

THE EFFECT OF FISCAL POLICY AND ITS COMPONENTS ON GDP IN ISRAEL

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Abstract

This article is the first attempt to use the VAR technique to investigate the effect of fiscal policy in Israel on GDP, aggregate demand in the private sector, private consumption and private investment. The research is carried out using quarterly cross-section data for the period 1986-2008.

Among the key findings:

- A positive shock of one percent in **public consumption** is expected to increase GDP by 0.2 percent, aggregate demand in the private sector by 1 percent, private consumption by 0.3 percent and private investment by 1.3 percent. In terms of level, an increment of 1 shekel in public consumption will increase GDP by 70 agorot, which means that the main finding supports the Neo-classical model based on it the level of the fiscal multiplier is less than 1.
- A positive shock of one percentage point in the statutory indirect **tax rate** is expected to reduce aggregate demand in the private sector by 1.3 percent, private consumption by 0.6 percent and private investment by 2 percent. In contrast, most of the tests found that a shock in the statutory direct tax rate had no effect on these variables.

Various components of public consumption have different effects. A positive shock in government local defense consumption has a moderate but persistence effect, in contrast with a positive shock in civilian government consumption, which has a sharp but short-term effect. A positive shock in public sector purchases has a more persistent and larger effect than that of a positive shock in total public sector wages.

1. INTRODUCTION AND REVIEW OF THE LITERATURE

The theoretical debate concerning the effect of fiscal policy on other macroeconomic variables, and the lack of consistency in the empirical findings on the subject, have served to stimulate additional macro-fiscal studies, especially in Israel, where very little empirical research has been done on this subject.

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In theory, those who have reservations about using the fiscal policy tool claim that it is slow to have an effect (in contrast with monetary policy), that it is subject to pressure from interested parties, that individuals take future income into account, and that a fiscal decision that may be appropriate at one point in the business cycle is irreversible. For example, it is difficult to reduce public expenditure once the decision has been made to increase it. The expansion of the deficit can undermine stability, the public's sense of economic security, and the government's fiscal credibility, and in particular it can lead to a rise in the expected permanent tax burden (Ricardian effect¹), thereby reducing the demand for investment and consumption in the present, too.² Those who advocate counter-cyclical expansion show that in a situation of price and wage rigidity, fiscal expansion—whether it involves a rise in public consumption and/or a reduction in tax rates—will stimulate demand, especially if it is credible and transparent. The public needs to know its extent and duration, and in particular to understand how it is financed.

As stated above, the empirical findings do not settle the debate. Some studies find that a positive public consumption shock generates a positive shock in private consumption and real wage (Fatas & Mihov, 2001 ; Blanchard & Perotti ,2002 ; Gali, Lopez-Salido & Valles, 2007). Others support the opposite view, among them Edelberg, Eichenbaum & Fisher, 1999; Ramey & Shapiro, 1998; Ramey, 2009)

There are several reasons for the lack of consistency in the findings, even when they refer to the same countries. First, in estimating the equations it is difficult to take into account many variables which might be relevant (omitted variables regressions). Second, in terms of method, it is difficult to distinguish between a deliberate change in government policy and one that stems from the automatic stabilizers. In addition, there are various ways of implementing policy—via taxes, transfers and/or government consumption—and they have different characteristics and effects. Sometimes, for the purposes of the examination the time when a policy is implemented is not clear—is it the day it was initiated or the day the law was ratified? The calculation of the fiscal variable is not uniform either, as it is subject to the researchers' subjective assumptions. In addition the definition of the *timing* of the news, for example: future increases in government spending, is also an issue (Ramey, 2009). Finally, some of the variables affect one another simultaneously. The last problem is the most difficult to solve. Various econometric methods have not managed to overcome all the problems, and each system has its own advantages and disadvantages.

Despite these difficulties, research throughout the world has reached several conclusions: 1. There is no evidence to show that the multiplier of government investment is greater than that of government consumption; 2. The short-term effect of taxes is smaller than that of expenditure, though this is not clear with regard to the medium term; 3. There is considerable variance between countries concerning the consumption multiplier; 4. The multiplier is greater in large countries, countries with a low debt, and in closed economies.

¹ Formally, Ricardian equivalence refers to inability of tax policy to have effect on output, as the government's intertemporal budget constraint would require an opposite change in taxes – equal in net present value – in a future date.

² See, for example, A. Sutherland (1997).

Using the VAR (Vector Auto Regressions) technique for quarterly data weakens the problem of simultaneity (Blanchard and Perotti, 2002). In particular, it may be assumed that fiscal policy, government spending or tax rate decisions, does not react immediately to changes in GDP, as these are not even known for certain by policymakers, and even if they are an immediate response is not possible as considerable time is required to approve any kind of fiscal policy. Thus, for example, the budget framework in Israel, as is the case in most countries, is annual, so that the flexibility for making macroeconomic changes within the year is limited.³

An interesting exercise is to distinguish between the various components of fiscal policy and analyze their effects separately. In this article I examine the influence of public consumption separately for wage payments and other components, as well as reviewing the different effects of civilian and defense consumption, and also that of the statutory tax rate. For this purpose, I examine macroeconomic variables—GDP, business-sector product, private consumption, private investment, the long-term interest rate; as well as a nominal variable—the CPI (Consumer Price Index).

In the US Blanchard and Perotti (2002) examined a basic VAR model with three variables—GDP, government consumption, and net tax receipts. They found that public consumption shocks have a positive effect on GDP (a cumulative effect of 50 percent after four quarters, and double after twelve quarters), as well as on private consumption, and that a tax-receipt shock has a negative effect. In general, a negative effect was estimated for the elasticity of private investment as a response to tax and public consumption shocks, while no consistent effect was found regarding imports and exports, if any effect at all was found. The crowding out of investment was also found by Alesina et al. (1999) for twenty OECD countries.

Fatas and Mihov (2001) used a similar technique, also for the US,⁴ and found similar coefficients to those of Blanchard, albeit with less persistence. They also distinguished between wage and non-wage expenditure, and found that the effect of a wage-expenditure shock was greater than that of a non-wage expenditure one. One reason for this is the greater persistence of the wage component. Woodford and Rotemberg (1992) examined primarily the effect of public defense consumption, separating wage expenditure from purchases, and found that the elasticity of GDP is above unity for defense purchases, but declines after eight quarters. Ramey and Shapiro (1998) and Edelberg et al. (1999) used the exogeneity of exceptional public defense consumption in the Vietnam War and estimated its effect in univariate models and VAR models respectively. In both studies they found that the elasticity of GDP was positive and relatively persistent. In addition, Burnside, Eichenbaum and Fisher (2004) add September 11, 2001 as an additional shock and find rise in the aggregate hours of works as well as decline in the real wage as a response to the shock.

³ Another point is that under the VAR system there is a tacit assumption that changes/residuals in fiscal policy are unanticipated, though in actual fact such changes may be anticipated by the private sector.

⁴ They used the fiscal deficit rather than public consumption and taxes, and the inverse order of variables, meaning that they assumed that the macroeconomic variables do not respond immediately to policy variables.

Caldara and Kamps (2008) employed a similar VAR model to the one estimated here, using US data for 1995-2006, and found a positive coefficient for public consumption vis-à-vis GDP, private consumption, and wages, but did not identify an effect regarding the number of persons employed. They also found a negative coefficient for the tax burden.

Giordano et al. (2008) examined a model for Italy very similar to the one used here, employing an identical method. They found that public purchases had a positive effect on business-sector product, with an elasticity of 0.6 after three quarters, which disappeared after two years. They also found a positive effect on private consumption, private investment, and private-sector employment, as well as a small effect on the inflation rate. In contrast with these, no effect was found for public-sector wage expenditure, except for a slight negative effect on business-sector employment.

Gali et al. (2006) included four components—GDP, government consumption, employment, and the real interest rate—in their basic model, using US data. They found that a shock in government consumption had a unitary positive effect on GDP after four quarters, and double that effect after twelve quarters. They also found that it had a positive effect on private consumption and no effect on investment.

