DISCUSSION PAPER SERIES

No. 4427

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INTERNATIONAL MACROECONOMICS

Centre for Economic Policy Research

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ISSN 0265-8003

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Discussion Paper No. 4427
June 2004

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CEPR Discussion Paper No. 4427

June 2004

ABSTRACT

Macroeconomic Consequences of Terror: Theory and the Case of Israel*

This Paper analyses the effect of terror on the economy. Terror endangers life such that the value of the future relative to the present is reduced. Hence, due to a rise in terror activity, investment goes down, and in the long run income and consumption go down as well. Governments can offset terror by putting tax revenues into the production of security. Facing a tide of terror, a government that acts optimally increases the proportion of output spent on defense, but does not fully offset the tide. Thus, when terror peaks, the long-run equilibrium with an optimizing government is of lower output and welfare. Next, we show that this theory of terror and the economy helps to understand changes in trend and business cycle of the Israeli economy. The estimates show that terror has a large impact on the aggregate economy. Continued terror, at the level of the death toll by about the same size as due to car accidents, is expected to decrease annual consumption *per capita* by about 5% in 2004. Had Israel not suffered from terror during the last three years, we estimate that output *per capita* would have been about 10% higher than it is today.

JEL Classification: E21, E27, H11 and H56
Keywords: consumption, investment, Israel, security and terror

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*This Paper prepared for presentation at the November 2003 meeting of the Carnegie-Rochester Conference on Public Policy. We thank Dotan Persitz for his endless effort to improve this work while being our research assistant. We thank Alex Cukierman, Amit Freidman, Bennett T McCallum, Dan Peled and participants at the Carnegie-Rochester Conference for their valuable comments.

Submitted 19 April 2004

1 Introduction

Recent events brought the economic effects of terrorism to our attention. This work conceptualizes some of the economic costs of terrorism. Once these costs of terrorism are formalized, we take the analysis in two directions. First, we build a framework that allows for a cost-benefit analysis of counter-terror expenditures. Second, we analyze the case of Israel and document the impact of changes in perceived insecurity on its economic performance.

Terror, among other things, endangers civilians' life. Needless to say, civilians' life is a very wide concept, perhaps so wide that trying to put it in one frame, no lens can avoid ambiguity. Assuming, that the level of imminent danger is constant and known, it is still very hard to measure insecurity in a way that provides an assessment of its effects. Fears, bewilderments, and different types of uncertainties, are all responsible for redirecting individuals economic activity. This paper focuses on one dimension of insecurity. It is assumed that insecurity manifests itself in daily life by an increase in uncertainty about life, such that, as terror increases, life becomes less certain and shorter on average. In reaction to the rise in insecurity, governments offset the terror by increasing defense expenditures. Thus, the *total* costs of terror emerge from both the individuals and government response to terror. Individuals change their consumption and investment decisions in response to the perceived change in the probability of survival. The government responds by increasing defense expenditures.

Why do governments react to terror? When life is endangered by an enemy, real resources must be spent to increase safety. In such cases, the public good aspect of defense expenditures, the increasing returns to scale in the production of security, and the fact that security is both non-rival and non-exludable, lead governments to be the main provider of security for its people.[1] Since safety does not come free, the government must use real resources to produce security. Therefore, the decision of the government about how much to spend on defense is based on comparing the social costs of resources, i.e., the costs of forgone consumption and forgone future consumption (investment), those which are used to provide security, with the

[1] The well documented inefficiencies in the procurement process of defense products are ignored in this work. The coproduction of security by both private and public sector is an important issue (see, Tsiddon et. al., Cesarea 2002 Conference Papers (Hebrew)). Trajtenberg (2003) uses an insightful model that justifies the public provision of security.

benefit that emerges from making life safer and longer, i.e., the benefit of reducing terror.

This work uses a variant of the closed-economy-infinite-horizon model where the government is in charge of the supply of defense. The outside threat (terror) is assumed to be both exogenous and constant and its level is neither too high (does not stop all economic activity) nor too low (cannot be ignored). In the core of the analysis we assume that insecurity is manifested *"only"* in the threat to each individual's life.[2] To reduce death toll the government supplies security. To simplify the analysis we assume investment in defense is done solely by the government, and that the government does nothing but supply security.[3]

We use the "Blanchard-Yaari Model" of finitely-lived individuals in an infinitely-lived economy (Yaari, 1965 and Blanchard, 1986). Yaari analyzed the effect of uncertain lifetime on the consumption path with and without an insurance market. Blanchard used this model to analyze the effect of debt versus tax financing of government expenditures. We use this model to demonstrate the costs and the benefits of defense expenditures, and to analyze the *optimal* response of a government to a certain level of outside terror.

The comparative static predictions on the impact of changes in aggregate fear-of-death on changes in economic activities are taken to the Israeli data. Israel is an informative case-study for the inspection of these comparative statics since many times during the last 55 years the national level of fear-of-death changed dramatically. Before we proceed into more formal analysis we compare the economic history of Israel over the last 53 years to that of the US. We show that the main observed correlations between changes in the aggregate fear-of-death and changes in relative per-capita growth rates, are consistent with our theory. That is, dramatic increases (decreases) in the level of national (perceived) security, followed by increases (decreases) in GDP per-capita relative to the US.

Once the historical events are put in perspective, we quantify the effects of terror on per-capita *GDP, consumption and investment*, using the Vector Autoregression (VAR) as the statistical reduced form framework for the economy. We construct a simple and intuitive index of terror outcomes in Israel. Using a simple VAR system, we show that the index of terror

[2] Tsiddon (1995) inspected two other effects of terrorism: *(a)* Terror induces personal stress or fatigue (or perhaps inflicts an injury with a constant probability), which reduces an individual's productivity over time. *(b)* Terror causes damage to physical capital.

[3] This is a simplifying assumption that helps us to focus on the main thrust of this paper.

has a significant effect on the evolution of all important macroeconomic variables. We find the effect of terror to be significant both in (log) level *VAR* of per-capita *GDP*, *consumption, investment and exports*, with linear trend, as well as in a *VAR* of log-differences of these variables. The data supports the claim that terror has a large negative and statistically significant impact on short run dynamics of the economy.

To estimate the impact of terror on "low frequency" changes in output and consumption, we estimate the effects of the index of terror on *changes* in the trend estimated by the *H-P filter* of these variables. We find changes in the *H-P filter* to be negatively correlated with the level of terror. These results are consistent with the view that the effect of terror is not easily washed away with time.

These effects are not only statistically significant, but they are of an important magnitude too. Terrorism, at the level that Israel experienced for the years 2001 - 2003, which is similar in magnitude with the number of casualties in car accidents in the country, induces a drastic reduction in both output and consumption per capita. Our forecasts show that if terrorism prevails at its 2003 level to 2005:3, then per-capita *GDP* will be about 3.5% lower than if terrorism ends by 2004:3. The same comparison for non-durable consumption per-capita shows a similar decline.

Towards the end of 2000 output per-capita in Israel was around 55% of output per-capita in the US. By the end of 2002, after 2 years of terror, output per-capita in Israel was only 45% of output per-capita in the US. From the end of 2000 to 2003:3 output per-capita in Israel is on the decline and as noted above is predicted to decline further if terror prevails. Looking back at the 3 years of terror, output per-capita declined annuly by about **3%**. During that period, the ratio of government defense expenditures to *GNP* climbed up from about 9 percent of *GNP* to about 12 percent of *GNP*.[4]

The rest of the paper is organized as follows. We first review the Blanchard - Yaari model. Second, we extend the model to allow for defense spendings and analyze the optimal government response to terror. We then give an overview of the economic history of security

[4] The decline in output was attenuated by the large expansionary fiscal policy that let the budget deficit to increase to 6% of *GNP* (starting at a target of 3%). In the absence of increased government expenditures, of which all went into additional defense expenditures, the decline in *GNP* would have been much larger.

and economic growth in Israel using the perspective of our theory. In the forth part we estimate different VAR systems to quantify the effects of the geopolitical situation as manifested by terror. In the last step we use data on tourism to analyze the quantitative role of substitutability on economic behavior at times of terror.

2 The Blanchard - Yaari model

This section describes the model we use parsimoniously. As noted above, the general idea we follow dates back at list as far as Irving Fisher and was first formalized in Yaari (1965). The model we use here is due to Blanchard (1986; hereafter Blanchard) and the specific version of the model that we follow is taken from Blanchard and Fischer (1989).

2.1 Population

Population is composed of many cohorts at the same time. At birth, all individuals, both within as well as across cohorts, are alike. Three key assumptions make this model: *(i)* As a risk of terror or war, each living individual faces a probability of dying at any moment. *(ii)* The probability of dying depends on the amount of resources the government spends on defense. *(iii)* The more the government spends on defense, the less probable are individuals to die.

For simplicity it is assumed that the probability to die per unit of time, d, is constant through life. Note that perhaps unrealistic for life in general, in the context of terror, this assumption seems innocuous. Moreover, Yaari (1965) analyzed the effect of uncertain lifetime on the individual's economic behavior and showed that under some mild restrictions (e.g., continuity, differentiability, etc.,) the individual's optimization is practically the same as in the constant-death-rate case analyzed in Blanchard. The constant death rate is however key to the aggregation performed in Blanchard and used below.

Given the constant death rate, time to death is exponentially distributed, and the expected duration of life is $(1/d)$. An exogenous increase in the threat of terror (or war) is modeled as a rise in d. A higher level of terror, every thing else equal, means a higher (perceived) probability to die.

The assumption that an increase in government expenditures on defense increases security implies that, *holding the exogenous threat constant*, a rise of government spending on defense decreases d. For simplicity, it is assumed that government expenditures are constant, are financed by a lump-sum tax, and are spent only on defense. Less innocuous, is our assumption that the government is the only provider of security services.[5]

Given the above structure, each individual maximizes the *expected value at time t, E_t*, of his utility:

$$E_t \left[\int_t^{\infty} \log c(z) \cdot \exp\left[-\rho(z-t)\right] dz \right], \tag{1}$$

where E_t is the expectation operator for time t, t is the time at which the maximization is done, z is the index of time, $c(z)$ is the consumption at time z, and ρ is the subjective rate of time preference. Equation (1) assumes that the instantaneous utility is logarithmic, and individuals have no bequest motive.[6]

For simplicity we assume population size is constant. Therefore, at any instant of time a new cohort of measure d of similar individuals is born.[7] While each individual's life is uncertain, the initial size of the cohort upon entering the workforce is d, and the rate at which the cohort size decreases over time is *deterministic* and equals d. Therefore, at any time t population size is normalized to equal 1:

$$\int_{-\infty}^{t} d \cdot \exp\left[-d(t-s)\right] ds = 1. \tag{2}$$

Since individuals maximize their expected utility, since there is no aggregate risk, and since information is all public, there is a clear role for insurance. The insurance arrangement

[5] We avoid the potential incentives for private actions against terror.

[6] Yaari shows that a direct bequest motive (joy of giving) does not change the results.

[7] One interpretation of this assumption is that, when born, the cohort is of measure one. However, at the moment of birth, due to the external conflict, each cohort suffers casualties of the size $(1-d)$. This assumption greatly simplifies the comparative statics of the model and is not too harmful since the model is designed to aggregate changes in the individual economic behavior and is not meant to account for the implicit demographic changes that seems to be second order in this context. It would have been desired for this paper to allow for the birth rate not to be changed in the case of increased death rate. However, this would cause an aggregation problem regarding all the macro variables that would dramatically complicate the analytics of the comparative statics.

is as follows: As long as a person is alive, he gives (pays) **all** his non-human wealth, v_t to the insurance company. In return, at every instant, he receives an annuity from the insurer. When a person dies, the insurance company gets all that person's non human wealth (positive or negative) and his human wealth disappears. This arrangement is similar in spirit to a pension-plan, except that the premium paid out by the insurer starts at birth. Given the constant death rate, and a competetive-zero-profit insurance market, Blanchard showed that a constant premium is sustainable and efficient and that with free entry and zero profit insurance companies, the premium an individual gets is $d \cdot v_t$ per unit of time.[8]

2.2 Individual consumption

Denote $c(s,t), w(s,t), v(s,t)$ and $h(s,t)$ as consumption, labor income, non-human wealth, and human wealth at time t of a person belonging to the cohort born in s $(t > s)$. Using the exponential probability density of death one can rewrite equation (1) as:

$$\int_t^{\infty} \log(c(z)) \exp[-d(z-t)] \exp[-\rho(z-t)]\, dz = \int_t^{\infty} \log(c(z)) \exp[-(d+\rho)(z-t)dz]. \quad (3)$$

The only difference between (3) and the usual infinite horizon maximization problem, is that the subjective rate of time preference is augmented by the death rate to form the *total* discount rate. Changes in the (perceived) death rate affect every economic activity via their effect on the discount rate.

