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SOURCES OF ECONOMIC GROWTH FROM DEMAND-SIDE

Merter Mert

Gazi University, Turkey
Email: mertermert@gazi.edu.tr

Abstract

Sources of economic growth can be explained both from supply-side and demand-side. Supply-side explanation, firstly, calculates contribution of input growth to output growth, and then remaining part of the output growth is admitted as growth rate of technology. Similarly, after calculating contributions of domestic demand and foreign demand, growth rate of technology which is motivated by domestic and foreign demand growth can be calculated. In this study, sources of growth from demand-side are calculated for China for 1972 and 2012. According to the results, growth is completely stemmed from domestic demand growth and technological progress, which is motivated by domestic demand. Since economic growth is motivated by domestic demand, then, macroeconomic policy should focus on domestic demand.

Keywords: Economic Growth, Sources of Growth, Domestic Demand, Foreign Demand

1. Introduction

The sources of economic growth can be explained both in terms of supply-side and demand-side. In the supply-side explanation, first, the contribution of the input growth to the output growth is calculated. The unexplained part of the output growth rate is called the growth rate of technology. It can be argued, however, that there are demand-side sources of economic growth. For example, Thirlwall (2002, p. 53) says: "In static macro theory, students are taught that national income (or output) is the sum of consumption expenditure, investment and exports, minus imports. In growth analysis, why not teach that national income growth is the weighted sum of the growth of consumption, investment and the balance between exports and imports, and proceed from there?"

The purpose of this study is to examine the demand-side sources of economic growth. For this purpose, the contributions of domestic and foreign demand growth to the output growth were first calculated for a sample country, and then the unexplained part of the rate of growth was called the rate of growth of technology. In this case, it is assumed that the rate of growth of technology is motivated by changes in demand.

The plan of the work is as follows: In the next section, the supply-side sources of growth are explained, and then how the demand-side sources of growth can be calculated is shown. In the following section, calculation results for a sample country are presented. The final section is the conclusion section.

2. Supply-Side Sources of Growth

Before describing the demand-side sources of the growth, it is necessary to show the supply-side explanation. The sources of economic growth are considered as approximate and fundamental sources in the literature. The approximate sources or determinants of economic growth are: i) input growth and ii) productivity growth. Szirmai (1993) expresses that input growth and productivity growth are the approximate sources of growth. In that case, the approximate sources of economic growth can also be called approximate determinants of growth. Growth accounting is carried out to identify the approximate sources or determinants of economic growth.

To apply growth accounting, the nature of technological progress can be considered as Harrod-neutral, Hicks-neutral and Solow-neutral. The production function in the case of labor-augmenting technological progress, that is, Harrod-neutral, can be written as:

$$Y = f(K, AL) \quad (1)$$

where Y is output, K is capital, L is labor and A is level of technology.

The output per labor is written as follows:

$$\frac{Y}{L} = f\left(\frac{K}{L}, A\right) \quad (2)$$

The production function is written in the Cobb-Douglas form under the assumption of constant return to scale:

$$Y = K^\alpha (AL)^{1-\alpha} \quad (3)$$

The output per labor is written as follows:

$$\frac{Y}{L} = \left(\frac{K}{L}\right)^\alpha A^{1-\alpha} \quad (4)$$

$$y = k^\alpha A^{1-\alpha} \quad (5)$$

If (5) is rewritten as rate of growth, then:

$$\frac{dy}{y} = \alpha \frac{dk}{k} + (1-\alpha) \frac{dA}{A} \quad (6)$$

The last equation gives the growth accounting equation when assuming Harrod-neutral technological progress.

In this case, while the nature of technological progress is Harrod-neutral, the sources of growth per labor are calculated as follows:

$$\alpha \frac{dk}{k} : \text{Contribution of per labor capital growth}$$

$$(1-\alpha) \frac{dA}{A} : \text{Contribution of growth rate of technology}$$

The production function in the case of Hicks-neutral technological progress is written as follows:

$$Y = f(AK, AL) \quad (7)$$

The output per labor is written as follows:

$$\frac{Y}{L} = f\left(\frac{AK}{L}, A\right) \quad (8)$$

The production function is written in the Cobb-Douglas form under the assumption of constant return to scale:

$$Y = (AK)^\alpha (AL)^{1-\alpha} \quad (9)$$

The output per labor is written as follows:

$$\frac{Y}{L} = \left(\frac{K}{L}\right)^\alpha A \quad (10)$$

$$y = k^\alpha A \quad (11)$$

If (11) is rewritten as rate of growth, then:

$$\frac{dy}{y} = \alpha \frac{dk}{k} + \frac{dA}{A} \quad (12)$$

The last equation gives the growth-accounting equation when Hicks-neutral technological progress is assumed.

