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Study of the Impact of Income on Commodity Consumption Using Simple Linear Regression Model

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Abstract
Consumption is one of the most important basic variables in the national economy, because it is linked to other economic variables such as production, savings and investment according to the concept of economic theory, and because it comes at the forefront of the topics facing the economies of countries, especially developing ones in general and the Iraqi economy in particular, which are characterized by limited resources that they face in consumption, and that consumer spending represents the final outcome of the activity The economic activity practiced by individuals to satisfy their needs and desires, and thus is the last link in the long chain of economic and social processes, and that its development quantitatively and qualitatively is the ultimate goal of economic development, so the caliber of failure or success of development is to increase actual consumption in the long term. One of the important and main aspects of national planning is that the process of proportionality between investment and consumption is one of the most difficult and complex things facing the economic planner and that the process of economic development is supposed to be seen as a deliberate process. It continues to work to create social, political and technological conditions, through changes in the economic structure with the intention of exploiting resources and energies, and thus is the process of raising the standard of living by achieving continuous increases in the average real income of individuals. [1] [8]
1. Through the study of consumer behavior and because it does not reflect the analysis of total spending only, but also in how the total expenditure is distributed to groups of goods and services, in the analysis of household consumption data, the spending pattern reflects the pattern of distributing the total expenditure of the family or individual for a specific period of time on the main groups of goods and services so that they reflect the behavior of consumers in satisfying their needs and desires, which are of great importance in several areas that can be summarized as follows: [2] [3]
Formulating policies for foreign trade (imports, exports) to ensure the provision of citizens' requirements of necessary goods, reduce luxury goods and encourage citizens to save.
2- Contribute to determining the nature of local production and developing the policy associated with it.
3- Develop the right economic plans to increase income and redistribute it in order to achieve an increase in the average per capita.
4- Monitoring changes in the tendencies and desires of society due to changes in the standard of living and the ability to direct the consumption habits of the family and the individual.

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Introduction

Basic concepts (spending, consumption, spending flexibility, commodity groups)

The impact of consumption on the process of economic development: [3] [1]

In the beginning, it is necessary to distinguish between the concepts of growth and economic development, due to the possibility of confusing them, economic growth may be limited to the growth of real income or growth in the net national product, or growth and development in some economic indicators and over time increasing human knowledge and the accumulation of capital and the increase in population and labor force, all of which can lead to the growth of societies naturally, and this means that economic growth is a growth achieved in some economic indicators and occurs naturally and over time, either Economic development means radical changes in some economic variables that lead to faster growth rates than their natural growth rates. On the other

hand, if economic growth is limited to the economic aspect, or in a specific sector, development means radical changes in all economic, social, political and cultural fields.
The concepts of development have differed according to different schools, time periods and different points of view, it was defined by (Meir Baldwin) as a process through which the real national income is increased, and within a long period of time, as it is noted that this definition included three pillars, the first is that development is a process and not a current event that leads to an increase in the net national product, as it takes place during a long period of time and not directly, in addition to that it means radical changes in economic structures.
As for the economist (Kendall Burger), he believes that development is nothing but an increase in the national product during a certain period of time, with the need to bring about technological, technical and organizational changes in the existing economic institutions.

As for economic development policies and their relations with consumption, there are five policies known to economists, some of which have direct and others indirect impact on consumption, and they are as follows:
1- Savings policy.
2- Investment policy.
3- Price Policy (Price Policy):
A- Income distribution.
B- Redistribution of income between individuals.
C- Changing consumption patterns.
4- Fiscal policy.
5- Monetary policy