Maximization of the utility (3), subject to: *(i)* a person's dynamic budget constraint, and *(ii)* the existence of the annuity insurance market that we describe above, was shown by Blanchard (1986) to provide the following consumption decision rule:

$$\dot{c}(t) = (\rho + d)[v(t) + h(t)]. \quad (4)$$

In this decision rule $v(t)$ is the non-human wealth of the individual at time t and $h(t)$ is the

[8] The insurance company is exactly balanced at every moment since it receives $d \cdot v_t$ from those who die and pays our $d \cdot v_t$ to those who are alive. For a more detailed discussion of this arrangement see Yaari and Blanchard. It should be noted that without full insurance each agent is subject to unintended bequest sequence that is due to the uncertain death of the parents. Such an extension introduces sever complications into the analysis such as the interlinks between the dynamics of the distribution of income, terror, and economic growth. The extension of the model to this case is beyond the scope of this paper.

individual human capital at each date t.[9]

2.3 Aggregate dynamics

Assume a closed economy, and suppose, that: *(i)* d has a natural positive level although there is no conflict, and *(ii)* government expenditures are zero. Under these conditions, Blanchard characterizes the behavior of all aggregates in the economy by:

$$\dot{C}(t) = (r - \rho) \cdot C(t) - d \cdot (d + \rho) \cdot V(t), \tag{5}$$

$$\dot{V}(t) = rV(t) + W(t) - C(t), \tag{6}$$

where C, V, W,are aggregate consumption, aggregate wealth, and aggregate wage respectively, and r is the risk-free rate-of-interest.

To close the model one must specify the risk free rate. Assume the aggregate production function, Γ, is CRS and:

$$F(K) \equiv \Gamma(K, 1) - \delta K, \tag{7}$$

where K is the stock of capital, *1* is population size (Equation 2), and δ is the rate of depreciation.[10] Since capital stock is the only form of non-human wealth, the other equilibrium condition is $V = K$. Using equations (5)-(7) and $V = K$ Blanchard gets:

$$\dot{C} = \left[F'(K) - \rho\right] C - d \cdot (d + \rho)K, \tag{8}$$

$$\dot{K} = F(K) - C. \tag{9}$$

Together with an initial level of the capital stock, these two equations provide a complete characterization of the economy. This characterization is depicted by the loci CC and KK in *Figure 1.* As was shown in Blanchard the equilibrium in this model is of the saddle-path type and its only, non-trivial, steady state equilibrium is of less capital, higher rate of interest and lower consumption than in the equally sized Ramsey economy.

[9] As standard in these models, we rule out non-stationary solutions in the form of a consumption path that could go to an infinite debt ("Ponzi games"). The formal definitions of $v(t)$ and $h(t)$ are given below.

[10] We elaborate below on a different interpretation that the depreciation rate could get in the context of terror or war.

3 Aggregate behavior in face of a conflict

3.1 Preliminaries

To maintain death rates under (some) control, the government takes actions against opponents. Needless to say, these actions cost money. The production function of defense is characterized in the following assumption:

***Assumption**: Resources the government devotes to defense increase the expected duration of life; the more the government spends the longer is life expectancy. Government spending on defense affects life expectancy at a decreasing rate. Government effect on security is bounded from above, it cannot make life infinite. Defense is financed efficiently. The production of security uses the same factor mix as output does and is of the CRTS type.*[11]

Since this work deals only with steady state effects, we assume that government expenditures on defense, G, are constant over time. Given the above assumption, *Equation (10)* summarizes the effects of defense expenditures on the death rate, d:[12]

$$d = d(G) \ ; \ 1 > d(0) > 0 \ ; \ d'(G) < 0 \ ; \ d''(G) > 0 \ ; \ 0 < G < F \ ; \ d(F(\cdot)) > 0 \ . \tag{10}$$

It follows immediately from the structure of the model that when government expenditures on defense are positive, constant, and are financed with a non-distortionary lamp sum tax of size G, then the KK locus shifts down by a constant G.[13]

Assume now that the rate of death increases due to, terror, a continual state of war, an ongoing "low intensity conflict", or due to any other form of conflict that endangers human life. It is easy to show that an increase in the death rate d tilts the locus CC to the left (counter-clockwise).

Lemma 1

(i) The steady state in the Blanchard model is necessarily comprised of a lower capital stock and a lower level of consumption than in the Ramsey model.

(ii) The higher is the death rate, d, the lower are capital stock and the level of consumption in the steady state (the deviation from the Ramsey model increases as d increases).

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[11] These simplifying assumption is essential for our results, although it might be questionable.

[12] One could make less restrictive conditions on the production of defense at the cost of more notation. The assumption that d is less than one is necessary only due to the normalization of the population size to 1.

[13] The region where KK becomes negative is excluded from the discussion by assumption.

Proof: immediate.

Figure 2 depicts the two *effects* of the conflict in a terrorized economy when the government invest bringing security to its citizens. *(i) The rise of insecurity:* The CC_0 represents the low-terror locus of stationary points. CC_1 represents the case the death rate has hiked due to the external conflict, and CC_G stands for the case the government has increased its defense spending to reduce death toll. *(ii) The effects of government expenditures on the dynamic budget constraint*: KK_G depicts the locus for the resource constraints when government expenditures are constant and larger than zero.

With a rise in the death toll, the market generates a lower level of security. With lower security, individuals die at a faster rate (CC_1). With a shorter expected life the individual's incentive to save is lower, thus pushing down both steady state capital stock and steady state consumption.

In a world where the government invests in defense to offset terror (or war) life is longer, and, therefore, the incentive to accumulate is stronger (CC_G). On the other hand, government expenditures can come only at the cost of a decline in resources available for private use. In this world, therefore, the claim that government expenditures reduce steady state consumption (or investment) is not necessarily true. For example, starting from a situation the government did not optimize its expenditures on defense, it may very well be the case that with an appropriate level of government expenditures on defense steady state consumption is higher than otherwise. In this case, consumption and utility are higher with government military buildup than without.

3.2 The reaction of the government to insecurity

This section analyses the case that facing a probability to die, d, the government decides to increase investment in defense. Under the assumptions specified above, the equations that characterize the dynamic evolution of the economy become:

$$\dot{C} = \left[F'(K) - \rho\right] C - (d(G))((d(G) + \rho)K, \tag{11}$$

$$\dot{K} = F(K) - C - G \tag{12}$$

where all variables were denoted above and $d(\cdot)$ has the properties as in *(10)*.

This system maintains the local saddle path stability of the original system only if one adds some technical assumptions on the co-behavior of $d(G)$ and $F(\cdot)$. Since these assumptions do not shed new light on the economics of this model, and since almost nothing is empirically known on the function *d(G),* we assume that all the necessary technical assumptions hold. The system *(11)-(12)* is, therefore, saddle path stable.[14] Throughout this work we assume local uniqueness is maintained.

An increase in government spending on defense, G, affects both equations. Suppose that the government collects a constant G with a lump-sum tax. Holding the CC curve momentarily fixed, an increase in G shifts the KK locus down to reduce the steady-state levels of capital, investment, and consumption (*Figure 2*). Resources that the government use crowd out both consumption and investment.

In this model government expenditure are all spent on the production of security. Government expenditures, therefore, have an impact on the CC locus. An increase in G increases the expected duration of life (reduces *d).* Suppose, momentarily, that defense comes free, i.e., a reduction in d is achieved with no shift in the KK locus. A decrease in d (an increase in the expected duration of life) tilts the CC locus to the right, (from CC_1 to CC_G) and increases consumption, investment, and the capital stock at the steady state. Thus, while on one hand financing government expenditures "appropriates" real resources and, therefore, reduces steady state consumption and investment, on the other hand, security, or personal safety, by extending the expected duration of life, increases the desire to save, and, therefore, increases both consumption and investment in the long-run.

As long as the equilibrium remains locally saddle-path-stable and unique, there is a clear role for (a well bounded) government intervention. The role of government is to extend life and it does that by using resources to increase personal security. While general statements about utility are impossible without more structure, it can be shown that a government that wants to maximize *steady state output* invest in defense as much is needed for equation (13)

[14] It is required that around the steady state the Jacobian is well defined and negative-definite. That is, that at the steady state level of K the following equation holds,

$$F'(F'-\rho)+F''(F-G)-d(G)(d(G)+\rho)<0.$$

to hold. A government that wants to maximize *steady state consumption* invest in defense to satisfy equation (14).

$$(F'(K,1) - \rho) = -d'(G) \cdot K \cdot (2d(G) + \rho) \tag{13}$$

$$K \cdot F'(K,1) \cdot [-d'(G)](2d(G) + \rho) = [-F''(K,1)]C + d(G)(d(G) + \rho) \tag{14}$$

The case for an active role for a government in the production of security is the one depicted in *Figure 2*. As we show below, whether a country can act to reduce death toll while consumption, output, or both increase depends on the initial situation. *Figure 2* depicts a case in which the government can decrease the death rate to increases private consumption and the capital stock. The figure is based on the assumption that their is no initial allocation of expenditures on defense *(KK)* to accentuate the case of a sub-optimal initial investment (C_1 is smaller than C_G)

This section established the fact that there are circumstances a government can and should act to reduce death toll. Two assumptions make this setup better suited for the analysis of external conflicts in the form of terrorism or in other forms of "low intensity conflicts" and less adequate to either wars or car accidents: *(i)* The model imposes a continuous long run impact of the external conflict - the death rate. *(ii)* The market is *assumed* not to provide an optimal level of protection.

3.3 The optimal reaction to insecurity

There are a number of ways to analyze the optimal steady state reaction of a government to an exogenous level of insecurity. One possible goal of a government is to maximize the utility of the representative individual.[15] Since we analyze only the steady state, maximization of utility amount to the maximization of discounted integral of steady state consumption over the expected length of life. In the steady state consumption equals *net* production, F , minus government expenditures on defense, G. Thus, one can integrate *Equation (3)* from time zero to infinity to get the *steady-state-expected-lifetime utility of individual i,* U_i . It is assumed

[15] We choose this criterion for the government although this is *not* the only criterion that seems to fit our case.Government intervention affects the "replacement rate" of individuals in the economy - an issue which is to the best of our knowledge not yet dealt from a utilitarian perspective.

hereafter that the goal of the government is to maximize U_i, which is given by,

$$U_i = (F(K(\mathrm{G})) - \mathrm{G}) / [d(\mathrm{G} + \rho] \tag{15}$$

were $F(K(\mathrm{G}))$ is the steady state value of net production when the government invest G in the production of defense (in *Figure 2*, $F(K(\mathrm{G}))$, is the (net) production which is associated with the level of capital K_G.

Simple calculation shows that a government that maximizes *Equation 15* choose *G,* such that *Equation (16*) is satisfied.

$$\frac{F(K(\mathrm{G}))' - 1}{F(K(\mathrm{G})) - \mathrm{G}} = \frac{d'(\mathrm{G})}{d(\mathrm{G}) + \rho} \tag{16}$$

$$OR$$

$$\frac{\left[F(K(\mathrm{G}))' \cdot \mathrm{G} - \mathrm{G}\right]}{[F(K(\mathrm{G})) - \mathrm{G}]} = \frac{d'(\mathrm{G}) \cdot \mathrm{G}}{[d(\mathrm{G}) + \rho]}$$

where $F(K(\mathrm{G}))$, $F(K(\mathrm{G}))'$ are the net production and the net marginal product at the steady state, respectively.

Since $d'(\mathrm{G}) < 0$, an optimal intervention of a government implies that $F(K(\mathrm{G}))' < 1$. This is immediate. When government expenditures increase *both* instantaneous consumption and the expected duration of life the government should continue to increase. Optimum exists only at level where extending life comes at the cost of a decline in steady state consumption. Using national accounts terminology this implies that at the optimum the share of government expenditures on defense in GDP goes up when the external threat goes up.

The *LHS of (16)* is the elasticity of steady state consumption with respect to changes in government expenditures. The *RHS of (16)* is just the elasticity of the total economic rate of discount with respect to government expenditures. Hence, *Equation (16)* implies that at the optimum, the elasticity of consumption with respect to government expenditures equals the elasticity of the total economic discount rate with respect to government expenditures. If one sets ρ to zero, then, at the optimum a percentage decline (increase) in the death rate must be accompanied by a percentage decline (increase) in consumption. When $\rho > 0$, 'a percentage change in the death rate' should be replaced with 'a percentage change in the total economic discount rate'.