It is almost certain that the relative rarity of similar studies outside the US is because quarterly data is not available. Perotti (2002) examined a similar model using five variables for Australia, the UK, Germany, and Canada. He found that the response to a shock in public consumption in those countries is weaker than that in the US, especially because after the 1980s a negative multiplier is not rare. Forni et al. (2007) examined the effect of various policy variables on macroeconomic variables in Europe. They found a relatively small and short-term effect of the expansion of public consumption, and a greater positive effect of transfers and/or tax cuts. In France Biau and Girard (2005) used a VAR model with five variables (government consumption, net tax receipts, GDP, prices, and the interest rate), and found a multiplier of 1.9 and 1.5 for the fourth and twelfth quarters respectively, as well as a positive effect on private consumption. In Spain De Castro and Hernandez de Cos (2006) found a positive relation between government consumption and GDP in the short term, and in the medium and long term a positive relation between public consumption and prices, as well as a negative one between public consumption and GDP.

A recent study undertaken by Burriel et al. (2009) in Spain used a similar technique to examine the effect of fiscal variables on GDP, private consumption, and private investment in Europe and the US, on the basis of quarterly data for 1980-2007. They found a multiplier of almost 1 for total GDP for Europe and the US, and a multiplier of less than 1 for private consumption in Europe and the US (lower in Europe), with a positive multiplier for private investment in Europe and a negative one for private investment in the US—as a result of a public consumption shock.

In Israel Lavi and Strawczynski (2005) examined the short- and long-term effects of public consumption on private consumption (crowding out), emphasizing the need to take consumers' expectations into account. They applied the cointegrative method to data from 1960 to 2000, and found limited substitution between public and private consumption (20 percent), as well as an effect on the way private-consumption expenditure is financed, contradicting the Ricardian theory.

Strawczynski and Flug (2007) examined the effect of fiscal policy variables on protracted growth episodes in Israel between 1961 and 2006. They found a positive effect of the quality of macroeconomic management on economic growth in Israel, estimating its effect at one-third, and accounting for the rest of explained growth with the aid of exogenous variables.

To sum up the empirical findings, in the US a positive public-consumption shock will have a positive and persistent effect on private consumption and GDP, while the results for other countries are not consistent. Note that these findings should be regarded as averages of points in the business cycle, and hence are not necessarily valid during a recession or period of growth beyond the average growth path.⁵

The structure of this article is as follows: section 2 describes the data, section 3 explains the method, section 4 presents the empirical results, including a robustness test at the end, and section 5 concludes.

2. THE DATA

This study examines the effect of public-expenditure shocks on other macroeconomic variables, using quarterly data from the period from 1986 to 2008. I have chosen to start the period reviewed in 1986 rather than earlier because in the years 1983-1985 Israel suffered from hyper-inflation, and this affects the reliability of the data in general and that of the effect examined in particular, as exceptional observations in periods of this kind could skew the results. Subsequently, an Economic Stabilization Plan (ESP) was put in place, giving rise to convergence to a far lower rate of inflation.

All the data are real and adjusted for own prices and seasonal factors. The data are from the Central Bureau of Statistics (CBS).

Public consumption is defined as total public expenditure *less* interest payments and transfers. Total public consumption can be divided into purchases and wage expenditure, which together account for 80 percent of public consumption (to which are added depreciation expenditure and pension payments), as well as into public civilian and defense consumption. In effect, the variable of public expenditure without defense imports was used. The statutory tax rate is its weighted rate (according to Strawczynski and Flug, 2007), and the interest rate is the lending rate. The number of employed persons in the private sector is published by the National Insurance Institute. The data on GDP and total private consumption are provided on a quarterly basis by the CBS.

The exogenous variables used are business-sector product in the US, the number of immigrants, the number of fatalities as a result of acts of terrorism (from data provided by the *B'Tselem* organization), the number of tourists, and the total population.

⁵ Alternative approaches to defining a public-consumption shock were examined by Edelberg et al. (1999) and Mountford and Uhlig (2002). The former examined the effect of an increase in defense expenditure in the US during a specific period and found that it had a positive effect in the short term.

Figure 1 gives the development of public consumption, wage expenditure, public purchases, and the statutory tax rate. Several basic conclusions can be drawn on the basis of the figure:

1. Public consumption without defense imports rose steadily and at a relatively even annual average rate of 2.2 percent. The exception to this is the period after the ESP and the period between 2002 and 2005, in both of which public consumption remained unchanged.

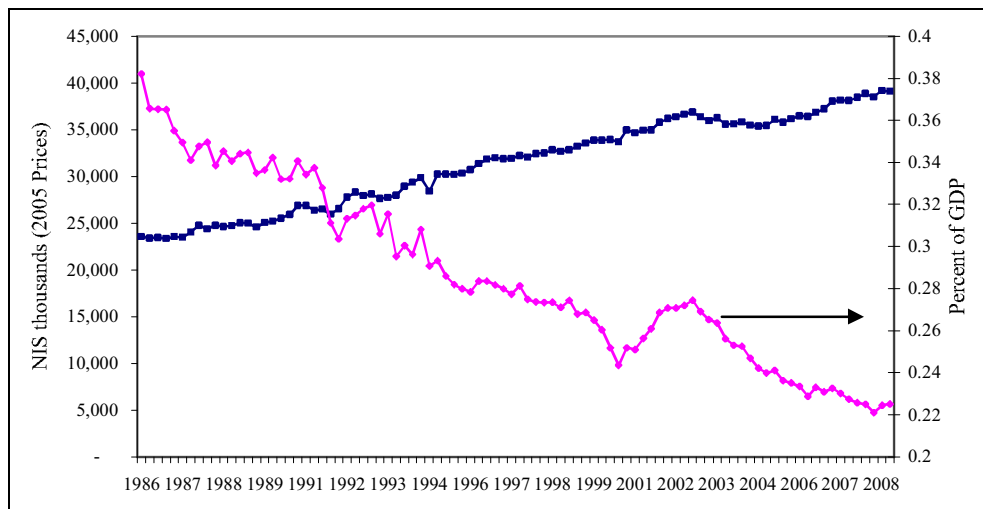
2. GDP rose at an annual average rate of 4.6 percent, leading to a reduction in the share of public consumption in GDP. This is reflected primarily in the faster rise of private consumption.

3. Total wage payments in the public sector, adjusted for own prices, grew in a fairly balanced way (except for the period between 2002 and 2005, when there was no real rise in total wage payments). By contrast, public consumption in the purchases category rose quite rapidly until 2000, leading to a decline in the share of wage expenditure in public consumption (from 68 percent at the beginning of the period to 58 percent in 2000).

4. The statutory tax rate declined during the period reviewed, doing so especially sharply since 2003, as a result of a relatively steep reduction of the statutory rate of direct taxes and the absence of a trend in the path of the statutory rate of indirect taxes.

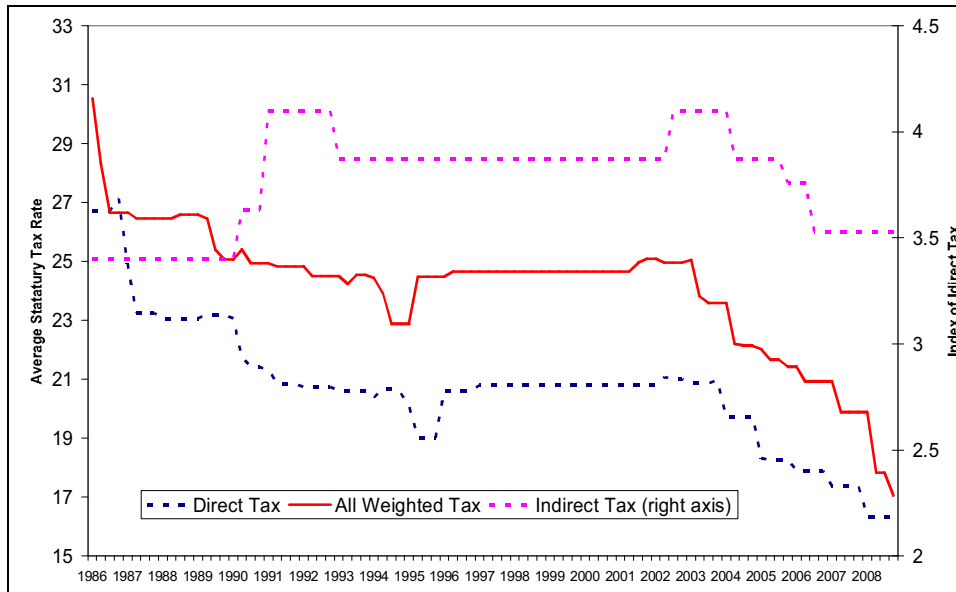
Figure 1

**The Development of the Fiscal Variables (data in NIS millions, seasonally adjusted)
Public Consumption without Defense Imports**



Public Consumption: Wages and Purchases

The Weighted Average Statutory Tax Rate



Granger tests show that most of the variables are correlated simultaneously, so that the problem which can arise in simple regression models does in fact exist. However, the greater the number of differences taken into account, the weaker is the relation between the variables.

