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The Effect of Imports of Intermediate and Capital Goods


Abstract

This study aims at investigating the effect of imports of intermediate and capital goods on economic growth in Jordan during the period 1980-2003.

A four variables cointegration analysis with the variables: Gross domestic product, Imports of capital and intermediate goods, capital, and labor are exploited.

Two unit root tests: Dickey-Fuller test and Philips Perron test were used to examine the integration order of the variables. Furthermore, Johanson Cointegration test is also used. In addition, and in order to affirm the results the dynamic relationships among the variables are illustrated by applying Variance Decomposition and the Impulse Responses.

The results of the study were found to be consistent with the results of many studies about the same topic in the sense that the imports of capital and intermediate goods have a positive impact on economic growth through transferring of technology acquired of such imports.
**Introduction**

Foreign trade plays an important role in economies of all countries. This role manifests through obtaining foreign bills devoted for financing the imports of capital and intermediate goods used in the industrialization process in developing countries.

The imports of capital and intermediate goods play a role in technology adoption measured by productivity gains, which could in its turn, promote economic growth.

In Jordan, the economy is characterized as vulnerable because foreign trade \(^{(1)}\) composes a high proportion of its gross domestic product. This proportion amounted to 71% in 1980, 88% in 1990, 72% in 2000 and 78% in 2002.

The amounts of exports and imports for the period of this study (1980-2003) are shown in appendix (1). As it seems in the appendix, the imports are much higher than exports. For the same years mentioned just above the imports are approximately two times higher than the exports.

Regarding the imports of capital and intermediate goods in Jordan these imports accounted in average for about half of total imports during the period of the study, i.e.48% in 1980, 44% in 1985, 51% in 1990, 58% in 1995, 54% in 2000 and 58% in 2001

It is known that the imports are deducted from exports when measuring national output by using the expenditures approach because imports are considered as a leakage from the national output.

This principle may be completely accepted for the imported consumption goods, but what about the imports of capital and intermediate goods.

We assume the existence of a positive effect of these imports on the economic growth, hence; this is the objective of this study, which in other words is, to investigate the

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\(^{(1)}\) National exports + imports

\(^{*}\) These shares are low compared to some New Industrialized Countries (NIC). In South Korea for example, these imports accounted for 90% of total imports in 1998.
effect of the imports of capital and intermediate goods on economic growth in Jordan over the period 1980-2003. The main hypothesis is that the imports of capital and intermediate goods have a positive effect on economic growth in Jordan.
**Economic Literature and Previous Studies:**

Most of previous studies deal with the impact of foreign trade and liberalization of foreign trade on the economic growth, whereas the empirical studies about the impact of imports of capital and intermediate goods on economic growth are limited.

Blalock and Veloso (2004) using a detailed panel of Indonesian manufacturers have presented evidence that importing is a driver of international technology transfer; their analysis shows that factory output increases approximately by 12% as the proportion of downstream imported materials rises by 1%.

Worz (2004), in her study about foreign trade and economic growth concludes that, on the import side, spillovers via embodied knowledge and other assets are put forward in favor of a positive impact for growth.

Ferrira & Rossi (2003), have presented evidence on the positive effect of international trade on productivity and economic growth in Brazil. The econometric results of their study show that the impact of the observed tariff reduction brought a 6% estimated increase in total factor productivity growth rate and a similar impact on labor productivity.

Diao, Rattso and Stokke (2002) in their study about Thailand, stated that the foreign technology spillover embodied in trade is assumed to be the driving force of the productivity growth, consistent with available econometric evidence.

Shotar, Hmaidate, and Moumani (2002) in their study entitled "Imports of Intermediate Goods and Growth in Manufacturing Industries: an Empirical Investigation", concluded that imports of intermediate goods have a significant positive impact on the growth and development of the manufacturing industries, and it would not be in Jordan's best interest to completely stop importing intermediate goods.
Hmaidate & Hazaymih (1995) in their study about the impact of foreign trade on the manufacturing sector in Jordan concluded that growth rates of gross output in the manufacturing industries are positively affected by the growth of imports of capital and intermediate goods. Their study shows that an increase by 5.89% in the imported goods results in an increase in the growth rate of the manufacturing industries by 1%.