To simplify the discussion we assume:

$$d(\mathrm{G}) = d_{\max} \exp(-a\mathrm{G}) - \rho \ , \ F > \mathrm{G} \geq 0 \ , \ 1 > d_{\max} > 0 \ , \ a > 0. \qquad (17)$$

When the government does not spend on defense the death rate is finite and strictly larger than zero ($d_{\max}$). The larger are expenditures on defense, the lower is the death rate (the death rate never gets down to zero). The sole purpose of subtracting ρ is to save notation. Given *Equation (17)* the elasticity of insecurity (or, the total economic discount factor) with respect to government spending equals $(-a\mathrm{G})$ and the *RHS* of the first equation in *(16)* is constant and equals $(-a)$.

Assume that government expenditures on defense are at their optimal steady state level. Suppose now the world is changing in an adverse way, i.e., for every level of defense expenditures, the death toll becomes higher. Assume further that $d_{\max}$ increases while *(-a)* does *not* change.

Compare now the two "optimal" steady states. Before the government chooses to change its intervention, the rise in $d_{\max}$ reduces steady state discounted utility. Also, the rise of $d_{\max}$, since it changes the incentive to save, decreases steady state production, F , and, thus, increases the steady state net marginal product, *F'* . The latter two forces cause *Equation (16),* not to hold. Inspection of this equation reveals that at the new *optimal* steady state when $d_{\max}$ is higher. The *optimal* proportion of defense expenditures to consumption is higher (the government spends a higher percentage of total output on defense) but the increase in spending does not fully offset the rise in insecurity. With this specification, at the new steady state people have less consumption and shorter lives.

3.4 Two simple extensions

Terror and the depreciation of wealth. A major effect of an act of aggression, whether in the form of a war or continuous terror, is to be found in its effect on individuals' wealth. 9/11 is a clear case for the destruction of physical capital. The simplest way to capture this effect is to assume that the depreciation rate, δ, is a function of government expenditures on defense. The more security services the government provides, the less likely it is that the conflict will damage wealth. Thus, the depreciation function, δ, now becomes $\delta(G)$ with $\delta\prime() < 0$. In this case, a higher G, while it shifts the KK vertically down due to the reduction in private resources, also tilts it counter-clockwise. While the downward shift is due to the reduction in private resources, the counter-clockwise tilt is due to the increase in the net productivity of capital. Even with this simple consideration, which resembles the effect of a conflict on property rights, it is easy to come up with examples where defense expenditures encourage investment in productive capital and foster steady state consumption. Simple calculations can show that upon taking the model to the data this channel must be included. The destruction of capital, when interacted with the death rate, generates a strong suppressing force on the economy even at small rates.[16]

Terror and human capital. Tsiddon, (1995) discussed also the effects of individual psychological stress on the labor force that accumulates as the conflict evolves. Stress, could also be relabeled as a probability to be injured in the conflict. A third interpretation of this "stress rate" is that as the conflict continues, individuals divert activities from the market to less efficient non-market activities (hide in the forest, stop shopping down-town, etc.). As long as "stress rate" is independent of the death rate it can be incorporated into the analysis to generate results of the same kind.[17]

4 A Case Study: Israel

From its very first day Israel has experienced several wars and periods of terror, each to end with different geopolitical and economic outcomes. These events make Israel an interesting case for an empirical evaluation of the above theory of terror, security and defense expenditures. Our goal with this empirical investigation is to evaluate whether times of fear and terror are times of an economic setback, or whether the economy reacts to terror in the direction predicted by our model.

We divide our empirical analysis to three parts. In its first part, we review the main changes in *GDP* per-capita and in the ratio of *GDP* per capita relative to that of the US and point out how wars and periods of terror might be related to these documented changes.

[16] We thank Michael Ben-Gad for making this point.

[17] Becker and Rubinstein (2004) explore the notion of "fear". Personal stress emphasizes the loss of human capital while fear emphasizes the loss of utility.

This "arm-chair" economics is designed to be the first check that following times of terror or wars the economy behaves in the model's predicted direction. The second part focuses on the business cycle frequency. Here the focus is on the co-movements of per capita *GDP* (GDP), consumption (C), exports (EXP) and investment (I) per-capita with exogenous levels of terror activities (TER). The main idea is to hypothesize that the business cycle movements of these aggregate macro variables, which are all endogenously determined in the model, show statistical significant changes in response to exogenous realizations of the level of terror (TER). Once high frequency correlations are documented, we conduct the third stage. Using simple *H-P* filter, we decompose the data into low and high frequency movements and test our assumption that terror (TER) impacts the low frequency, medium term, evolution of the economy.

In the third part of our empirical analysis we turn away from macro-data to analyze data on tourism in Israel. We compare the behavior of Israelis and foreigners by number of bed-nights in Israel in order to document the impact of terror on the demand for tourism which has different elasticities of substitution across Israelis and foreigners.

4.1 An Overview of the Israeli Economy: 1950-2003

This section inspects the history of Israel through the eyes of the above theoretical framework as a way of interpreting the observed correlations between wars and terror episodes and the performance of the Israeli economy.[18] Israel became independent in 1948 during a war that involved local Palestinian militias, and the Egyptian, Jordanian, Iraqis, and Syrian armies. The war ended with an Israeli victory but at a large cost of many casualties and brought an economic contraction.[19] At the same time the population of Israel grew at more than 25% annually from about 650 thousands to almost 2 million from the beginning of 1948 to the end

[18] This description is *not* a brief history of the Israeli economy, but a casual attempt to use theory above to shed new lights on the association of GDP per-capita changes and geopolitical major events. It also serve as a first attempt to see if the theory is consistent with main economic facts on a country with frequent changes in individual security.

[19] The number of Israeli soldiers and civilian death and wounded of the 1948 War was much larger than any war later, including the October 1973 Yom Kippur war. The Jewish community in the country lost about 1 percent of its 650,000 population.

1952. Although this wave of immigrants brought practically no wealth with them, GDP per capita grew at about 6.4 percent annually from 1950 to 1956 (see Table A1). It is certainly the case that the success in the war and the establishment of a Jewish state, as well as the large inflow of population, cause a positive change in the rate of the individual security and the perceived life expectancy in Israel. The population was dominated by immigrants from Eastern Europe and from the Arab countries. The first group have just survived the holocaust and the second was coming out from an overall oppression that Jews have experienced from the 1930's to1948. In Israel in the early 1950's savings are very high and an overall optimistic view prevails; for the first time in decades Jews in Israel could hope for better life.

In 1954-56 Israeli periphery was under a terror attack from Jordan and Egypt (Gaza Strip) which were contained due to both the successful counter-terror military activities and the Suez war that Israel coordinated with the British and the French (1956). Once a wide international and active basis of support for containing terror from Jordan and Egypt was gained, Israel withdrew from Sinai. The overall level of security in Israel was on the rise and the main focus was on economic development. Defense expenditures were kept low relative to GNP (*Figure 4).* The observed exceptional high growth rates of GDP per capita (Table A1) and the large increase of the ratio of GDP per capita in Israel relative to the US from about 0.35 to 0.48 is correlated well with the increase security at a low level of defense expenditures just as the theory predicts.

The recession of 1965-66 resulted mainly from a drastic change in government investment policy as well as some other issues, none of which related to external insecurity. The deep decline in 1967 GDP is however related to insecurity. First and foremost, for a long period the reserve army was all drafted prior to the 1967 war. Furthermore, Israel was isolated in May and June 1967 where the armies of Syria, Jordan and Egypt where ready to attack. The USSR supported Syria and Egypt and the US, UK and France shifted to a neutral position.[20] The first half of 1967 was clearly a period of insecurity. Its correlation with the low GDP, is what the theory predicts.

In June 1967, Israel attacked Egypt, Syria and Jordan and in 6 days defeated all three

[20]These three countries were the main source of military equipment for Israel at that time. In May 1967 they announce that they stop all sales of military equipment to Israel.

armies. This unexpected success of the Six Days War increased substantially the level of perceived security, life expectancy and self confidence of the people of Israel. The large growth that followed during the years until October 1973 is consistent with the predictions of our theory and can be partially attributed to the impact of the war on perceived individual security. It is important to point out that the military actions and terror activities that followed the 1967 war were all far away from the urban-economic centers of the country and did not require a shift from the civilian labor force to military uses in the form of reserve military service as was the case during the 1948 war.[21]

At the eve of the Yom Kippur War in October 1973 the GDP per-capita of Israel was about 60% that of the US, relative to about 30% in 1948 *(Figure 3)*. There are many competing and complementing explanations for this economic success for the period from 1950 to 1973, one of them, which we promote here, is that this period is associated with relatively low levels of defense expenditures relative to GNP *(Figure 4)* that, given the perceived threat, generated increasing and very high levels of security and life expectancy in the Israeli population.

The Yom Kippur war was a major shock to the country. The level of individual security, the confidence in the power of the IDF and the intelligence community to contain Arab aggression within few days collapsed. As a response to this hike of insecurity, the government increased substantially the level of defense expenditures relative to GNP. The large economic and military support from the US overcame part of the large decrease in the level of individual security and life expectancy in two ways. The high level of defense budget, that hovered around 25% of GNP, helped to balance the immediate impact of the 1973 war on the level of individual security. On the other hand, the increase in defense expenditures contribute to the high level of budget deficit that was financed by increasing domestic and external debt. The economy experienced a large economic slowdown that has been attributed directly to the war, and the Israeli GDP per-capita reduced to about 47% of the US GDP per-capita.[22]

[21] Following the 1967 war Israel was attacked by Palestinians from Jordan which ended with few invasions of Jordan by Israel and the expel of the Palestinian leadership to Lebanon. At the same time the Egyptian army attacked Israeli positions along the Suez Canal. These attacks also ended with a cease fire agreement in 1970 and overall where viewed as Israeli success in containing Arabs attempts from damaging the Israeli economy and society. The outcome of these wars should be interpreted as overall increasing the level of security of the Israeli population.

[22] At the aftermath of the Yom Kippur war Jewish population in Israel went down for the first time since the

1978 was a new beginning. The peace process that quickly developed into the Egypt-Israeli Camp David accord dramatically reduced the prospects for major war at the scale of 1948 and 1973. This peace process and peace treaty were indeed a major change in the individual and the nation level of security. Growth of GDP per-capita was high relative to the world (see Table A1 *and Figure 3)*.[23]

Several points should be made. First, the defense expenditures went up rather than down as response to the peace treaty in 1980. Second, from 1978 the Israeli army was not successful in containing the shelling and terror activities from Lebanon as Israel successfully did in the 1950's. The invasion of Lebanon by Israel in 1982 was a great military disappointment and signaled again, together with overall economic mismanagement, the instability and insecurity that exist in Israel given the unresolved disputes with Syria, Jordan and the Palestinians. Again, we observe that unsuccessful military actions that reduced internal security were associated with the economic slowdown in GDP per capita growth relative to the world (1982-85).[24]

The unilateral partial withdrawal from Lebanon in 1985 jointly with the economic stabilization in July 1985 are associated with the growth in 1986-7.[25] The Palestinians in the West Bank and Gaza started in 1988 the first Intifada. This uprising involved mainly the collapse of the civilian Israeli occupation control of the West Bank and Gaza territories and did not affect the level of individual security of the people of Israel.[26]

At the same time, in October 1989 the large immigration flow of Jews from the former

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begging of the century, and the overall prospects for a Jewish state in Israel reached a new low levels among Israelis.

[23] If it was not for the mismanagement of the economy with excessive defense expenditures (still 25% of GNP, *Figure 4*) and high budget deficit (13% of GNP) this growth could perhaps continue for many years.

[24] Note that at this period Israel experienced high inflation, high internal and external debt and high government deficit. These were corrected by a stabilization policy in July 1985 that was followed also by a partial withdrawal from Lebanon.

[25] This growth is more likely related to the stabilization of inflation by balancing the budget, exchange rate stabilization, US financial support and Central Bank independence that enabled the economy to stop the deteriorating economic performance and return to what one may call, "normal" economic growth under the level of insecurity existed at that time.

[26] The army was successful in containing the uprising to instability in the Palestinian cities with almost no effect on the Israeli population.

