The Trade–Growth Relationship in Israel Revisited: Evidence from Annual Data, 1960-2004

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Abstract

The topic of trade effects on economic growth has been usually controversial. Former empirical evidence linking trade to growth in Israel has been mixed and inconclusive either. This study reexamines the role of trade in Israel by testing for cointegration and causality from both exports and imports to output and total factor productivity over the period 1960-2004. The results suggest that both output and TFP are positively long-run correlated with exports and imports. The Granger causality tests indicate positive effects of exports on both output and TFP, where imports influence output only. In addition, physical capital has also been found to be Granger-caused by imports. This may suggest that the impact of imports on output is through the accumulation of physical capital and/or improvement in TFP over time.

Keywords: Trade-growth relationships, Cointegration, Causality , Israeli economy

JEL Classification: C22, F43, O47

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1 Introduction

The role of trade in economic growth has been frequently discussed in both theoretical and empirical literature. Although the direction and the magnitude of the effects of trade on output growth are still controversial, literature usually suggests that trade-open economies benefit from integration with trade partners (Grossman and Helpman, 1991; Wacziarg and Welch, 2003; Kose, Prasad, Rogoff and Wei, 2004). A wider acceptance of a trade-accelerated growth is credited to the emergence of the endogenous growth theory. This theory provides a more convincing theoretical basis for the positive trade-growth association, mainly through the absorption of new technologies, research and development spillovers, and the enhancement of both specialization and efficiency in production.

Despite this strong theoretical basis, there is still some disagreement in empirical studies regarding the validity of the positive trade-growth relationship. Rodrik (1993) and Krugman (1994) are among the first studies to cast doubts on the cross-nation findings of the early 1990s. Rodriguez and Rodrik (1999), in a very comprehensive study, provide one of the most critical papers of the role of trade in economic growth. They argue for econometric problems and poor measuring of trade-openness that make the results of several previous studies biased in favor of indicating positive trade-growth ties.

The skepticism regarding the effects of trade on economic growth is also the case of Israel. Despite the increasing reliance of the Israeli economy on its exports sector (see, for instance, Bank of Israel, Annual Report, 2005, p. 281), the lack of any conclusive empirical evidence makes its role uncertain. Hercowitz, Lavi and Melnick (1999) employ a cointegration and causality approach to test for the impact of macroeconomic factors on TFP over 1960-1996. Trade openness (measured as the exports-GDP ratio) has been found to be neither cointegrated with TFP nor causing it. In their times-series study on the influence of policy variables on output, TFP and production factors during the period 1960-1995, Lavi and Strawczynski (2001) have been inconclusive about the role of trade openness (measured, again, by the exports-GDP ratio) in the evolution of these variables. This result reflects, on one hand, positive long-run coefficients of trade openness in some specifications, and, on the other, no improvement in the overall cointegration relationship (measured by the magnitude and significance of the ADF statistic). The recent study of Bregman and Marom (2005), on the contrary, does report positive effects of trade on growth.

The trade-growth relationship, however, has been the main topic in none of these studies. The current study revisits this issue by testing for long-run relationships and causal links between trade and growth. In particular, direct effects of trade on both output and TFP are examined. The main results of the paper can be summarized as follows. Output and total factor productivity (TFP) have been found to be long-run correlated with trade. The causality tests suggest positive effects of export on both output and TFP. Imports have been found to cause only output. These results are, in general, robust to the changes of specification and/or changing variables.

The remainder of this paper proceeds as follows. Section 2 reviews the empirical literature on trade and economic growth. Section 3 briefly describes an endogenous-theory-based empirical model. Data descriptions are presented in section 4, while section 5 presents the empirical results. Section 6 presents some robustness results, and section 7 concludes.

2 Empirical Literature Review

Over the last two decades the role of trade in stimulating economic growth has been the topic of several empirical studies. Due to diverse trade measures and the different issues examined, literature is still debated whether more trade (or more trade orientation) is an ingredient of enhanced economic development.

Although theoretical literature usually focuses on the effects of trade *policy* on economic growth, most empirical studies examine the effects of *actual* trade rather than trade policy (Harrison, 1996).[1] Using such measures, Quah and Rauch (1990) and Frankel and Romer (1999), among others, support the positive effect of trade in economic growth.

The major class of trade-growth studies has been focusing in the popular Export-Led Growth (ELG) hypothesis, believing that only exports are significant for sustainable economic expansion. Numerous studies examine its validity for various types of countries.[2] Employing time-series techniques, Thornton (1996), Ghatak *et al* (1997) and Awokuse (2005) among others, show that output has been driven by exports in Mexico, Malaysia and Japan, respectively. Dar and Amirkhalkhali (2003) support this hypothesis for a group of 19 OECD countries, where the magnitude of exports impact on growth increases with the degree of openness.

However, despite its popularity, both cross-section and times-series readings cast doubts on the ELG validity. Some studies show that exports are insignificant for economic growth (e.g., Jung and Marshall, 1985; Kugler, 1991). Others, as Oxley (1993) and Henriques and Sadorsky (1996), argue for only a reverse causation running from output to exports (named Growth-Driven Exports). Some other scholars (e.g. Dodaro, 1999 and Doyle, 2001), establish bidirectional causality between exports and output.

Another group of studies, occasionally referred to as Import-Led Growth (ILG), highlights the contribution of imports to economic activity, usually through its impact on total factor productivity. For example, Riezman, Summers and Whiteman (1995) argue that omitting imports may make the ELG causality tests misleading. Lawrence and Weinstein (1999) show that imports have been supportive for total factor productivity in Japan, Korea and the United States. Coe and Helpman

[1] Among the studies that examine the impact of trade policy is Edwards (1998).
[2] See Gils and Williams (2000) for the most comprehensive review of this literature.

(1995) show that imports spur productivity by enhancing R&D spillovers among nations. Serletis (1992), contrarily, fails to indicate a causal relationship from imports to output growth.

3 Short Empirical Model: Trade, Total Factor Productivity and Output

My empirical model starts from the following simple Neoclassical production function form:

$$Y_t = A_t K_t^{\alpha} L_t^{\beta} e^{\varepsilon_t}, \quad (1)$$

where: Y_t denotes the aggregate output, A_t stands for Total Factor Productivity, K_t is the physical capital stock, L_t is the stock of labor, and ε_t is an error.

Aligned with the endogenous growth theory, the TFP is expressed as a function of some trade measure (i.e. exports, imports, trade volume, etc.,), a human capital index and other factors which may influence TFP (denoted by *T*, *H* and *C* in (2), respectively). For simplicity, the function of TFP is assumed to be of Cobb-Douglas type (as in Herzer, Nowak-Lehmann and Siliverstovs, 2004).

$$A_t = T_t^{\gamma} H_t^{\delta} C_t \ . \quad (2)$$

Substituting equation (2) into equation (1) yields:

$$Y_t = C_t K_t^{\alpha} L_t^{\beta} H_t^{\gamma} T_t^{\delta} e^{\varepsilon_t}. \quad (3)$$

Taking natural logarithms gives the following linear function:

$$\ln Y_t = \ln C_t + \alpha \ln K_t + \beta \ln L_t + \gamma \ln H_t + \delta \ln T_t + \varepsilon_t \ . \quad (4)$$

Equation (4) serves here as the benchmark specification to test for trade-GDP relationships. Equation (2), once natural logarithms are taken, will be the main equation for testing the effects of trade on TFP. Each coefficient in (4) represents the elasticity of output with respect to the particular variable. Finally, in the above formulation I do not restrict the sum of elasticities to equal 1, thus allowing for non-constant return to scale function.

4 Data

The empirical analyses are based on annual data covering the period 1960-2004. I use Israeli National Accounts data published by the Central Bureau of Statistics. Capital is the fixed capital formation, and the data are available in the Bank of Israel database. In what follows, exports and imports are calculated using the export deflator and imports deflator, respectively. GDP is deflated by the GDP deflator. For complete and detailed definitions of the variables, see Appendix 1.