3. THE VAR MODEL

In common with the study by Giordano et al. (2008), the model uses seven endogenous variables. In contrast with that study, however, I add exogenous control variables, as follows: public consumption without defense imports⁶ or wage payments in the public sector, and public purchases without defense imports, or public domestic defense consumption, or civilian consumption; the direct and indirect statutory tax rates;⁷ the

⁶ This variable is more relevant for Israel than total public consumption, and is equivalent to the variable of total public consumption employed in studies of economic policy in other countries, because in Israel these imports are almost entirely financed by the defense aid received from the US, and its timing is determined in long-term contracts, and not by current decisions.

⁷ In other studies it is customary to substitute net tax receipts for the statutory tax rate. The main problem with the former is that it is endogenous to GDP fluctuations. For this reason, tax revenues the structural VAR identifications accounts for the GDP-elasticity of the tax revenues, thus controlling for the automatic movements of the revenues respect to GDP. Even those, in this study I have preferred to use the average weighted statutory tax rate because, by the same reason as public consumption, it does not respond automatically to changes in the business cycle.

number of persons employed in the private sector; GDP or aggregate private-sector demand or private consumption or private investment; the interest rate and the CPI.

The effects of the main components of public consumption—purchases and wages—may differ, and is the logic behind relating to each component separately. On the one hand, the effect of public purchases on demand is direct, in contrast to the effect of wage payments; on the other, a shock in purchases is less persistent. There may also be a rise in defense consumption, signaling a deterioration in the security situation alongside a change in government priorities, while an increase in civilian consumption may signal the opposite; these influences are added to the direct effect on aggregate demand.

The order of the variables is very important for logical reasons, but as it turns out, in most cases it does not affect the quality of the empirical results (see below). The exogenous control variables are GDP in the US, the number of immigrants, the number of tourists, the number of fatalities in acts of terrorism, the population, and a linear time trend variable. The time trend is correlated in a different way with each variable in the system, so that in fact the model estimates deviations from the long-term time trend; thus, in the model these detrended variables are stationary⁸. All the variables in the basic model are in log form (increase by percentages) with the exception of the interest rate and the statutory tax rate, for which no log was taken. I have chosen to use the long-term rather than the short-term interest rate (essentially the Bank of Israel's key interest rate), because the former appears to be more significant for the components of business-sector product. Not all the results are presented in the article, and I have confined myself to giving only the significant and robust ones.

The basic form of the VAR model is as follows:

$$(1) \quad Y_t = C + B(L)Y_{t-1} + C(L')X_t + U_t$$

Where Y_t is the vector of the endogenous variables, $B(L)$ is the matrix of the own lags, $C(L')$ is another matrix of lags, U_t is the residual, and C is the constant.

All the variables as they appear in the VAR model (the first difference or the log difference) are stationary at a significance level of less than 1 percent (Dickey-Fuller tests). As regards level—all of them, except the interest rate, are I(1), i.e. the detrended variables are stationary (for example see in the appendix the Dickey-Fuller tests for the detrended variables in the first system). I also examined the level of cointegration between the variables according to a cointegration rank trace test, and found that the variables have a level of cointegration with two own variables although this depends on the number of lags of the variables; and according to a maximum eigenvalue test the variables have a cointegrative relation with a single own vector (resistant to the number of lags). This means that the variables are cointegrative with one another.

⁸ The Unit root tests are available by request.

a. Definition of a fiscal shock

The method presented below is based on that of Blanchard and Perroti (2002) and Perroti (2002), which is also the one used in Giordano et al. (2008). As is the case in the standard SVAR model, we assume a relation between the error in the basic regression and structural shocks, or, as in this case, the structural fiscal shocks. In this article we use the Cholesky decomposition, namely, a triple matrix (zeros on one side of the diagonal) to describe the simultaneous effect of a shock in each of the endogenous variables on the endogenous variables in the system. In other words, **each variable in the estimation order has a simultaneous effect on the variables which are below it, but is not affected by them.**

I assume the following relation between the structure shocks V and the residuals U

$$(2) \quad AU_t = BV_t$$

with the assumption that the structural shocks are i.i.d.

An alternative way to write (2) is:

$$(3) \quad \begin{aligned} u_t^g &= \alpha_y^g u_t^y + \alpha_p^g u_t^p + \alpha_i^g u_t^r + \alpha_e^g u_t^e + \beta_T^g v_t^T + \beta_w^g v_t^w + v_t^g \\ u_t^w &= \alpha_y^w u_t^y + \alpha_p^w u_t^p + \alpha_i^w u_t^r + \alpha_e^w u_t^e + \beta_T^w v_t^T + \beta_g^w v_t^g + v_t^w \\ u_t^T &= \alpha_y^T u_t^y + \alpha_p^T u_t^p + \alpha_i^T u_t^r + \alpha_e^T u_t^e + \beta_g^T v_t^g + \beta_w^T v_t^w + v_t^T \end{aligned}$$

The parameters α_j^i are the elasticity of the fiscal variable i to macro variable j (y, p, i, e – the GDP, Prices, Interest and Employees, respectively), which contains an automatic and discretionary component. The parameters β_j^i estimate the impact of the structural and fiscal shocks one on each others. This paper purpose is to estimate the structural shocks v_t^i .

(2) does not make it possible to define the fiscal shock without more assumptions. As accepted in this kind of literature we define this shock by exploiting the fact that the decision about the fiscal variable is not performed simultaneously with the other variables. Particularly, we assume that the decision makers need at list one quarter to react to the other variables. This assumption is logical as it takes time to publish the national outcomes (six weeks at list), to analyze them, to decide what to do, to confirm the decision and finally to implement it. As a result the coefficients α_j^i estimate only the automatic impact of the macro variables j on the fiscal variable i . Due to the delay in the policy decisions and their implementation the simultaneous coefficients the impact of the macro variables j on the fiscal variable i is null.

By reason of u are correlated with the structural shocks, we can not estimate correctly the coefficients α_j^i . Thus, to define appropriately the system we should set haddock coefficients as the automatic impact of variable j on variable i . As a basic we assume that those coefficients are null.

Define:

$$\begin{aligned}
 u_t^{w,CA} &\equiv u_t^w - \alpha_y^w u_t^y - \alpha_p^w u_t^p - \alpha_i^w u_t^r - \alpha_e^w u_t^e = \beta_T^w v_t^T + \beta_g^w v_t^g + v_t^w \\
 (4) \quad u_t^{g,CA} &\equiv u_t^g - \alpha_y^g u_t^y - \alpha_p^g u_t^p - \alpha_i^g u_t^r - \alpha_e^g u_t^e = \beta_T^g v_t^T + \beta_w^g v_t^w + v_t^g \\
 u_t^{T,CA} &\equiv u_t^T - \alpha_y^T u_t^y - \alpha_p^T u_t^p - \alpha_i^T u_t^r - \alpha_e^T u_t^e = \beta_g^T v_t^g + \beta_w^T v_t^w + v_t^T
 \end{aligned}$$

CA are for Cyclically-Adjusted. Because of β_j^i can not being defined simultaneous, we must set an order to the policy variables. As a basic, we assume that the decision about the wage component is the first decision, which means that $\beta_T^w, \beta_g^w = 0$; then the decision about the purchasing component, which means that ; and finally the tax rate decision. Consequently three coefficients are remained $\beta_w^g, \beta_g^T, \beta_w^T$, which we would like to estimate by the following model:

$$\begin{aligned}
 (5) \quad u_t^{w,CA} &= v_t^w \\
 u_t^{g,CA} &= \beta_w^g v_t^w + v_t^g \\
 u_t^{T,CA} &= \beta_g^T v_t^g + \beta_w^T v_t^w + v_t^T
 \end{aligned}$$

After we defined the fiscal shocks we want to estimate the impact of them on the macro variables by using (6):

$$(6) \quad u_t^y = \alpha_g^y u_t^g + \alpha_w^y u_t^w + \alpha_T^y u_t^T + v_t^y$$

While setting $\hat{v}_t^g, \hat{v}_t^w, \hat{v}_t^T$, which estimated in (5), instead of u_t^g, u_t^w, u_t^T , respectively.

b. The shocks

Figure 2 presents the development of the fiscal shocks over time, i.e., shocks⁹ in public consumption, public consumption without defense imports, public consumption which is wage payments and purchases, and civilian and defense public consumption. From the figure it is possible to draw the following conclusions:

1. The shocks declined gradually over time. Due to the "stabilization program" and its implementation after 1986 the changes in the government spending have become progressively smaller, except years 1993 to 1995, in which very large wage agreements in the public sector in Israel were signed and be implemented.