Soviet Union started, which amount to almost million immigrants by the year 2000. This immigration flow together with the collapse of the Intifada in 1991, and the first Oslo agreement with the Palestinians of 1993, are believed to be directly related to the sustained period of growth from 1993 to 1996. Private savings rose significantly and the level of private and national confidence increased. The level of GDP per capita relative to that of the US almost reached the 1973 peak to be about 57% in 1996. A year after Rabin's assassination, after the first large wave of suicide bombing in the urban centers of Israel, after a subsequent deterioration of the peace process. Again, we observe that GDP per-capita growth decreased (Table A1) and relative to the US it went back to 50%.

The final collapse of the peace process and the beginning of the El-Akza Intifada in September 2000, that followed with a wave of terror (*Figure 5)* into the Israeli urban centers has drastically reduced the level of individual security. Moreover, the nation's belief in its capacity to survive reached a new low record only to "compete" with the time following the Yom Kippur war. For the first time since 1965 the GDP per-capita reduced by 3 percent in 2001 and 2002 and by -0.4% in 2003**.**

Summary: A brief review of the history of Israel's economic performance provides a case for the conclusion that war and terror generated an increase (decease) in the national perception of security and increase (decrease) in individual perception of life expectancy, which in turn were associated with large swings in economic growth. The comparison to the US provides a benchmark for economic performance for a small open economy. It should be emphasized that many other factors affect economic growth and the discussion above did not try to make the point that the geopolitical state is the *only* factor in affecting economic performance. Moreover, we did not even try to measure the relative importance of the defense and security level on the economic performance. We only make a point that correlations overtime are consistent with the above suggested theory. 55 years of wars and terror provide a good number of stylized facts which are consistent with basic analysis of changes in security and economic performance.

4.2 Terror and the business cycle[27]

The Israeli quarterly data from 1980 to 2003 provide a unique case study to document the conditional empirical impact of fear and terror on per capita GDP (GDP), investment (I), exports (EXP) and non-durable consumption (NDC).[28] The four macro variables are set in logs of real per-capita terms. The terror variable, (TER), is the natural log of an index that is equal to the number *e,* plus the equal weighted sum of the number of fatal Israeli victims of terror, the number of injured Israeli from terror, and the number of terror event. *Figure 5* shows the log of this index. *Table* 1 provides the Basic VAR (standard vector autoregression) estimation of quarterly data with two lags and the exogenous variables are: the real interest rate (R) with one and two lags, the log of terror index (TER) at one lag, seasonal dummies and linear trend. The VAR estimated equations provide a very good fit to the data.[29] It should be noted that the turning points of GDP at the beginning of 2001 could not be well fitted without incorporating the terror variable.

The terror index (TER) captures the impact of the flow of terror activity in Israel. We find that one lag of this index has a significant negative impact on economic activity. The impact on exports and investment is three times larger than the impact on non-durable consumption and GDP, as the coefficient on the two first variables is about -0.015 while the coefficient on the two latter is about -0.005.[30]

[27] In the paper presented at the November 2003 conference we used data from 1970:1 to 2003:1. Recently, we received better data from the Bank of Israel national accounts where each of the main aggregate variables is properly chained and deflated by its own specific price index. In previous versions we used the CPI as the deflator for all series. We decided to move to the new series even though they are available only from 1980:1 to 2003:3, since this is the most accurate macro aggregate data. As we indicate below, the results regarding the effect of terror on the economy were not substantially influenced from this data choice.

[28] These are the main variables included in a model of any open economy. We restrict our analysis to non-durable consumption since this part of consumption responds more quickly to changes in the desired level of consumption. Durable consumption is based on the flow of services from the stock of durable goods. Terror does not affect significantly the stock of durable goods, and, hence, the measured flow of consumption from this source. Terror however affects the flow of new durable goods which are part of investment.

[29] In the paper presented at the conference we included a WAR dummy that reflected mainly the 1973 war decline in output. Given that 1973 is not included in our current series, we excluded the WAR dummy from the VAR. Using the restricted sample the WAR dummy, based on the other wars, turned out to be insignificant.

[30] It should be noted that we run many alternative specifications and many lag tests. We do find that in

We also estimated *first difference VAR* for the same variables without trend, for two reasons. First, this specification implies a stochastic random walk process for the trend and as such this specification provides a robustness check on the results of the standard *VAR*. Second, this specification is viewed to be a better model for forecasting macro economic variables (Stock and Watson, 1993). The important result, displayed in *Table 2: panel A*, is that the estimated coefficients TER are about the same as in the basic VAR, both regarding the value of the estimators and their standard errors. That is, the terror index (TER) has lower coefficients on NDC and GDP than on EXP and I.

Since in the years 2000 and 2001 the world has undergone a number of sever shocks (September 11, the collapse of the stock market in the US and world-wide), we also estimate *first difference VAR* using only data until the beginning of the *Intifada* in 2000:3. Presented in *Panel B of Table 2*, the coefficients on *TER* are negative and similar to those from *panel A,* although the number of quarters with terror is relatively small and events such as the collapse of the stock market of September 11 are excluded by construction.

These results indicate that terror activities have negative aggregate economic impact that is consistent with the prediction of the model. That is, the model guides us to expect changes to affect the entire economic activity and not just some sectors of the economy. Clearly, some activities, such as, exports and investment, are more sensitive but also more volatile in their

NDC and GDP equations the inclusion of non-linear effects of the terror index and the inclusion of a dummy for the El Akza intifada are not rejected. We preferred to present the equations in a common simple format to keep the transparency of the main results. Moreover, the TER coefficients from this VAR are very close to the estimated parameters from the VAR based on the 1970-2003 data we used in earlier versions.

response.[31][32]

In order to analyze the quantitative importance of terror on the economy we provide in *Figures 6a-6c* predictions for the three main macro variables under three alternative geopolitical cases:[33]

1. Terror stops as of fourth quarter of 2003 (2003:4).

2. Terror continues until the third quarter of 2004 (2004:3).

3. Terror continues until the third quarter of 2005 (2005:3).

The implications for the *GDP* per-capita growth rates are:

(i) Without terror from 2003:4 on, *GDP* per-capita is predicted to grow annually at about 2.5 percent from the beginning of 2003:4 to 2005:3. In this case, over eight quarters, *GDP* per-capita could recover about one-half of the reduction in per capita GDP since the beginning of the intifada at the forth quarter of 2000 *(Figure 6a)*.[34]

[31] Besides the fact that we used two data sets and other specifications we also tried to include alternative explanations of the reduction in GDP per capita since 2000:4. One suggested indicator is the value of the NASDAQ index. Given the importance of the Hi-Tech sector in Israel, in addition to exports, many economists claim that the collapse of the NASDAQ market in 2000 was an important source for the observed reduction in GDP in the following years. To evaluate this claim we used the first differences in logs of the NASDAQ index in real dollar terms for the period 1980:1 to 2003:3 as an additional exogenous variable in the VAR system with two and one lags. The NASDAQ index reduced the negative values of TER and the marginal significance levels. The estimated coefficients for had the predicted sign, but most of them were not statistically significantly different from zero. Yet, the results in Table 2: Panel B, for the period until 2000:3 indicate that TER has a significant negative impact by itself (see also Figure 7).

[32] An alternative formulation for TER in the VAR is to add a dummy variable for the Intifada period (2000:4-2003:3). This way allows for unspecified alternative reasons for the decline in GDP per capita. The inclusion of the dummy reduced the negative values of TER and the marginal significance levels. Yet, there is no question that the most significant event of the period 2000:3 to 2003:3 is the level of terror. Hence, from all the many experiments we conclude that there is a strong evidence that the terror variable has an impact on the macro economy that does not depend on other events. However, for forecasting the Israeli economy it would be wise to use additional explanatory indicators (NASDAQ, dummies, etc.).

[33] For all cases we assume that as long as terror continues its continuation is at the average level of the period 2002:4-2003:3. We also assume real interest rate is set at the average level of 2002:4-2003:3.

[34] A fast recovery of this magnitude is reported also in Abadie and Gardeazabal (2003) when they explore the Basque region.

(ii) If terror ends at 2004:3 the estimated *VAR* predicts about zero per-capita growth rate from 2003:4 to 2005:3.

(iii) If terror continues at its 2002:4 - 2003:3 level up to 2005:3, then *GDP* per-capita is expected to decrease by about 4 percents from the beginning of 2003:4 to the end of 2005:3. That is, *annual GDP* per-capita declines by about 2 percent *(Figure 6a)*. The impact on the other aggregate indicators is 1 percent annually, for non-durable consumption *(Figure 6b)*, and 10 percents annually, for investment *(Figure 6c)*.[35]

To further demonstrate the quantitative impact of terror on economic activity we use *pre-intifada data* to estimate a first-difference-*VAR* and predict with this earlier (up to 2000:3) data the performance of the Israeli *GDP* during the years of the three years of intifada *(Table 2: panel B)*. This experiment is demonstrated by *Figure 7.*

Actual *GDP* per capita in each quarter has a diamond-shap in *Figure 7.* Forecasts, that do not account for any effect of terror and are based on pre-intifada data, are marked with triangles in *Figure 7.*[36] Clearly, the two, the actual and the forecast, are different. While the actual *GDP* per-capita crawls down, the forecast for *GDP* per-capita conditional on zero level of terror (*TER = 1),* is increasing. Given our theory, an economist who forecasts for the *GDP* in Israel during the Al-Aktza intifada without considering the effect of terror on the economy must turn to be wrong. To get a better prediction of output one must account for the effect of terror.

We use the coefficients estimated from *pre-intifada* first-differences VAR (*Table 2 panel B),* together with actual terror activity *(TER)* and actual real interest rate for the period 2000:4 to 2003:3, to forecast *GDP* per capita for these three years. The result is displayed by the line marked by "*x*" in *Figure 7.* The predicted *GDP* per capita at the last period is about the same as the actual. However, most of the period the VAR predicts about one half of the reduction in GDP per-capita. *Figure 7* demonstrates that the data supports

[35] The numbers of GDP per capita are very much in line with the results in Abadie and Gardeazabal (2003). The expected decline of GDP is attenuated due to the fact government expenditures on defense are up and therefore increase GDP. Note however that terror in the Basque region is far lower than terror in Israel according to any reasonable measure.

[36] These forecasts are constructed under the assumption that TER is identically zero throughout the period 2000:4 - 2003:3.

the intuition derived form the theory, that terror activity has a large share in the observed economic depression of Israel since the beginning of the wave of terror. Obviously, we do not claim that terror is the only factor that affects the Israeli economy during 2000:3 to 2003:3.

To capture the longevity of the impact of terror on the economy we analyze the impact of the TER on the low frequency trend in *GDP* and non-durable consumption. We do it by regressing the standard *H-P* filter estimate for the low frequency of *NDC* and *GDP* per-capita.[37] The first two columns in *Table 3* reports the *OLS* of the first difference of the trend of each series as depended variable on a constant, real interest rate (R) and TER. The result is that terror has a negative impact on the trend of both *GDP* and consumption. *Column 3 and 4* in *Table 3* reports the *OLS* of the first difference of deviation from the *H-P* filtered data, the cyclical part of the series, on the same variables, that is, real interest rate and TER. Here, the coefficient of TER is close to zero. These results indicate that terror activities that we observe in the 1990's had a significant negative impact on the low frequency of *GDP* and *NDC* per-capita but not on the high frequencies.

4.3 Substituting away from terror: the case of tourism

Looking at the windows of major hotels in Israel during nights of terror or war cannot leave the casual observer ignorant of the severe causal effect from threat to life to the demand for tourism. The elasticity of foreign visits to Israel with respect to threat of terror or war is seen to be so high, that no regression is needed to verify it. Do similar patterns govern local tourism? Do Israelis cancel vacations at the same rate as foreigners do? This section uses quarterly Israeli data on bed-nights to analyze the composition of tourism in Israel over the cycles of terror. Variations in the composition of tourism from time of peace (by Israeli standards) to times of terror (or war) allow the comparison of the reaction of foreigners to that of Israelis to a change in the threat that stems from external conflicts.