In this case, while the nature of technological progress is Hicks-neutral, the sources of growth per labor are calculated as follows:

$$\alpha \frac{dk}{k} : \text{Contribution of per labor capital growth}$$

$$\frac{dA}{A} : \text{Contribution of growth rate of technology}$$

Solow (1957) expanded his own growth model in his work by assuming the nature of technological progress is Hicks-neutral. For this reason, the contribution of the Hicks-neutral technological progress is also called Solow residual. Solow residual is the part of output growth that cannot be explained by input growth. In addition, Solow residual is the rate of growth of technology in the short term. According to Abramovitz (1956), the growth rate of technological progress is the measure of ignorance.

To apply growth accounting, the nature of technological progress can also be considered as capital-augmenting; i. e. Solow-neutral

$$Y = f(AK, L) \quad (13)$$

The output per labor is written as follows:

$$\frac{Y}{L} = f\left(\frac{AK}{L}\right) \quad (14)$$

The production function is written in the Cobb-Douglas form under the assumption of constant return to scale:

$$Y = (AK)^\alpha L^{1-\alpha} \quad (15)$$

The output per labor is written as follows:

$$\frac{Y}{L} = \left(\frac{K}{L}\right)^\alpha A^\alpha \quad (16)$$

$$y = k^\alpha A^\alpha \quad (17)$$

If (17) is rewritten as rate of growth, then:

$$\frac{dy}{y} = \alpha \frac{dk}{k} + \alpha \frac{dA}{A} \quad (18)$$

The last equation gives the growth-accounting equation when Solow-neutral technological progress is assumed.

In this case, while the nature of technological progress is Solow-neutral, the sources of growth are calculated as follows:

$$\alpha \frac{dk}{k} : \text{Contribution of per labor capital growth}$$

$$\alpha \frac{dA}{A} : \text{Contribution of growth rate of technology}$$

The main determinants of economic growth are, according to Rodrik (2002), geography, integration and institutions. Rodrik (2002) named these three elements as fundamental determinants of growth (deep determinants of growth). Geography includes the disadvantages or advantages of the climate, the location, the physical structure of the country, etc. Integration includes the disadvantages or advantages of economic relations with other countries. Finally, institutions are the disadvantages or advantages of causes provided by the characteristics of socio-economic regulations. Thus, the fundamental determinants of growth are: geography, integration, and institutions. These affect the rate of growth of approximate determinants, which leads to a high productivity or low productivity.

Before Rodrik (2002), Szirmai (1993) described the ultimate sources of growth. According to Szirmai (1993), the ultimate sources of growth are the elements underlying factor accumulation and technological change. In other words, the ultimate sources of growth are the elements underlying the approximate sources of growth. According to North (1993), ultimate source of growth is the investment in society's knowledge and skills. According to North (1993), the existence and design of institutions that will encourage individuals to invest in knowledge is necessary. Here, an important issue in the discussion of the ultimate sources or fundamental determinants of the growth is to determine what the underlying elements of the sources of growth are, and to design them to increase productivity.

3. Demand-Side Sources of Growth

To explain the demand-side sources of growth, the gross domestic product is first defined as:

$$Y(t) = C(t) + I(t) + G(t) + X(t) - M(t) \quad (19)$$

where $C(t) + I(t) + G(t)$ is domestic demand and $X(t) - M(t)$ is net foreign demand. $C(t)$, $I(t)$ and $G(t)$ are consumption, investment and government expenditures, respectively. $X(t)$ and $M(t)$ are export and import, respectively.

Domestic demand and foreign demand, respectively, are written as follows:

$$D(t) = C(t) + I(t) + G(t) \quad (20)$$

$$F(t) = X(t) - M(t) \quad (21)$$

Thus, (19) is rewritten:

$$Y(t) = D(t) + F(t) \quad (22)$$

Assume that the output can be written such as a function below:

$$Y(t) = D(t)^x \cdot F(t)^y \quad (23)$$

Here, the x and y parameters indicate the elasticity of the output with respect to domestic demand and the elasticity of the output with respect to the foreign demand, respectively.

