interventions may lead to serious price repercussions in the economy. Particularly, flour product price stabilization programs are likely to skew producer incentives for meat and household product groups. Moreover, price interventions have undesirable allocative inefficiency effects.

In contrast, the high-income elasticities of demand for most food commodities suggest that income-generating policies foster higher levels of consumption for normal commodities, and thus, steady growth in production by enhancing effective demand. Short-run targeted income transfer programs, and longer-term income-generating programs (such as labor-intensive infrastructure development, and investments in irrigation and agricultural research) have the potential to activate a sustainable development process.

The impact of the VAT rate on household welfare varies depending on the group of goods and services, but it is fully explained by the supply and demand theory. For example, if the VAT rate increases by 10%, the demand for all goods and services, except fruits and leguminous plants, will vary depending on their price sensitivity and price. (these groups of goods and services can be classified as Giffen goods),

The most sought-after commodity groups are fruits (increased demand), seafood, sweets and jams, and alcoholic beverages (decreased demand for these goods). The survey result shows that most of the time, the actual amount of VAT collected from household consumption does not reach the set level.

In the short term, tax reform, a reduction in value-added tax, has a positive effect, while an increase has a negative effect and is statistically significant.

Factors such as real GDP growth, population growth, and the share of foreign trade in GDP have statistically significant effects on tax efficiency in the short term. Of these indicators, the impact of the population growth rate on the efficiency of VAT collection is the highest.

The efficiency of VAT collection increased from at least 24% in 1992 to 88.6% in 2014, a significant increase. Based on Arthur Laffer's idea, the share of Armey's government expenditures in GDP is estimated at an optimal level of 11.5%.

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## AUTHOR'S INTRODUCTION

1. First Author

Purevjav GANTUMUR gantumur.p@ufe.edu.mn

Ph.D and Professor of the Department of Economics of the University of Finance and Economics, Mongolia

Work field: Economic growth, Regional Economy, Labor market

2. Corresponding Author

Chimedgochoo UNURJARGAL unurjargal.ch@ufe.edu.mn

Senior lecturer of the accounting department of the University of Finance and Economics, Mongolia

Work field: VAT, Taxation, Social Insurance, Accounting

3. Co-Author

Enkhtaivan UURIINTUYA uuriintuya.e@ufe.edu.mn

Senior lecturer of the Institute of Foreign Languages of the University of Finance and Economics

Work field: Small and medium business entrepreneurship