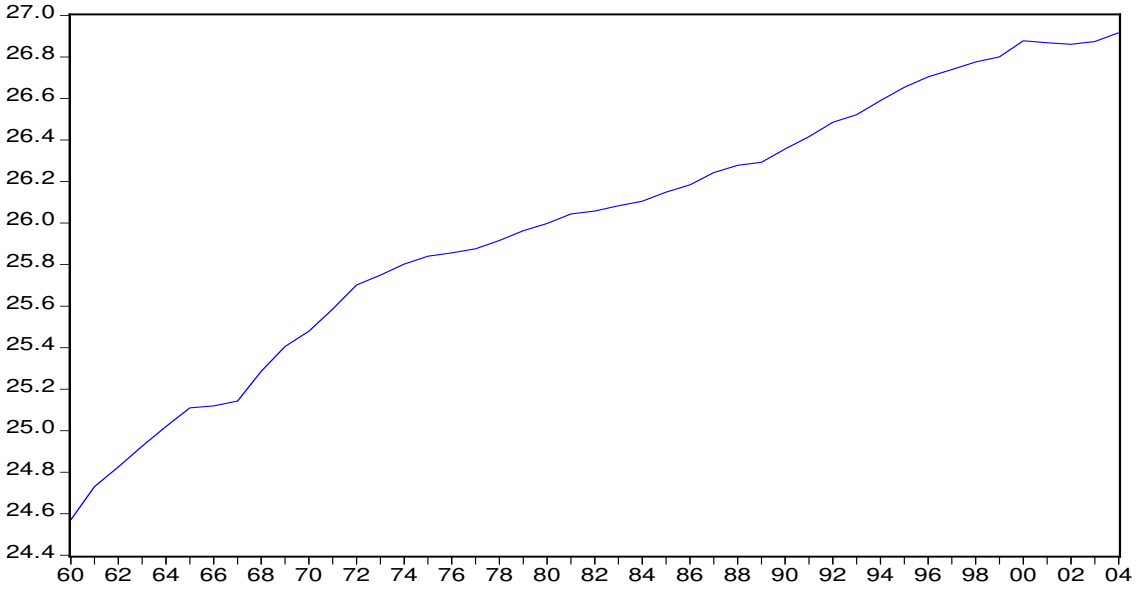
4.1. Main Data Description

This subsection presents brief descriptions of my main variables (GDP, Trade, and TFP), and discuss the measuring of trade-openness and human capital.

4.1.1 Trade and Growth in Israel

Figures 1 and 2 show the evolutions in the Israeli GDP and the trade volume (and its components, exports and imports), respectively. All the variables experienced relatively higher growth rates until the Oil Crisis of 1973, and a fall in growth rates afterwards. Despite some increase in growth rates since the beginning of the 1990s, largely due to the immigration from the former Soviet Union, they are still low compared to their pre-crisis levels.

Figure 1: The natural logarithm of GDP in Israel: 1960-2004



4.1.2 Measuring the Degree of Trade Openness

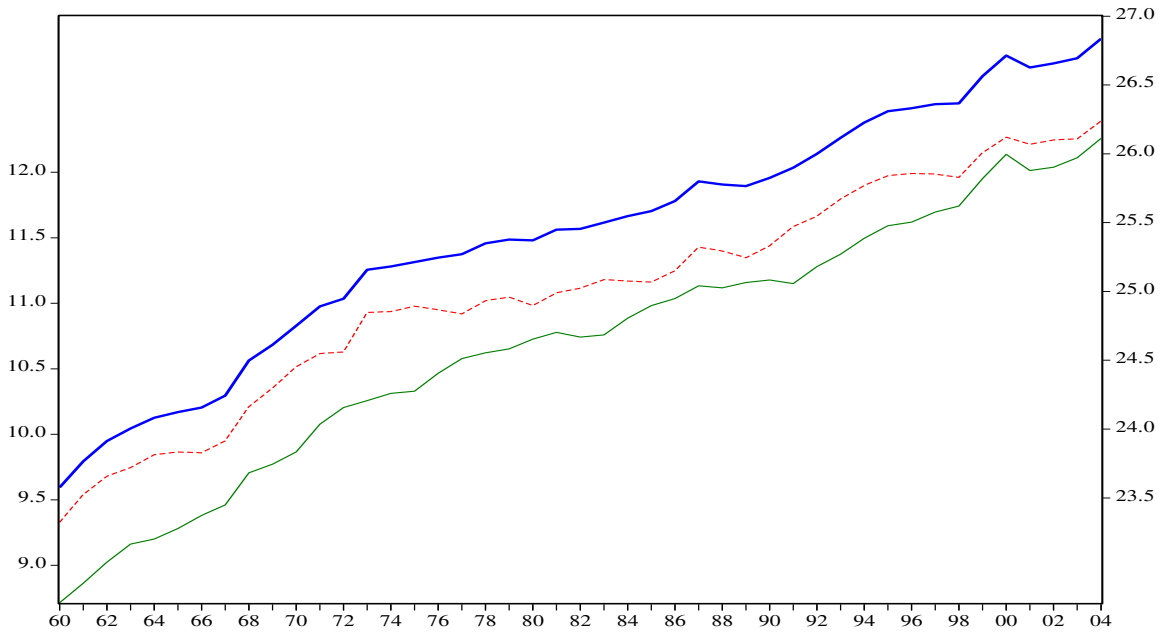
Empirical literature on trade and growth suggest various indicators to measure the degree of trade openness [3]. For time-series studies, the ratio of trade volume (exports plus imports) to GDP is the simplest one (Harrison, 1996). The two main reasons for its attractiveness are its availability compared to other indices, and the fact that it reflects the effective degree of integration. This measure has been used in several studies (e.g., Harrison, 1996; Weinhold and Rauch, 1997; Frankel and Romer, 1999).

Former studies dealing with the role of trade in the Israeli economic growth have usually referred to trade-GDP ratios as indices of trade openness. Although this measure is considered as the most preferable measure for the actual trade-openness degree, it is less favorable in testing for trade effects

[3] See Harrison (1996), Edwards (1998) and Rodriguez and Rodrik (2000) for comprehensive reviews of these measures.

on GDP or TFP. First, this variable is itself a function of output, which may bias the results. For instance, if this measure does not increase (e.g., due to slower trade growth compared to GDP growth), then even a negative relationship may be obtained. Second, regressing GDP or TFP on this index shows whether higher trade *openness* is associated with economic growth. However, this is not necessarily the right question, since trade may be growth-promoting even if the degree of openness stays unchanged. In this regard, even in years where the Israeli trade-openness degree decreases, the economy may still benefit from international trade. Finally, this measure is very volatile from one period to another (Figure 3), whereas output exhibits more stable growth. Therefore, in specific years, the trade-to-GDP ratio may "miss" the right (positive) trade-GDP correlation.

Figure 2: The natural logarithms of Exports, Imports and Trade Volume in Israel: 1960-2004



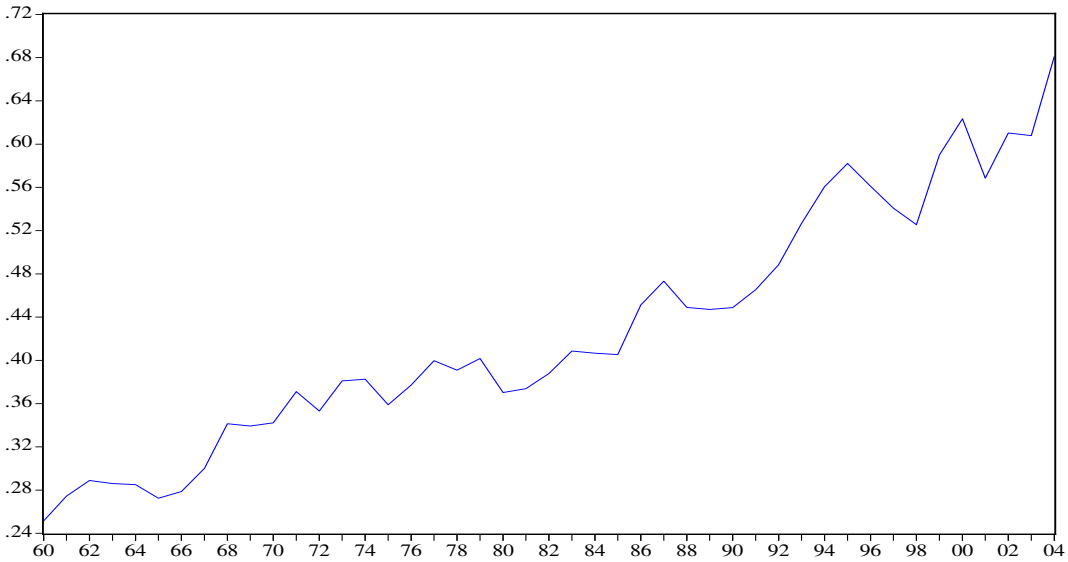
Thick line-Trade Volume (right-hand axis); Thin line-Exports; Dashed line-Imports (left-hand axis).

