

## **Analysis of Economic and Social Impact of Investment Development Policy in Agricultural Sector**

P. Zand<sup>1</sup>, H. Mirzaie<sup>1\*</sup>, H. Mehrabi<sup>1</sup>, and S. Nabieian<sup>1</sup>

### **ABSTRACT**

Capital as the engine of economic growth and development is one of the fundamental pillars of economy. Many developing countries are struggling to achieve sustainable economic growth through investment in order to achieve economic development. Investing in agricultural sector, due to the steady increase in demand for food and other agricultural products, is of particular importance and can lead to growth in production and employment in this sector. In addition, backward and forward relationships of the agricultural sector with other sectors also contribute to the growth of production and employment. Accordingly, in the present study, the analysis of the effects of the policy of investment growth in agriculture based on the method of Social Accounting Matrix (SAM) was considered. The effects of applying this policy (including net, open and closed effects) have been analyzed in three scenarios. The results of net effects showed that the incomes of production activities would be increased in each of these scenarios. In addition, due to the implementation of the first scenario, industrial and agricultural sectors, and because of the implementation of the second and third scenarios, the sectors of industries, agriculture, and horticulture had the maximum increase in production. Also, the study of open effects also shows an increase in the income of the factors of production and institutions caused by the application of the above policies. Investigating the closed effects of the package also showed that the overall economy resulting from the above scenarios increases, such that closed effects are much stronger than direct effects. The findings also showed that the closed effects of the aforementioned scenarios on the industries, services, and commerce were more than the agricultural sector itself and its sub-sectors, indicating a strong link between these sectors and the agricultural sector and its sub-sectors.

**Keywords:** Horticulture sub-sector, Income of production activities, Social accounting matrix.

### **INTRODUCTION**

From the theoretical point of view, the role of capital among economists is based on the idea that capital is the engine of mobility and economic growth and development of societies, and all models and patterns of economic growth are based on this idea. The use of domestic and foreign investment opportunities through the optimal use of sources of production is one of the most important factors in achieving economic progress and materials empowerment. Today, investment is one of the main issues in

economic debates that the growth of capital is important for the continuation of economic growth in any country, especially in developing countries (Zehi *et al.*, 2005). Capital is very important in terms of its ability to be converted to other factors in the production process. In Iran, the concept of capital and investment has always been associated with many problems due to its dependence on oil revenues and its price instability; therefore, investment in various economic sectors, including the agricultural sector, has been accompanied by rapid fluctuations. In the agricultural sector, due to

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<sup>1</sup> Department of Agricultural Economics, Shahid Bahonar University of Kerman, Kerman, Islamic Republic of Iran.

\*Corresponding author, e-mail: mirzaei\_h@uk.ac.ir



structural bottlenecks and lack of facilities for most beneficiaries, investment issues have been more evident, and despite the fact that this sector has the largest share of *GDP* and employment in other sectors, it also supplies the essential needs of the population. However, it has a small share in line with allocating investment resources (Nikookar, 2002).

Therefore, among investments in different sectors of the economy, investing in agricultural sector has an important role. Investing in agriculture, due to the steady increase in demand for food and other agricultural products, could boost production and employment in this sector. Indeed, the increase in demand will lead to higher prices and higher prices will increase incentives for investment. Therefore, more investment will result in higher production and more employment. In addition, the previous and past relationships of agriculture with other sectors also contribute to the growth of production and employment. Most agricultural activities are carried out in rural areas; therefore, the expansion of agricultural investment in the form of public and private investments can create more employment opportunities in rural areas, thus preventing the villagers from migrating to cities and increasing the growth rate of agricultural sector (Amini and Falihi, 1998).

Also, investment in agricultural section takes into account the relative advantage of products, increases agricultural production and, as a result, increases the export of agricultural products, thus the lack of foreign exchange earnings is partly solved by this solution (Aghanasiri, 2012).

Here are some articles that have examined the impact of investment on economic growth and the growth of the agricultural sector.

Lotfipour *et al.* (2012) examined the effect of government expenditures on the growth of the agricultural sector and the economy as a whole. The results showed that the ratio of private investment in the agricultural sector to value added and the ratio of public sector investment to long-run value added had a positive effect on the growth of the

agriculture sector. Also, Marmazi *et al.* (2014) investigated the impact of investment in agriculture, industry and services sectors on employment and income distribution in Iran during the period 1980-2010 by using VAR and Logit and Probit methods. The results of their study showed that the effect of investment on employment in the agricultural sector is much stronger than the two sectors of industry and services. However, investigating the effect of investment on income distribution in the three sectors indicated that the effect of investment on income distribution in the industrial sector was stronger than the two sectors of agriculture and services. In addition, Poursafar and Mohammadi (2015) investigated the effect of investment in Iran's agricultural sector on employment and value added of this sector by using the Johansen-Juselius method. They eventually concluded that the investment had the highest positive impact on employment and the value added of the agricultural sector.

Khosravi *et al.* (2014) also examined the role of financial market and foreign direct investment on economic growth of agricultural sector by using the dynamic combination data approach during the period from 1984 to 2011. The results indicate that financial market development has a positive effect on the economic growth of the agricultural sector, but in developing countries, this relationship is not very significant compared to developed countries. Also, foreign direct investment (FDI) in both groups of countries has boosted the economic growth of the agricultural sector, but it is weaker in developing countries. Mahadika *et al.* (2017) also examined the relationship between *GDP*, *FDI* and export volumes in Indonesia. The results showed that *FDI* and export volumes have a significant impact on economic growth in Indonesia. In addition, according to the Johansen Tests for Co-integration, there is a long-term relationship between *GDP*, *FDI* and export volumes in Indonesia. Also, in a paper titled "*FDI*, Trade and Economic Growth, an empirical analysis

for Bangladesh in the period 1973-2014”, Hussain and Haque (2016), using the Vector Error Correction Model (VECM), concluded that FDI and trade have a significant impact on GDP growth per capita, because FDI and trade are two of the key components of economic growth in Bangladesh. In addition, Agrawal (2015) investigated the relationship between direct foreign investment and economic growth in the five economies of Brazil, Russia, India, China and South Africa (BRICS) during the period of 1989-2012, and by using panel data method concluded that a long-term equilibrium relationship exists between FDI and economic growth. Almfraji and Almsafir (2014), in their paper entitled “FDI and Economic Growth: An overview of the 1994-2012 studies”, concluded that there was a positive and significant relationship between FDI and economic growth. But, in some cases, this relationship is negative, and even in some cases, there is no relationship. Thus, there are other factors, such as adequate human capital, developed financial markets, a complementary relationship between FDI and domestic investment, and the existence of an open commercial organization that affect economic growth.