Esfahani (1991) in his study on (31) semi-industrialized countries added the imports to the inputs of domestic output in order to measure the effect of imports of intermediate and capital goods on the economic growth. He indicated that minimizing imports compression will result in an expansion of the output and consequently of the exports that contribute in its turn, on financing the imports and finally contributing positively on the rates of economic growth.

Khan & Knight (1988) in their econometric study on (34) developing countries conclude that imports compression by (10%) will produce a decline in exports by (2%) in the short run and by (5%) in the long run. They argue that this negative impact on the exports will lead, in its turn, to a decrease in imports and finally a negative impact on the process of economic development.

Alsefo & Hamadi (1988) in their study about Iraq considered the imports of intermediate and capital goods as important and essential element in the development of manufacturers. By using a simple econometric model, they concluded that these imports have a positive effect on the manufacturers’ product.
Methodology and Data:

First of all, it seems convenient to indicate that the empirical work about this topic is very limited, particularly in Jordan, where imports account for a very high proportion of its GDP. The imports of capital and intermediate goods constitute about the half of total imports as mentioned above.

In the national income accounts, imports are deducted from exports when measuring GDP as follows:

\[ \text{GDP} = \text{C} + \text{I} + \text{G} + (\text{EX} - \text{IM}) \] \[ (1) \]

where,

GDP = Gross Domestic Product.
C = Private Consumption.
G = Government Expenditures
EX = Exports.
IM = Imports.
I = Gross Domestic Private Investment.

But the hypothesis of this study attributes a positive effect of the imports of capital and intermediate goods on the economic growth proxied by the GDP.

For investigating this effect four main variables have been used:

1-Real Gross Domestic Product (RGDP): The real GDP amounted to JD2682.5 million in 1980, increased to JD3001.5 million in 1990, toJD4776.0 million in 2000 and to5260.3 million in 2003 (base year: 1992). The average annual growth rate is estimated to be 2.93% for the period of study.

2-For the purpose of this study, the real imports of capital and intermediate good are added to the real GDP ( or not deducted from exports ),in order to test their effect on the GDP in the economic analysis.
3-The real imports of intermediate and capital goods are defined by the Department of General Statistics in Jordan, as: crude materials and intermediate goods plus capital goods. These imports (R1) amounted to JD1076.9 million in 1980 and have increased to JD1409.0 million in 1990, to JD1755.4 million in 2000 and reached to JD 2117.8 million in 2003. The average annual growth rate is estimated to be 4.3%. This rate is higher than the growth rate of the GDP.

4- The labor force proxied by the annual real amounts of the compensation of employees in Jordan during the period covered by the study. These compensations ranged between JD950.2 million in 1980 and JD2125.3 in 2003 in real prices of 1992. The average annual growth rate is 3.5%

5-The real capital: the capital was estimated during the period 1980-2003 by using the Incremental Capital Output Ratio (ICOR) method which was used before by several researchers. (Hammad, 1986, Talafhah, 1986, and Hmaidat & Hazaymih, 1995).

The following equation was used in this method:

\[
\text{ICOR} = \frac{\sum_{t=1980}^{t=2003} N_t}{R_{\text{GDP}}^{2003}-R_{\text{GDP}}^{1980}}
\]  

Where:

\textbf{ICOR} = \text{Capital Output Ratio}

\textbf{N_t} = \text{Real Net Capital Formation per year}

\textbf{RGDP} = \text{Real Gross Domestic Product}

By using this equation, this ratio for the period 1980-2003 is found to be:
\[
\sum_{t=1980}^{t=2003} N_{It} = \frac{16142.1}{5260.3 - 2682.5} = 6.26^{**}
\]

\[ RGDP_{2003} - RGDP_{1980} \]

And for the rest of the period the capital is estimated by adding the real \( N_{It} \) in a given year to the capital of the previous year.

The main sources of the data exploited in this study were the department of statistics and the monthly statistical bulletins issued by the Central Bank of Jordan.