For example, the savings policy occupies great importance in the process of economic development and the importance of saving stems from the fact that it occupies the internal source of financing the investments necessary to achieve development, and highlights the importance of saving as one of the driving elements of the economic development process, a high volume of savings would encourage the establishment of a large number of productive projects that would contribute to expanding the volume of capital accumulation and achieving a high rate of economic growth, as well as highlighting its importance as an effective way to achieve economic balance. Monetary stability contributes to reducing the excessive consumption of the rich social classes, whose consumption behavior is characterized by a wasteful nature in a way that leads to the waste of many national savings, as reducing excessive consumption leads to reducing the volume of imports of consumer goods, especially luxury, and this means providing savings that can be used in the purchase of productive goods.
The investment policy is an expression of the creation of new productive capacities in addition to maintaining existing energies, and the investment policy goes to decide the priorities of investment in the framework of economic development and the process of this report involves two aspects, namely the size of the total investment, which secures the full operation of productive capacities, and the distribution of this volume to the different economic sectors, and that determining the size of investment in the macro economy depends on three basic factors: the level of economic surplus and the degree of internal waste and external depletion of it As well as the ability of the national economy to provide appropriate and sufficient labor for the implementation and operation of new projects in addition to the absorptive capacity of the national economy.
The third price policy, which has a direct impact on consumption because it specializes in (income distribution, income redistribution and changing consumption patterns), where the price policy affects the distribution of income between consumption and investment, the high prices of consumer goods stimulate economic resources to go to the areas that specialize in the production of those goods and discourage their orientation towards the areas of production of investment goods, while the high prices of investment goods stimulate the expansion of investment projects, and when adopting planning The economic as a method of managing the national economy, the economic plan is the one that decides the share of consumption and investment of the national income and according to the priorities set.
The other policy that has a direct impact on consumption is the financial policy and this effect occurs from the state to buy types of consumer goods directly and distribute them as income, part of which is allocated for consumption purposes, as well as consumption is affected by tunnels indirectly as the tunnels on the construction of roads, dams, buildings and reservoirs lead to an increase in consumption due to the resulting tunnels of encouraging private investment and expanding the volume of use and the consequent distribution of workers' income and directs part of them to Consumption, taxes can also play a prominent role in reducing the luxury consumption associated with luxury goods by imposing high taxes on them and directing consumption towards national products and thus returning the volume of resources leaked in exchange for luxury imports to the estuaries of national income.
Government spending is also considered one of the important tools of fiscal policy through which countries aim to manage the macro economy to achieve their economic, social, and political objectives and attain high growth rates in output. It works to achieve economic stability, which leads to a state of equilibrium in the relationship between one of the components of aggregate demand, represented by government spending, and real supply, which consists of the goods and services produced by the local economy. This helps to avoid any imbalance between supply and demand.
Due to the importance of the relationship between government spending and gross domestic product (GDP) in utilizing financial capacities to correct the economic structure and remove the distortions it suffers from on one side, and improving the level of financial achievement on the other side, government spending is seen as a dependent variable on the changes occurring in economic, social, and political structures while also influencing them. In Iraq, government spending constitutes a high percentage of GDP, thus exerting a significant impact on all aspects of economic activity. Therefore, the changes occurring in spending leave clear effects on the production structure and, consequently, influence the size of aggregate demand.

Government spending is determined by the amount of available financial resources, which primarily consist of oil resources and non-oil resources. Fiscal policy seeks to increase the revenue generated from these resources, especially non-oil ones, given that oil is a depleting resource.

The concepts of expenditure and consumption: [4][5]

The concept of public expenditure, its importance and effects: [4]

Public expenditure can be defined as an amount of money spent by a public person for the purpose of achieving a public good. From this definition, three important elements characterize public expenditure are clear:

- Public spending is characterized by being a monetary amount of public expenditure carried out by a public person (whether consumer or investment)
- Public spending aims to achieve a public benefit or satisfy a public need There is no doubt about the important role played by public spending as an effective instrument of the fiscal policy of the State, which is implemented by its fiscal authorities to achieve its economic or social objectives during a given period.

The development of the role of the state and the change in the nature of this role by moving from the "guardian state" or "neutral" to the intervening state "and then to the "producing state" led to the expansion of the functions and purposes of the state, which entailed an increase in public spending, which in turn led to an increase in its economic effects, especially with regard to investment spending or spending with the aim of redistributing income. Which was applied in order to get out of the Great Depression that hit the world during the thirties of the last century. Perhaps one of the most important direct effects of public spending is that of both production and consumption as the main activities in the national economy, and these effects can be explained as follows:

First: The impact of public spending on national production:

The national production of any country depends on two types of factors:

• **National productive capacity:** or the so-called material factors of production, and these include both the natural resources of the state, the element of labor in it, in-kind capital, and the productive art used in the production process.