Given these considerations, this study refers to several trade measures (besides the trade-GDP ratio, TVY) to test for role of trade.[4] The trade volume in absolute values (TV) serves as the main measure here. The use of the trade volume has several advantages. First, it shows the actual quantitative gain form a given increase in trade volume (or any of its components). Second, regressing GDP (or TFP) on this measure better shows whether an increase in promotes growth. Therefore, it enables to identify true trade effects even in times of fall in the openness degree. Third, compared to the trade-GDP ratio, this variable is less affected by endogenieties. Finally, its relatively solid evolution helps to establish a more stable relationship. Using this class of trade measures is very

[4] Corresponding measures for exports and imports are also used: exports and imports in absolute values (EX, IM), exports as share of world imports (EXWM) and imports as share of world exports (IMWX).

common in times-series studies (see, for example, Kugler, 1991; Henriques and Sadorsky, 1996; Thornton, 1996).

Figure 3: The Israeli Trade Openness, 1960-2004



The share of the Israeli trade volume in world trade (TVWT) is another measure to test for this nexus. Using this variable shows the trade effects when the trade volume is normalized to some exogenous measure. The shares of Israeli exports in world imports and Israeli imports in overall world exports are also considered.

Finally, since this study tests whether *actual* trade has been growth-promoting along the examined period, only *ex-post* trade measures are used. Having the inconclusive findings of previous studies, a focus on this question solely is required. Other issues, as the appropriate growth-promoting trade *policy*, are not discussed here despite their high significance. Moreover, trade policy measures do not always go in line with the actual trade volume (Edwards, 1998), thus possibly suggesting considerably different relationships with growth (Yannikaya, 2003). An examination of the desired trade policy is more applicable when it is based on some historical empirical investigation that studies the role of trade in economic growth. The effects of trade policy on economic growth are left for future work.

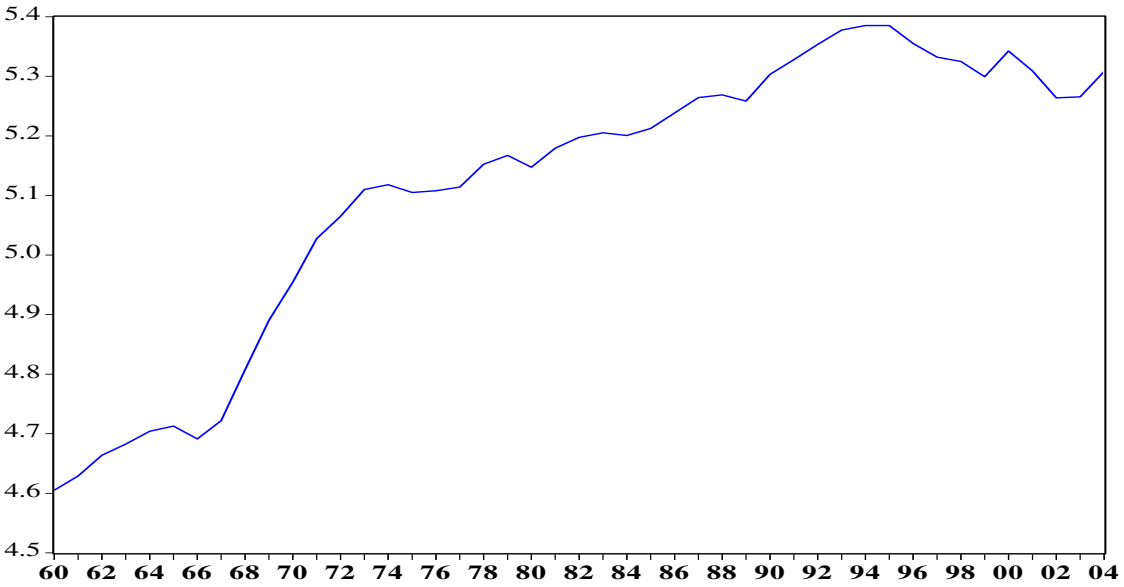
4.1.3 Total Factor Productivity in Israel

Total Factor Productivity measures the output growth not credited to the augmentation of production factors. It is calculated as a residual from a constant return to scale production function with labor and physical capital as the only inputs. Formally,

$$A_t = \frac{Y_t}{K_t^{\alpha} L_t^{1-\alpha}}, \tag{5}$$

with α denoting the share of capital. In line with previous studies and the assumptions of the Bank of Israel, α is set to 0.32. The Israeli TFP is shown in Figure 4.

Figure 4: The natural logarithm of Total Factor Productivity in Israel, 1960-2004.



Until 1972, it experienced high growth due to high output growth and moderate labor growth. After the Oil Crisis and the Yom-Kippur War it continues to grow, but with very modest rates. The sharp increase in the labor force resulting from the mass migration from the former USSR in early 1990s combined by high investments led to the decline in TFP since 1993. This decline reflects low output growth rates compared to inputs growth rates (i.e., the extremely high growth in capital and labor was not accompanied by a corresponding output growth). Detailed discussion about the Israeli TFP since 1960 can be found in Hercowitz, Lavi and Melnick (1999).

4.1.4 Measuring Human Capital in Israel

Several variables have been proposed as proxies for human capital. *School enrollment ratios* are among the first and most frequently used measures of human capital (e.g., Barro, 1991 and Levine and Renelt, 1992). This index shows the ratio between the number of pupils enrolled at some grade level (e.g., secondary school) and the number of habitants in the corresponding age group. The current study refers to the enrollment ratio as the main measure of human capital. To check for the robustness of the results, some of my specifications are rerun using another human capital measure- the share of population with at least 13 schooling years. Using this index is in line with some previous studies in Israel (e.g. Lavi and Strawczynski, 2001; Flug and Strawczynski, 2002).

4.2 Other Variables and Their Expected Effects

The effects of other variables on GDP and TFP growth are presented in this subsection.

Fiscal policy: Government actions may influence growth both by causing productivity and investments. As for TFP, Government activities may play a role in the allocation of resources, thus influencing productivity. The overall influence of a government on TFP is, however, controversial; a government may, on one hand, provide public goods to promote growth, whereas, on the other, it may wastes resources in financing *non*-growth-promoting activities (Levine and Renelt, 1992). In addition, theories argue that taxes necessary to finance government spending may distort agents' incentives and decisions, thus reducing the efficiency of resources allocation (Levine and Renelt, 1992; Bregman and Marom, 1993).

The literature is inconclusive also about the direction of fiscal policy affect on physical capital. Theoretical predictions suggest negative effects of government size (as measured by the total government expenditures-GDP ratio) on physical capital accumulation, possibly due to more crowding out of investments. In addition, higher government expenditure is more likely to be associated with higher budget deficits, which usually adversely affect capital accumulation (Fischer, 1993). In the current study, I add total government expenditures (both its absolute value and it value as a share of GDP), total taxes-GDP ratio and deficit-GDP ratio as measures of fiscal policy. The empirical tests here focus mainly on the effects of fiscal actions on TFP.