Concerning the methodology adopted in this study it is based on an econometric analysis assuming the following model:

\[
\text{Log } RGDPI = C_0 + C_1 \text{Log } RCOE + C_2 \text{Log } RK + C_3 \text{Log } RI + \mu .
\]

Where all variables in log form, and:

- \( RGDPI \): Real Gross Domestic Product + Real imports of capital and intermediate goods.
- \( RCOE \): Real Compensation Of Employees.
- \( RK \): Real Capital.
- \( RI \): Real Imports of Capital and Intermediate Goods.
- \( \mu \): measures the random error term.

\( C_0, C_1, C_2 \text{ and } C_3 \): are the parameters to be estimated.

The researcher has employed the time series analysis; the cointegration analysis in particular.

\[ ** \text{Example: the capital in 1980} = 6.26 \times \text{Real GDP} = 6.26 \times 2682.5 = \text{JOD 16899} \]
The Empirical Results

First: the integration order of the variables

The integration order of the variables determines the appropriate approach of estimation. If all the variables are integrated of the same order it is possible for these variables to be cointegrated and, the Ordinary Least Squares (OLS) approach can be applied. Otherwise, the results of the OLS could be misleading and other approaches of estimation should be considered.

To determine the order of integration of the variables and for comparison purposes, the researcher has conducted two tests:

(I) Augmented Dickey Fuller (ADF) Test:

which examines the hypothesis $p=0$ versus the Hypothesis $p<0$ in the following formula:

$$\Delta Y_t = \mu + p Y_{t-1} + a_i \sum_{i=1}^{M} \Delta Y_{t-i} + \epsilon_t \quad \text{---------}(3)$$

In this test the lagged difference terms are considered where their number is normally chosen empirically, i.e. enough terms could be included for obtaining a serially independent error term in the equation (3).

The results of this test are displayed in table (1) below:
### Table (1): Augmented Dickey-Fuller Test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Calculated value</th>
<th>1% critical value</th>
<th>5% critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(RGDPI)</td>
<td>0.07</td>
<td>-3.77</td>
<td>-3.00</td>
</tr>
<tr>
<td>D(log(RGDPI))</td>
<td>-3.40</td>
<td>-3.79</td>
<td>-3.01</td>
</tr>
<tr>
<td>D(log(RGDPI),2)</td>
<td>-5.03</td>
<td>-3.81</td>
<td>-3.02</td>
</tr>
<tr>
<td>log(RCOE)</td>
<td>-0.72</td>
<td>-3.77</td>
<td>-3.00</td>
</tr>
<tr>
<td>D(log(RCOE))</td>
<td>-3.23</td>
<td>-3.79</td>
<td>-3.01</td>
</tr>
<tr>
<td>D(log(RCOE),2)</td>
<td>-3.56</td>
<td>-3.81</td>
<td>-3.02</td>
</tr>
<tr>
<td>Log(RK)</td>
<td>-1.51</td>
<td>-3.77</td>
<td>-3.00</td>
</tr>
<tr>
<td>D (log(RK))</td>
<td>-2.97</td>
<td>-3.79</td>
<td>-3.01</td>
</tr>
<tr>
<td>D (log(RK),2)</td>
<td>-2.92</td>
<td>-3.81</td>
<td>-3.01</td>
</tr>
<tr>
<td>Log(RI)</td>
<td>-0.81</td>
<td>-3.77</td>
<td>-3.00</td>
</tr>
<tr>
<td>D(log(RI))</td>
<td>-3.41</td>
<td>-3.79</td>
<td>-3.01</td>
</tr>
<tr>
<td>D(log(RI),2)</td>
<td>-6.39</td>
<td>-3.81</td>
<td>-3.01</td>
</tr>
</tbody>
</table>

**Notes:**
- D (log X): the first difference of the variable (log X).
- D (logX,2): the second difference of the variable (log X).

These results indicate that log (RI) is integrated of order (1), i.e. I (1) considering the calculated value (in absolute value) is higher than the critical value (in absolute number) at 5% significance level. By the same token, log (RGDPI) is I (1), and log (RCOE) is I(1) at 5% level of significance also. Nevertheless log(RK) seems to be higher than I(2).