Using, (22) and (23), (24) can be written:

$$D(t) + F(t) = D(t)^x \cdot F(t)^y \quad (24)$$

To leave x alone:

$$(D(t) + F(t)) / (F(t)^y) = D(t)^x \quad (25)$$

$$\ln((D(t) + F(t)) / (F(t)^y)) / \ln D(t) = x \quad (26)$$

In that case, if the value of y is determined, the value of x is calculated.

Similarly:

$$(D(t) + F(t)) / (D(t)^x) = F(t)^y \quad (27)$$

$$\ln((D(t) + F(t)) / (D(t)^x)) / \ln F(t) = y \quad (28)$$

In that case, if the value of x is determined, the value of y can also be calculated. On the other hand, if net foreign demand is negative, the calculation cannot be made. For this reason, in the years when net foreign demand is negative, net foreign demand should be taken as an absolute value.

Note that econometric estimation cannot be made in order to determine the value of x ; because the sum of D and F already will equal to Y . On the other hand, the followings can be applied when determining the value of x :

Recognize that $Y(t) = D(t) + F(t)$.

Taking the first order difference:

$$\Delta Y(t) = \Delta D(t) + \Delta F(t) \quad (29)$$

Both sides are first divided by $Y(t-1)$, then by $\Delta D(t) / D(t-1)$

$$\frac{(\Delta Y(t) / Y(t-1)) / (\Delta D(t) / D(t-1))}{(\Delta D(t) / Y(t-1)) / (\Delta D(t) / D(t-1)) + (\Delta F(t) / Y(t-1)) / (\Delta D(t) / D(t-1))} = \quad (30)$$

Rearranged:

$$\frac{(\Delta Y(t) / Y(t-1)) / (\Delta D(t) / D(t-1))}{(D(t-1) / Y(t-1)) + (\Delta F(t) / Y(t-1)) / (\Delta D(t) / D(t-1))} = \quad (31)$$

$$\frac{(\Delta Y(t) / Y(t-1)) / (\Delta D(t) / D(t-1))}{(D(t-1) / Y(t-1)) + (\Delta F(t) / F(t-1)) / (\Delta D(t) / D(t-1))} \cdot (F(t-1) / Y(t-1)) = \quad (32)$$

(32) gives the elasticity of Y with respect to D . In order to make correct calculations, the elasticity obtained from (26) should be justified by (32).

Similarly, in order to determine y , both sides of $\Delta Y(t) = \Delta D(t) + \Delta F(t)$ is first divided by $Y(t-1)$, and then $\Delta F(t) / F(t-1)$.

$$\frac{(\Delta Y(t) / Y(t-1)) / (\Delta F(t) / F(t-1))}{(\Delta D(t) / Y(t-1)) / (\Delta F(t) / F(t-1)) + (\Delta F(t) / Y(t-1)) / (\Delta F(t) / F(t-1))} = \quad (33)$$

Rearranged:

$$\frac{(\Delta Y(t) / Y(t-1)) / (\Delta F(t) / F(t-1))}{(F(t-1) / Y(t-1)) + (\Delta D(t) / Y(t-1)) / (\Delta F(t) / F(t-1))} = \quad (34)$$

$$\frac{(\Delta Y(t) / Y(t-1)) / (\Delta F(t) / F(t-1))}{(F(t-1) / Y(t-1)) + (\Delta D(t) / D(t-1)) / (\Delta F(t) / F(t-1))} \cdot (D(t-1) / Y(t-1)) = \quad (35)$$

(35) gives the elasticity of Y with respect to F . In order to make correct calculations, the elasticity obtained from (35) should be equal to the elasticity obtained from (28). (23) can be rewritten to compute the demand-side sources of the growth:

$$Y(t) = D(t)^x \cdot F(t)^y \quad (23)$$

Here, the x and y parameters indicate the elasticity of the output with respect to domestic demand and the elasticity of the output with respect to the foreign demand, respectively. (23) is rewritten in terms of growth rate:

$$\frac{(dY(t) / dt) \cdot (1 / Y(t))}{x \cdot (dD(t) / dt) \cdot (1 / D(t)) + y \cdot (dF(t) / dt) \cdot (1 / F(t))} = \quad (36)$$