Therefore, considering the importance of the impact of investment on economic growth, this study aimed to analyze the economic and social effects of investment growth in agriculture in three scenarios including: (1) An increase of 15% in agricultural sector investment, (2) A 10% increase in investment in the agriculture and horticulture sector, and (3) An increase of 15% investment in agriculture and horticulture and 10% investment in other sub-sectors.

## MATERIALS AND METHODS

In this study, the Social Accounting Matrix (SAM) of 2011 was used. This matrix is provided by the Islamic Consultative Assembly Research Center. The SAM of 2011 is square and has 99 rows and columns. This matrix includes 71 productive activities,

3 production factors accounts, 2 rural and urban households, 1 company account, 1 government account, 1 outside world account, 1 capital account and total input or total output. Government account, outside world account, and capital account are exogenous variables and other accounts were included in the group of endogenous accounts.

In fact, the SAM is the matrix expression of the national accounts, with an emphasis on the social dimension of the types of transactions in the real and financial sectors, which is based on the sequence of accounts inserted in the national accounts system. In addition, SAM is a tool that can be used to simultaneously examine socio-economic issues such as economic growth and income distribution issues, and through it, the interaction between various economic variables such as production, income, consumption and capital formation can be seen in the form of a single matrix (Central Bank, 2008).

The social accounting matrix is also a type of accounting system in which the flows of income and cost between institutions and sectors of the economy are represented in the form of rows and columns of a matrix. In this matrix, each macro-economic account is represented by a column representing the payments and a row representing the receipts of that account (Central Bank, 2008).

Table 1 shows the SAM in a summarized form. According to this table, this matrix shows the relationship between productive activities, the distribution of income from these activities among the factors of production, and the distribution of income among social institutions. In addition, the matrix describes how to use the income of socio-economic institutions in the structure of the economy (Permeh *et al.*, 2011).

Also, in Table 1, there is a general categorization for accounts in the SAM.

**Table 1.** Types of endogenous accounts social accounting matrix (2011).<sup>a</sup>

Inputs	Outputs	Endogenous accounts				Exogenous accounts		Total input (Demand and total revenue)
		1. Production	2. Production factors	3. Institutions and companies without government)	4. Other accounts (Government, accumulation, outside world)	$X_1$	$X_2$	
Endogenous accounts	1. Production	$T_{11}$	0	$T_{13}$	$X_1$	$Y_1$	$Y_1$	
	2. Production factors	$T_{21}$	0	0	$X_2$	$Y_2$	$Y_2$	
	3. Institutions (Households and companies without government)	0	$T_{32}$	0	$X_3$	$Y_3$	$Y_3$	
Exogenous accounts	4. Other accounts (Government, accumulation, outside)	$I_1$	$I_2$	$I_3$	$T$	$Y_x$	$Y_x$	
Total input (Demand and total revenue)		$Y'_1$	$Y'_2$	$Y'_3$	$Y'_x$			

<sup>a</sup> Source: (Defournay and Thorbecke, 1984).

Under this subdivision, the accounts are divided into endogenous and exogenous groups. The importance and use of this categorization is in the transformation of SAM into an analytical model and the calculation of multiplier coefficient. Endogenous accounts of SAM are a group of accounts that their revenue levels are determined by model requirements. While exogenous accounts revenues are considered out of the equation, they are determined in the model. The standard mode of categorization of endogenous and exogenous accounts is such that production accounts, production factors, households and companies, and the rest of the accounts, including government accounts, capital, and outside world, are part of exogenous accounts (Permech *et al.*, 2011).

The set of accounts in Table 1 are in an economic system for both cost and revenue interaction, so that, based on the summarized form of the SAM, which includes the economic and social flows of the country, the income and expenditure flows can be as follows:

$T_{11}$  shows the interactions between the productive sectors,  $T_{21}$  shows the value-added transfer matrix of the productive activities to the factors of production. Block  $T_{32}$  is the matrix of production factors income transfer to households (owners of production factors). Block  $T_{13}$  represents the pattern of household consumption and shows how household income is consumed on goods and services (Kohansal and Permech, 2014).

$X_1, X_2,$  and  $X_3$  represent the expenditures and  $l'_1, l'_2, l'_3$  show the income of the set of

the external world, government and investors for purchasing goods and services, the use of factors of production, and payments to the institutes. Furthermore,  $Y_1, Y_2, Y_3,$  and  $Y_x$  show the total income and  $Y'_1, Y'_2, Y'_3, Y'_x$  show the total expenditures in each of the related accounts. Since each of the accounts will spend as much as its income, the sum of columns is equal to the sum of rows in each account. In other words, SAM matrix is a square matrix (Salami and Permech, 2001).