(2). Philips-Perron unit root test:

This test examines essentially the hypothesis p=1 in the formula:

\[ \Delta Y_t = \mu + p Y_{t-1} + \varepsilon_t \quad \text{----------(4)} \]
The least squares method is utilized to estimate formula (4) and after that the t-statistic of(p) coefficient is corrected for autocorrelation in $\varepsilon_t$.

The results of this test are shown in the following table (2):

<table>
<thead>
<tr>
<th>variable</th>
<th>Calculated value</th>
<th>1% critical value</th>
<th>5% critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(RGDPI)</td>
<td>-1.06</td>
<td>-3.75</td>
<td>-3.00</td>
</tr>
<tr>
<td>D(log(RGDPI))</td>
<td>-5.28</td>
<td>-3.77</td>
<td>-3.00</td>
</tr>
<tr>
<td>D(log(RGDPI),2)</td>
<td>-8.52</td>
<td>-3.79</td>
<td>-3.01</td>
</tr>
<tr>
<td>log(RCOE)</td>
<td>-1.18</td>
<td>-3.75</td>
<td>-3.00</td>
</tr>
<tr>
<td>D(log(RCOE))</td>
<td>-2.96</td>
<td>-3.77</td>
<td>-3.00</td>
</tr>
<tr>
<td>D(log(RCOE),2)</td>
<td>-4.37</td>
<td>-3.79</td>
<td>-3.01</td>
</tr>
<tr>
<td>log(RK)</td>
<td>-2.80</td>
<td>-3.75</td>
<td>-3.00</td>
</tr>
<tr>
<td>D (log(RK))</td>
<td>-1.71</td>
<td>-3.77</td>
<td>-3.00</td>
</tr>
<tr>
<td>D (log(RK),2)</td>
<td>-5.68</td>
<td>-3.79</td>
<td>-3.01</td>
</tr>
<tr>
<td>log(RI)</td>
<td>-1.39</td>
<td>-3.75</td>
<td>-3.00</td>
</tr>
<tr>
<td>D(log(RI))</td>
<td>-5.47</td>
<td>-3.77</td>
<td>-3.00</td>
</tr>
<tr>
<td>D(log(RI),2)</td>
<td>-10.33</td>
<td>-3.79</td>
<td>-3.01</td>
</tr>
</tbody>
</table>

Notes: D (log X): the first difference of the variable (log X).

D (log X,2): the second difference of the variable (log X).

These results indicate that log (RI) is integrated of order (1), i.e. I (1) because the calculated value (in absolute value) is higher than the critical value (in absolutevalue) at 1% and 5% significance levels. By the same token, log (RGDPI) is I(1), log (RCOE) is I (2), and log (RK) is I (2).
Even though the results of the two tests are not completely identical; the essential aim is that all the results confirm that all the variables are integrated to different orders, which enables the researcher to conclude that the utilization of the OLS method isn't the appropriate method, therefore other approaches of estimation should be utilized. So the cointegration analysis is adopted in this study.

**Second: The Co integration Analysis:**

This analysis aims to verify whether the four variables are cointegrated, i.e., if a linear combination of these variables is stationary. If yes, the regression on the levels of the variables would be significant and any important long-run information will not be missed (Gujarati, 1995, p.726).

An important and empirical test for cointegration is Johanson Cointegration Test. For this test the assumption is linear deterministic trend in the data. The application of this test has produced the results displayed in table (3) below:

**Table (3): Johanson Cointegration Test**

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Likelihood Ratio</th>
<th>5 Percent Critical Value</th>
<th>1 Percent Critical Value</th>
<th>Hypothesized No. of CE(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.767991</td>
<td>59.33753</td>
<td>47.21</td>
<td>54.46</td>
<td>None**</td>
</tr>
<tr>
<td>0.558587</td>
<td>27.19599</td>
<td>29.68</td>
<td>35.65</td>
<td>At most 1</td>
</tr>
<tr>
<td>0.199203</td>
<td>9.204959</td>
<td>15.41</td>
<td>20.04</td>
<td>At most 2</td>
</tr>
<tr>
<td>0.178201</td>
<td>4.317715</td>
<td>3.76</td>
<td>6.65</td>
<td>At most 3*</td>
</tr>
</tbody>
</table>

*(**)denotes rejection of the hypothesis at 5% (1%) significance level
L.R. test indicates 1 cointegrating equation(s) at 5% significance level

As it appears in the table above, the results indicate the rejection of the null hypothesis of no cointegration at 5% (1%) significance level and the likelihood ratio (L.R) test confirms the
existence of one cointegrating equation at 5% significance level. Referring to these results, the researcher could use the variables in their levels; so any order of differencing will not be used.