Standard deviation of inflation: following Fischer (1993), I use this variable as a measure of macroeconomic instability. The variability of inflation provides a signal for an unstable macroeconomic system and possibly less budget control. Therefore, it could be harmful for economic growth either by reducing capital accumulation or total factor productivity.[5] The results of Fischer (1993) shows that a higher inflation rate and higher inflation variability reduce capital accumulation, while higher inflation rate has a negative effect on TFP. His finding regarding capital accumulation is consistent with the strong negative effect of inflation on investments shown by De Gregorio (1993). The standard deviation for a given year used in the current study is the standard deviation of inflation in the previous 5 years.

The U.S. TFP: this variable serves to test for possible exogenous effects on the Israeli TFP. The evolution of the U.S. TFP is used since it represents the leading world technology and therefore it best reflects technology diffusion. This test is in line with Hercowitz, Lavi and Melnick (1999), Lavi and Strawczynski (2001) and Véganzonès and Winograd (1998), who all show that domestic TFP is positively correlated with U.S. TFP.

Finally, in what follows, I use the natural logarithm of variables with exception of the standard deviation of inflation, the budget deficit-GDP ratio and tax revenues-GDP ratio.

[5] One channel for Inflation variability to affect TFP is that economic uncertainty, through inducing excess capacity, may reduce factor utilization. For further discussion see Hercowitz *et al* (1999).

5 Results

5.1 Unit Root Tests

In order to investigate the stationarity properties of the data, conduct I unit root tests using the Augmented Dickey-Fuller (ADF) approach developed by Dickey (1976) and Dickey and Fuller (1979). The ADF test results are reported in Table 1 both for the levels and the first differences of the main variables. For other variables, refer to Appendix 2.

Table 1: The statistical values ADF unit roots tests, 1960-2004

Variable	Levels	First Differences	Variable	Levels	First Differences
GDP	-2.03	-1.61	TVWT	-2.58	-7.40 *
TFP	-0.86	-4.16 *	EX	-3.16	-2.00 *
L	-1.66	-3.01 *	EXY	-2.30	-5.23 *
K	-2.88	-1.92 **	EXWM	-2.76	-3.76 *
H	-3.08	-3.87 *	IM	-2.64	-3.76 *
TV	-2.88	-2.94 *	IMY	-2.83	-7.33 *
TVY	-3.17	-6.23 *	IMWX	-2.56	-7.79 *

Notes: The critical values are from Mackinnon (1996). * and ** denote significance at 5% and 10%, respectively. The null hypothesis is that the variable *x* is nonstationary.

The results show that all the variables are nonstationary in their levels, and that all, except GDP, are stationary in their first differences. The result for the first difference of GDP might be biased due to the structural break in 1973 since, given a structural break, the ADF test tends to indicate unit root even if the series is indeed stationary. For this reason, I carry out the unit root test using the Perron (1989) test. By employing the Perron (1989) test, the first difference of this variable has been found to be stationary.[6] I conclude that all my variables are integrated of order one ($I(1)$).[7]

5.2 Cointegration Tests and Cointegration Vectors

Since all variables are of the same integration order ($I(1)$), cointegration tests between different sets of variables are processed using the Johansen (1991, 1995) technique.

5.2.1 Trade and GDP

In this subsection, I test for the validity of trade-GDP cointegrating relationships both in the benchmark multivariate model and in a bivariate model with GDP and a trade measure as the only variables. The tests, summarized in Table 2, indicate unique cointegration vectors in each case. These vectors are presented in Table 3.

[6] The statistic value is (-1.71). Considering the structural break in 1990 either, the statistic value has been found to be (-1.77).
[7] Also, the natural logarithm series of GDP is not integrated of order 2.

Table 2- Statistical Values for the Johansen cointegration tests

Model	Max-Eigenvalue Test			Trace Test		
	H_0	H_1	***Statistic***	H_0	H_1	***Statistic***
1	$r=0$*	$r=1$	46.97	$r=0$*	$r\leq 1$	74.11
	$r=1$	$r=2$	17.78	$r\leq 1$	$r\leq 2$	27.14
2	$r=0$*	$r=1$	51.43	$r=0$*	$r\leq 1$	80.54
	$r=1$	$r=2$	20.04	$r\leq 1$	$r\leq 2$	29.11
3	$r=0$*	$r=1$	59.93	$r=0$*	$r\leq 1$	92.31
	$r=1$	$r=2$	23.70	$r\leq 1$	$r\leq 2$	32.38
4	$r=0$*	$r=1$	21.39	$r=0$*	$r\leq 1$	24.56
	$r=1$	$r=2$	3.17	$r\leq 1$	$r\leq 2$	3.17
5	$r=0$*	$r=1$	21.34	$r=0$*	$r\leq 1$	24.75
	$r=1$	$r=2$	3.41	$r\leq 1$	$r\leq 2$	3.41
6	$r=0$*	$r=1$	16.93	$r=0$*	$r\leq 1$	18.53
	$r=1$	$r=2$	1.61	$r\leq 1$	$r\leq 2$	1.61

Notes: * denotes rejection of the hypothesis at the 5% level. The critical values are from Haug, Mackinnon and Michelis (1999).

The coefficient of the trade volume (TV) in model 1 is around 0.35. The coefficient of the trade volume-GDP ratio (TVY) is larger than the coefficient of the trade volume, possibly due to endogeneity. The Israeli trade as a share of world trade (TVWT) is also positively related to output, although with a moderate coefficient (Model 3).

I next check if the trade-GDP relationships hold when dropping all other variables. This is an important test since part of the long-run ties found above may result from the linkages between GDP and variables other than trade. Identifying cointegration in a bivariate system will confirm that (at least) part of the long-run relationship in a multivariate model is due to true trade-GDP relationships. The results of the Johansen tests in Table 2 show that the different trade measures are indeed positively cointegrated with output. Their corresponding cointegration vectors are reported in columns 4 through 6 in Table 3.

To sum up, GDP and trade measures exhibit long-run relationships. Moreover, since the results using TVY and TVWT are all consistent with those obtained by using TV, this subsection proceeds with the latter as the only trade measure.

The elasticity of output with respect to physical capital is roughly 0.40, an acceptable estimate for Israel. GDP-labor elasticity is found to be around 0.10 while the human capital coefficient is roughly 0.20.[8] Since the labor coefficient seems lower than expected, it should be noted that a part of its effect

[8] The coefficient of the other human capital measure (the share of population with 13 schooling years or more is similar- between 0.23-0.27). The results are unreported here.

on output is embodied in the coefficient of human capital. This result is consistent with the growth theory that highlights labor heterogeneity. According to this theory, the production function may include a human-capital-augmented labor input rather than only labor, or separate labor and human capital inputs. Therefore, summing the two coefficients shows that "real" labor elasticity is around 0.30. This estimate resembles that of Plumper and Graff (2001) who find a sum of 0.37 for a sample of 90 developed and developing countries.

Table 3: Cointegration vectors of GDP with different specifications of the trade variables.

Variable	**1**	**2**	**3**	**4**	**5**	**6**
K	0.399	0.651	0.720			
L	0.095	0.102	0.211			
H	0.227	0.322	0.218			
TV	0.347			0.756		
TVY		0.506			3.080	
TVWT			0.138			3.782
Const.	5.789	8.248	5.675	6.796	27.625	46.723

Some notable result arises from my estimates: the relationship between physical capital and trade. The cointegration tests, which are not reported here, indicate log-run relationships. As Table 4 shows, dropping the trade volume from the benchmark specification yields much higher capital coefficient (roughly 0.80), whereas the sum of human capital and labor elasticities remains unaltered. The coefficient of capital is approximately the sum of the trade and capital elasticities reported earlier.[9] Consequently, this finding may hint that the coefficient of physical capital in a trade-excluded specification embodies the contribution of trade to growth. I will refer to this issue later when discussing the possible role of imports in the process of accumulating physical capital.