Although this investigation is directly related to the above theory it sheds light on the magnitude of the decline in utility of the "captive audience" of Israelis. Also, the diverse

[37] We first run unrestricted standard *HP* filter for $\frac{GDP_t - GDP_{t-1}}{GDP_{t-1}}$ and for the same transformation of *NDC* (per-capita). In the second stage we use as depended variable the estimated change in the trend. This trend represents the low frequency property of each series.

response to terror across groups with different outside options sheds light on the importance of the substitution effect in the case of threat to life. We find this issue important although it goes beyond our main argument. We document these evidence since we think they may have some implications on cross-section variations one should expect to find in response to large terror attacks on specific targets in the US, such as US urban centers like NYC, Washington, Chicago etc..[38]

We use the same quarterly index on terror we used before.[39] In addition, we use a dummy variable for the Intifada and a dummy variable for wars. The demand for foreign tourism is measured by the number of observed bed-nights in a quarter used by foreign tourists in Israel. *Table 4a* provides a simple demand (reduced form) equation. The price is the ratio of the price of recreational services in Israel in dollar terms divided by the US CPI.[40] The result from a standard OLS regression (*Table 4a*) is that the coefficient of this price is positive but insignificant, which can be interpreted as a standard result of the endogeneity determination of the price with the unobserved changes in actual bed-nights (demand or supply) shocks.[41] The negative, large, and significant coefficients on wars and terror activities show the sensitivity of demand of foreign tourism for local Israeli security. A joint test for the exclusion of the terror and war variables is rejected. Only little or no work is necessary to demonstrate the main result we want to document here. Note however, that given the composition of foreign visits to Israel, this observation implies a reduction in the demand for business trips to Israel as well. With the latter to decline one can only expect export of

[38] See also, Esteban Rossi-Hansberg (2004).

[39] We also used each of the indicators as well as other indicators to measure terror activities in Israel. The evidence that emerge are just more of the same.

[40] The inclusion of the lag dependent variables is due to the high serial correlation and the idea that foreign travel is a long term commitment. The results without the lag dependent variable are basically the same. Tourism is a seasonal product that we control by seasonal dummies.

[41] A simple model is that the number of available beds is pre-determined but the industry price of bed-night is determined in equilibrium where hotel mangers determine the price and the total foreign bed-nights and local Israeli bed-nights are determined by the demand. Then the regressions here are the demand but the price is expected to be correlated with the shocks to demand. Assuming that the terrors and wars are uncorrected with the shocks to demand, the coefficients on these indicators are consistent if these are not correlated with the contemporaneous price. Also, one may assume that the supply response to the shocks in foreign tourists demand and not to changes in local shocks.

goods that require foreign supervision to decline too.[42]

Table 4b provides the demand estimated for the bed-nights of Israelis. We regress Israelis bed-nights on the same price of recreational activities relative to Israeli CPI, Israeli *GDP* per-capita, the same terror and war variables, and seasonal dummies. The estimated results for demand for domestic tourism are almost a mirror image of the demand of foreign tourist to Israel. *(i)* Price elasticity is negative and significant. *(ii)* Income elasticity is positive and close to one. *(iii)* The terror index is *zero or positive*. *(iv)* The intifada dummy is either uncorrelated or positively correlated with higher local demand for bed-nights. *(v)* The war dummy has no significant impact on demand. The explanation is simple. Remote tourist locations, like Eilat and the Dead-Sea, are much less vulnerable to terror than the center cities. For Israelis, the vacation in a rural/touristic place is a relaxing activity vs. regular shopping, eating and traveling on buses in the centers of Haifa, Tel Aviv and Jerusalem.[43]

What do we learn from these two simple regressions? First, that terror and wars affect strongly the demand for individuals depending on their alternative consumption goods through the perceived effect of danger to life. Given the information set of the potential foreigner-tourist on daily life in Tel Aviv, and given the close substitutes he or she obtains, the "effective" relative price of a trip to Israel for the non-Israeli is almost prohibitively high and, hence, the demand for visits to Israel of overseas people decrease substantially. On the other hand, for Israelis who live and work at city centers where most terror activities are targeted, tourism to rural locations is an activity with a lower "effective" price and the demand may even go up.

To learn about the cross-sectional impact of terror one has to analyze carefully the different perceptions of the "effective" price of the products by different consumers in the different locations. Terror tends to hit heavily populated areas. Thus, migration from the center of cities to less populated (rural) locations seems as a natural prediction for the impact of terror

[42] Trade in an open economy most likely increase the negative impact of local instability since local individuals can invest abroad and the demand of foreigners to local goods is very sensitive to local security as the tourism analysis shows. Since trade allow individuals to diversify risk the above comment is not about the general equilibrium effect of trade.

[43] A simple F - test for the restriction of no terror/war valriable in this equation is rejected using 5% significance level.

of that kind of the 9/11. The reason we have not seen major demographic trends in Israel thus far may be due to the fact that to a large extent rural Israel is on the borders of enemy countries. One does not run from one source of insecurity into another. Moreover, in Israel, rural areas' labor markets are very thin and given the major economic slump no jobs are open in those areas.

5 Additional Evidence

Since the beginning of the Al-Aktza intifada, and as predicted by the theory, the ratio of *defense expenditures* to *GDP* in Israel has gone up while *investment to GDP* and *non-durable consumption* continuously decline. Yet not enough data is available to allow an inspection of the direct links that form these correlations. Nonetheless, support for the prediction of our theory that when terror *increases* government expenditures *increases* too while private investment *decreases,* were recently documented using international data in a "cross country" setup. In a recent study, Blomberg, Hess and Orphanides (2003) conclude that "... terrorism is associated with a redirection of economic activity away from investment spending and towards government spending". This redirection of resources from investment to defense spendings conforms with the predictions of our model.[44]

A different view is provided in the studies on the "atomic clock". These studies discuss the impact on saving decisions of the perception individuals have on the expected duration of their live. Slemrod (1990) analyzed data from twenty OECD countries in the period 1981-1984. In that paper he combines data on fears of a nuclear war gathered by Gallup International with the Feldstein's original data and re-estimates the original Feldstein (1980) saving equations. He shows that the index of fear of a nuclear war is negatively related to savings to output ratio. In a more recent paper, Russett and Slemrod (1993) analyzed a survey conducted in April and October 1990 across individuals in the United States. Their results show the same qualitative effect of fears of war on savings. These studies provide additional evidence in support of the theory above.

[44] Blomberg (1996) provided earlier evidence in this direction.

6 Concluding remarks

Terror endangers civilians' life. Our theory focuses on the effects of terror on the very existence of individuals. More specifically, it is assumed that as terror increases, life becomes less certain and shorter on average.

The main forces of the theory are two: On one hand stands the *exogenous* level of terrorism that shortens expected duration of life while making life less certain. On the other hand stands the government provision of security which is all aimed at undoing some of the malice inflicted by terrorists. Since safety does not come free, and since the market is assumed to fail in producing enough security, the government must take real resources from the private sector to produce security.

In this world an optimizing government must balance the economic costs of resources it uses to temper terrorism, against the economic benefits the economy obtains from reducing the level of terror. We show that when terror increases, the optimal response of the government is *not* to fully offset this turbid tide. Thus, in economies that face terror, although government spending on security is higher, life are on average less secure and shorter, growth is slower and steady state output and consumption are lower.

These comparative static results provide a prediction regarding the impact of changes in aggregate fear of death on changes in economic activities. Israel is an informative case-study for the inspection of these comparative statics since many times during the last 55 years the national level of fear-of-death changed dramatically. Scrutinizing the economic history of Israel over the last 55 years we show that the main observed correlations between changes in the aggregate fear of death and changes in aggregate variables are roughly consistent and better understood using our theory of individual security. Moreover, using the VAR methodology we show that an index of terror increases significantly the predictive power of the model. With a high rate of terror, output, consumption, investment, and exports, all decline significantly. Was terror absent from the streets of Israel over the last three years, per-capita output would have been about 10 to 15 percent higher than they were actually at 2003:3. Additional 8 consecutive quarters of intensive terror are predicted to further decrease per-capita output by additional 3 to 5 percents, from its level in 2003:3.

At its peak, terrorism in Israel caused the same death rate as the death rate due to car accidents. Nonetheless, economic slow-down due to terror is documented here to be very large. The steady state theory above cannot account directly for these facts. Future work on this subject may consider additional several channels by which terror affect economic activity in addition to the implied actual death rate. First, terror signal about potential further deterioration in safety. Second, there is not enough information to construct full insurance market against terror. Third, subjective probabilities of terror may be larger than the objective probabilities, such that individuals over value the aggregate risk. Each of these aspects may provide an additional insight on the channels by which terror affect the economy. Directly relating those to the data and the potential policy response may lead to a better understanding of the macroeconomic impact of terrorism.

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7 Appendix A

1. **Definitions and sources of variables for Tables 1-3 and Figures 5-7:**

- NDC - Consumption expenditure by Israeli households without durable goods at 2000 prices. The series are quarterly and were taken from The Bank of Israel (BOI), which use Central Bureau of Statistics (CBS) as a source. To turn the real data into per capita we divided those figures by the population from the BOI (Source: CBS).

- GDP – Gross Domestic Product at 2000 prices. The series are quarterly and were taken from BOI, which use CBS as a source. To turn the real data into per capita we divided those figures by the population from the BOI (Source: CBS).

- I - Fixed Capital Formation without ships and aircrafts and increase in inventory at 2000 prices. The series are quarterly and were taken from the BOI, which use CBS as a source. To turn the real data into per capita we divided those figures by the population from the BOI (Source: CBS).

- EXP - Total Export without diamonds at 2000 prices. The series are quarterly and were taken from the BOI, which use the CBS as a source. To turn the real data into per capita we divided those figures by the population from the BOI (Source: CBS).

- INF - The inflation rate was calculated as the ratio of successive consumer price indices (from the CBS).

- R – Nominal short-term debitory interest rate. These data were built from an annual short-term interest rate as was found in the IFS, the BOI and from the CBS. It was turned to a quarterly interest rate by the formula . Then it was turned into real interest rate by the formula ((1+nominal_interest)/(1+"inflation rate")).

- TER - The terror database was taken from the International Policy Institute for Counter-Terrorism at the Interdisciplinary Center Herzliya (www.ict.org.il). The data includes all the terror actions on a monthly base including number of injured, Number of killed, method of operation, etc. For terror index we use the logarithm of "e" plus the average of: the number of fatal victims of terror, the number of injured from terror actions and the number of terror events (within the pre 1967 borders of Israel only; terror activity in the West Bank and Gaza Strip is excluded from the analysis).

2. **Additional definitions and sources for Table 4:**

- Visitors-Beds: Number of occupied beds by foreign guests at hotels in Israel. The data were drawn from the CBS. We divided the data by the relevant domestic population (from the CBS) to get the data in per capita values.
- Foreign-Price – The basic data is the domestic CPI for vocational activity, which was drawn from the CBS. To turn the data into dollars we divided it by the exchange rate (Nominal Exchange Rate from the BOI) and to turn it into real price we divided it by the US CPI that was drawn from the Federal Reserve Bank of St. Louis Database.
- INTIFADA – Dummy variable, which gets 1 if an Intifada took place in the given quarter. There are two periods of Intifada – The first during 1987:3 – 1993:3 and the second since 2000:3.
- Domestic-Beds: Number of occupied beds by domestic guests at hotels in Israel. The data were drawn from the CBS. Then we divided the data by the relevant domestic population (from the CBS) to get the data in per capita values.
- Domestic-Price: Domestic CPI for vocational activity, which was drawn from the CBS.

3. **Data for Figure 3:**

The data for Figure 3 (years 1950-2000) comes from "Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP), October 2002 (RGDPL)". Data for 2001 - 2003 were calculated by the real growth rates of Israel and the US relative to the 2000 GDP-PPP (US GDP in current USD was taken from the Bureau Of Economic Analysis and CPI-U was taken from The Bureau of Labor Statistics, Israeli data was taken from the CBS). The GDP per capita of Israel was taken from the CBS.

4. Data for Defense expenditures in Figure 4 is taken from the CBS. The data for early years was taken from the CBS's special publication number 1097. More recent data is taken from the yearly publications of the CBS, as was the yearly GNP.

5. Data for Table A1 was taken from the CBS. The growth rate of the whole period was calculated as the product of the yearly growth rates. Taking the x-root of the result (when x is the number of years in the period minus one) we got the yearly average growth of the period.