Therefore, the cointegration equation resulted from this test could be stated as follows:

\[
\text{Log (RGDPI)} = 3.31 + 0.78 \text{ log (RCOE)} - 0.26 \text{ log (RK)} + 0.31 \text{log (RI)} \quad \text{(5)}
\]

Equation (5) provides the equilibrium relationship between the variables and indicates a positive effect of the imports of capital and intermediate goods log (RI) on the domestic output (RGDPI) where the result is strongly significant. Likewise, the effect of the labor force on GDP is positive and strongly significant. On the other hand, the effect of the capital proxied by log (RK) on GDP is negative and significant. The last result is not compatible with the economic theory which can be explained by the fact that the effect of investment in capital on the GDP does not appear immediately and takes more time from one side and this investment is mainly implemented in the construction and building sector in Jordan, from the other side.

**Third: Variance Decomposition:**

For the purpose of obtaining more solid results, the researcher has attempted to investigate the dynamic short-term relationship among the variables through decomposing the variance of log(RGDPI) from one hand, and finding the impulse responses of log(RGDPI) to shocks to log(RI), log(RCOE) and log(RK) from the other hand. The results of decomposing the variance of log (RGDPI) are shown in table (4).
Table (4); Variance Decomposition of log (RGDPI)

<table>
<thead>
<tr>
<th>Period</th>
<th>LOG(RGDPI)</th>
<th>LOG(RCOE)</th>
<th>LOG(RK)</th>
<th>LOG(RI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100.0000</td>
<td>0.0000000</td>
<td>0.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>4</td>
<td>82.31381</td>
<td>12.10642</td>
<td>1.574396</td>
<td>4.005370</td>
</tr>
<tr>
<td>7</td>
<td>59.72238</td>
<td>24.57839</td>
<td>9.650924</td>
<td>6.048309</td>
</tr>
<tr>
<td>10</td>
<td>53.14455</td>
<td>22.82233</td>
<td>18.58776</td>
<td>5.445360</td>
</tr>
</tbody>
</table>

Table (4) indicates that log (RI) explains a bit more than 4% of the variation of log (RGDPI) after four time periods and, this percentage rises to 6.3% after seven time periods, but declines gradually after that. The innovation to the labor force proxied by log (RCOE) were responsible to explain 12.11% of the forecast error of the GDP after four time periods; this percentage goes up to 24.6% after seven time periods and it nearly stabilizes after that.

On the other hand, innovation to the real capital were responsible to explain 1.57% of the forecast error of the GDP after four time periods, 9.65% after seven time periods and 18.6% after ten time periods.

These results indicate that the impact of the RI on the economic growth is smaller than the impact of the RCOE, but greater than the impact of RK after four time periods. But after that, the impact of RI becomes smaller than the impacts of the other two variables.

In general, it seems that these results and the results of the cointegration equation mentioned above are not far away.
**Fourth: The Impulse Response Function:**

The dynamic adjustments of Gross Domestic Product to shocks to the other variables in the system are expressed by the impulse response function in figure(1), which shows the response of RGDP to a one standard deviation shock in the labor force proxied by RCOE, real capital, and real imports of capital and intermediate goods with two standard error bands. In response to RI, as it seems from the lower part of figure(1) that the effect is neutral at the beginning and during the first two periods of time, but improves positively and gradually after that to become negative after the eighth period. The labor force proxied by (RCOE) seems to have a positive impact on the GDP for about two periods of time, but it deteriorates after that to become negative after the third period (the upper part of the figure). This negative effect may be accrued to the diminishing marginal productivity of the Jordanian worker.

Although a real capital shock deteriorates the (RGDP) initially, but after four periods of time; it affects the domestic product positively and permanently, (the middle part of figure1). The negative effect of the real capital in the first period may be due to the nature of the investments in Jordan, which are mainly implemented in the construction and buildings sector as it is mentioned above.
Figure (1)

Response to One S.D. Innovations ± 2 S.E.

