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ISRAELI POLICY TOWARDS REACHING CANCUN PLEDGE: A COMPARISON OF ACTIONS IN PLAN AND ECONOMICALLY EFFICIENT MEASURES

Introduction

Israel is a relatively small emitter of Greenhouse Gases (GHGs), contributing less than half a percent of world annual emissions. However, Israel is tied to Europe and the US both economically and politically; therefore interests of international relations will force Israel to mitigate. First of all, in the Cancun Agreements Israel has re-committed for a 20% emissions reduction target beginning in 2020 compared to a business as usual scenario. Secondly, Israel's new membership of the OECD also obliges it to make binding commitments under International Environmental Agreements (OECD, 2010). Thirdly, the conditions of international trade with the EU, which conducts a significant GHG emission reduction policy, will not allow Israel to gain a competitive advantage by escaping mitigation policy, which generally causes prices to rise.

In addition to pressure arising from international concerns, there is also a national interest in a greener Israeli economy. Israel lacks natural reserves of coal and oil, and up until recently has mostly relied on imported fossil fuels, for energy generation. Israeli politicians see in renewable energy and natural gas reserves, discovered recently off Israeli shores, the way to improve energy security. Therefore, both national and international interests drive Israel to action.

On the damage side for Israel, climate change is best viewed as a threat multiplier which exacerbates existing trends, tensions and instability. Israel is a small, densely populated country, characterized by an expanding population and economic growth against a backdrop of land and water scarcity. Reduction of arable land, widespread shortage of water, diminishing food and fish stocks, increased flooding and prolonged droughts are already happening. Climate change will alter rainfall patterns and further reduce avail-

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able freshwater by as much as 20—30%. IPCC scenarios indicate a tendency towards a more arid climate in Israel. The consequences will be even more intense in areas under strong demographic pressure like Israel and the Palestinian Authority. Water shortage in particular has the potential to cause civil unrest and to lead to significant economic losses. The core challenge is that climate change threatens to overburden this region, which is already fragile and conflict-prone (EC, 2008). It is important to recognize that the risks are not just of a humanitarian nature; they also include political and security risks — water and energy scarcity in Israel which are closely linked with political stability in the region. Impacts of climate change on international security are interlinked, requiring comprehensive policy responses.

Nevertheless, Israeli officials apparently try to escape too stringent commitments. Israel, like other parties, faces uncertainty in its commitments because many factors that affect the burden of achieving the target evolve between the year of negotiation and the commitment period. The recent financial crisis and global economic downturn are clear reminders of the volatility in the underlying economic environment in which parties make these emission commitments. Additional uncertainties include unanticipated economic growth, technology breakthroughs, prices for renewable, domestic natural gas extraction prospects (a lower-emitting alternative to coal), and political upheavals. Many policy problems have frustratingly long histories of inefficient regulation that can be difficult or impossible to reverse, even where large efficiency gains might be had from doing so. This paper observes climate change mitigation policy in Israel in light of environmental economic theory. It provides insights into current policy and one most efficient economically.

Although the latest Input-Output table for Israel is dated 1995, we create a SAM for 2004 employing most updated Supply and Use Tables enriched with the relevant data from natural accounts.

In addition, to improve for IGEM's reliability, we estimate empirically labour-capital Constant Elasticity of Substitution (CES) in various Israeli sectors. In the previous version of IGEM this parameter was adapted from the literature.

To evaluate a 20% emission reduction below BAU in 2020 we derive baseline for the Israeli economy at 2020. We formulate a no-abating-policy baseline scenario for 2020, following official projections on population, capital and GDP growth in Israel, as well as the "Business as Usual" (BAU) bundles of energy sources and energy demands by various economic sectors and households.

The ultimate goal of the paper is to analyze the instruments that could be employed in carbon abatement policy in Israel, and to propose a set of instruments maximally tuned to attain abatement at the least cost.

The rest of this paper is structured as follows. Part 2 presents briefly the general structure of IGEM model, data updates and evaluation of labour — capital CES. Part 3 illustrates the analysis of carbon pricing as an incentive to reach Israel's commitment under Cancun Agreements. It then scans actual policy suggestions currently discussed by Israeli policymakers. Part 4 concludes.

The IGEM model

The general structure of IGEM, the computable general equilibrium economic model, is familiar having had several applications, including analysis of the effects of GHG emission restrictions as noted above. IGEM is a structural, real, static model of a small open economy with five energy commodities, 14 other commodities, a government, an investment agent, a foreign agent, and a single representative household. It incorporates energy flows among producers and between producers and consumers. The standard assumptions of market clearing, zero excess profits, and a balanced budget for each agent apply. Commodity markets merge primary endowments of households with producer outputs. In equilibrium the aggregate supply of each good must be at least as great as the total intermediate and final demand. Producer supplies and demands are defined by producer activity levels and relative prices. Final demands are determined by market prices.