Also, according to Table 2, the total revenue received by endogenous accounts ( $Y_n$ ) consists of two parts: (1) The cost of  $T_{nn}$  endogenous accounts, which is briefly represented by the vector  $n$ ; and (2) The cost of  $T_{nx}$  exogenous accounts, which is summarized with vector,  $x$ .

$$Y_n = n + X \tag{1}$$

Similarly, for income received by exogenous accounts  $Y_x$ , if  $T_{xn}$  is equal to  $l$  and  $T_{xx}$  is displayed with  $t$ , then, it can be written as:

$$Y_x = l + t \tag{2}$$

By dividing each of the elements of the  $T_{nn}$  matrix onto the corresponding column, another matrix called Average propensity to consume is obtained. If the new matrix is called  $A_n$ , then, we can show the  $T_{nn}$  matrix in the form of Equation (4) based on  $A_n$ :

$$A_n = [A_{ij}] = T_{ij}[\hat{Y}_j]^{-1} \quad i, j = 1, 2, 3 \tag{3}$$

$$T_{nn} = A_n \cdot \hat{Y}_n \tag{4}$$

$$A_n = \begin{bmatrix} A_{11} & 0 & A_{13} \\ A_{21} & 0 & 0 \\ 0 & A_{32} & A_{33} \end{bmatrix} \tag{5}$$

**Table 2:** Providing an outline of exogenous and endogenous accounts in SAM.

Total income	Expenditure			
	Sign	Exogenous	Sign	Endogenous
$Y_n$	$x$	$T_{nx} = A_x \hat{Y}_x$	$n$	$T_{nn} = A_n \hat{Y}_n$ Endogenous
$Y_x$	$t$	$T_{xx} = A_t \hat{Y}_x$ $Y'_x$	$l$	$T_{xn} = A_l \hat{Y}_n$ Exogenous $Y'_n$ Total expenditure

Incomes



In the (4),  $\hat{Y}_n$  is a diagonal matrix which elements are on the main diameter of  $Y_i$  ( $i=1 \dots n$ ). Similarly, the matrix  $T_{xn}$  can be represented by the Equation (6):

$$T_{xn} = A_l \hat{Y}_n \quad (6)$$

In Equation (6),  $A_l$  is called Average propensity to leak matrix. Given the definition of the two matrices  $A_n$  and  $A_l$ , we can show  $l$  and  $n$  as follows:

$$n = A_n \cdot Y_n \quad (7)$$

$$l = A_l \cdot Y_n \quad (8)$$

By combining the above equations, a new equation is obtained as follows:

$$Y_n = A_n Y_n + X = (I - A_n)^{-1} X = M_a X \quad (9)$$

$$M_a = (I - A_n)^{-1} \quad (10)$$

Equation (9) shows the SAM model in which the level of income of the endogenous accounts in the SAM is expressed as a function of the level of exogenous  $X$  variable. In this equation,  $M_a$  is called accounting multiplier matrix. This matrix is called the Accounting Multiplier matrix, because it only represents the structure formed in the context of SAM as it stands, and establishes the relationship between certain levels of  $Y_n$  and  $X$ . Therefore, based on this model, any changes in the amount of injections to each of the exogenous accounts will lead to a change in the income of the endogenous accounts (receipts of productive activities, factors of production and institutions) (Salami and Perme, 2001):

$$\Delta Y_n = M_a \cdot \Delta X \quad (11)$$

For example, in this equation,  $\Delta X$  indicates the change in investment in the agricultural sector,  $M_a$  is the Multiplier coefficient matrix and  $\Delta Y_n$  is the change in the received endogenous accounts.

As stated, in order to use the static model of SAM in the study of economic policies, it is necessary to calculate multiplier coefficients. But, one of the cases that can be derived from the multiplier coefficient matrix is the effectiveness of economic shocks on the structure of the economy of a country and the separation of effects to detailed effects, so that the matrix can be broken down into the matrix of multiplier coefficients of net effects, open effects, and closed effects. In fact, this section is a distinguishing feature of

the general equilibrium models in comparison to partial equilibrium models. Because partial equilibrium models do not fully examine the pure effects of policy maker variables, they ignore the two subsequent parts, which are the consequences of these policies (Kohansal and Perme, 2014).

As already mentioned, the production level is in the form of Equation (12).

$$Y_n = A_n Y_n + X \quad (12)$$

Now Equation (12) can be rewritten as Equation (13).

$$Y_n = (A_n - A_n^\circ) Y_n + A_n^\circ Y_n + X = (I - A_n^\circ)^{-1} (A_n - A_n^\circ) Y_n + (I - A_n^\circ)^{-1} X = A^* Y_n + (I - A_n^\circ)^{-1} X \quad (13)$$

In Equation (13),  $A_n^\circ$  is a sub-matrix for the matrix  $A_n$ .

Also,  $A^*$  is defined as Equation (14):

$$A^* = (I - A_n^\circ)^{-1} (A_n - A_n^\circ) \quad (14)$$

Then, the two sides of the equation  $Y_n = A^* Y_n + (I - A_n^\circ)^{-1} X$  is multiplied by  $A^*$  then the left-hand statement of Equation (15) is replaced with the equation  $A^* Y_n = Y_n - (I - A_n^\circ)^{-1} X$ .

$$A^* Y_n = A^{*2} Y_n + A^* (I - A_n^\circ)^{-1} X \quad (15)$$

$$Y_n - (I - A_n^\circ)^{-1} X = A^{*2} Y_n + A^* (I - A_n^\circ)^{-1} X \quad (16)$$

$$Y_n = A^{*2} Y_n + (I - A_n^\circ)^{-1} X + A^* (I - A_n^\circ)^{-1} X \quad (17)$$

$$Y_n = A^{*2} Y_n + (I + A^*) (I - A_n^\circ)^{-1} X \quad (18)$$

$$Y_n = (I - A^{*2})^{-1} (I + A^*) (I - A_n^\circ)^{-1} X \quad (19)$$

For the next round, the two sides of the equation  $Y_n = A^* Y_n + (I - A_n^\circ)^{-1} X$  are multiplied by  $A^{*2}$  then the equation  $A^{*2} Y_n = A^* Y_n - A^* (I - A_n^\circ)^{-1} X$  is replaced by Equation (20).