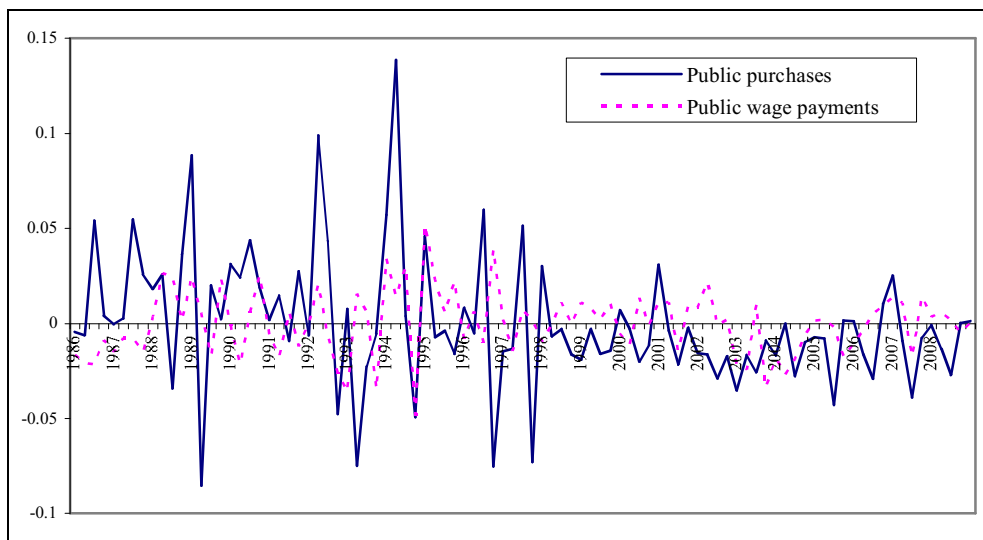
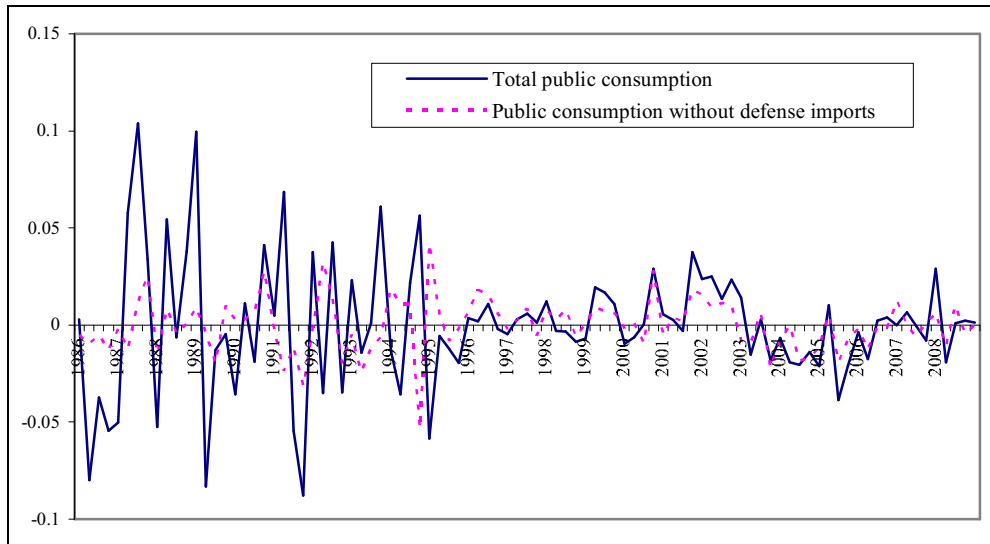
2. The volatility of total government consumption is two and a half times as great as that of government consumption without defense imports. The volatility of the purchases

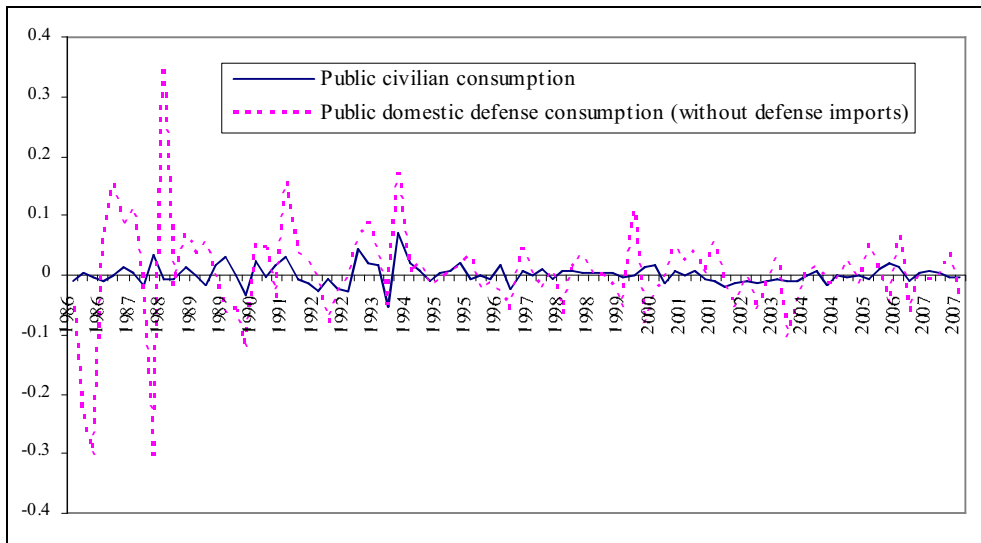
⁹ The shocks were defined as the residuals of autoregressive equations with three lags; shocks defined as the residuals of equations which also included other variables were found to be very similar.

component in government consumption is twice as great as that of wage payments. The volatility of government domestic defense consumption is five times as great as that of public civilian consumption.

3. The residuals derived from each equation are stationary—the results of the D.W. tests are around 2 for all the residuals.

Figure 2
The Fiscal Variable Shocks





Because of the problem of the reliability of the data, the period of inflation, and the ESP, the statistical tests focus on the period from January 1990 to April 2008. Examining this period, which incorporates several business cycles, serves the purpose of the study. Furthermore, because it is relatively brief it is also less exposed to changes in coefficients during it, and in effect the small sample reduces the possibility of applying the Lucas critique (1976) to the research results.

4. THE EFFECT OF FISCAL SHOCKS

In this section I present the empirical results of the VAR model. The impulse responses are those of the macroeconomic variables to a 1 standard deviation change in the fiscal variable from its long-term trend line (henceforth, the shock). The result is presented as both a marginal and a cumulative effect. The results are given in graphic form only when the effect of the estimated variable is significant; the remaining results may be obtained from the author. Each figure also presents the confidence intervals of the effect at the 95 percent level, so that if 0 is not included in the interval we conclude that the effect is significant at the 95 percent level. Each model is examined separately, once with the variables at levels (*log*) (presented in the article), and once in the form of difference differences (*dlog*) (not presented in the article and obtainable on request).