Table 4: Cointegration vectors of GDP with different variables

Variable	**1**	**2**	**3**
K	0.786	0.724	0.835
L	0.133	0.306	
H	0.242		0.370
Const.	4.017	3.646	4.252

Note: No trade measure.

[9] Cross-country studies found similar estimates for K: 0.63 in Plumper and Graff (2001) and 0.64-0.87 in Benhabib and Spiegel (1994).

5.2.2 Trade and Total Factor Productivity

The Johansen cointegration tests for TFP and other variables reported in Table 5 indicate one cointegration vector in each case. Consistent with the endogenous growth theory, trade is positively correlated with TFP (the cointegration vectors are shown in Table 6). This result is robust both to the choice of the trade measure and to the inclusion of the human capital index.

Table 5: Statistical Values for the Johansen cointegration tests

Model	**Max-Eigenvalue Test**			**Trace Test**		
	H_0	H_1	***Statistic***	H_0	H_1	***Statistic***
1	$r=0$ *	$r=1$	37.60	$r=0$ *	$r\leq 1$	40.59
	$r=1$	$r=2$	2.98	$r\leq 1$	$r\leq 2$	2.98
2	$r=0$ *	$r=1$	25.31	$r=0$ *	$r\leq 1$	27.36
	$r=1$	$r=2$	2.06	$r\leq 1$	$r\leq 2$	2.06
3	$r=0$ *	$r=1$	21.47	$r=0$ *	$r\leq 1$	21.63
	$r=1$	$r=2$	0.16	$r\leq 1$	$r\leq 2$	0.16
4	$r=0$ *	$r=1$	40.55	$r=0$ *	$r\leq 1$	54.97
	$r=1$	$r=2$	11.42	$r\leq 1$	$r\leq 2$	14.42
5	$r=0$ *	$r=1$	29.56	$r=0$ *	$r\leq 1$	40.05
	$r=1$	$r=2$	8.49	$r\leq 1$	$r\leq 2$	10.49
6	$r=0$ *	$r=1$	44.58	$r=0$ *	$r\leq 1$	54.52
	$r=1$	$r=2$	6.54	$r\leq 1$	$r\leq 2$	9.93

Notes: * denotes rejection of the hypothesis at the 5% level. The critical values are from Haug, Mackinnon and Michelis (1999).

Table 6: Cointegration vectors of TFP with different specifications of the trade variables.

	1	**2**	**3**	**4**	**5**	**6**
H				0.139	0.415	0.873
TV	0.306			0.266		
TVY		1.102			0.747	
TVWT			1.413			0.674
Const.	2.337	10.692	17.876	3.449	10.803	14.441

5.4 Vector Error Correction Models (VECM) and Granger Causality Tests

Since in almost all cases cointegration has been detected between both GDP and TFP on one hand and trade measures, on the other, VECM-based causality tests are carried out. This subsection presents only the parts of the VECM models that are relevant for the current study. The method is

briefly described here. Letting $\Delta y_t = y_t - y_{t-1}$, the vector error-correction (VEC) equation can be formulated as follows:

$$\Delta y_t = \mu + \alpha \mathrm{ECT}_{\mathrm{t\text{-}1}} + \sum_{k=1}^{p-1} \beta_{yx,k} \Delta x_{t-k} + \sum_{k=1}^{p-1} \beta_{yy,k} \Delta y_{t-k} + \varepsilon_t, \quad (6)$$

where, μ is a constant, $\mathrm{ECT}_{\mathrm{t\text{-}1}}$ is the error correction term lagged one period, and $\beta_{ij,k}$ represents the effect of the *k*th lagged value of variable *j* on the current value of variable *i*. Specifically, if a lagged value of some variable is significant, then causality runs from that variable to the dependent variable. Therefore, in the causality subsection we will report the significance tests results for the trade variables. In addition, the study will report the results for the coefficient α, which represents the speed of adjustment to equilibrium.

As for causality, if certain are cointegrated, I apply Granger (1969) causality tests within the VAR system. According to Granger (1969), *y* is said to be caused by *x*, if the forecast for *y* is improved by using both the historical values of *x* and *y* rather than by using its own past values only.

5.4.1 Trade and GDP

The causality tests reported in Table 7 show that, in general, trade does Granger-cause output (causality has been found in 4 out of 6 cases). The only two cases where such causality is not observed are the multivariate models with TVY and TVWT. As for the first measure, this result is probably biased by the different problems discussed above.[10] The result for the TVWT may be surprising, although its evolution is hardly affected by the Israeli trade, so that any effect trade may truly have on GDP is not detected here. Specifically, if the rapid growth of the Israeli trade is unassociated with a higher share of overall world trade, then the causal link is subject to a bias.

A very notable result is the positive sign of the error-correction term. Usually, for a gradual return to equilibrium, this ECT should be negative and less than one in absolute value (i.e., between -1 and 0). The opposite sign found here is possibly biased by the omission of other variables or due to a big shock to some of the explanatory variables, thus taking the system further away of its long-run equilibrium. Therefore, one possible omitted variable is the 'stock' of immigrants in Israel. Adding this variable yields significant negative ECT almost in all cases without altering the positive trade-GDP long-run association or the trade-to-output causality (Table 6, Appendix 4).[11]

[10] As previously discussed, another reason for the unclear effect of this variable on GDP or TFP is its volatility. Taking its four-period moving average shows that causality runs from this variable to GDP.
[11] I am grateful to Michel Strawczynski who suggested me considering this variable.

Table 7: Granger Causality Tests, GDP and Trade measures

The trade measure	Independent Variables			
	ECT(-1)	**D(trade(-1))**	**D(trade(-2))**	**D(trade(-3))**
TV	1.284 *	0.092	0.279 ***	0.130
	(2.58)	(0.73)	(1.65)	(1.00)
TVY	0.843 *	0.088	0.264	0.134
	(2.43)	(0.67)	(1.55)	(0.87)
TVWT	0.631 ***	0.147	-0.016	0.125
	(1.90)	(1.58)	(-0.14)	(1.23)
TV	0.502 *	0.205 **		
	(3.25)	(2.28)		
TVY	0.147 *	0.206	0.232 ***	0.139
	(2.86)	(1.42)	(1.77)	(1.14)
TVWT	0.063 **	0.302 *	0.123	0.097
	(2.21)	(3.10)	(1.31)	(1.18)

Notes: * Significant at the 1% level. ** Significant at the 5% level.
*** Significant at the 10% level.

5.4.2 Trade and Total Factor Productivity

The Israeli TFP has been found to be positively caused by trade in two cases (Table 8). The results show that neither TVWT nor TVY Granger-causes productivity. However, testing for causality for the pre-1994 period shows that TVY does cause TFP. Such causality has also been detected when taking both the trend and the moving average of this volatile measure. Therefore, it seems that both the structural break in 1993 and the volatility of this measure render the causality from this variable to output not being robust.

Table 8: Granger Causality Tests, TFP and Trade measures

The trade measure	Independent Variables		
	ECT(-1)	**D(trade(-1))**	**D(trade(-2))**
TV	-0.286 *	0.109 *	
	(-6.05)	(2.26)	
TVY	-0.212 *	-0.023	
	(-4.48)	(-0.32)	
TVWT	-0.088 *	-0.068	
	(-2.39)	(-1.18)	
TV	-0.309 *	0.119 *	-0.018
	(-6.24)	(2.33)	(-0.34)
TVY	-0.262 *	0.018	
	(-5.196)	(0.26)	
TVWT	-0.292 *	-0.072	
	(-5.75)	(-1.50)	

Notes: *, **, ***- as in Table 7.

In each case, The ECT lays in the expected range, suggesting a gradual return to the long-term equilibrium. Since TFP measures the output net of capital and labor, its calculation embodies the

strong impact of migration on these inputs. Hence, the negative coefficient found here supports the prediction that the mass migration in the early 1990s has, via its influence on the labor force and investments[12], a sizeable influence on the long-run stability.