• **Actual demand:** or demand for consumer goods and demand for investment goods (current national product)

It is known that public expenditure is divided into capital (investment or productive) expenditure and consumer (current) expenditure. Investment public expenditure leads to a direct increase in current national income through the rewards (wages and salaries) generated for the factors of production involved in this income, in addition to increasing the productive capacity of the state. Moreover, consumer public expenditure also contributes to enhancing productive capacity (for instance, social spending on educational, health, and cultural services, as well as technical training for workers, improves the skill level of the workforce, thereby increasing productive capacity), in addition to contributing to the increase in current national output. Economic public subsidies provided to private and public projects lead to an increase in the profit rates of those projects, which affects their productive capacity. Furthermore, traditional public expenditure on defense, security, and justice services helps achieve the stability necessary for the production process.

On the other hand, public spending constitutes an important part of the components of actual demand (or demand for consumer and investment goods), which directly affects the volume of production, provided that the level of economic activity is less than the level of full operation of the factors of production (land, labor and capital), and that the productive apparatus has the necessary flexibility to allow the transfer of elements of production between different economic activities.

It is noted that social public spending, in both forms—whether in-kind social transfers (such as funds allocated for producing goods and services used for achieving social purposes like health, culture, education, and housing) or cash social transfers (such as those provided to the poor to address illness, old age, or unemployment)—leads to an increase in the current output of consumer goods that public spending is allocated to acquire. Additionally, cash transfers to individuals with limited incomes increase the demand for essential consumer goods, which in turn leads to an increase in the production of these goods. Furthermore, economic subsidies granted to certain private or public projects, or to specific goods and services, such as support for basic commodities like bread and gasoline, help combat inflation by reducing prices and increase national output by achieving financial balance for public benefit projects by covering budget deficits. They also promote exports by providing subsidies to exporters to improve the balance of payments and encourage investment and development.

Second: The Impact of Public Spending on National Consumption:

Public spending affects consumption directly through an initial increase in demand for consumer goods due to this spending. This type of direct impact of public spending on national consumption can be observed through government or public consumption expenditures, as well as through the expenditures distributed by the state to individuals in the form of salaries or wages, a significant portion of which is allocated to satisfying consumer needs for goods and services.

Concept of Consumption

1. **Consumption**

Consumption is the process of satisfying human material and moral needs through the available income to meet those needs. Changes in consumption are always attributed to changes in income.

In developed societies, an increase in income is not entirely directed towards consumption, indicating a tendency towards saving and subsequently using it for effective investment. In contrast, in developing countries, the increase in income is directed towards direct or indirect consumption, suggesting that such societies are developing and not fully developed.

The economic behavior practiced by individuals in a society can determine that society's ability to grow and develop in the future, as well as whether this economic behavior contributes to its decline.

Changes in income lead to changes in individual consumption behavior, which depends on the amount of income and the rate of increase in it. Households can be categorized based on increases in income and spending on consumption.

Medium or Low-Income Households: Most of the increase is directed to consumption at a greater rate due to the following:

1. Some households may suffer from deprivation, and their needs—such as food, clothing, and housing—are not fully met, prompting them to direct all their income increase towards satisfying these needs.
2. An increase in income may result in moving from one social class to a higher class, driving them to attempt to align with the consumption patterns of the new class. Consequently, the increase in spending may exceed the increase in income, often financed through credit purchases or withdrawing part of previous savings for consumption.

-High-Income Households: An increase in income for these households may lead to increased spending on consumption, but at a lower rate since they have already satisfied many needs. Thus, part of the increase may be allocated to saving, investment, or selecting high-quality products that meet superior standards. Consumption may involve the use of organizational units (institutional) of goods or services to satisfy individual or collective needs, which can be either intermediate (inputs consumed during the accounting period) or final goods and services used by households or society to meet their desires and needs or capital formation needs.

2. Final Consumption:

Goods and services used by households or society to meet their individual or collective needs and desires.

Types of Regression Models

Regression models can be divided into two main types

1. Simple Regression Models: These contain one independent variable and can be linear or nonlinear.
2. Multiple Regression Models: These contain more than one independent variable and can also be linear or nonlinear.