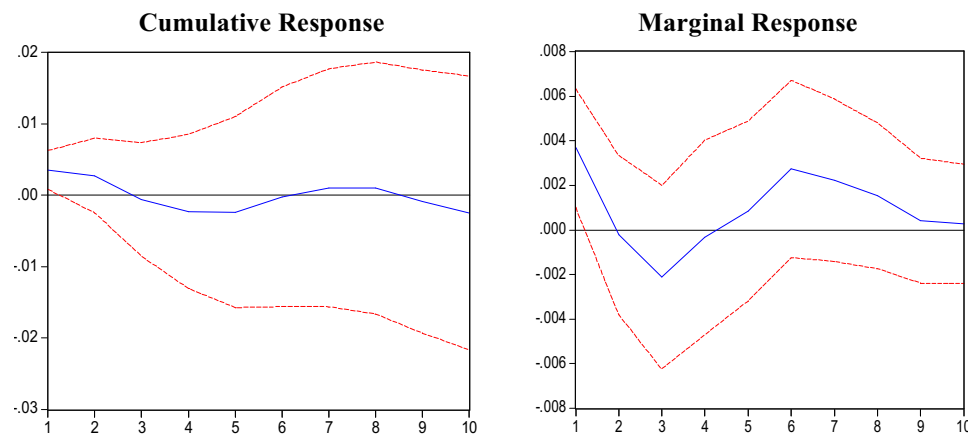
General note: in order to translate the results into percentage elasticities they have to be divided by the standard deviation of the dependent variable.

a. GDP

Figure 3 describes the marginal and cumulative response of GDP to policy variable shocks.

Figure 3a presents the cumulative and marginal response of GDP to a shock in public consumption without defense imports. A positive shock of 1 percent in this type of public consumption is expected to have a positive effect on GDP, increasing it by 0.23 percent in the first quarter after its occurrence, and by a similar rate in the two subsequent quarters. This finding is robust. (Here and later "robust" is robust to change at the studied period, at the number of lags, at the order of the endogenous variables and to a specification with rates of change) The multiplier¹⁰ of GDP obtained is 0.17, which is lower than in the developed countries.¹¹ In other words, given the average share of public consumption without defense imports in GDP during the period reviewed (27 percent, Figure 1), a rise in total public consumption does not increase GDP beyond the expansion of public consumption itself, and may even reduce it slightly. The size of the multiplier ranges from 8 to 31 percent (Table 1), and on average is 19 percent. Taking into account the average value of the multiplier in the models examined, an addition of 1 shekel of public consumption without defense imports will increase total GDP by 70 agorot. The latter result supports Neo-classical model which its main prediction is that the elasticity of the public consumption is less than 1.

Figure 3
The Response of GDP to a Shock in Public Consumption without Defense Imports



¹⁰ The multiplier is the quotient of the cumulative result of GDP to the cumulative result of the fiscal variable.

¹¹ A recent study in the Bank of Spain (Burriel et al., 2009) found a multiplier of 0.87 in Europe (EMU) and 0.91 in the US.

We now distinguish between a shock in public wages consumption and a shock in public purchases consumption without defense imports.¹² The analysis shows that a positive shock in public wages consumption is not expected to affect GDP. However, a positive shock in public purchases consumption is expected to have a positive effect over a two-quarter term. A positive shock of 1 percent in public purchases consumption is expected to have a positive effect on GDP, increasing it by 0.2 percent over the subsequent six months. The multiplier of public civilian purchases is 0.13, meaning that given the average share of public civilian purchases in GDP throughout the sample period (7 percent), a one percent rise in public civilian purchases increases GDP by 0.06 percent beyond its growth rate two quarters later.

We next distinguish between a shock in public domestic defense consumption and a shock in civilian consumption¹³. The analysis shows that both components are expected to have a positive effect on GDP.

A positive shock of 1 percent in civilian consumption is expected to increase GDP by 0.24 percent after only one quarter. The multiplier in this instance is 0.26 percent. Given the average share of public civilian consumption in GDP throughout the sample period (20 percent), a 1 percent increase in it expands GDP beyond its growth rate by 0.06 percent in the first quarter alone, but not subsequently.

A 1 percent positive shock in domestic defense consumption is expected to increase GDP by 0.07 percent after one quarter and by a cumulative 0.12 percent after two quarters. The multiplier is 0.08, given the average share of public defense consumption in GDP throughout the period reviewed (7 percent), a 1 percent rise in it increases GDP beyond its growth trend by 0.01 percent. Thus, the multiplier of public civilian consumption relative to GDP is greater than the multiplier of public defense consumption, and the size of the multiplier of total public consumption lies between them.

According to the VAR model, a shock in the overall statutory tax rate, whether it expresses a shock in the direct or the indirect tax rate, is not expected to have a (significant) effect on GDP.

Table 1 (as well as Tables 3 and 4 below) sums up the elasticities of GDP to each of the variables examined. The table shows the highest marginal elasticity and its quarter; the cumulative elasticity until the time when it is not significant at the 95 confidence level, and the quarter in which this occurs. Alongside these, the table gives robustness tests by means of additional models which were examined and estimates of elasticity. The robustness tests employed were: an examination of the variables in the rate of change instead of level¹⁴ (dlog instead of log) an examination of a longer period (from 1986), the change in the order of the policy variables, and finally the change in the number of lags introduced into the model - In the benchmark I used VAR with 3 lags because this number of lags is commonly used at other researches used VAR methodology and according to standard tests based on

¹² In this study we use public civilian consumption, which is a good proxy for public consumption without defense imports.

¹³ In the basic model it is assumed that the decision regarding defense consumption precedes that regarding civilian consumption.

¹⁴ This is an econometric test which examines the robustness of the result when the variables in the system are stationary, i.e., rates of change.

information criterion there is no single number of lags that is better than other, i.e. in some cases it is better to use 2,3,4 or even more lags.

In all the tests the quality of the effect remained the same, even when models with rates of change are used instead of level; this finding reinforces our results.

Table 1
The Elasticity of GDP and Robustness Tests

	Marginal effect	Cumulative effect	Rate of change ^a	Longer period	Change in order of variables	2 lags	4 lags
Public consumption without defense imports	23% (1)	22% (2)	2	22% (3)	28% (1)	10% (2)	33% (2)
Multiplier of public consumption		17%		19%	22%	8%	31%
1 Shekel increase in public consumption		64 agorot		68 agorot	79 agorot	28 agorot	112 agorot
Civilian purchases	11% (1)	19% (2)	2	21% (2)	17% (2)	18% (2)	7% (1)
Public civilian purchases	24% (1)	24% (1)	1	56% (3)	35% (2)	17% (3)	Not significant
Public domestic defense purchases	7% (1)	12% (2)	2	Not significant	Not significant	19% (3)	12% (2)

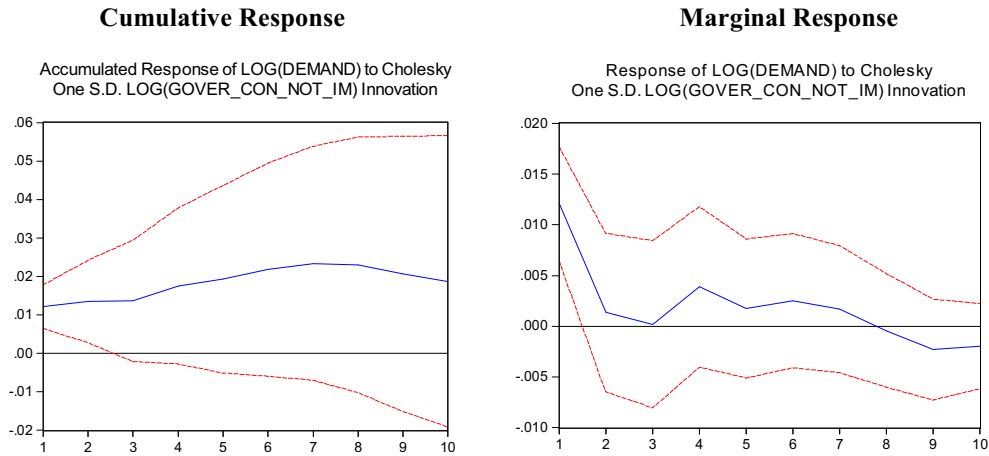
^a In the column for rate of change 0 denotes a situation in which the main finding (positive or negative elasticity) is not robust, 1 one in which the finding is weakened, 2 one in which the finding remains unchanged, - not relevant.

b. Aggregate Demand

Figure 4 describes the marginal and cumulative response of aggregate demand in the private sector (henceforth demand) to shocks in the policy variables. Demand comprises private consumption, private investment, and exports.