A less common feature is the separation of activities from commodities; this permits activities to produce multiple commodities, while any commodity may be produced by multiple activities. In addition the model allows export of imported commodities, adopting the Armington assumption. It is assumed that the economy is at equilibrium at the benchmark. A policy simulation is implemented as a 'counter-factual' scenario, which consists of an exogenous set of shocks to the system. The model output shows the state of the economy after all markets have reached a new equilibrium. Palatnik (2009) presents a detailed description of IGEM. To keep this work self-contained, in the following subsections we present solely modifications produced within described here research.

1. Constructing Social Accounting Matrix 2004

CGE models are generally used to provide quantitative analysis of economic policy problems integrating a sound theoretical structure with actual economic data. Lacking the traditionally used GTAP[1] database (Badri, Walmsley, 2008), we construct a consistent Social Accounting Matrix for Israeli economy in 2004. Although the most recent year for which the Central Bureau of Statistics (CBS) produced Input-Output Tables (CBS, 2002) — the main data source for the SAM — is 1995, we employ supply and use tables for 2004 (CBS, 2009) in order to update this database.

The SAM was built on the basis of a 14-industry aggregation Use Table, whilst implementing the disaggregation of 'Manufacture' into crude oil (COIL), coal (COAL), refined petroleum (ROIL), and other manufacturing (MNF). 'Electricity and water' sector was disaggregated over electricity (ELE) and water (WAT) using sectoral weights in a 162-industry aggregation Input-Output Tables (CBS, 2002) and complementing data from the statistical report of Israel Electric Corporation for 2004. Consequently, 18 commodities/activities are presented.

2. Labour-Capital CES

In applied climate policy models the ease with which one input can be substituted for another is represented by elasticities of substitution. Production technologies in the CGE models are ruled by nested Constant Elasticity of Substitution (CES) functions. Therefore, it is important that the substitution possibilities in applied climate policy models are not only empirically founded, but also disentangled from changes in the production isoquant that come from technological change. Too high (low) elasticities may lead to under (over)-estimates of the effects of endogenous technological change.

Two studies have recently evaluated labour-capital CES functions. Both Van der Werf (2007) and Okagawa and Ban (2008) used industry-level data from OECD countries to empirically estimate the CES nesting structure for capital and labour. Israeli data was not available in their analyses. Therefore, the previous version of IGEM (Palatnik, Shechter, 2008) adapted the value for labour-capital substitution for Italy from these studies.

In the present research we follow the methodology of Van der Werf (2007) and Okagawa and Ban (2008) to empirically assess the constant elasticity of substitution for Israeli sectors as presented by equation 1.

$$KL_i = \left[\alpha_{KL,i} K_i^{\frac{\sigma_{KL,i}-1}{\sigma_{KL,i}}} + (1-\alpha_{KL,i}) L_i^{\frac{\sigma_{KL,i}-1}{\sigma_{KL,i}}} \right]^{\frac{\sigma_{KL,i}-1}{\sigma_{KL,i}}}. \quad (1)$$

[1] GTAP database aggregates Israel together with the rest of the Middle East countries.

Where: K is capital input; L — is labor input; KL is composite goods of capital and labor; σ is substitution elasticity; α is the distribution parameter. This is a primary factors ratio, taken from national accounting tables.

Substitution elasticity σ_{KL} is the degree of substitution of two factors K, L. If the relative price of factors $\frac{P_K}{P_L}$ changes by 1% then the relative quantities $\frac{Q_K}{Q_L}$ will change by $\sigma_{KL}\%$.

Equation (2) is derived applying first order conditions of cost-minimization to equation (1):

$$\frac{L_i}{K_i} = \left[\frac{1-\alpha_{KL,i}}{\alpha_{KL,i}}\right]^{\sigma_{KL,i}} \left[\frac{PK_i}{PL_i}\right]^{\sigma_{KL,i}}, \tag{2}$$

where PL_i and PK_i are labor and capital prices respectively. Applying a natural algorithm on both sides of Equation (2) offers equation (3) for empirical estimation

$$\ln\left(\frac{L_i}{K_i}\right) = \beta_{KL,i} + \sigma_{KL,i} \ln\left(\frac{PK_i}{PL_i}\right). \tag{3}$$

Where $\beta_{KL,i} = \sigma_{KL,i} \ln\left(\frac{1-\alpha_{KL,i}}{\alpha_{KL,i}}\right)$.

Clearly, the form of this equation is linear relative to $\ln\left(\frac{PK_i}{PL_i}\right)$ and $\ln\left(\frac{L_i}{K_i}\right)$ while elasticity of substitution $\sigma_{KL,i}$ is the slope of linear dependency between them. A linear regression for the pair $\left(\ln\left(\frac{PK_i}{PL_i}\right), \ln\left(\frac{L_i}{K_i}\right)\right)$ estimates the value of labour-capital elasticity of substitution.