Figure 1:
Equilibrium and Steady State in the Blanchard – Yaari Model

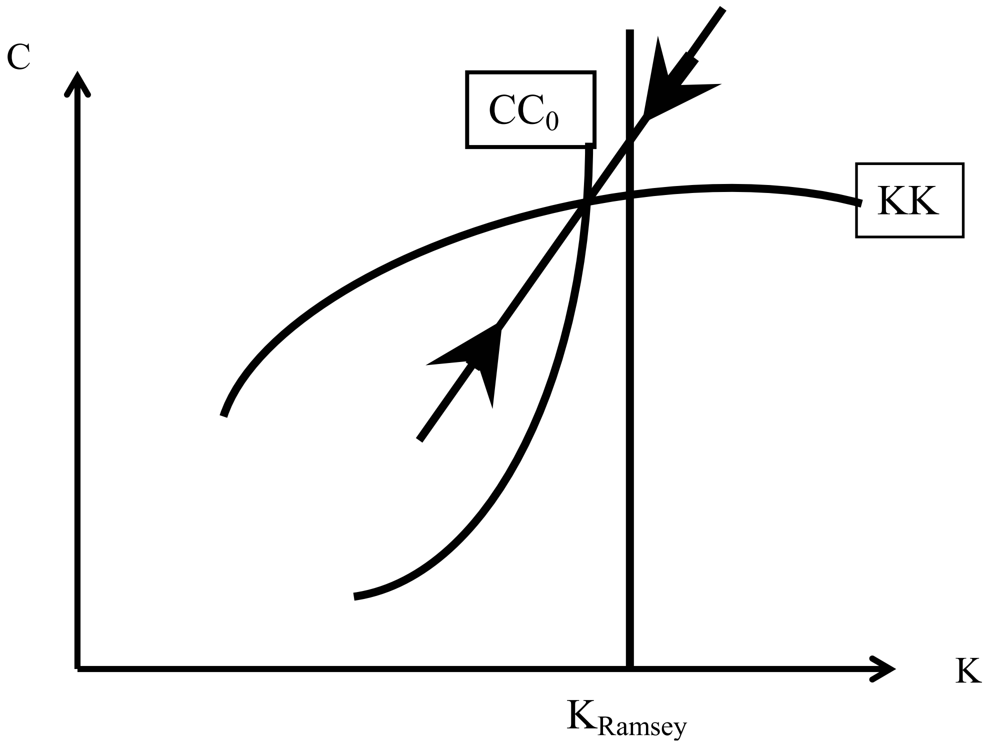


Figure 2:
The decline in security and the reaction of the government

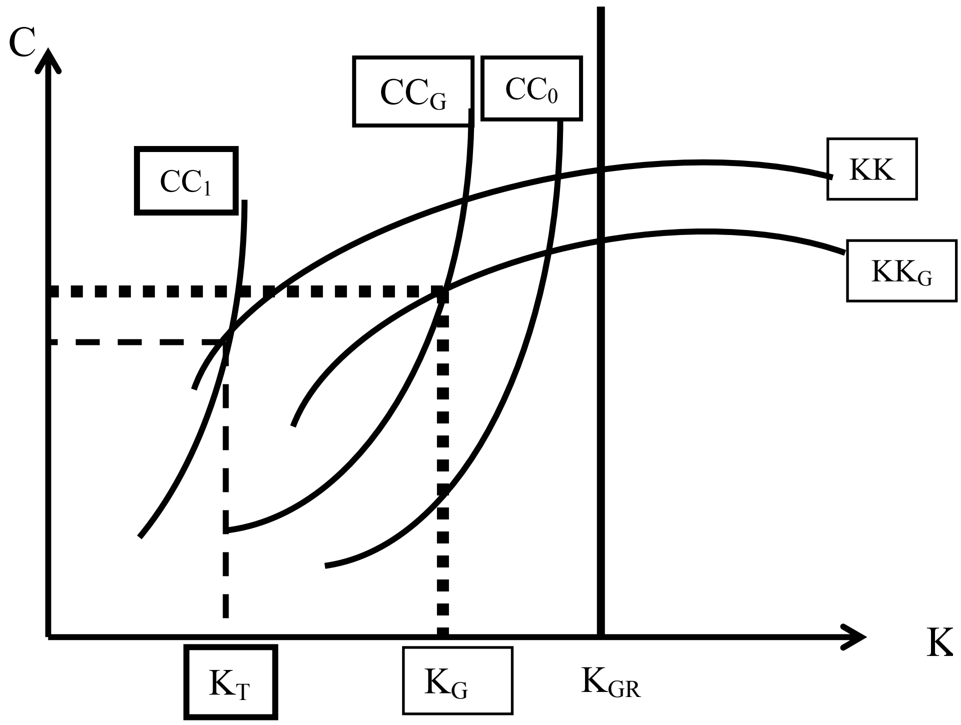
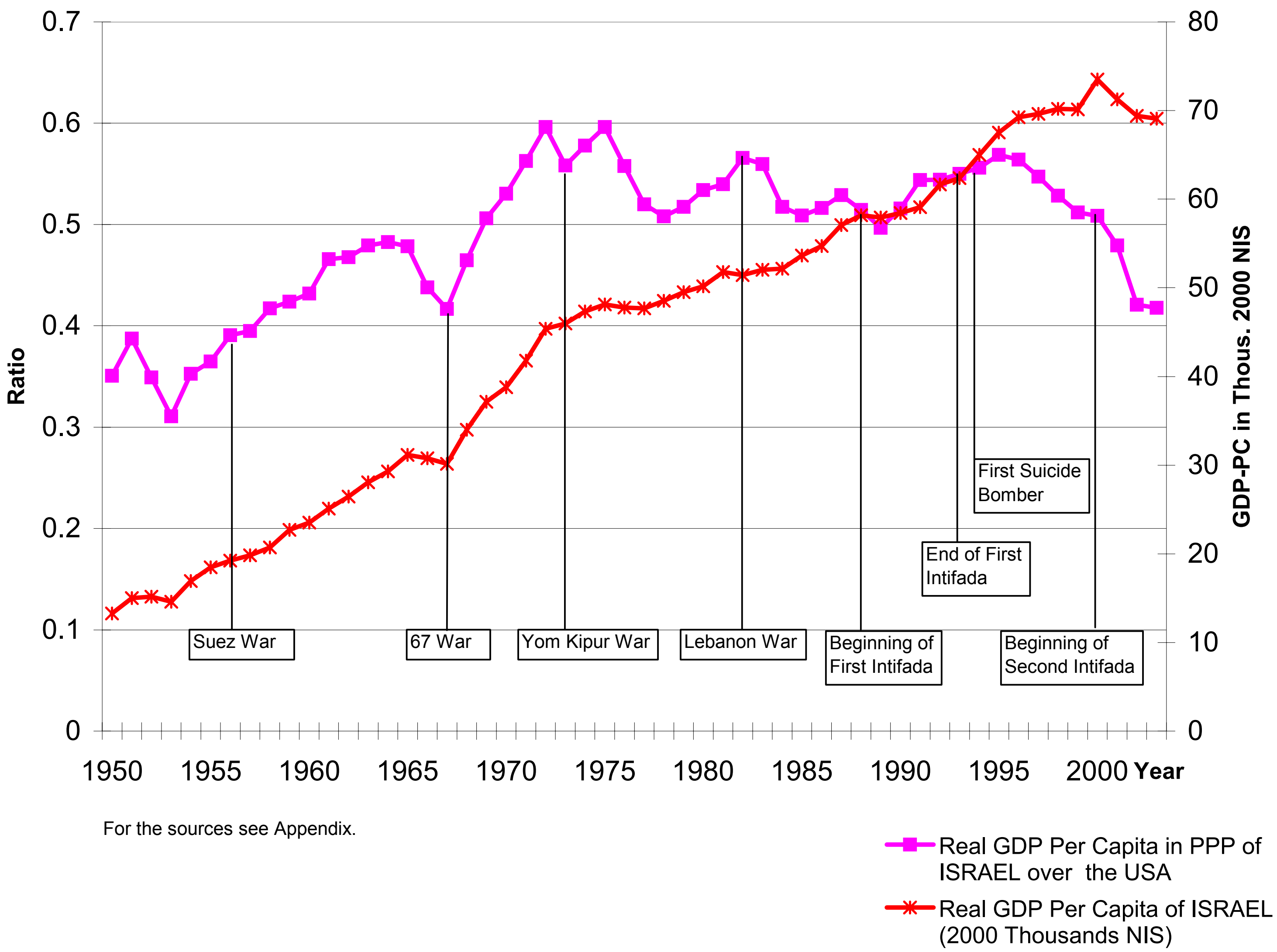
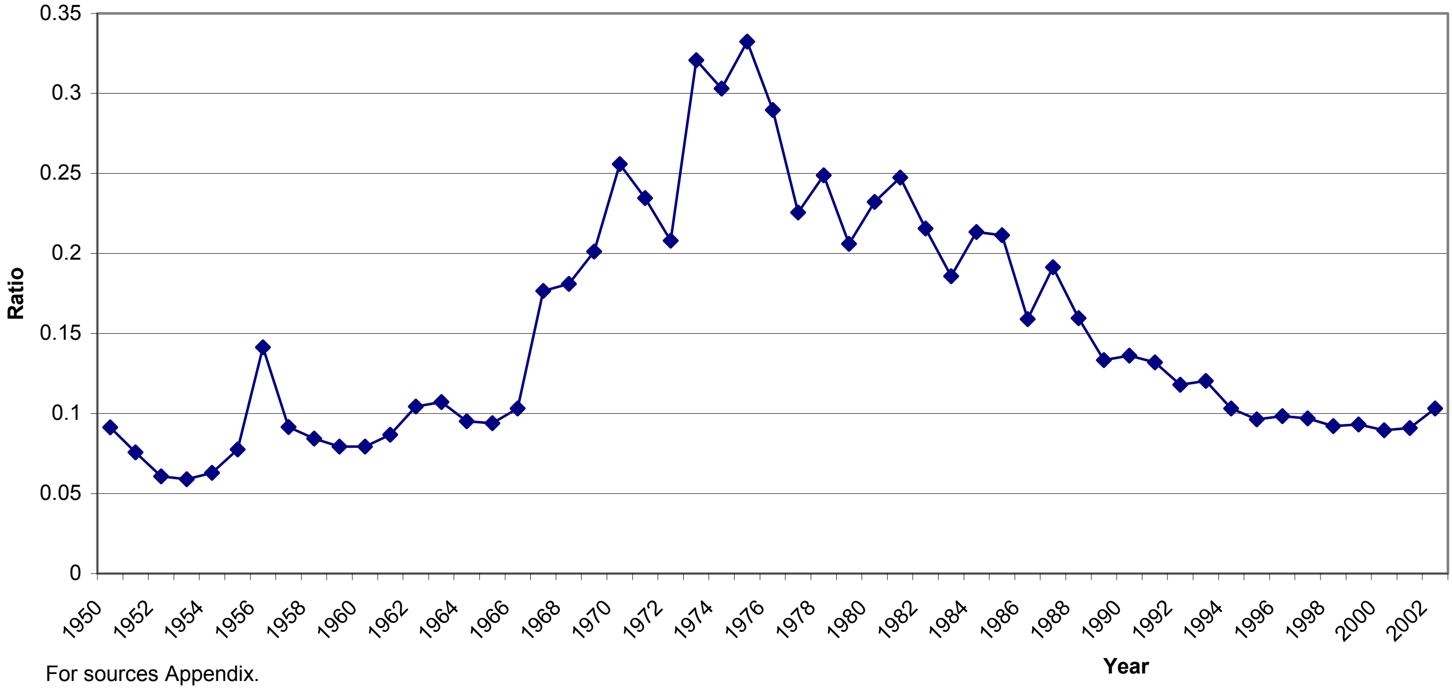


Figure 3: Real GDP Per Capita in PPP of Israel over the US and Real GDP Per Capita of Israel: 1950-2003