Figure 4 presents the cumulative and marginal response of demand to a shock in public aggregate consumption without defense imports. A positive shock of 1 percent in public consumption without defense imports is expected to increase demand by 0.95 percent after one quarter, and cumulatively by 1.05 percent after two quarters. This result is robust as regards direction, but its cumulative intensity ranges from 0.5 to 1.6 percent (Table 2). The multiplier of demand is 0.8.

Figure 4
The Response of Demand to a Shock in Public Consumption without Defense Imports



The analysis shows a positive effect of shocks in public civilian consumption and public domestic defense consumption. The effect of a shock in the latter is more persistent but less sharp.

A positive shock of 1 percent in public defense consumption is expected to increase demand by 0.22 percent after one quarter, and cumulatively by 1.2 percent after 8 quarters. The multiplier of public domestic defense consumption relative to demand is 0.6 percent. The result is robust.

A positive shock of 1 percent in public civilian consumption is expected to increase demand by 0.9 percent after only one quarter. The multiplier of public civilian consumption relative to demand is 0.9. The result is robust.

The analysis indicates that there is a similar effect in a positive direction when public purchases consumption is distinguished from public wages consumption, even though the effect of a shock in purchases is more persistent.

A positive shock of 1 percent in total wage payments is expected to increase demand by 0.6 percent in the first quarter. A positive shock of 1 percent in total public civilian purchases is expected to increase demand by a similar rate in the first quarter, but cumulatively, after 7 quarters, by 1.5 percent.

Table 2 gives the various elasticities estimated for the different components of public consumption. The first column is elasticity vis-à-vis GDP, the second is the elasticity of total sources, the third is the elasticity of imports, and the fourth is the elasticity of aggregate demand in the private sector. As Table 2 shows, the elasticities of GDP are smaller than those of aggregate demand in the private sector.

There are two main differences between GDP and aggregate demand in the private sector (apart from the fact that public consumption is part of GDP). The first difference is a question of definition and derives from the equation of sources and uses: aggregate demand

as equivalent to GDP and imports. Hence, the strong and positive response of imports can explain part of the difference between the elasticities. The cumulative elasticity of imports to public consumption without defense imports, as well as to civilian consumption, is 1.1 percent and 0.7 percent respectively. This finding supports the hypothesis that the main component of the difference in elasticities stems from the elasticity of imports (Table 2). This channel is also expressed in the greater elasticity of aggregate demand in the private sector than of GDP, as is particularly evident in the estimation of the elasticity of civilian purchases.

Table 2
Cumulative Elasticity

	I GDP	II Total sources	III Imports	VI Private sector demand
Public consumption without defense imports	22%	58%	110%	105%
Civilian consumption	24%	41%	68%	90%
Wages	Not significant	25%	Not significant	61%
Civilian purchases	19%	17%	Not significant	145%

The second difference is a technical one. As calculated,¹⁵ the scheme of aggregate demand (including government consumption) is not identical to total sources. Because of the different way of calculation the volatility of aggregate demand is greater than that of total sources, and is apparently more closely related to shocks in public consumption and its components.

We now examine the response of demand to shocks in statutory tax rates. A shock in the overall statutory tax rate and/or in the direct tax rate is not expected to affect demand in a robust way (results available on request). However, a positive shock in the indirect tax rate is expected to moderate demand, as is indicated by Figure 5. A positive shock of 1 percent in the statutory rate of indirect taxes is expected to reduce demand by 0.3 percent after 5 quarters, and by 1.3 percent after 9 quarters. The multiplier of demand relative to the statutory rate of indirect taxes is -0.28.

¹⁵ Adjustment of each component by own price and seasonal adjustment of each component separately.

Figure 5
The Response of Demand to a Shock in the Indirect Tax Rate

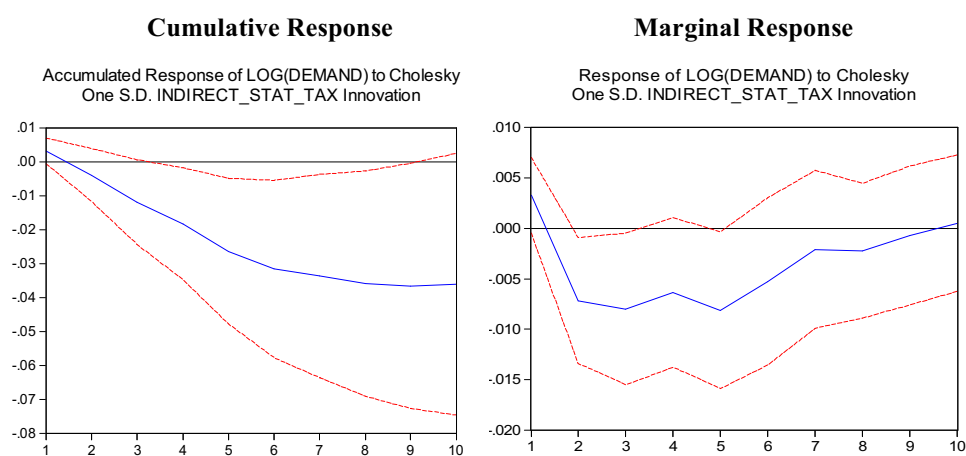


Table 3 sums up the elasticities of demand for each of the variables examined.

Note that the direction of the effect remains unchanged in most cases, even when models of rates of change instead of models of level are examined. This finding serves to reinforce the results.

Table 3
The Elasticity of Demand in the Private Sector and Robustness Tests

	Marginal effect	Cumulative effect	Rate of change ^a	Longer period	Change in order of variables	2 lags	4 lags
Public consumption without defense imports	95% (1)	105% (2)	2	74% (1)	156% (4)	52% (1)	102% (2)
Domestic defense consumption	22% (1)	120% (8)	2	134% (9)	Not significant	86% (8)	99% (8)
Civilian consumption	90% (1)	90% (1)	2	85% (3)	224% (7)	67% (1)	100% (2)
Wages	61% (1)	61% (1)	2	44% (1)	48% (1)	65% (1)	127% (4)
Purchases	38% (2)	145% (7)	1	51% (3)	162% (8)	64% (3)	75% (4)
Indirect taxes	-29% (5)	-131% (9)		-155% (19)	Not significant	Not significant	-123% (9)

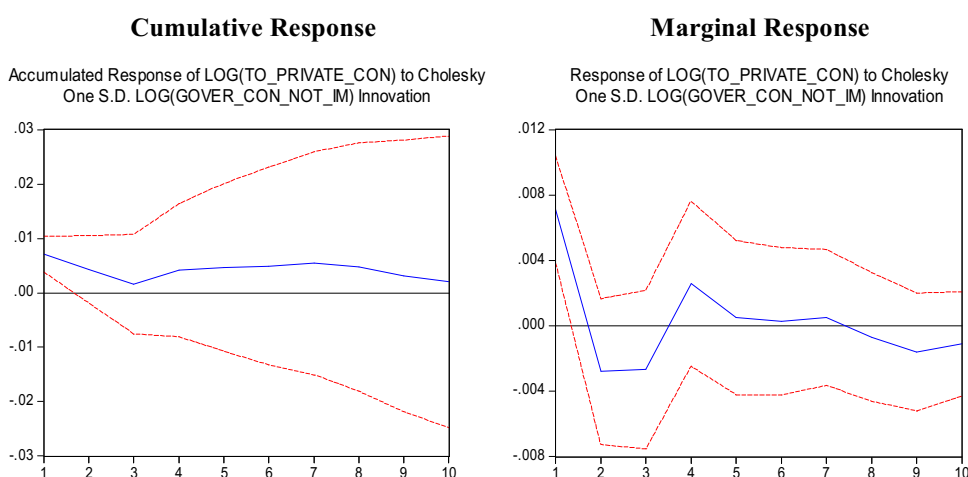
^a In the column for rate of change 0 denotes a situation in which the main finding (positive or negative elasticity) is not robust, 1 one in which the finding is weakened, 2 one in which the finding remains unchanged, - not relevant.

c. Private consumption

As in the previous section, here, too, we examine the elasticity of the main variable in uses—private consumption.