It is known that the methods used to estimate regression models apply to linear models. However, these methods can also be applied to nonlinear models if they can be transformed into a linear form. In this context, two types of nonlinear models can be distinguished as follows:

1. Inherently Nonlinear Models: These models can be expressed in linear form using an appropriate transformation. Assuming that the model is nonlinear, it takes the following form:

= F (X2t, X3t, ..., Kit, UT)

The above model is inherently linear if it can be transformed into the following form:

F(Yet)= B2g2(X2t, ..., Kit) +.....+Bog (X2t, Kit) +UT

or

Yet* = B2X2t* +B3X3t* +.....+BkXkt*+UT --------(2.3)

Since the functions f, g_2, ... g_o must be known to obtain estimates for the parameters, it is noted that the relationship (2.3) is a linear form in the parameters B_2, B_3, ..., B_k.

Models that are inherently non-linear:

The non-linear models that cannot be expressed in terms of the form (2.3) using a specific transformation or by rearranging their terms are inherently non-linear models. An example of this type of model is:

Yet = B0 X1t X2t X3t +UT ..... (2.4)

Since this model is inherently non-linear and cannot be transformed into a form in which it is linear in its parameters.

Income Elasticities

Definition of Elasticity [6][7][9]

Elasticity is defined as the sensitivity or response to something. The price elasticity of demand measures the degree of responsiveness of the quantity demanded of a good to a change in its price in the market, while the income elasticity of demand measures the degree of responsiveness of the quantity demanded of a good to a change in income. The price elasticity of supply measures the degree of responsiveness of the quantity supplied of a good to a change in its price in the market, and so on.

Elasticity is also defined as the relative change (percentage change) in a dependent variable divided by the relative change (percentage change) in an independent variable that causes this change, assuming that all other factors remain constant:

$$E = \frac{\%\Delta Q}{\%\Delta Q}$$

Where

Q: is the dependent variable.

X: is the independent variable.

The larger the value of E, the greater the elasticity or degree of responsiveness of Q to changes in X .

The Practical Aspect:

1)

$$\hat{\beta}_1 = \frac{\sum_{i=1}^{n} X_i Y_i - \frac{\sum_{i=1}^{n} X_i \sum_{i=1}^{n} Y_i}{n}}{\sum_{i=1}^{n} X_i{}^2 - \frac{(\sum_{i=1}^{n} X_i)^2}{n}}$$

X_i	Y_i	$X_i Y_i$	$X_i{}^2$	$\hat{Y}_i$	$e_i = Y_i - \hat{Y}_i$	$e_i{}^2 = (Y_i - \hat{Y}_i)^2$
150	144	21600	22500	141.166667	2.833333	8.0277771356
200	170	34000	40000	183.047619	-13.047619	170.2403649615
250	218	54500	62500	224.928571	-6.928571	48.0051027535
300	275	82500	90000	266.809524	8.190476	67.0838998913
350	320	112000	122500	308.690476	11.309524	127.9053290351
400	355	142000	160000	350.571429	4.428571	19.6122452649
450	410	184500	202500	392.452381	17.547619	307.9189367806
500	410	205000	250000	434.333333	-24.333333	592.1111060822
2600	2302	836100	950000		zero	1340.904762

$\sum_{i=1}^{n} Y_i = \sum_{i=1}^{n} \hat{Y}_i$ To ensure the solution, it must be equal.

$$\hat{\beta}_1 = \frac{836100 - \frac{(2600) * (2302)}{8}}{950000 - \frac{(2600)^2}{8}} = 0.837619047$$

$$\hat{\alpha} = \bar{Y} - \hat{\beta}_1 \bar{X}$$

$$\bar{Y} = \frac{\sum_{i=1}^{n} Y_i}{n} = \frac{2302}{8} = 287.75$$

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n} = \frac{2600}{8} = 325$$

$$\hat{\alpha} = 287.75 - (0.837619047) * (325)$$

$$\therefore \hat{\alpha} = 15.52380973$$

$$\therefore \hat{Y}_i = 15.52380973 + 0.837619047\ X_i$$

$X_i - \bar{X}$	$\sum_{i=1}^{n} (X_i - \bar{X})^2 = S_{xx}$
-175	30625
-125	15625
-75	5625
-25	625
25	625
75	5625
125	15625
175	30625
0	105000