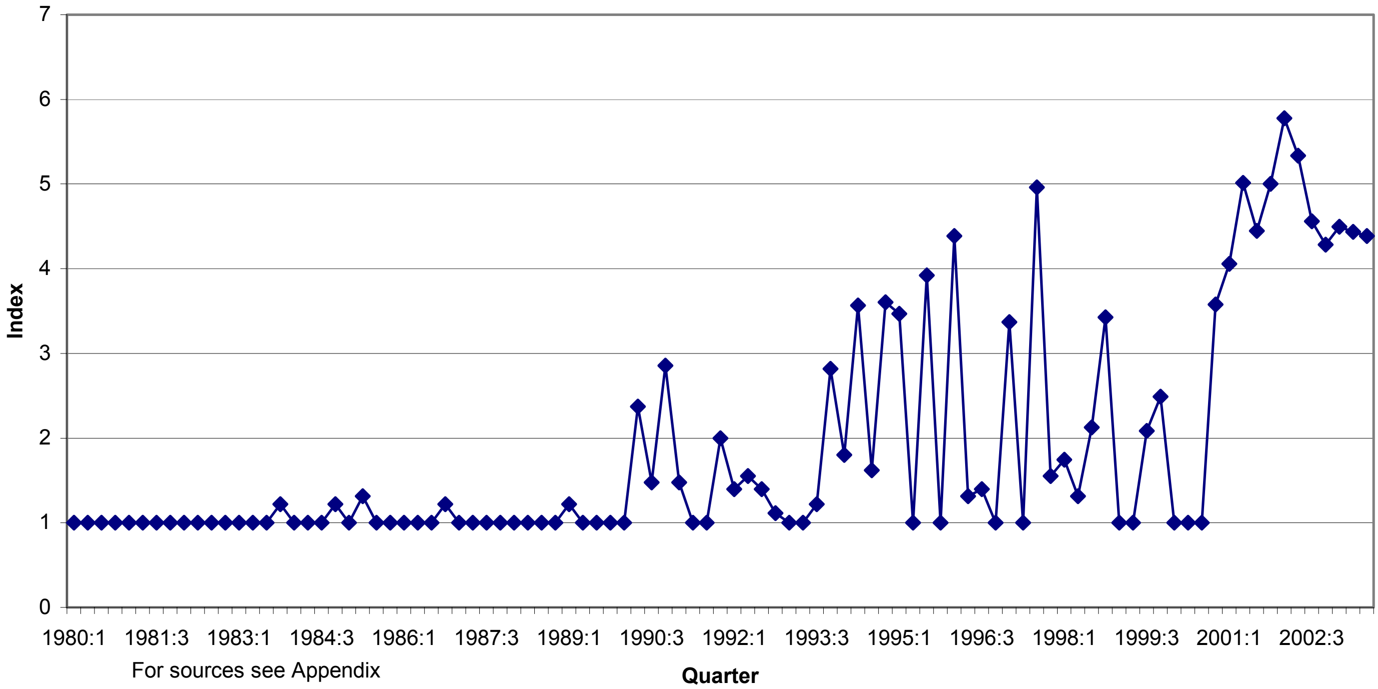
For the sources see Appendix.

Figure 4: Defense Consumption to Gross National Product Ratio (1950-2002)



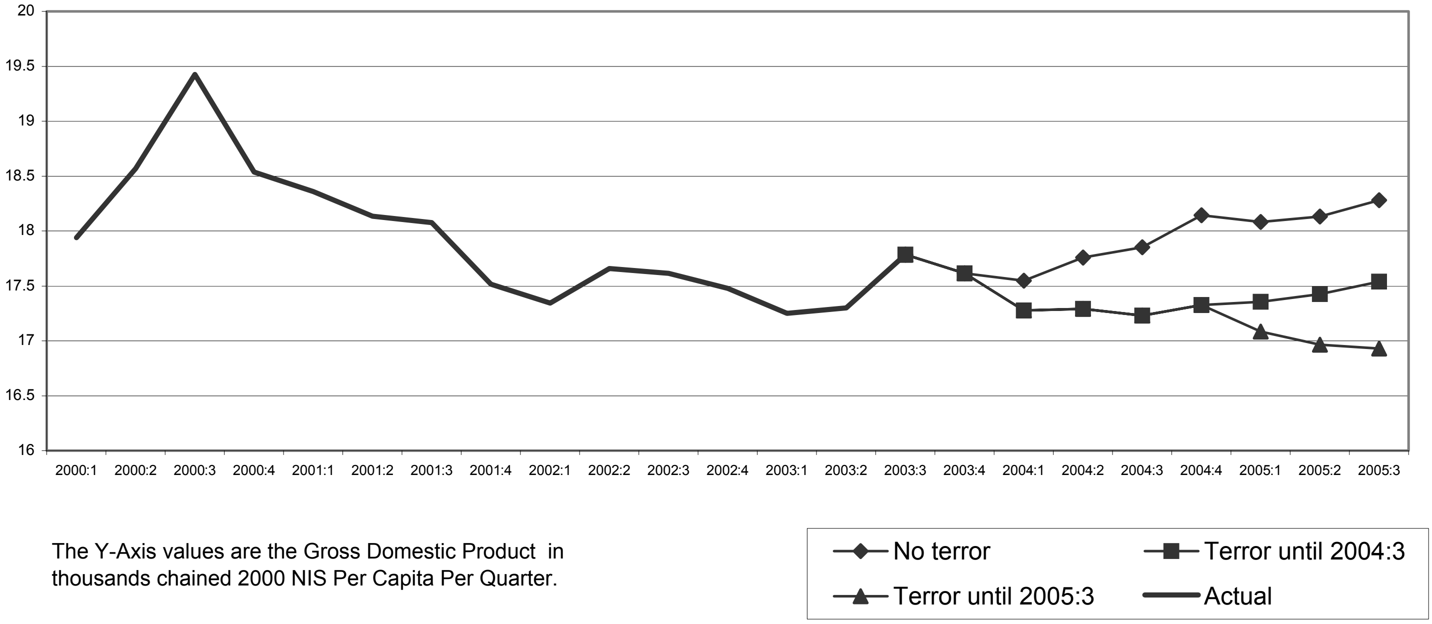
For sources Appendix.

Figure 5: Terror Index (TER)



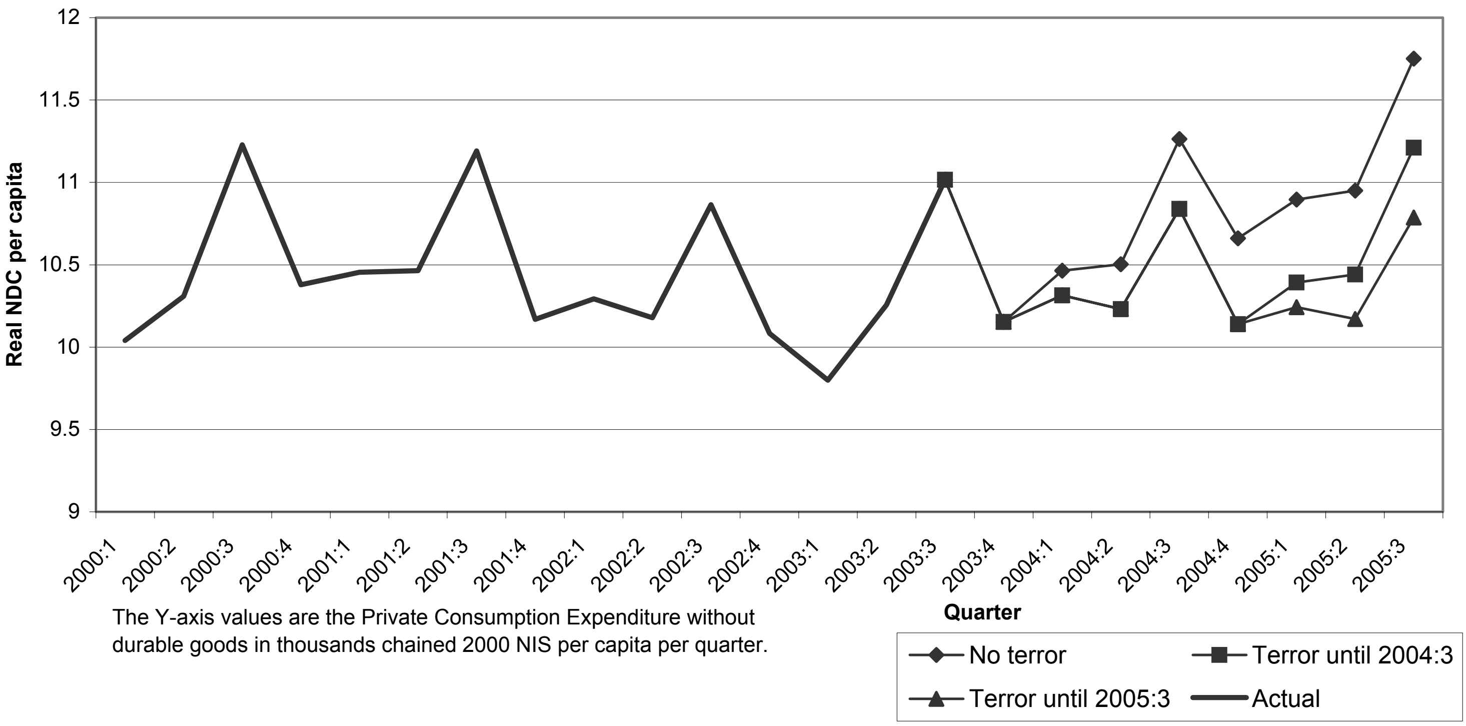
For sources see Appendix

Figure 6a: Real GDP Per Capita Prediction for 2003:4-2005:3



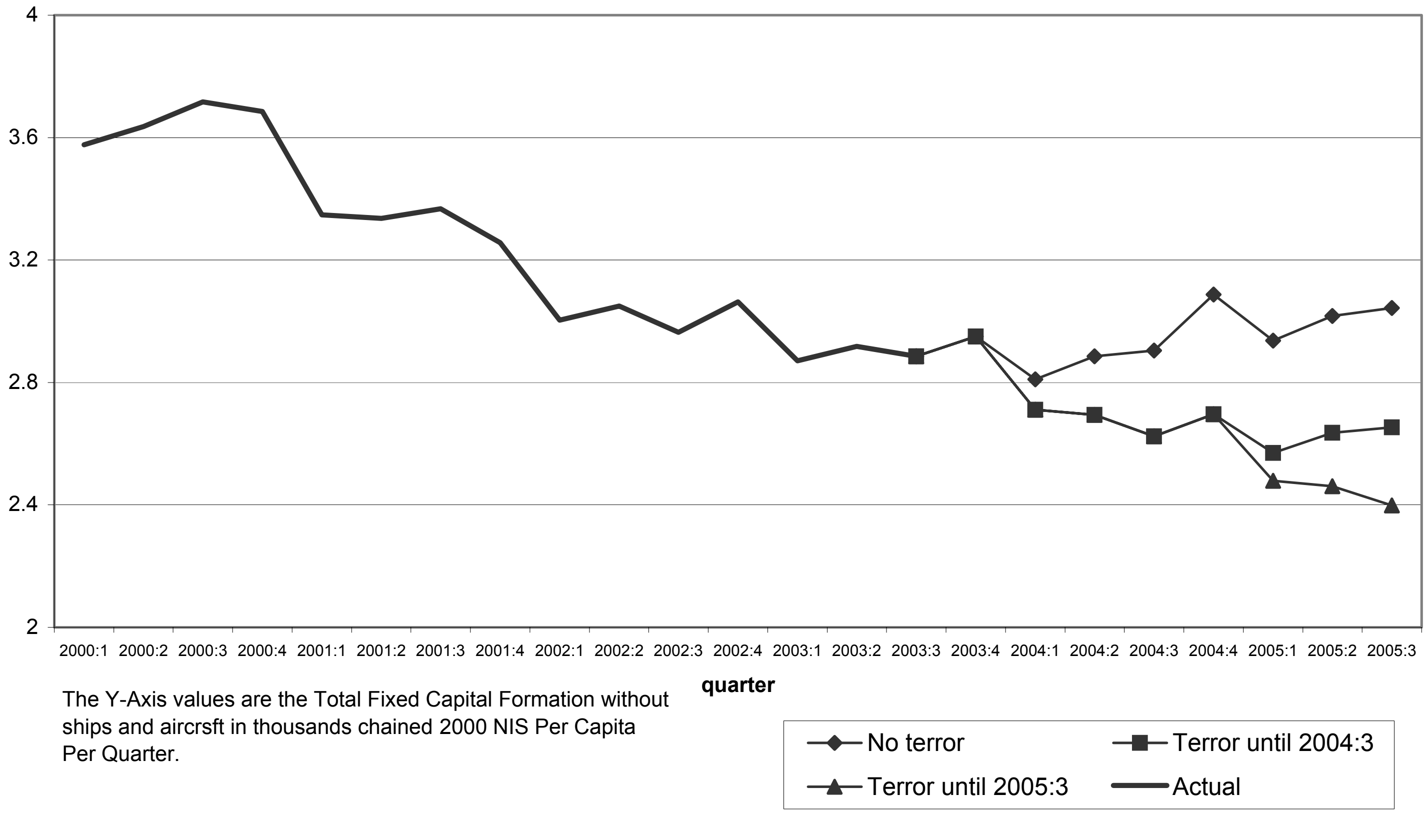
The Y-Axis values are the Gross Domestic Product in thousands chained 2000 NIS Per Capita Per Quarter.