$$A^{*2} Y_n = A^{*3} Y_n + A^{*2} (I - A_n^\circ)^{-1} X \quad (20)$$

$$Y_n = A^{*3} Y_n + (I + A^* + A^{*2}) (I - A_n^\circ)^{-1} X = (I - A^{*3})^{-1} (I + A^* + A^{*2}) (I - A_n^\circ)^{-1} X \quad (21)$$

Finally, in order to achieve more general results, Equation (21) can be rewritten as follows:

$$Y_n = (I - A^{*k})^{-1} (I + A^* + A^{*2} + \dots + A^{*(k-1)}) (I - A_n^\circ)^{-1} X \quad (22)$$

Given that three endogenous accounts are present in the SAM, or in other words, the

income stream in the SAM is seen in three stages, so,  $K=3$  is considered.

The three matrices  $A^*$ ,  $A_n^\circ$  and  $A$  are defined as follows:

$$\begin{bmatrix} A_n & & \\ A_{11} & 0 & A_{13} \\ A_{21} & 0 & 0 \\ 0 & A_{32} & A_{33} \end{bmatrix} = \quad (23)$$

$A_n^\circ$  is a sub-matrix of intra-part exchanges of production and institution accounts.

$$A_n^\circ = \begin{bmatrix} A_{11} & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & A_{33} \end{bmatrix} \quad (24)$$

$$A^* = (I - A_n^\circ)^{-1}(A_n - A_n^\circ) \quad (25)$$

In Equation (25), the first statement is equal to:

$$\left( \begin{bmatrix} I & 0 & 0 \\ 0 & I & 0 \\ 0 & 0 & I \end{bmatrix} - \begin{bmatrix} A_{11} & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & A_{33} \end{bmatrix} \right)^{-1} = \begin{bmatrix} (I - A_{11})^{-1} & 0 & 0 \\ 0 & I & 0 \\ 0 & 0 & (I - A_{33})^{-1} \end{bmatrix} \quad (26)$$

And the second statement is equal to:

$$\begin{bmatrix} A_{11} & 0 & A_{13} \\ A_{21} & 0 & 0 \\ 0 & A_{32} & A_{33} \end{bmatrix} - \begin{bmatrix} A_{11} & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & A_{33} \end{bmatrix} = \begin{bmatrix} 0 & 0 & A_{13} \\ A_{21} & 0 & 0 \\ 0 & A_{32} & 0 \end{bmatrix} \quad (27)$$

Finally, the product of these two expressions is calculated as the matrix  $A^*$ .

$$A^* = \begin{bmatrix} 0 & 0 & (I - A_{11})^{-1}A_{13} \\ A_{21} & 0 & 0 \\ 0 & (I - A_{33})^{-1}A_{32} & 0 \end{bmatrix} \quad (28)$$

Now, if the elements of the matrix  $A^*$  are defined as:

$$(I - A_{11})^{-1}A_{13} = A_{13}^* \quad (29)$$

$$A_{21} = A_{21}^* \quad (30)$$

$$(I - A_{33})^{-1}A_{32} = A_{32}^* \quad (31)$$

The matrix  $A^*$  can be rewritten as follows:

$$A^* = \begin{bmatrix} 0 & 0 & A_{13}^* \\ A_{21}^* & 0 & 0 \\ 0 & A_{32}^* & 0 \end{bmatrix} \quad (32)$$

So that  $A^*$  follows the circular revenue stream in SAM.

$$Y_n = (I - A^{*3})^{-1}(I + A^* + A^{*2})(I - A_n^\circ)^{-1}X = M_a \quad (33)$$

We can now define the matrix of Multiplier coefficients  $M_a$  in terms of the product of three matrices.

$$M_a = M_{a3} \cdot M_{a2} \cdot M_{a1} \quad (34)$$

$$\text{So that: } M_{a1} = (I - A_n^\circ)^{-1} \quad (35)$$

$$M_{a2} = (I + A^* + A^{*2}) \quad (36)$$

$$M_{a3} = (I - A^{*3})^{-1} \quad (37)$$

Therefore,  $M_{a1}$  is defined as:

$$M_{a1} = \begin{bmatrix} I & 0 & 0 \\ 0 & I & 0 \\ 0 & 0 & I \end{bmatrix} - \begin{bmatrix} A_{11} & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & A_{33} \end{bmatrix} = \begin{bmatrix} (I - A_{11})^{-1} & 0 & 0 \\ 0 & I & 0 \\ 0 & 0 & (I - A_{33})^{-1} \end{bmatrix} \quad (38)$$

$M_{a1}$  is the net Multiplier effect or transfer effect. In fact, this sub matrix calculates the transfer effects in the endogenous accounts. This effect is the SAM as the direct effect of the change in the policy maker variables of a sector (production activity) on themselves (the total production activities include the agricultural sector, industry, and services), This is due to the interactions between the exogenous variables that make up this set of accounts.