In this last equation, the contribution of domestic demand growth is expressed as follows:

$$x \cdot (dD(t) / dt) \cdot (1 / D(t)) \quad (37)$$

The contribution of foreign demand growth is expressed as follows:

$$y \cdot (dF(t) / dt) \cdot (1 / F(t)) \quad (38)$$

If domestic and foreign demand growth cannot explain the growth of the output, in other words, if

$$x \cdot (dD(t) / dt) \cdot (1 / D(t)) + y \cdot (dF(t) / dt) \cdot (1 / F(t))$$

and

$$(dY(t) / dt) \cdot (1 / Y(t))$$

are not equal each other, it can be argued that the difference arises from the technological progress that is motivated from changes in demand.

As will be recalled, in the supply-side explanation, the part of the output growth that cannot be explained by the input growth is called the Solow residual. Solow residual can also be expressed as the total factor productivity growth. Similarly, in demand-side explanation, the unexplained part of output growth can also be called as the rate of growth of technology. In this case, it should be assumed that demand growth is motivating productivity growth or technological progress.

This, equation (5) should be rewritten.

$$Y(t) = A(t)^x \cdot D(t)^x \cdot A(t)^y \cdot F(t)^y \quad (39)$$

Here $A(t)$ shows the level of technology. (39) can be rewritten:

$$\begin{aligned} (dY(t) / dt) \cdot (1 / Y(t)) = \\ x \cdot (dA(t) / dt) \cdot (1 / A(t)) + y \cdot (dA(t) / dt) \cdot (1 / A(t)) + \\ x \cdot (dD(t) / dt) \cdot (1 / D(t)) + y \cdot (dF(t) / dt) \cdot (1 / F(t)) \end{aligned} \quad (40)$$

In this last equation, the contribution of technological progress is expressed as follows:

$$x \cdot (dA(t) / dt) \cdot (1 / A(t)) + y \cdot (dA(t) / dt) \cdot (1 / A(t)) \quad (41)$$

In this equation

$$x \cdot (dA(t) / dt) \cdot (1 / A(t))$$

is assumed as the technological progress motivated by domestic demand growth, and

$$y \cdot (dA(t) / dt) \cdot (1 / A(t))$$

can be considered as the technological progress motivated by foreign demand growth.

The equations given since (23) should then be rewritten to include the level of technology, $A(t)$. Assume that following function can be written:

$$Y(t) = A(t)^x \cdot D(t)^x \cdot A(t)^y \cdot F(t)^y \quad (42)$$

Here, the x and y parameters indicate the elasticity of the output with respect to domestic demand and foreign demand, respectively.

Using (22) and (42), (43) can be rewritten:

$$D(t) + F(t) = A(t)^x \cdot D(t)^x \cdot A(t)^y \cdot F(t)^y \quad (43)$$

Leaving x alone:

$$(D(t) + F(t)) / (A(t)^y \cdot F(t)^y) = A(t)^x \cdot D(t)^x \quad (44)$$

$$\ln((D(t) + F(t)) / (A(t)^y \cdot F(t)^y)) / \ln(A(t)D(t)) = x \quad (45)$$

In that case, if the value of y is determined, the value of x can be calculated. Similarly, the followings are obtained:

$$(D(t) + F(t)) / (A(t)^x \cdot D(t)^x) = A(t)^y \cdot F(t)^y \quad (46)$$

$$\ln((D(t) + F(t)) / (A(t)^x \cdot D(t)^x)) / \ln(A(t) \cdot F(t)) = y \quad (47)$$

In that case, if the value of x is determined, the value of y can also be calculated. Note that the calculation cannot be made if net foreign demand is negative. For this reason, in the years when net foreign demand is negative, net foreign demand should be taken as an absolute value. Furthermore, econometric estimates cannot be made because the sum of D and F already yields Y . Finally, since (17) gives the elasticity of Y with respect to F , the calculations obtained from (35) should be confirmed with (47).