Response of LOG(RGDPI) to LOG(RCOE)

Response of LOG(RGDPI) to LOG(RK)

Response of LOG(RGDPI) to LOG(RI)
Concluding Remarks:

This study attempted to examine the effect of the imports of capital and intermediate goods on economic growth in Jordan in addition to the other two main factors of production; labor, and capital. The researcher examined the four variables for stationarity by applying the Augmented Dickey-Fuller (ADF) Test and Philips-Perron Unit Root Test. The first test confirmed that all variables were integrated of order one and integrated of order one or two in the second test.

Also the Johanson Cointegration Test affirmed the existence of a long run relationship between all variables. These results are consistent with the results of many previous studies about a positive impact of imports of capital and intermediate goods on economic growth. It seems that the imports of capital and intermediate goods represent a channel through which import-driven technology transfer takes place. The effect of this transfer should be positive on the productivity and consequently positive on the economic growth.
References


ملخص باللغة العربية


ولاختبار جذر الوحدة تم استخدام أساليب هما: اختبار ديكي-فولر الموسع واختبار فيلبس-بيرون وذلك لاختبار درجة تكاملية المتغيرات المستخدمة في الدراسة. وبالإضافة لذلك تم استخدام طريقة جوهانسن للتكامل المشترك في التحليل. وبدافع دعم نتائج الدراسة تم دراسة التفاعل الدينيميكلي بين المتغيرات باستخدام تحليل مكونات التباين ودالة الاستجابة لرد الفعل.

وتشير نتائج الدراسة التي تطابقت مع نتائج الدراسات السابقة إلى أن المستوردات من السلع الوسيطة و الرأسمالية تؤثر بشكل إيجابي على النمو الاقتصادي في الأردن وذلك عن طريق نقل التكنولوجيا المكتسبة من خلال تلك المستوردات.
Appendix ( 1 ): Time series data exploited in the study (in real prices):
Exports (EX), Imports (IM), Real Gross Domestic Product (RGDP), Real Capital (RK), Compensation Of Employees (COE), Imports of Capital and Intermediate Goods (RI), Consumer Price Index (CPI)

<table>
<thead>
<tr>
<th>Year</th>
<th>EX (in JD million)</th>
<th>IM (in JD million)</th>
<th>RGDP (in JD million)</th>
<th>RK (in JD million)</th>
<th>COE (in JD million)</th>
<th>RI (in JD million)</th>
<th>CPI (base year 1992)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>1069.3</td>
<td>2258.4</td>
<td>2682.5</td>
<td>16891.8</td>
<td>950.2</td>
<td>1076.9</td>
<td>44</td>
</tr>
<tr>
<td>1981</td>
<td>1333.8</td>
<td>3011.6</td>
<td>3099.8</td>
<td>17666.2</td>
<td>1086.3</td>
<td>1520</td>
<td>47.4</td>
</tr>
<tr>
<td>1982</td>
<td>1316.7</td>
<td>3056.4</td>
<td>3342</td>
<td>18812.4</td>
<td>1182.3</td>
<td>1516.1</td>
<td>50.9</td>
</tr>
<tr>
<td>1983</td>
<td>1195.5</td>
<td>2716.3</td>
<td>3418.1</td>
<td>19781.8</td>
<td>1227.7</td>
<td>1286.6</td>
<td>53.5</td>
</tr>
<tr>
<td>1984</td>
<td>1344.7</td>
<td>2737.1</td>
<td>5370.1</td>
<td>20550.2</td>
<td>1275.3</td>
<td>1124.8</td>
<td>55.5</td>
</tr>
<tr>
<td>1985</td>
<td>1366.3</td>
<td>2627.1</td>
<td>3531.8</td>
<td>21219.5</td>
<td>1314</td>
<td>1167.8</td>
<td>57.2</td>
</tr>
<tr>
<td>1986</td>
<td>1108.6</td>
<td>2097</td>
<td>3782.5</td>
<td>21583.8</td>
<td>1492.6</td>
<td>1314.7</td>
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Note: the figures for the last three years are preliminary or estimated by the researcher.