The effect of an open-loop or cross effect: The sub-matrix  $M_{a2}$  shows the interactions between the groups of endogenous accounts. This effect is the SAM as the cross effects of the change in policy maker variables on sectors where economic shock has not occurred. In other words,  $M_{a2}$  calculates the effects of an injection into the system, so that the effect is transmitted throughout the system without returning to its origin (open loop effect). In fact,  $M_{a2}$  shows how an external injection of the endogenous accounts is transmitted into revenues (interconnected institutions), but it is not transferred from income to demand (for example, the impact of investment in agriculture on production factors and institutions). It can also be said that this matrix is the only matrix with elements outside the original diameter.

$$M_{a2} = (I + A^* + A^{*2}) \quad (39)$$

$$= \begin{bmatrix} 0 & (I - A_{11})^{-1}A_{13}(I - A_{33})^{-1}A_{32} & 0 \\ 0 & 0 & A_{21}(I - A_{11})^{-1}A_{13} \\ (I - A_{33})^{-1}A_{32}A_{21} & 0 & 0 \end{bmatrix} \quad (40)$$



$$A^{*2} = \begin{bmatrix} 0 & A_{13}^*A_{32}^* & 0 \\ 0 & 0 & A_{21}^*A_{13}^* \\ A_{32}^*A_{21}^* & 0 & 0 \end{bmatrix} \quad (41)$$

$$\begin{aligned} M_{a2} &= \begin{bmatrix} I & 0 & 0 \\ 0 & I & 0 \\ 0 & 0 & I \end{bmatrix} + \begin{bmatrix} 0 & 0 & A_{13}^* \\ A_{21}^* & 0 & 0 \\ 0 & A_{32}^* & 0 \end{bmatrix} \\ &+ \begin{bmatrix} 0 & A_{13}^*A_{32}^* & 0 \\ 0 & 0 & A_{21}^*A_{13}^* \\ A_{32}^*A_{21}^* & 0 & 0 \end{bmatrix} \\ &= \begin{bmatrix} I & A_{13}^*A_{32}^* & A_{13}^* \\ A_{21}^* & I & A_{21}^*A_{13}^* \\ A_{32}^*A_{21}^* & A_{32}^* & I \end{bmatrix} \quad (42) \end{aligned}$$

Closed-loop effect: The sub-matrix  $M_{a3}$  measures the circular effect of an injection into the economy and the transition to the whole economy and its return to its origin. For example, these effects transfer from production activities to production factors and then to institutions, and eventually return to production activities (in the demand form). In other words,  $M_{a3}$  presents the total net effect of the circular effect of Multiplier coefficients of  $M_{a1}$  and  $M_{a2}$ , and is calculated by the following equations (Kohansal and Perme, 2014, Roland-Halst *et al.*, 2013 and Ferede, 2000):

$$M_{a3} = (I - A^{*3})^{-1} \quad (43)$$

$$A^{*3} = \begin{bmatrix} A_{13}^*A_{32}^*A_{21}^* & 0 & 0 \\ 0 & A_{21}^*A_{13}^*A_{32}^* & 0 \\ 0 & 0 & A_{32}^*A_{21}^*A_{13}^* \end{bmatrix} \quad (44)$$

$$M_{a3} = \begin{bmatrix} (I - A_{13}^*A_{32}^*A_{21}^*)^{-1} & 0 & 0 \\ 0 & (I - A_{21}^*A_{13}^*A_{32}^*)^{-1} & 0 \\ 0 & 0 & (I - A_{32}^*A_{21}^*A_{13}^*)^{-1} \end{bmatrix}$$

Now it can be written as:

$$M_a = M_{a3}M_{a2}M_{a1} = I + T + O + C \quad (45)$$

$I$ : Multiplier coefficient unit

$$T = (M_{a1} - I): \text{Net Transfer increasing multiplier coefficient} \quad (47)$$

$$O = (M_{a2} - I)M_{a1} = (M_{a2}M_{a1} - M_{a1}): \text{Open loop multiplier coefficient} \quad (48)$$

$$C = (M_{a3} - I)M_{a2}M_{a1} = (M_{a3}M_{a2}M_{a1} - M_{a2}M_{a1}): \text{Close loop multiplier coefficient} \quad (49)$$

## RESULTS AND DISCUSSION

As mentioned earlier, in this section, the analysis of the economic and social effects of the investment development policy in the agricultural sector and its sub-sectors on different economic sectors is considered in three scenarios. The basis of the investment increase in agriculture in the following scenarios is the trend of increasing capital formation in agriculture sector in the past years and the base year is the SAM as in 2011.

### First Scenario: An Increase of 15% in Agriculture Sector Investment

One of the important advantages of the general equilibrium models, including the SAM, is considering the recurrence effects on the sector where the momentum occurred, which results in the final effect of the impulse far more than its initial effect (Kohansal and Perme, 2014). For example, investment in agriculture sector increased by 20,709,073.23 million Rials, while production in this sector increased by 28,097,181.26 million Rials due to the indirect effects that interred to this subsection and this is the SAM as the advantages of the macro-oriented models in simulating policies that have direct and indirect effects. Due to an increase in investment in a sector, the production of this sector will increase, which is known as the net effect (Kohansal and Perme, 2014). Due to the implementation of the first scenario, the net effect of agricultural sector was 4,489,600.65 million Rials. However, another indirect effect that has a very strong impact is known as the closed loop effect. The amount of this effect in the agricultural sector is 2,898,507.39 million Rials. This is due to the increase in production in the agricultural sector, which increases households' received incomes. Because households are owners of production factors, these factors increase as demand increases and, as a result, households' received income will increase. As household incomes



increase, household purchasing power increases and, consequently, their demand for agricultural produce increases. By increasing revenue, the purchasing power of households will be increased, and, as a result, demand for agricultural products will increase, thus production will increase again and this trend is repeated.

In the second column of Table 3, the net effect (direct) as an increase of 15% in agricultural investment is indicated. This effect is the SAM as the effect of changes in policy maker variables of a sector (an increase of 15% in agriculture) on their own (total production activities). According to this column, the direct effect of 15% increase in agricultural investment, in total, will increase the production activities by 12,531,905.43 million Rials, of which 4,489,600.65 million Rials has come from this increase in agricultural production. In addition, the industrials sectors (4,534,284.34 million Rials), trade (1,262,612.18 million Rials) and

services (735,219.84 million Rials) had the largest increase in production, indicating that the agricultural sector has the highest link with these sectors, and this increased investment in the agricultural sector also affects these sectors.