Figure 6 shows the cumulative and marginal response of private consumption to a shock in total public consumption without defense imports. A positive shock of 1 percent in the latter is expected to increase private consumption by 0.6 percent after one quarter, and by 0.35 percent after two quarters. The multiplier of private consumption relative to public consumption without defense imports is 0.3, lower than in Europe, and especially than in the US. The marginal effect of public consumption without defense imports on private consumption is maintained when a model is examined in which GDP with a lag is an additional exogenous variable (0.58 percent in the first quarter).

Figure 6
The Response of Private Consumption to a Shock in Public Consumption without Defense Imports



A positive shock of 1 percent in public consumption which is wage payments is expected to increase private consumption by 0.3 percent after one quarter, an effect which weakens rapidly. A positive shock of 1 percent in public consumption which is purchases is expected to increase private consumption by 0.2 percent after one quarter, and cumulatively—after 7 quarters—by 0.95 percent. Thus, the positive effect on private consumption of a shock in public consumption which is purchases has a more extended effect than that of a shock in public consumption which is wages.

A positive shock of 1 percent in public civilian consumption is expected to increase private consumption by 0.5 percent after one quarter, an effect which moderates after the second quarter. The multiplier of private consumption relative to public civilian consumption is 0.5. A positive shock of 1 percent in public domestic defense consumption

is expected to increase private consumption by 0.1 percent, also after one quarter, and the significance of the effect weakens after two quarters. The multiplier of private consumption relative to public domestic defense consumption is 0.1.

We now examine how a shock in the statutory tax rate affects private consumption. A positive shock of 1 percentage point in the statutory tax rate is expected to reduce private consumption by 0.11 percent after two quarters, and cumulatively by 0.61 percent after 20 quarters. The robustness of the effect of a shock in the overall statutory tax rate is weak as it was not found to be significant in most of the tests. The lack of robustness of the overall tax rate derives from the lack of effect of the statutory rate of direct taxes. A positive shock of 1 percentage point in the statutory rate of indirect taxes affects private consumption by 0.1 percent in the second quarter, and cumulatively by 0.6 percent after 20 quarters (Figure 7). The multiplier of private consumption relative to the statutory rate of indirect taxes is -0.22.

Figure 7
The Response of Private Consumption to a Shock in the Statutory Rate of Indirect Taxes

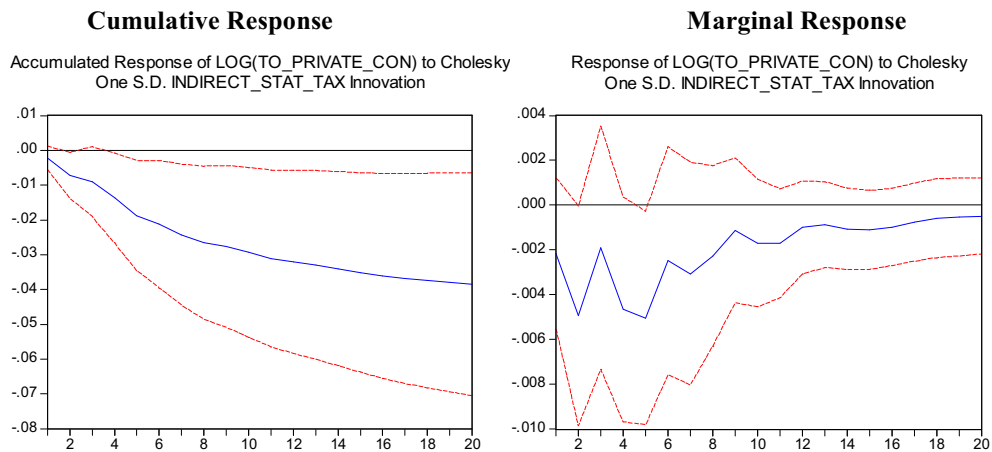


Table 4 sums up the elasticities of private consumption to each of the variables examined. In all the tests the quality of the effect remained unchanged, even when models of rates of change were examined instead of those of level, a finding which reinforces these results.

Table 4
The Elasticity of Private Consumption and Robustness Tests

	Marginal effect	Cumulative effect	Rate of change ^a	Longer period	Change in order of variables	2 lags	4 lags
Public consumption without defense imports	57% (1)	35% (2)	2	44% (2)	58% (2)	33% (1)	23% (2)
Wages	31% (1)	27% (1)	2	26% (2)	16% (1)	9% (2)	11% (2)
Civilian consumption	20% (1)	95% (7)	2	100% (20)	91% (7)	47% (6)	74% (6)
Public civilian consumption	49% (1)	49% (1)	2	47% (2)	42% (2)	38% (1)	46% (1)
Public domestic defense consumption	13% (1)	13% (1)	2	9% (1)	78% (9)	32% (4)	14% (2)
Indirect taxes	-8% (2)	-62% (20)	-	66% (20)	62% (20)	56% (20)	48% (20)

^a In the column for rate of change 0 denotes a situation in which the main finding (positive or negative elasticity) is not robust, 1 one in which the finding is weakened, 2 one in which the finding remains unchanged, - not relevant.

d. Private investment

In this section we examine the elasticity of private investment.¹⁶ The next figures below describe the marginal and cumulative response of private investment to shocks in the policy variables. We find that private investment is more sensitive to policy variables than the other variables.

The intensity of the effect of the policy variables, although not its direction, is particularly sensitive to the number of lags chosen in the VAR model. Hence, in this section we make use of the lag test in order to choose the optimal model (augmentals test).

Another difference in analyzing the effect on private investment is that the (log) of this variable is not characterized by a general linear trend, so that it is more appropriate to examine its deviation from the trend calculated by means of the HP filter.

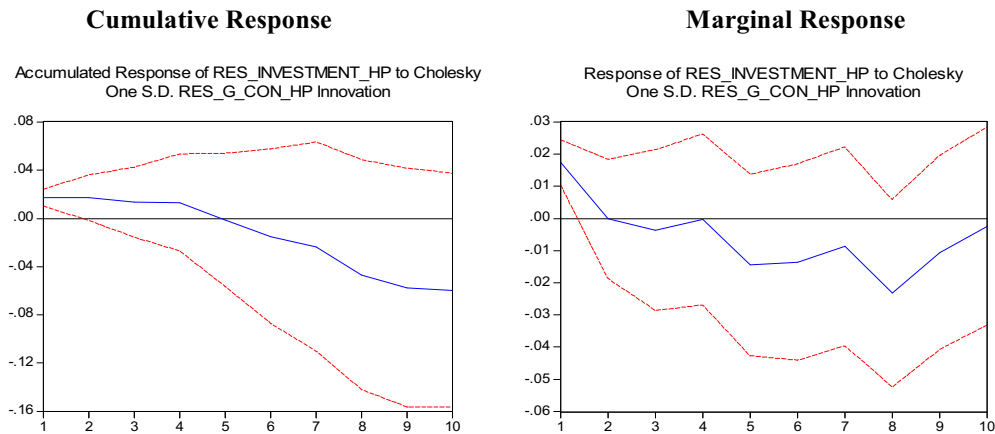
On the theoretical level, according to both the neo-classical and the Keynesian approaches an increase in public consumption may have a positive effect on private investment. According to the neo-classical approach, this may occur when the shock to public consumption is permanent, and the effect of taxes does not create substantial distortion; according to the Keynesian approach, this may occur when the effect of the multiplier is greater than the negative effect of the rise in the interest rate.

Figure 8 presents the cumulative and marginal response of private investment to a shock in total public consumption without defense imports. In this case the VAR model contains 6 lags. Private investment is expected to be positively affected by a shock in total public consumption without defense imports: a positive shock of 1 percent in the latter is expected

¹⁶ Investment in the principal industries.

to increase private investment by 1.3 percent in the first quarter, and cumulatively by a similar rate after two quarters. The multiplier of private investment is 1.4.¹⁷ The direction of the result is robust and its intensity when GDP with a lag is incorporated as an exogenous variable is almost identical.