1) $\hat{\beta}_1 \mp t(\frac{\alpha}{2}, n-2) \sqrt{\frac{\hat{\sigma}_e^2}{\sum_{i=1}^{n} (X_i - \bar{X})^2}}$

$$\hat{\sigma}_e^2 = \frac{(Y_i - \hat{Y}_i)^2}{n-2}$$

$\hat{Y}_1 = 15.52380973 + 0.837619047\ (150)$

$= 141.166667$

$$\hat{Y}_8 = 15.52380973 + 0.837619047\ (500)$$
$$= 434.333333$$

$$\therefore \hat{\sigma}_e^2 = \frac{1340.904762}{8-2} = 223.4841$$

$$t\left(\frac{\alpha}{2}, n-2\right) = t\left(\frac{0.05}{2}, 8-2\right) = t(0.025,6) = 2.447$$

$$\therefore L = 0.837619047 - (2.447)\sqrt{\frac{223.4841}{105000}}$$

$$= 0.724727185$$

$$U = 0.837619047 + (2.447)\sqrt{\frac{223.4841}{105000}}$$

$$= 0.950510908$$

$$\Pr\left(\hat{\beta}_1 - t\left(\frac{\alpha}{2}, n-2\right)\sqrt{\frac{\hat{\sigma}_e^2}{\sum_{i=1}^{n}(X_i - \bar{X})^2}} \le \beta_1 \le \hat{\beta}_1 + t\left(\frac{\alpha}{2}, n-2\right)\sqrt{\frac{\hat{\sigma}_e^2}{\sum_{i=1}^{n}(X_i - \bar{X})^2}}\right)$$

$$\Pr(\mathrm{L} \le \beta_1 \le \mathrm{U})$$

$$\Pr(0.724727185 \le \beta_1 \le 0.950510908)$$

To verify the solution $\frac{L+U}{2}$, we calculate $\hat{\beta}_1$ it should yield

2)

$$\hat{\alpha}_1 \mp t(\frac{\alpha}{2}, n-2)\sqrt{\frac{\hat{\sigma}_e^2 \sum_{i=1}^{n} {X_i}^2}{n\ \sum_{i=1}^{n}(X_i - \bar{X})^2}}$$

$$\hat{\sigma}_e^2 = \frac{(Y_i - \hat{Y}_i)^2}{n-2} = \frac{1340.904762}{8-2} = 223.4841$$

$$t\left(\frac{\alpha}{2}, n-2\right) = t\left(\frac{0.01}{2}, 8-2\right) = t(0.005,6) = 3.707$$

$$L = \hat{\alpha}_1 - t(\frac{\alpha}{2}, n-2)\sqrt{\frac{\hat{\sigma}_e^2 \sum_{i=1}^{n} {X_i}^2}{n\ \sum_{i=1}^{n}(X_i - \bar{X})^2}}$$

$$= 15.52380973 - 3.707 * \sqrt{\frac{223.4841 * 950000}{8 *\ 105000}}$$

$$= -43.41048094$$

$$U = \hat{\alpha}_1 + t(\frac{\alpha}{2}, n-2)\sqrt{\frac{\hat{\sigma}_e^2 \sum_{i=1}^{n} {X_i}^2}{n\ \sum_{i=1}^{n}(X_i - \bar{X})^2}}$$

$$= 15.52380973 + 3.707 * \sqrt{\frac{223.4841 * 950000}{8 *\ 105000}}$$

$$= 74.45809997$$

$$\Pr(= -43.41048094 \le \alpha \le 74.45809997)$$

To verify the solution we calculate $\frac{L+U}{2}$, it should yield $\hat{\alpha}$

3) (a) $H_0: \beta = 0.75$

$v.s$

$H_1: \beta \neq 0.75$

$$t = \frac{\hat{\beta} - \beta}{\sqrt{V(\hat{\beta})}} = \frac{0.837619047 - 0.75}{\sqrt{\frac{223.4841}{105000}}}$$

$$t_{cal} = 1.899196318$$

$$t_t = t\left(\frac{\alpha}{2}, n-2\right) = t\left(\frac{0.05}{2}, 8-2\right) = t(0.025,6) = 2.447$$