In the fourth column, the opening effect is due to the implementation of the first scenario. This effect is the SAM as the open effects of changes in policy makers on sectors where there was no economic shock (the impact of increased agricultural investment on production factors and households). Therefore, in this column, the amount of changes in the production activities of zero and the impact of this shock on the factors of production, households, and companies have been calculated. Because of this shock, the combined revenue will increase by 12,562,208.3 million Rials, operating surplus, gross amount by 3,456,812.77 million Rials, and compensation by 1,118,244.75 million Rials. Also, in equation of households' incomes, the tenth

**Table 3.** First scenario: Net, open and closed effects.

Sectors	Net effect	Percent	Open effect	Percent	Closed effect	Percent
Agriculture	4489600.65	35.82	0	0	2898507.39	5.18
Petroleum and natural gas	97251.998	0.78	0	0	197651.11	0.35
Other mines	43480.77	0.35	0	0	90227.001	0.16
Industry	4534284.34	36.18	0	0	9746001.2	17.41
Electricity, gas and water	580783.31	4.63	0	0	1639060.45	2.93
Building	64432.8	0.51	0	0	277913.63	0.5
Commerce, hotel and restaurant	1262612.18	10.07	0	0	4222977.65	7.54
Transportation	724239.53	5.78	0	0	1485380.74	2.65
Services	735219.84	5.87	0	0	6589862.08	11.77
Compensation service	0	0	1118244.75	3.26	3072427.05	5.49
Mixed income, gross	0	0	12562208.3	36.67	4731583.23	8.45
Operating surplus, gross	0	0	3456812.77	10.09	6714069.11	11.996
Households (First decile)	0	0	356809.42	1.04	299118.96	0.53
Households (Second decile)	0	0	612406.03	1.79	439354.71	0.78
Households (Third decile)	0	0	800561.24	2.34	539060.67	0.96
Households (Fourth decile)	0	0	949129.84	2.77	629069.7	1.12
Households (Fifth decile)	0	0	1063889.035	3.11	696630.49	1.24
Households (Sixth decile)	0	0	1249783.9	3.65	812372.24	1.45
Households (Seventh decile)	0	0	1507317.365	4.4	944045.81	1.69
Households (Eighth decile)	0	0	1681036.92	4.91	1093379.075	1.95
Households (Ninth decile)	0	0	2122029.08	6.19	1346345.16	2.41
Households (Tenth decile)	0	0	4150064.11	12.12	2427428.46	4.34
Companies	0	0	2623038.72	7.66	5074669.35	9.07
Total	12531905.43	100	34253331.48	100	55967135.27	100



decile has been affected (increased by 4,150,064.11 million Rials) and the first one has the lowest impact (an increase of 356,809.42 million Rials). It can also be said that the increase in household incomes is due to increased production consequent to increased investment, as a result of the demand for the factors of production increased and due to the increase in the income of the factors of production; the income of households who own these factors also increases. In addition, the company accounts and total received revenue by economy are increased by 2,623,038.72 and 34,253,331.48 million Rials

In the eighth column, the close effect of the first scenario is presented. This means that the policy of increasing investment in the agricultural sector will initially increase the amount of inputs of production factors. As households are owners of production factors, their income and purchasing power increase, and then by increasing demand, they increase production and, as a result, increase the purchasing power by production activities and, eventually, increase production activity for the second time and this process continues to be repeated.

According to the results of the closed effects in the Table 3, among production activities, the amount received by industry sectors (9,746,001.2 million Rials), services (6,589,862.08 million Rials), trade, hotel and restaurant (4,222,977.65 million Rials) and agriculture (2,898,507.39 million Rials) are more than others. Also, among the factors of production, the amount of received operating surplus increased (6,714,069.11 million Rials) more than mixed income (4,731,583.23 million Rials) and compensation (3,072,427.05 million Rials). In addition, the income of the tenth decile of households (2,427,428.46 million Rials) increased more than the others, meanwhile, the total households' revenues increased by 9,226,805.28 million Rials and companies by 5,074,669.35 million Rials. Source: Research findings, Unit: Million Rials-Percent).

As a result of the implementation of the second scenario, the amount of investment in

the sub sector of agriculture and horticulture increases by 10%. The results of net effects in the second column indicate that the increase in production activities was 83.3352705 million Rials. Also, the industrial sectors (1,330,594.35 million Rials), agriculture and horticulture (768,698.51 million Rials), trade (263,390.42 million Rials) and services (252,026.62 million Rials) showed the highest revenues.

In the open effects of implementing this policy are visible in Table 4. As stated above, in this column, the level of change in production activity is zero and the impact of this policy-making on the factors of production, households, and companies can be observed. Among the factors of production, the maximum and minimum increase in the revenues are related to mixed income accounts, gross is 5482848.93 million Rials and compensation service is 326,887.87 million Rials. Also, in equation of household accounts, the maximum and minimum amounts of increase were related to the tenth decile (1,759,159.35 million Rials) and the first decile (145,738.34 million Rials). In addition, the company accounts revenues increased by 900,321.19 million Rials and the total economy revenues increased by 13,992,551.78 million Rials.

The sixth column in Table 4 shows the closed effects caused by this shock. The activities of the industry sectors (4,095,516.055 million Rials), services (2,771,716.62 million Rials), commercial (1,773,624.47 million Rials) and agriculture and horticulture (756,876.74 million Rials) sectors have experienced the highest increase. Operating surplus account, gross (2,824,988.07 million Rials) and compensation (1,292,018.88 million Rials), respectively, have received the highest and lowest incomes, respectively. Also, in connection with household accounts, the increase in the amount of the first decile and the first decile accounts were 1,020,782.3 and 125,783.06 million Rials, respectively. In addition, the increase in incomes of the company's accounts and the increase of the

total economy were 2,135,197.675 and 23,512,727.02 million Rials, respectively.