Figure 6b: Real Non Durable Consumption Per Capita Prediction for 2003:4-2005:3



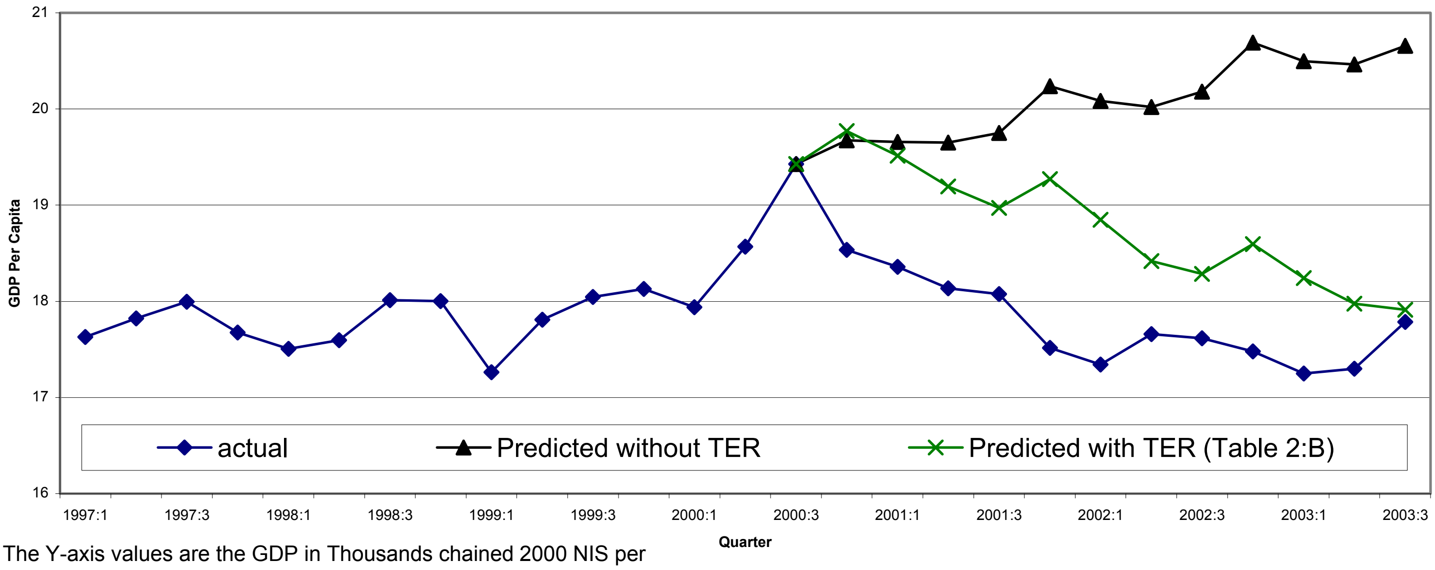
The Y-axis values are the Private Consumption Expenditure without durable goods in thousands chained 2000 NIS per capita per quarter.

Figure 6c: Real Investment Per Capita Prediction for 2003:4-2005:3



The Y-Axis values are the Total Fixed Capital Formation without ships and aircrsft in thousands chained 2000 NIS Per Capita Per Quarter.

Figure 7: Predicted GDP per-Capita 2000:4-2003:3 using Table 2 Diff-VAR



The Y-axis values are the GDP in Thousands chained 2000 NIS per capita per quarter.

Table 1: Basic VAR: 1980:1-2003:3

	NDC	GDP	I	EXP
NDC(-1)	0.5324	0.1681	-0.0288	0.1449
	0.1222	0.1037	0.1799	0.2154
NDC(-2)	0.0777	-0.0136	-0.1236	0.0095
	0.1218	0.1034	0.1793	0.2147
GDP(-1)	0.2096	0.4556	0.4232	-0.2731
	0.1664	0.1413	0.2450	0.2935
GDP(-2)	0.0347	-0.0308	-0.1804	-0.4960
	0.1734	0.1472	0.2553	0.3057
I(-1)	0.1172	0.0477	0.8588	-0.1291
	0.0858	0.0729	0.1263	0.1513
I(-2)	-0.1107	-0.0102	0.0714	0.2372
	0.0821	0.0697	0.1209	0.1448
EXP(-1)	-0.1044	-0.0650	-0.2433	0.6504
	0.0786	0.0667	0.1157	0.1386
EXP(-2)	0.1167	0.0422	0.0945	0.1886
	0.0813	0.0690	0.1197	0.1434
C	0.0107	1.1991	-0.1273	1.8006
	0.3289	0.2793	0.4843	0.5800
R(-1)	-0.0142	0.0482	-0.2461	0.0987
	0.1044	0.0886	0.1537	0.1840
R(-2)	-0.0622	0.0467	0.0021	0.1100
	0.1033	0.0877	0.1521	0.1821
TER(-1)	**-0.0053**	**-0.0093***	**-0.0150***	**-0.0183***
	0.0036	**0.0031**	**0.0053**	**0.0063**
@SEAS(1)	0.0465	-0.0024	-0.0778	-0.0758
	0.0198	0.0168	0.0292	0.0349
@SEAS(2)	0.0407	-0.0064	-0.0353	-0.0721
	0.0112	0.0095	0.0165	0.0198
@SEAS(3)	0.1000	-0.0022	-0.0449	-0.0906
	0.0132	0.0112	0.0194	0.0232
@TREND	0.0017	0.0015	0.0024	0.0037
	0.0007	0.0006	0.0011	0.0013
R-squared	0.9811	0.9572	0.9705	0.9732
F-statistic	265.77	114.90	168.79	186.74

Notes:

1. The first row presents the coefficient and the second presents the standard error.
2. (*) denotes 5% significant level of TER(-1) coefficients only. We do not indicate significance level of test for other parameters.
3. For a description of the data see Appendix.

Table 2: First Difference VAR: 1980:1 – 2003:3

	A: 1980:1-2003:3				B: 1980:1-2000:3			
	D _NDC	D_GDP	D_I	D_EXP	D _NDC	D_GNP	D_I	D_EXP
D_NDC(-1)	-0.2866	0.0939	-0.1390	-0.0135	-0.2506	0.1061	-0.1233	0.0234
	0.1196	0.0989	0.1723	0.2137	0.1285	0.1038	0.1874	0.2059
D_NDC(-2)	-0.2030	0.0196	-0.2344	-0.1035	-0.1680	0.0700	-0.2000	0.0250
	0.1219	0.1008	0.1758	0.2180	0.1290	0.1042	0.0188	0.2065
D_GDP(-1)	0.1431	-0.4596	0.3471	-0.1044	0.1397	-0.5037	0.3737	-0.2528
	0.1668	0.1379	0.2404	0.2981	0.1797	0.1452	0.2621	0.2879
D_GDP(-2)	0.1008	-0.4970	0.2045	-0.3327	0.0816	-0.4871	0.2424	-0.2648
	0.1675	0.1385	0.2415	0.2994	0.1798	0.1453	0.2622	0.2880
D_I(-1)	0.0766	0.0274	-0.0143	-0.1566	0.0797	0.0278	-0.0081	-0.2400
	0.0833	0.0689	0.1201	0.1489	0.0904	0.0730	0.1318	0.1448
D_I(-2)	-0.0161	-0.0047	0.1243	-0.0115	-0.0398	0.0032	0.1317	-0.0338
	0.0829	0.0686	0.1195	0.1482	0.0908	0.0733	0.1323	0.1454
D_EXP(-1)	-0.1066	0.0073	-0.1960	-0.1973	-0.1468	0.0557	-0.2162	0.0129
	0.0814	0.0673	0.1174	0.1455	0.1051	0.0849	0.1532	0.1683
D_EXP(-2)	0.0336	0.1062	-0.1520	0.0105	0.1022	0.1423	-0.1580	0.0041
	0.0785	0.0649	0.1131	0.1403	0.1030	0.0832	0.1502	0.1649
C	-0.0351	0.0196	0.0751	0.1038	-0.0360	0.0279	0.0809	0.1131
	0.0122	0.0101	0.0175	0.0218	0.0141	0.0114	0.0206	0.0226
D_R (-1)	0.0369	0.0303	-0.1884	-0.0368	0.0374	0.0361	-0.1842	-0.0047
	0.0999	0.0826	0.1440	0.1786	0.1073	0.0867	0.1564	0.1718
TER(-1)	**-0.0043**	**-0.0046***	**-0.0106***	**-0.0101***	**-0.0047**	**-0.0067****	**-0.0128***	**-0.0054**
	0.0027	**0.0022**	**0.0038**	**0.0048**	**0.0044**	**0.0036**	**0.0064**	**0.0071**
@SEAS(1)	0.0624	-0.0048	-0.0977	-0.0911	0.0733	-0.0141	-0.1006	-0.1251
	0.0210	0.0173	0.0302	0.0375	0.0245	0.0198	0.0358	0.0393
@SEAS(2)	0.0362	-0.0144	-0.0507	-0.0900	0.0295	-0.0211	-0.0538	-0.0944
	0.0153	0.0126	0.0220	0.0273	0.0168	0.0136	0.0245	0.0270
@SEAS(3)	0.1161	-0.0056	-0.0455	-0.1016	0.1174	-0.0135	-0.0504	-0.1229
	0.0145	0.0120	0.0209	0.0259	0.0164	0.0133	0.2394	0.0263
R-squared	0.7063	0.3462	0.4984	0.5032	0.6884	0.3884	0.4920	0.5792

Notes:
1. The first row presents the coefficient and the second presents the standard error.
2. * (**) denotes 5% (10%) significant level of TER(-1) coefficients only. We do not indicate significance level of test for other parameters.
3. For a description of the data see Appendix.

Table 3: Low and High Frequency Components of Consumption and GDP, 1980:1-2003:3

	LF_NDC	LF_GDP	HF_NDC	HF_GDP
C	0.0092	0.0050	0.0232	0.0047
	0.0006	0.0005	0.0103	0.0058
R(-1)	-0.0017	0.0028	-0.3653	0.0307
	0.0072	0.0062	0.1314	0.0743
R(-2)	0.0081	0.0046	0.0811	-0.0281
	0.0072	0.0062	0.1309	0.0741
TER(-1)	**-0.0013***	**-0.0011***	**-0.0051**	**-0.0026**
	0.0002	**0.0002**	**0.0035**	**0.0020**
R-squared	0.3776	0.3928	0.1070	0.0224
F-statistic	17.996	19.192	3.554	0.681

Notes:
1. The first row presents the coefficient and the second presents the standard error.
2. (*) denotes 5% significant level of TER(-1) coefficients only. We do not indicate significance level of test for other parameters.
3. For a description of the data see Appendix.

Table 4a: Demand for Foreign Tourism: 1970:1-2003:1

Dependent Variable: **LOG_Visitors-Beds**	
C	-0.0515
	0.2460
Log_Foreign-Price	0.1810
	0.1590
TER	**-0.0506***
	0.0194
TER(-1)	**-0.0572***
	0.0202
INTIFADA	-0.1335
	0.0431
WAR	-0.5161
	0.0881
@SEAS(1)	0.0275
	0.0471
@SEAS(2)	0.2522
	0.0480
@SEAS(3)	0.0205
	0.0473
Log_Visitors-Beds(-1)	0.5666
	0.0584
R-squared	0.8043
F-statistic	55.717

Table 4b: Demand for Local Tourism: 1970:1-2003:1

Dependent Variable: **LOG_Domestic-Beds**	
C	-3.5867
	0.2773
Log_Domestic-Price	-0.7553
	0.3578
LOG_GNP	0.8988
	0.1392
TER	**0.0163**
	0.0258
TER(-1)	**0.0536***
	0.0258
INTIFADA	0.1228
	0.0551
WAR	-0.0858
	0.1136
@SEAS(1)	-0.1720
	0.0610
@SEAS(2)	0.1516
	0.0617
@SEAS(3)	0.6343
	0.0624
R-squared	0.7307
F-statistic	36.780

Notes:
1. The first raw shows the coefficient and the shows the Standard error.
2. (*) denotes 5% significant level of TER(-1) coefficients only. We do not indicate significance level of test for other parameters.
3. For a description of the data see Appendix.

Table A1: Israeli Per-Capita GDP Annual Growth Rates: Selected Period, 1950-2003

Period	Annual Growth rates
1950-1956	6.36%
1956-1964	5.40%
1964-1967	0.94%
1967-1973	7.29%
1974-1978	0.63%
1978-1982	1.46%
1982-1987	2.11%
1987-1990	0.78%
1990-1993	2.21%
1993-1996	3.55%
1996-2000	1.50%
2000-2003	-2.04%

Note: For sources see Appendix.