On the other hand, since $A(t)$ in (47) is not known, then, first it is assumed that $A(t) = 1$. If domestic and foreign demand growth cannot explain output growth, in other words if

$$x \cdot (dD(t) / dt) \cdot (1 / D(t)) + y \cdot (dF(t) / dt) \cdot (1 / F(t))$$

and

$$(dY(t) / dt) \cdot (1 / Y(t))$$

are not equal to each other, then, it is assumed that $A(t)$ is not equal to zero. It is assumed that the difference is due to the technological progress, which is motivated by changes in demand.

So the difference between the $x \cdot (dD(t) / dt) \cdot (1 / D(t)) + y \cdot (dF(t) / dt) \cdot (1 / F(t))$ and $(dY(t) / dt) \cdot (1 / Y(t))$ is equal to the residual:

$$\begin{aligned} & (dY(t) / dt) \cdot (1 / Y(t)) \\ & - x \cdot (dD(t) / dt) \cdot (1 / D(t)) - y \cdot (dF(t) / dt) \cdot (1 / F(t)) = \\ & x \cdot (dA(t) / dt) \cdot (1 / A(t)) + y \cdot (dA(t) / dt) \cdot (1 / A(t)) \end{aligned} \quad (48)$$

In this study, it is assumed that

$$x \cdot (dA(t) / dt)$$

is the technological progress motivated by domestic demand growth,

$$y \cdot (dA(t) / dt) \cdot (1 / A(t))$$

is the technological progress motivated by foreign demand growth.

4. Calculation Results

The following Tables show the calculation results. China has been taken as a sample country. The calculation results for the years 1972 and 2012 of China are presented. The reason for the selection of years 1972 and 2012 is that the results of positive net foreign demand elasticities are valid for the year 1972 at the earliest and for the year 2012 at the latest. The data source is the UNCTAD.

The calculation results are presented in Table 1 and Table 2. The growth rate of China in 1972 was 3.8%. The domestic demand elasticity of output in the same year is close to 1, while the foreign demand elasticity of output is about 0.02 (see Table 1).

$0.0160 / 0.0380 = 42\%$ of the growth rate is explained by domestic demand growth and $-0.0043 / 0.0380 = -11\%$ is explained by net foreign demand growth (see Table 2). Only 68% of the growth occurred due to the technological progress stemming from domestic demand growth, while only 1% was due to technological progress resulting from foreign demand growth.

In 2012, the growth rate in China was 7.70%. The domestic demand elasticity of output in the same year was 0.8439, while the net foreign demand elasticity of output was about 0.2062 (see Table 1). While $0.0706 / 0.0770 = 92\%$ of the growth rate is explained by domestic demand growth, $-0.0144 / 0.0770 = -19\%$ is explained by the growth of net foreign demand

(see Table 2). Only 22% of the growth occurred due to technological progress resulting from domestic demand growth, while only 5% emerged due to the technological progress, which is motivated by foreign demand growth.

Table 1. Rate of Economic Growth and Domestic and Net Foreign Demand Elasticity of Output in 1972 and 2012 in China

	Output growth rate	Elasticity of output with respect to domestic demand	Domestic demand growth rate	Elasticity of output with respect to foreign demand	Net foreign demand growth rate
1972	0.0380	0.9914	0.0161	0.0196	-0.2206
2012	0.0770	0.8439	0.0837	0.2062	-0.0700

Source: UNCTADstat (2016)

Table 2. Demand-side sources of growth in China in 1972 and 2012

	Output growth rate	Contribution of domestic demand growth	Contribution of net foreign demand growth	Contribution of technological progress motivated by domestic demand growth	Contribution of technological progress motivated by net foreign demand growth
1972	0.0380	0.0160	-0.0043	0.0258	0.0005
2012	0.0770	0.0706	-0.0144	0.0167	0.0041

Source: UNCTADstat (2016)

In Figures 1 and 2, the calculation results for China are presented as percentage contributions. According to both figures, almost all of China's growth in 1972 and 2012 stemmed from domestic demand growth and the technological progress, which is motivated by domestic demand growth.