In Table 5, the results of the direct, open, and closed effects caused by implementation of policy is visible as an increase of 15% in agriculture and horticulture sub-sectors and 10% in other sub-sectors. The results of direct effects in the second column of Table 5 show that the production in industries (3,642,013.41 million Rials), agriculture and horticulture (2,377,754.77 million Rials), animal husbandry (1,154,878.48 million Rials) and commercial (970,238.09 million Rials) has increased more than the other sectors. Also, the increase in production activities was 10030921.73 million Rials. The fourth column of Table 5 also shows the open effects arising from the implementation of this scenario, and in this column only the

effects of implementing this policy on production factors, households, and companies are examined. Based on considering this shock, the receipt of mixed income accounts will increase the gross by 11,518,726.58 million Rials, operating surplus, the gross as 2,641,790.79 million Rials and the compensation of services as 746,215.52 million Rials. In equation to household accounts, the maximum and minimum revenues were related to the tenth decile (3,717,427.99 million Rials) and the first decile (309,996.58 million Rials). Also, the company's accounts were increased by 5,226.72 million Rials and the total economy revenues were increased by 29,814,286.02 million Rials.

Finally, column 6 of Table 5 shows the closed effects. The results show that the

**Table 4.** Scenario II: Net, open and closed effects.<sup>a</sup>

Sectors	Net effect	Percent	Open effect	Percent	Closed effect	Percent
Agriculture and horticulture	768698.51	22.93	0	0	756876.74	3.22
Animal husbandry	205847.35	6.14	0	0	381799.44	1.62
Forestry	26319.16	0.78	0	0	7997.94	0.03
Fishing	968.23	0.03	0	0	53748.15	0.23
Petroleum and natural gas	30371.86	0.91	0	0	83073.26	0.35
Other mines	12733.55	0.38	0	0	37900.20	0.16
Industry	1330594.35	39.69	0	0	4095516.055	17.42
Electricity, gas and water	240791.59	7.18	0	0	689366.95	2.93
Building	16804.19	0.5	0	0	116763.13	0.5
Commerce, hotel and restaurant	263390.42	7.86	0	0	1773624.47	7.54
Transportation	204159.999	6.09	0	0	622830.19	2.65
Services	252026.62	7.52	0	0	2771716.62	11.79
Compensation service	0	0	326887.87	2.34	1292018.88	5.49
Mixed income, gross	0	0	5482848.93	39.18	1989327.4	8.46
Operating surplus, gross	0	0	1184929.97	8.47	2824988.07	12.01
Households (First decile)	0	0	145738.34	1.04	125783.06	0.53
Households (Second decile)	0	0	254632.02	1.82	184750.57	0.79
Households (Third decile)	0	0	335011.97	2.39	226676.98	0.96
Households (Fourth decile)	0	0	397796.30	2.84	264526.69	1.12
Households (Fifth decile)	0	0	446415.07	3.19	292937.47	1.26
Households (Sixth decile)	0	0	524795.03	3.75	341611.67	1.45
Households (Seventh decile)	0	0	635095.7	4.54	396977.41	1.69
Households (Eighth decile)	0	0	705844.15	5.04	459779.5	1.955
Households (Ninth decile)	0	0	893075.89	6.38	566156.19	2.41
Households (Tenth decile)	0	0	1759159.35	12.57	1020782.3	4.34
Companies	0	0	900321.19	6.43	2135197.675	9.08
Total	3352705.83	100	13992551.78	100	23512727.02	100

<sup>a</sup> Source: Research findings, (Unit: Million Million Rials-Percent).

**Table 5.** Third scenario: Net, open, and closed effects.

Sectors	Net effect	Percent	Open effect	Percent	Closed effect	Percent
Agriculture & horticulture	2377754.77	23.7	0	0	1601416.57	3.22
Animal husbandry	1154878.48	11.51	0	0	807766.28	1.62
Forestry	43219.14	0.43	0	0	16922.33	0.03
Fishing	6338.11	0.06	0	0	113711.33	0.23
Petroleum and natural gas	79042.55	0.79	0	0	175747.99	0.35
Other mines	34946.66	0.35	0	0	80181.85	0.16
Industry	3642013.41	36.31	0	0	8664379.14	17.42
Electricity, gas and water	502996.63	5.01	0	0	1458492.88	2.93
Building	46530.96	0.46	0	0	247016.07	0.5
Commerce, hotel and restaurant	970238.09	9.67	0	0	3751834.42	7.54
Transportation	578320.92	5.76	0	0	1317719.45	2.65
Services	594642.002	5.93	0	0	5863942.22	11.79
Compensation service	0	0	746215.52	2.5	2733413.29	5.49
Mixed income, gross	0	0	11518726.58	38.63	4208554.9	8.46
Operating surplus, gross	0	0	2641790.79	8.86	5976534.29	12.01
Households (First decile)	0	0	309996.58	1.04	266106.08	0.53
Households (Second decile)	0	0	539812.12	1.810582	390856.73	0.79
Households (Third decile)	0	0	709395.52	2.38	479555.42	0.96
Households (Fourth decile)	0	0	842124.72	2.82	559629.71	1.12
Households (Fifth decile)	0	0	944877.36	3.17	619735.09	1.25
Households (Sixth decile)	0	0	1110716.42	3.72	722709.46	1.45
Households (Seventh decile)	0	0	1343260.15	4.5	839840.13	1.69
Households (Eighth decile)	0	0	1493943.06	5.01	972703.84	1.95
Households (Ninth decile)	0	0	1889472.49	6.34	1197752.53	2.4
Households (Tenth decile)	0	0	3717427.99	12.47	2159549.99	4.34
Companies	0	0	2006526.72	6.73	4517216.24	9.08
Total	10030921.73	100	29814286.02	100	49743288.26	100

industries (8,664,379.14 million Rials), services (5,863,942.22 million Rials), trade, hotel and restaurant (3,751,834.42 million Rials) and agriculture and horticulture subsectors (1,601,416.57 million Rials) have had the maximum increase in production. In addition, among gross operating surplus factors, gross was increased as 5,976,534.29 million Rials, mixed income, gross as 4,208,554.9 million Rials, and compensation of services as 2,733,413.29 million Rials. Also, in equation to household income, the amount of increase in the tenth decile was 2,159,549.99 million Rials and the first decile was 266,106.08 million Rials. The total households' incomes and corporate accounts receipts increased by 8,208,438.99 and

4,517,216.241 million Rials. Also, the total economy revenue increased by 49,743,288.26 million Rials, indicating that the closed effect is much stronger than the direct effect.