We accept the null hypothesis H_0 and reject the alternative hypothesis H_1

(b) $H_0: \beta = 0.6$

$v.s$

$H_1: \beta > 0.6$

$$t = \frac{\hat{\beta} - \beta}{\sqrt{V(\hat{\beta})}} = \frac{\hat{\beta} - \beta}{\sqrt{\frac{\hat{\sigma}_e^2}{S_{xx}}}} = \frac{\hat{\beta} - \beta}{\sqrt{\frac{\hat{\sigma}_e^2}{\sum_{i=1}^{n}(X_i - \bar{X})^2}}} = \frac{0.837619047 - 0.6}{\sqrt{\frac{223.4841}{105000}}}$$

$$t_{cal} = 5.039033479$$

$$t_t = t(\alpha, n-2) = t(0.05,8-2) = 1.943$$

We reject the null hypothesisH_0 and accept the alternative hypothesis H_1.

(c) $H_0: \alpha = 15$

$v.s$

$H_1: \alpha \neq 15$

$$t_{cal} = \frac{\hat{\beta}_0 - \beta_0}{\sqrt{V(\hat{\beta}_0)}} = \frac{\hat{\alpha} - \alpha}{\sqrt{V(\hat{\alpha})}} = \frac{\hat{\alpha} - \alpha}{\sqrt{\frac{\hat{\sigma}_e^2 \sum_{i=1}^{n} {X_i}^2}{n \sum_{i=1}^{n}(X_i - \bar{X})^2}}} = \frac{15.52380973 - 15}{\sqrt{\frac{223.4841 * 950000}{8 * 105000}}}$$

$$t_{cal} = 0.032234634$$

$$t_t = t\left(\frac{\alpha}{2}, n-2\right) = t\left(\frac{0.05}{2}, 8-2\right) = t(0.025,6) = 2.447$$

We accept the null hypothesis H_0 and reject the alternative hypothesis H_1.

5)

$$SST = \sum_{i=1}^{n}(Y_i - \bar{Y})^2$$

$\boldsymbol{Y_i - \bar{Y}}$	$\boldsymbol{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}$
-143.75	20664.0625
-117.75	13865.0625
-69.75	4865.0625
-12.75	162.5625
32.25	1040.0625
67.25	4522.5625
122.25	14945.0625
122.25	14945.0625
0	75009.5

$$SSE = \sum_{i=1}^{n} {e_i}^2 = \sum_{i=1}^{n} \left(Y_i - \hat{Y}_i\right)^2 = 1340.904762$$

$$SSR = SST - SSE$$

$$= 75009.5 - 1340.904762$$

$$= 73668.59524$$

or

$$SSR = \hat{\beta}^2 Sxx = (0.837619047\ )^2 * 105000$$

$$= 73668.59513$$

$H_0: \beta_1 = \beta_2 = \beta_3 = \cdots = \beta_k = 0$

$H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \cdots \neq \beta_k \neq 0$

$s.o.v$	$d.f$	$s.s$	$m.s$	F_c
$Regression$	1	73668.59524	73668.59524	329.6368131
$Error$	6	1340.904762	223.4841265	
$Total$	7	75009.5		

$$msR = \frac{SSR}{df} = \frac{73668.59524}{1} = 73668.59524$$

$$msE = \frac{SSE}{df} = \frac{1340.904762}{6} = 223.4841265$$

$$F_c = \frac{msR}{msE} = \frac{73668.59524}{223.4841265} = 329.6368131$$

$$F_t(\alpha, df_R, df_e) = F_t(0.05,1,6) = 5.99$$

$$F_{call} > F_{table}$$

∴ The decision is to reject the null hypothesis H_0 and accept the alternative hypothesis H_1 indicating the presence of a statistically significant difference at the significance level.0.05

6)

$$R^2 = \frac{SSR}{SST} = 1 - \frac{SSE}{SST}$$

$$= 1 - \frac{1340.904762}{75009.5}$$

$$R^2 = 0.982123534$$

This means that 98.2% of the differences or variations in consumer spending among households are caused by differences in income.

7)

$$r = \sqrt{R^2}$$

$$= \sqrt{0.982123534} = +0.99102146$$

* The sign is determined by the sign of $\hat{\beta}_1$

* This indicates a strong positive relationship between income and consumer spending.

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