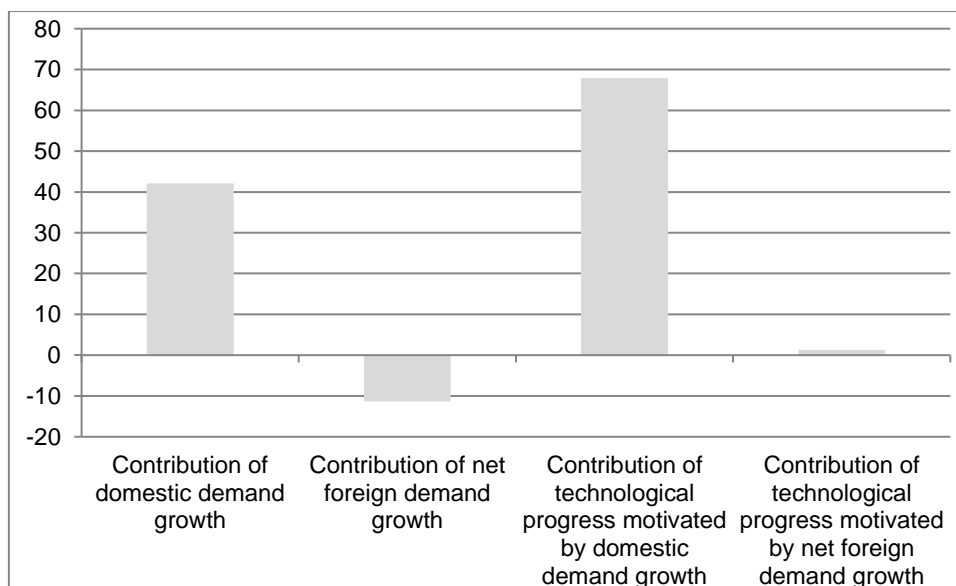


Figure 1. Demand-side sources of growth in China in 1972 (percentage contributions)

Source: UNCTADstat (2016)

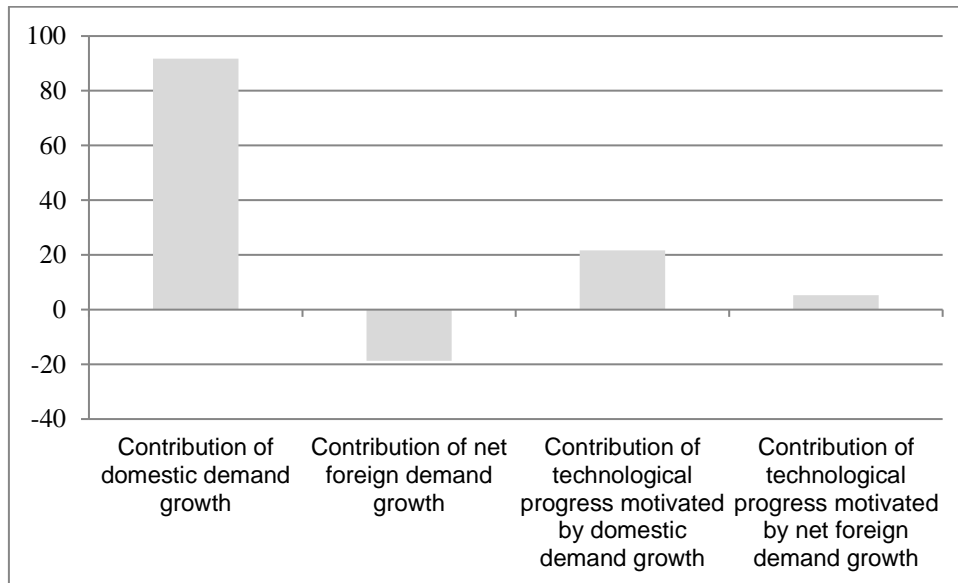


Figure 2. Demand-side sources of growth in China in 2012 (percentage contributions)
 Source: UNCTADstat (2016)

5. Conclusion

It is clear that economic growth will stem from inputs. On the other hand, it can be argued that the motivating element of economic growth is demand. In this sense, it must be investigated whether the demand-side sources of economic growth are motivated by domestic demand or foreign demand. Similar to the supply-side explanation, the contributions to the output growth of the domestic and foreign demand growth were first calculated and then the unexplained part of the growth was considered as the rate of technological progress. It has been accepted that the rate of growth of technological progress is motivated by changes in demand. In the study, after explaining how the demand-side sources of growth could be calculated, sample calculations were made for China for 1972 and 2012. According to the results, almost all of the growth in China in 1972 and 2012 stemmed from domestic demand growth and the technological progress motivated by domestic demand growth. This result implies that macroeconomic policy should focus on the domestic demand since economic growth is mainly based on domestic demand.

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