## CONCLUSIONS

By applying the first, second, and third scenarios, the net effects of the production activity revenues in each of these scenarios increased up to 12,531,905.43, 3,352,705.83, and 10,030,921.73 million Rials, respectively. Also, consequent to the implementation of the first scenario of industries and agriculture, and as a result of

the implementation of the second and third scenarios, the sectors of industries and agriculture and horticulture showed the maximum increase in production. Therefore, the net effects of the above-mentioned scenarios in the industrials sector were more than the agricultural sector and its sub-sectors. In connection with the study of open effects, it can be said that the total income of the production factors increases as a result of the implementation of the first, second, and third scenarios up to 17,137,265.82, 6,994,666.77, and 14,906,732.89 million Rials. In addition, the total incomes of institutions through the implementation of these scenarios increase by 17,116,065.66, 6,997,885.013 and 14,907,553.13 million Rials, respectively. The total economy revenues in the mentioned scenarios are 34,253,331.48, 13,992,551.78 and 29,814,286.02 million Rials. Also, the study of the closed effects shows that due to the implementation of the first, second, and third scenarios, the revenue of the total economy is increased by 55,967,135.27, 23,512,727.02 and 49,743,288.26 million Rials. Thus, the closed effects are much stronger than the net effects. In addition, the results of the closed effects indicate that the sectors of industry, services, commerce and agriculture in the first scenario and the industries, services, commerce, agriculture, and horticulture sectors in the second and third scenarios show the maximum increase in production. Therefore, the closed effects of the aforementioned scenarios on the sectors of industry, services, and commerce were more than the agricultural sector itself and its sub-sectors. Thus, it can be said that the sectors of industry, services, and trade benefit from the agriculture sector and its sub-sectors, indicating a strong link between these sectors and the agricultural sector and its sub-sectors. Among the operating factors, gross operating surplus revenue has increased in all three scenarios more than other accounts. It should be noted that the total revenue of production factor in the first, second, and third scenarios increases by 14,518,079.39, 6,106,334.35 and 12,918,502.49 million Rials,

respectively. Also, the results of the closed effects of the above scenarios show that the total income of the institutions in the first, second, and third scenarios are increased up to, respectively, 14,301,474.63, 6,015,179.52, and 12,725,655.23 million Rials. Therefore, it is recommended that measures such as the use of improved factors and modern and suitable technologies be developed to increase the productivity of capital and labor in the agricultural sector. In addition, the government can play an effective role in controlling inflation and preventing price fluctuations in order to create confidence and motivation for investors to increase investment in the agricultural sector.

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## تجزیه و تحلیل آثار اقتصادی و اجتماعی سیاست توسعه سرمایه گذاری در بخش کشاورزی

پ. زند، ح. میرزایی، ح. محرابی، و ص. نبی‌بیان

### چکیده

سرمایه به عنوان موتور رشد و توسعه اقتصادی از ارکان بنیادین اقتصاد به شمار می‌رود. بسیاری از کشورهای در حال توسعه، برای رسیدن به توسعه اقتصادی می‌کوشند تا رشد اقتصادی مستمر خود را از طریق سرمایه گذاری تامین نمایند. سرمایه گذاری در بخش کشاورزی به لحاظ افزایش پیوسته تقاضا

برای مواد غذایی و دیگر محصولات کشاورزی، از اهمیت و جایگاه خاصی برخوردار است و می‌تواند منجر به رشد تولید و اشتغال در این بخش شود. افزون بر این، ارتباط پیشین و پسین بخش کشاورزی با دیگر بخش‌ها، به رشد تولید و اشتغال در آنها نیز کمک می‌کند. بر این اساس در مطالعه حاضر به تجزیه و تحلیل آثار سیاست رشد سرمایه‌گذاری در بخش کشاورزی بر اساس رهیافت ماتریس حسابداری اجتماعی ۱۳۹۰ پرداخته شده است. آثار ناشی از اعمال این سیاست (شامل اثرات خالص، باز و بسته) در قالب ۳ سناریو مورد تجزیه و تحلیل قرار گرفته است. نتایج ناشی از اثرات خالص نشان می‌دهد که دریافتی فعالیت‌های تولید در هر یک از سناریوهای مذکور افزایش می‌یابد. به علاوه در اثر اجرای سناریو اول بخش‌های صنایع و کشاورزی و در اثر اجرای سناریوهای دوم و سوم، بخش‌های صنایع و زراعت و باغبانی با حداکثر افزایش تولید مواجه شده‌اند. هم‌چنین بررسی اثرات باز نیز نشان‌دهنده افزایش درآمد عوامل تولید و نهادها ناشی از اعمال سیاست‌های فوق است. بررسی اثرات بسته نیز نشان داد که دریافتی کل اقتصاد ناشی از سناریوهای فوق افزایش می‌یابد به طوری که می‌توان گفت اثرات بسته بسیار شدیدتر از اثرات مستقیم هستند. هم‌چنین یافته‌ها نشان داد که اثرات بسته در سناریوهای فوق بر بخش‌های صنایع، خدمات و بازرگانی بیش از خود بخش کشاورزی و زیربخش‌های آن بوده است. که این مطلب نشان‌دهنده پیوند قوی بین بخش‌های مذکور و بخش کشاورزی و زیربخش‌های آن می‌باشد.