5.5 Decomposing Trade: Exports, Imports and Economic Growth

The above causality tests are applied here using separate measures for exports and imports. I carry out these analyses to check if the sources of the causalities found above are both exports and imports or only one of them.

7.5.1 Exports, Imports and GDP

The cointegration tests indicate long-run relationship between GDP and export measures (Table 1, Appendix 3), and between GDP and import measures (Table 2, Appendix 3).[13] The tables are not shown here to economize in presentation. These results suggest that the long-run relationships of the trade volume with GDP arise because of exports and imports alike.

As for causality, Table 9 shows that exports cause GDP in 5 out of 6 cases, and Table 10 reports causality from imports to GDP in all cases. Therefore, exports and imports contributed to the trade-GDP causalities reported above.

Table 9: Granger Causality Tests, GDP and Exports measures

The exports measure	**Independent Variables**			
	ECT(-1)	**D(trade(-1))**	**D(trade(-2))**	**D(trade(-3))**
EX +	0.678 ** (2.19)	0.199 *** (1.77)	0.064 (0.60)	0.103 (1.01)
EXY +	0.570 ** (2.19)	0.199 *** (1.77)	0.064 (0.60)	0.103 (1.01)
EXWM	0.820 * (3.24)	0.100 *** (1.72)	-0.077 (-1.09)	0.052 (0.76)
EX	0.022 * (0.21)	0.164 ** (2.07)		
EXY	0.018 * (0.49)	0.165 * (2.03)	0.037 (0.41)	
EXWM	-0.064 * (-2.64)	-0.013 (-0.18)		

Notes: *, **, ***- as in Table 7.

[12] Refer to Lavi and Strawczynski (2001) for a detailed discussion on the positive effects of immigration on production inputs.

[13] The only case where cointegration has been rejected is the bivariate model with GDP and IMWX.

Table 10: Granger Causality Tests, GDP and Import measures

The imports measure	Independent Variables				
	ECT(-1)	D(trade(-1))	D(trade(-2))	D(trade(-3))	D(trade(-4))
IM	0.361 * (2.45)	0.177 ** (2.22)	-0.217 (-1.48)	0.043 (0.45)	
IMY	1.163 * (2.45)	0.177 ** (2.22)	-0.127 (-1.48)	0.043 (0.45)	
IMWX	0.720 * (2.25)	0.114 *** (1.84)	-0.040 (-0.54)	0.068 (0.97)	
IM	0.253 * (1.89)	0.317 * (3.05)	0.086 (0.85)	0.121 (1.40)	0.086 (1.08)
IMY	0.048 *** (1.89)	0.317 * (3.05)	0.086 (0.85)	0.121 (1.40)	
IMWX	–	0.072 *** (1.65)			

Notes: *, **, ***- as in Table 7.

5.5.2 Exports, Imports and TFP

Table 3 and Table 4 of Appendix 3 show, respectively, that and TFP is cointegrated with export measures and import measures. Hence, as in the case of GDP, the long-run relationships of the trade volume with TFP are due to exports and imports.

The causality tests results show that the Israeli TFP is driven by exports (Table 11), whereas imports seem as having no influence over TFP (Table 12). In particular, causality runs from exports to TFP in 3 cases whereas no imports-to-TFP causality has been detected. For the bivariate model with EXY, causality has been found for the period 1960-1993 and for both the trend and the moving average of this variable.

Table 11: Granger Causality Tests, TFP and Export measures

The exports measure	Independent Variables		
	ECT(-1)	D(trade(-1))	D(trade(-2))
EX	-0.250 * (-6.06)	0.125 * (2.85)	0.00 (0.01)
EXY	-0.181 * (-4.81)	0.034 (0.55)	
EXWM	-0.194 * (-5.78)	-0.060 (-1.14)	
EX	-0.276 * (-6.13)	0.135 * (3.00)	0.007 (0.13)
EXY	-0.343 * (-5.87)	0.104 *** (1.80)	-0.012 (-0.20)
EXWM	-0.201 * (-7.22)	-0.049 (-1.01)	

Notes: *, **, ***- as in Table 7.

Table 12: Granger Causality Tests, TFP and Import measures

The imports measure	Independent Variables		
	ECT(-1)	**D(trade(-1))**	**D(trade(-2))**
IM	-0.292 * (-5.52)	0.030 (0.74)	
IMY	-0.112 * (-2.39)	-0.067 (-1.02)	
IMWX	–	0.011 (0.26)	
IM	-0.314 * (-5.77)	0.032 (0.74)	-0.038 (-0.91)
IMY	-0.251 * (-4.16)	-0.062 (-1.12)	
IMWX	-0.311 * (-5.61)	-0.017 (-0.54)	

Notes: *, **, ***- as in Table 7.

5.6 On the Imports-GDP Causality: Is it Physical Capital Accumulation?

The surprising lack of imports' impact on TFP raises questions about the channel through which output is caused by imports. One possible channel is the influence of imports on physical capital accumulation that has been discussed in literature. Wacziarg (1998) argues that trade may provide a 'big push' effect on physical capital accumulation. He suggests three possible ways for this channel to operate. First, trade liberalization enables domestic agents to import unavailable capital goods (or produced at home but with higher costs). The imports of capital goods reduce the constraints on investment, and allow the adoption of new technologies, thus enhancing the process of capital accumulation. Second, open countries are better able to exploit increasing returns to scale, which operate by expanding the extents of markets (Ades and Glaeser, 1994). Market sizes increase the rate of capital accumulation, consequently supporting growth. The third channel usually applies to relatively labor-abundant economies. When adopting free-trade policies, they experience an increase in wages and decrease in the prices of investment goods as a part of factor-price equalization. The decrease in investment prices leads to higher investments and, thus, to more physical capital.

Levine and Renelt (1992), Wacziarg and Welch (2003) and Giavazzi and Tabellini (2004) are among the scholars who suggest positive effects of trade on physical capital accumulation. Romer (1990b) shows that a higher imports-GDP ratio is associated with higher physical investment. The positive effect of trade on capital accumulation in Levine and Renelt (1992) is one of only two robust results in their sensitivity analyses. Therefore, they conclude that the positive effect of trade on output growth "may be based on enhanced resource accumulation and not necessarily on the improved allocation of resources".

Following these studies, I conduct cointegration and causality tests between imports and physical capital. The cointegration vectors are presented in Table 5 of Appendix 3 and the causality tests are

reported in Table 1 of Appendix 4. The cointegration tests suggest a robust positive imports-physical capital association. Based on these specifications, the Granger causality tests, in general, support the prediction that capital accumulation is enhanced by imports: Causality has been found in 6 out of 11 cases, whereas in the other 5 cases it has been rejected (models 2 and 7-10). As for Model 2, causality has not been found possibly due to the problems of this measure mentioned earlier.[14] Each of the models 7 through 10 contains some variable that has been very unstable during the sample period. Therefore, the results found here may have been biased by the volatility of each of these variables. These results may reflect the contribution of imports to the Israeli economic development through the accumulation of inputs. This finding seems reasonable since most of the Israeli imports are production inputs and investment goods rather than consumption goods.

Finally, the fact that imports are cointegrated with TFP but not causing it may suggest that imports have long-run effects, rather than short-run effects, on the evolution of TFP. Over time, imports enable the absorption of new technologies and capital goods that lead to gradual improvements in productivity.

6 Robustness checks

This section presents the results of some robustness tests. I start by presenting cointegration results and then move to discuss the causality results. The main focus will be on examining the role of other variables on the evolution of TFP, either in the short-run or the long-run. The reason for that is the fact that, as discussed in section 4, most of these variables are believed to affect TFP, hence GDP.