Figure 8
The Response of Private Investment to a Shock in Total Public Consumption without Defense Imports



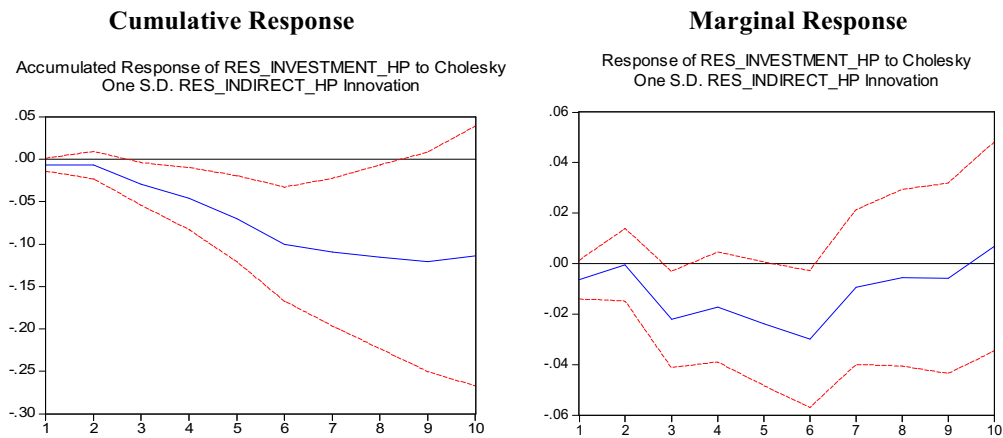
As was the case with the previous tests, we separate public consumption that is wages from public consumption that is civilian purchases (the model chosen comprises 5 lags). A positive shock of 1 percent in total wage payments is expected to increase private investment by 0.7 percent in the first quarter only; however, a shock in public civilian purchases is not significant.

Separating civilian from defense purchases (the model chosen contained 5 lags), we found that a shock of 1 percent in civilian consumption is expected to increase private investment by 0.4 percent in the first quarter, and cumulatively—after two quarters—by 0.6 percent; however, a shock in defense consumption is not expected to affect private investment.

We now examine how a shock in the statutory tax rate affects private investment. We find that shocks in the overall statutory rate of direct taxes does not affect private investment (not presented in the article; available on request). By contrast, the statutory rate of indirect taxes has a negative effect, with a relatively strong intensity and extending over a long period of time (Figure 9): the strongest marginal effect is after 6 quarters, when private investment is expected to decline by 0.5 percent, and cumulatively—after 8 quarters—when cumulative investment is expected to contract by 2.0 percent. The multiplier of private investment relative to the statutory rate of indirect taxes is -1.2

¹⁷ Europe is characterized by a positive multiplier and the US by a negative one (Bank of Spain, 2009).

Figure 9
The Response of Private Investment to a Shock in the Statutory Rate of Indirect Taxes



5. CONCLUSION

The purpose of this study was to estimate the effect of policy variables on Israel's main macroeconomic variables. The findings indicate that an increase in public consumption without defense imports, including in the purchases component, and/or in civilian consumption and/or in domestic defense consumption accelerates the rise in aggregate demand, and especially in private consumption and private investment. As an open, developing economy for most of the period reviewed, Israel has had a large public debt and an exchange-rate regime which has altered during that period, and is characterized by lower multipliers than in the developed countries, as most of Israel's basic economic features are negatively correlated with the size of the multiplier found relative to international levels.

We also found that imports respond positively and relatively sharply to changes in total public consumption and its components, being expressed in the large gap between the elasticity of total sources and demand in the private sector, on the one hand, and the relatively small elasticity of GDP, on the other.

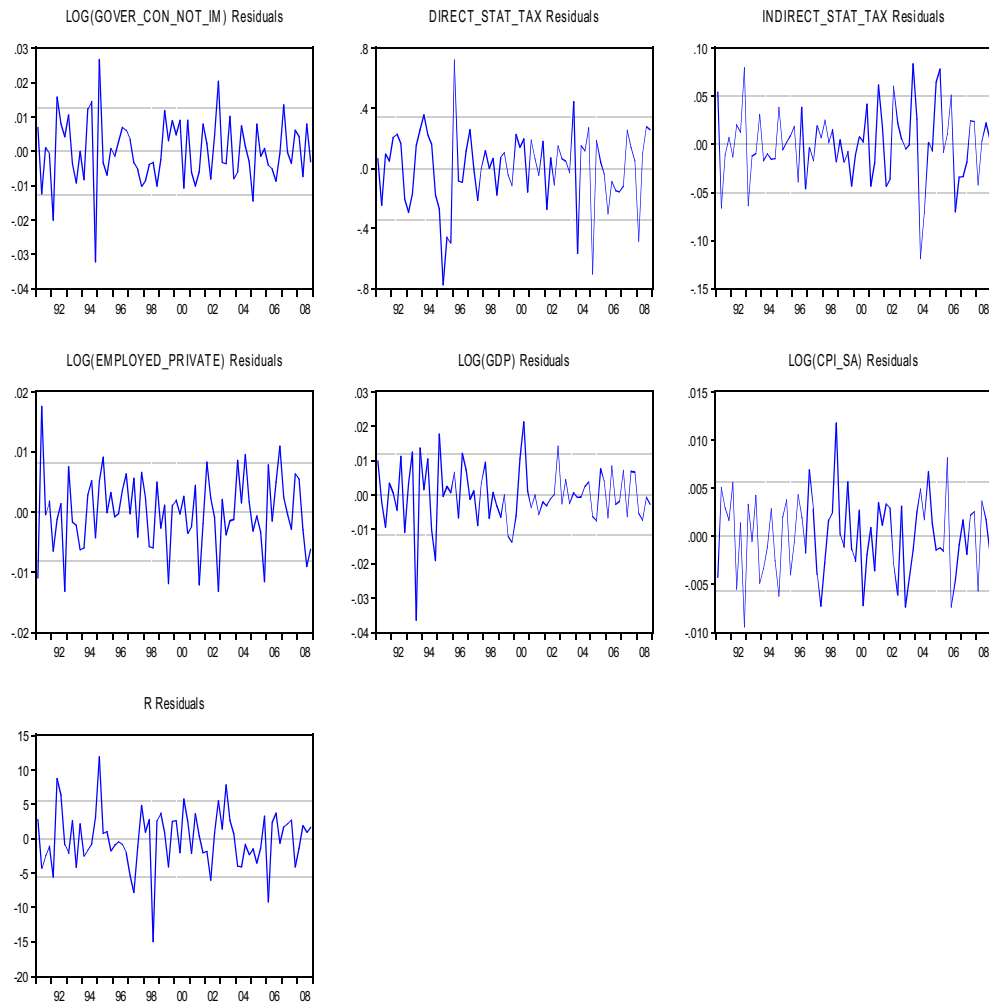
However, the positive effect of public consumption on demand in the private sector, especially on domestic demand, demonstrates that there is scope for counter-cyclical policy in Israel, as is the practice in developed countries. This was also observed to be the case for Israel to a relatively moderate extent in the recent crisis (counter-cyclical policy), in contrast with the pro-cyclical regime which generally characterizes developed countries and was employed in Israel in the past.

Another finding indicated by the data is that the statutory rate of indirect taxes moderates GDP growth, although the statutory rate of direct taxes was not found to have any effect. This finding is quite surprising, as a change in direct taxation is usually more persistent.

Appendix

Dickey-Fuller Tests for the first system

The following graph describes the residuals of the endogenous **detrended** variables in the VAR system:



Dickey-Fuller Tests for *Government Consumption*

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-11.64270	0.103739	-1.207803	RES1(-1)
0.9948	0.006554	0.000980	6.42E-06	C

Dickey-Fuller Tests for *Indirect Tax*

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-11.12035	0.104569	-1.162845	RES1(-1)
0.9871	0.016152	0.032489	0.000525	C

Dickey-Fuller Tests for *Direct Tax*

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-10.18651	0.105689	-1.076599	RES1(-1)
0.9907	-0.011664	0.004958	-5.78E-05	C

Dickey-Fuller Tests for *Employees in the Private Sector*

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-8.765998	0.105727	-0.926805	RES1(-1)
0.9979	-0.002616	0.000696	-1.82E-06	C

Dickey-Fuller Tests for *GDP*

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-11.43706	0.104066	-1.190206	RES1(-1)
0.9998	0.000229	0.001078	2.47E-07	C

Dickey-Fuller Tests for *CPI*

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-9.711345	0.105963	-1.029045	RES1(-1)
0.9188	-0.102291	0.000589	-6.02E-05	C

Dickey-Fuller Tests for *r*

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-9.911067	0.105863	-1.049217	RES1(-1)
0.9903	0.012176	0.501891	0.006111	C

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