6.1 Cointegration:

The inclusion of other determinants of TFP does not alter the conclusion of positive long-run trade-TFP associations (Table 6, Appendix 3). The signs of the various variables are, in general, as expected: Higher standard deviation of inflation and higher deficit as share of GDP are both negatively correlated with TFP. In contrast, government expenditures and taxes are positively cointegrated with TFP. The result about taxes is not in line with our earlier expectations (that consider higher taxes as harmful for efficiency, hence productivity). This surprising result may be biased due to the volatility of this variable, and/or by its role in financing productive government actions. Finally, the inclusion of the interaction variable (USTFP*OPENMUS) reveals that the spillover of U.S. technological knowledge to Israel is larger the higher the Israeli imports from the U.S. as share of overall Israeli imports. This finding is in line with suggestions of Coe and Helpman (1995).[15]

[14] The causality test using the trend of this measure indicates a significant positive causality.

[15] Since USTFP is an exogenous variable it is not a part of the cointegration vector (It only influences the relationship exogenously without being a part of it). Therefore, the USTFP is not shown in the table. However, since in model 8 USTFP is multiplied by OPENMUS (which is endogenous), the outcome is endogenous either. Consequently, its coefficient is reported above.

As for exports and imports, the cointegration tests suggest that adding more variables to the system does not alter the conclusion of long-run relationships between TFP on one hand and exports or imports, on the other. The cointegration vectors are presented in Table 7 and Table 8 of Appendix 3.

6.1 Causality:

The analyses show that adding more variables that affect TFP do not change the conclusion regarding the causality that runs from trade to TFP. As Table 2 of Appendix 4 shows, TFP has been found to be Granger-caused by the trade volume (TV) in all cases. These causality tests correspond to the cointegration vectors reported in Table 6 of Appendix 3.

Finally, considering the alternative human capital measure (YS13) even strengthen the above findings: with the exception of TVWT as the trade measure, causalities from the trade measure to TFP have been observed in 2 of the 3 multivariate specifications (Table 5 in Appendix 4).

7. Concluding Remarks

This paper examines the impact of international trade on the Israeli economic growth over the period 1960-2004. Despite a strong belief that trade (particularly exports) is an engine for a sustainable Israeli economic growth, former empirical studies were inconclusive regarding the validity of this prediction.

To test for this nexus, cointegration and causality tests were processed. The cointegration tests indicate positive long-run relationships between exports and imports from on one hand, and output and TFP, on the other. The results are robust both to the choice of the trade measure and to adding other variables that affect GDP and TFP.

The causality tests show that output is enhanced by both exports and imports. Total factor productivity, however, is caused only by exports suggesting that the Israeli economy is export-led through productivity. As for imports, the study suggests a positive effect on the accumulation of physical capital. Moreover, the addition of variables other than trade measures that affect GDP or TFP do not usually change the results regarding the role of trade in the Israeli economic growth.

Although this study provides evidence about the significant role of exports in macro-level growth, it does not point to the economic sectors that have been either benefited from or were harmed by the Israeli integration in international markets. Therefore, a future research that copes with this issue may possibly be complementary to the current study. Such a study is of high importance since it helps both to identify the desirable trade policy needed to support economic growth and to ensure the survival of some import-threatened economic fields.

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Appendix 1: Data Summary

GDP: Gross Domestic Product in real terms.

TFP: The Israeli Total Factor Productivity.

TV: The trade volume (exports plus imports) in real terms**.**

TVY: The trade volume-GDP ratio.

TVWT: The trade volume as a share of world trade.

EX: Exports in real terms.

EXY: The exports-GDP ratio.

EXWM: Exports as a share of world imports**.**

IM: Imports in real terms.

IMY: The imports-GDP ratio**.**

IMWX: Imports as a share of world exports**.**

OPENMUS: the share of Israeli imports from the U.S. to overall Israeli imports.

K: Gross capital stock, in real terms.

L: The weekly number of labor hours.

H: A human capital index: the enrollment rate at secondary school (the ratio of pupils in secondary school to the number of people in the age group 15-18 years).

YS13: A human capital index: the share of the Israeli population with 13 schooling years or more.

G: Total government expenditures, in real terms.

GY: The government size (the ratio of total government expenditures to GDP).

TAXY: Taxes as a share of GDP.

DEFY: The government budget deficit-GDP ratio.

USTFP: The U.S. TFP, calculated with a labor share of 2/3 and capital share of 1/3.

STDINF: the 5-year moving average of the standard deviation of inflation prior to year *t*.

Appendix 2: Unit Root Tests

Table 1: ADF unit root tests, 1960-2004

Variable	Levels	First Differences	Variable	Levels	First Differences
G	-2.00	-1.83	GDPPL	-0.64	-1.94
GY	-2.03	-7.70	KPL	-2.53	-2.62
TAXY	-1.55	-6.79	HPL	-1.33	-5.72
DEFY	-2.51	-6.47	TVPL	-2.39	-3.99
USTFP	-2.98	-3.24	GPL	-1.87	-6.44
YS13	-1.58	-7.25			

Notes: The critical values are from Mackinnon (1996). * and ** denote significance at 5% and 10%, respectively.

Appendix 3: Cointegration Vectors

Table 1: Cointegration Vectors of various variables with GDP.

Variable	1	2	3	4	5	6
K	0.580	0.689	0.617			
L	0.133	0.159	0.372			
H	0.214	0.254	0.126			
EX	0.159			0.702		
EXY		0.190			2.405	
EXWT			0.149			2.224
Const.	7.731	6.576	6.623	18.442	29.415	39.926

Table 2: Cointegration Vectors of various variables with GDP.

Variable	1	2	3	4	5	6
K	0.546	0.640	0.583			
L	0.205	0.240	0.431			
H	0.498	0.583	0.285			
IM	0.146			0.812		
IMY		0.171			4.320	
IMWX			0.155			__
Const.	8.128	7.157	7.045	16.942	30.447	__

Table 3: Cointegration Vectors of exports measures and human capital with TFP.

Variable	1	2	3	5	6	7
H				0.246	0.737	0.178
EX	0.280			0.233		
EXY		0.718			0.171	
EXWM			0.861			0.875
Const.	7.117	11.151	15.157	7.804	10.893	15.371

Table 4: Cointegration Vectors of imports measures and human capital with TFP.

Variable	1	2	3	4	5	6
H				0.166	0.741	1.301
IM	0.317			0.225		
IMY		1.414			0.687	
IMWX			_			0.223
Const.	6.596	11.584	_	7.292	11.358	12.211

Table 5: Cointegration Vectors of imports measures with physical capital (*K*).

	1	2	3	4	5	6
IM	0.854			0.633	0.989	0.837
IMY		3.667				
IMWX			-			
H				1.495		
G					-0.195	
GY						-0.172
Const.	16.825			20.345	20.207	16.853

Table 6: Cointegration vectors of TFP with trade and other variables.

Variable	1	2	3	4	5	6	7	8
H	0.566	0.500	0.507	0.633	0.428	0.500	0.777	0.494
TV	0.085	0.203	0.121	0.143	0.230	0.131	0.338	
G	0.143					0.114		0.314
GY		0.301						
TAXY			0.254					
DEFY				-0.524				
STDINF					-0.042	-0.010		-0.020
USTFP*OPENMU								0.247
Const.	4.787	5.185	7.669	6.903	4.591	4.288	2.068	2.238

Table 7: Cointegration Vectors of various variables with TFP.

Variable	1	2	3	4	5	6	7
H	0.550	0.620	0.353	1.046	0.546	0.451	0.849
EX	0.114	0.174	0.198	0.084	0.191	0.139	0.350
G	0.129					0.203	
GY		0.113					
TAXY			0.047				
DEFY				-0.543			
STDINF					-0.059	-0.012	
Const.	6.064	8.798	8.296	9.943	8.480	3.872	6.959

Table 8: Cointegration Vectors of various variables with TFP.

Variable	1	2	3	4	5	6	7
H	0.594	0.549	0.182	0.516	0.353	0.476	0.100
IM	0.044	0.194	0.248	0.174	0.251	0.147	0.288
G	0.187					0.182	
GY		0.142					
TAXY			0.097				
DEFY				-0.433			
STDINF					-0.034		
Const.	5.367	8.479	7.596	8.535	8.480	4.274	6.991

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Appendix 4: Causality Tests

Table 1: Granger Causality Tests, K and Import measures

The Imports		**Independent Variables**
measure	**ECT(-1)**	**D(trade(-1))**
IM	-0.059 *	0.044 *
	(-3.94)	(2.63)
IMY	-0.025 *	0.019
	(-3.80)	(0.79)
IMWX	–	0.065 *
		(5.26)
IM	-0.044 *	0.051 *
	(-3.36)	(2.85)
IM	-0.081 *	0.036 ***
	(-5.23)	(1.86)
IM	-0.085 *	0.032 ***
	(-5.06)	(1.86)
IM	-0.086 *	0.009
	(-4.25)	(0.46)
IM	-0.075 *	0.022
	(-5.27)	(1.28)
IM	-0.075 *	0.018
	(-4.60)	(0.93)
IM	-0.080 *	0.017
	(-5.34)	(1.00)
IM	-0.013 **	0.045 *
	(-2.04)	(2.39)

Note: *, ** and *** denote significance in the 1%, 5% and 10% level, respectively.

Table 2: Granger Causality Tests, TFP and Trade measures

	Independent Variables	
ECT(-1)	**D(trade(-1))**	**D(trade(-2))**
-0.372 *	0.140 *	-0.002
(-5.21)	(2.42)	(-0.02)
-0.340 *	0.123 *	
(-6.10)	(2.38)	
-0.370 *	0.145 *	-0.019
(-5.61)	(2.53)	(-0.31)
-0.358 *	0.137 *	
(-6.33)	(2.76)	
-0.331 *	0.122 *	-0.010
(-6.33)	(2.34)	(-0.19)
-0.351 *	0.132 *	-0.006
(-5.47)	(2.19)	(-0.09)
-0.369 *	0.118 ***	
(-6.42)	(1.91)	
-0.266 *	-0.034	
(-5.23)	(-0.98)	

Note: *, ** and *** denote significance in the 1%, 5% and 10% level, respectively.

Table 3: Granger Causality Tests, TFP and Export measures

Independent Variables			
ECT(-1)	**D(trade(-1))**	**D(trade(-2))**	**D(trade(-3))**
-0.335 *	0.153 *	0.049	
(-6.06)	(3.29)	(0.92)	
-0.338 *	0.154 *	0.041	
(-6.15)	(3.30)	(0.77)	
-0.295 *	0.130 *	0.001	
(-6.03)	(2.72)	(0.03)	
-0.380 *	0.206 *	0.068	0.112 *
(-6.00)	(4.64)	(1.27)	(2.34)
-0.284 *	0.119 *		
(-6.25)	(2.60)		
-0.270 *	0.111 *		
(-6.57)	(2.45)		
-0.325 *	0.134 **	-0.052	0.088
(-4.67)	(2.06)	(-0.79)	(1.30)

Note: *, ** and *** denote significance in the 1%, 5% and 10% level, respectively.

Table 4: Granger Causality Tests, TFP and Import measures

Independent Variables			
ECT(-1)	**D(trade(-1))**	**D(trade(-2))**	**D(trade(-3))**
-0.354 *	0.068		
(-5.73)	(1.37)		
-0.354 *	0.047		
(-5.73)	(1.07)		
-0.317 *	0.035		
(-5.41)	(0.81)		
-0.349 *	0.049		
(-5.77)	(1.20)		
-0.330 *	0.048	-0.020	0.034
(-4.78)	(0.87)	(-0.38)	(0.60)
-0.317 *	0.045		
(-7.11)	(1.09)		
-0.267 *	0.031		
(-4.25)	(0.72)		

Note: *, ** and *** denote significance in the 1%, 5% and 10% level, respectively.

Table 5: Granger Causality Tests, TFP and Trade measures

The trade measure	**Independent Variables**		
	ECT(-1)	**D(trade(-1))**	**D(trade(-2))**
TV	-0.297 *	0.118 **	-0.023
	(-5.77)	(2.28)	(-0.46)
TVY	-0.271 *	0.060	-0.041
	(-5.20)	(0.86)	(-0.59)
TVWT	-0.337 *	0.010	0.005
	(-5.75)	(0.16)	(0.09)

Notes: *Note*: *, ** and *** denote significance in the 1%, 5% and 10% level, respectively.
The human capital index: YS13.

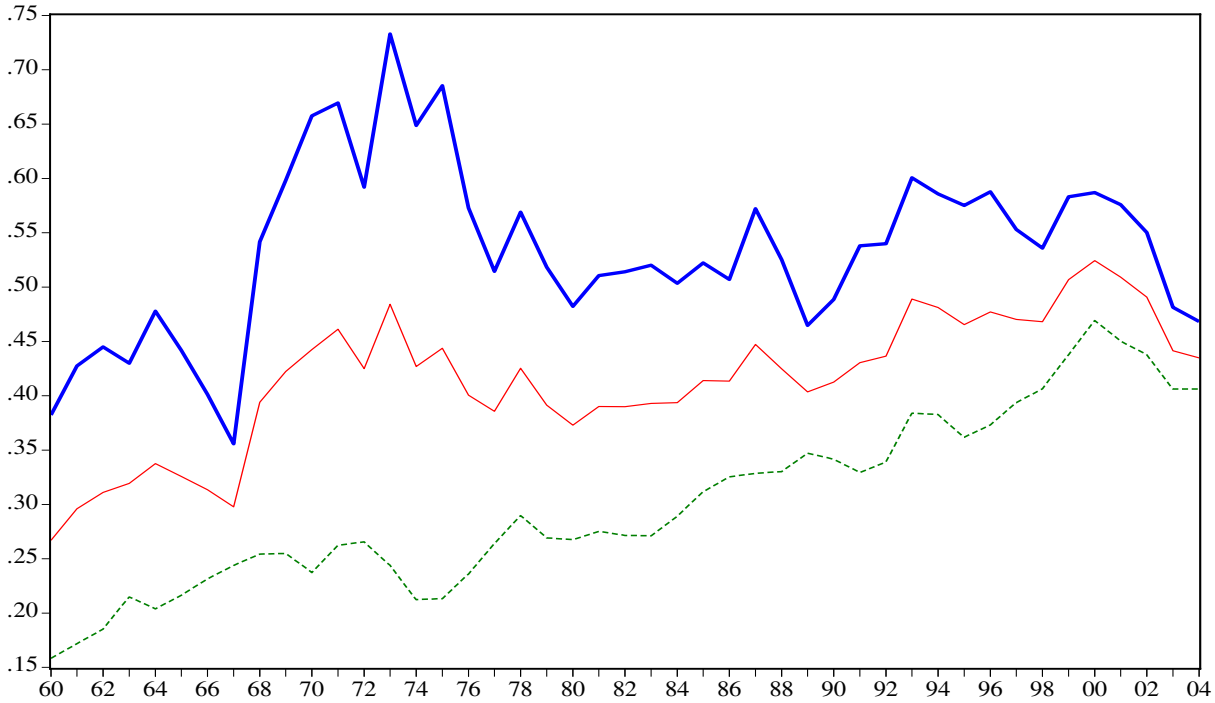
Table 6: Granger Causality Tests, GDP and Trade measures

The trade measure	Independent Variables		
	ECT(-1)	**D(trade(-1))**	**D(trade(-2))**
TV	-0.422 **	0.172 ***	-0.039
	(-2.29)	(1.92)	(-0.42)
TVY	-0.372 **	0.439 ***	-0.040
	(-2.29)	(1.92)	(-0.42)
TVWT	-0.525	0.121	0.002
	(-0.52)	(1.47)	(0.02)

Note: Here, the number of immigrants in part of the specification.

Appendix 5: Graphs

Figure 1: Israeli Trade share in world trade, in percents, 1960-2004



Note: Thin Line-the share of Israeli trade in world trade; thick line- the share of Israeli imports in world exports; dashed line- the share of Israeli exports in world imports.