Monthly data for the period of 1995—2006 on labour and capital prices and quantities are derived from national accounting tables. The regression is performed for four economic sectors, for which the data is available: agriculture, manufacturing, water and electricity, and the joint sector of trade and services. Table 1 summarizes the regression results.

Table 1

Regression model results

Sector	$\sigma_{KL,i}$	R^2	Standard deviation	P-value
Agriculture	0,8528	0,5645	0,063	2,54E–27
Manufacturing	0,6496	0,6959	0,036	1,58E–38
Water & Electricity	0,5458	0,601	0,037	4,03E–30
Trade & Services	0,3929	0,6496	0,024	3,81E–34

Table reflects the range of labor-capital CES for main sectors of Israeli economy. It varies from approximately 0,85 for agriculture sector to approximately 0,39 for trade and services sector. The higher the elasticity of substitution, the easier it is to substitute away from an input that faces an increase in its relative price; and the lower will be the need to invest in input-saving technological change. The results are in line with estimations of (Van der Werf, 2007; Okagawa, Ban, 2008). Empirically estimated labour-capital elasticities of substitution improve the reliability of IGEM modeling of climate policy.

3. Baseline for 2020

To evaluate a 20% emission reduction below BAU in 2020 we follow (Dixon, Rimmer, 2002) to derive baseline for the Israeli economy at 2020. This entails inserting, in the model calibration data, scenario values for key economic variables, to identify a hypothetical general equilibrium state for the future. This hypothetical equilibrium provides a benchmark, on which we build our comparative static exercise. This benchmark is subsequently compared with a counter-factual equilibrium, in which carbon and/or coal taxes are levied.

To get the model baseline, we tag along (Bosello et al., 2007) focusing primarily on the supply side, by imposing estimates for future endowments of labour, capital, natural resources, as well as variations in factor-specific and multi-factor productivity, for the various industries of the model. Most of these variables (e.g., labour) are "naturally exogenous" in CGE models, so it is sufficient to change their levels from those of the initial calibration year of the model (2004) to those estimated for the future. In some other cases, we consider variables, which are normally endogenous in the model, and swapped them with exogenous variables.

A unique impediment in producing a baseline projection for Israeli economy in 2020 is concealed in the ongoing process of increasing natural gas fraction in electricity production. Natural gas was not in use for electricity generation in Israel until as recently as 2004 (the year of the most updated supply and use tables for Israel). Since then, the composition of fuels for electricity production has changed dramatically: the component of coal declined from 70% at 2004 to 50% in 2010, oil declined from about 30% in 2004 to about 5% in 2010 and natural gas raised from nearly zero in 2004 to about 45% in 2010. This process created a unique complication in producing a benchmark for 2020 using an existing data as we are forced to create a natural gas industry for the future benchmark, while it absents in the balanced SAM for 2004. To overcome this restriction we used projections for 2003-2030 of energy demand and supply by sectors and users published in the master plan of the Israeli Ministry of National Infrastructures (2005).

The socio-economic and technological characteristics of the baseline scenario are key determinants of mitigation costs. Cost estimations of GHG reductions and other mitigation efforts are not made in a vacuum but as a change from assumed baseline conditions. The baseline scenario reflects our best estimate of the likely evolution of Israel's economy without concerted climate policy measures. To generate this scenario, we calibrated the model to reproduce approximately the relationship of the country's economic growth and emission growth.

Policy Analysis and Discussion

This study analyzes the economy-wide cost to Israel to reach the Cancun target with the focus on fossil-fuel-related CO_2 emissions employing counter-factual carbon tax and newly-levied coal tax on a revenue-neutral basis. The revenue from the new green instrument is therefore matched by a proportional reduction in revenue from pre-existing taxes.

In 1st of January, 2011, The Israeli government levied a new coal tax that increased the price of coal by about 10%. The coal tax is planned to double in 2012. In the simulation, revenues of both carbon and coal taxes are used to proportionally reduce existing distortive taxes, so that the total government budget remains unchanged.

We estimate and compare the overall costs, price signals, and emissions outcomes of Cancun Agreements on the Israeli economy. A number of insights emerge. In the policy scenario, Israel achieves its targets domestically (i.e. with no offsets or international emission trading) by imposing an economy-wide price signal on carbon. The results show that levying a coal tax, as proposed for the next year's budget, coupled with a carbon tax at level of EURO 15 per ton of CO_2-equivalent, allows Israel to reach Cancun target of 20% below the BAU emission path by 2020 at a total cost of 0.5% reduction of GDP.

The stipulation that all abatement is domestic could differ markedly from the actual implementations of Cancun Agreements. We model a simplified and stylized interpretation of Cancun commitments. Since the agreements are silent on emission trading, there is no clear way to anticipate the quantity or price of imported reductions that a country might use to comply with its commitments. In addition, Israeli legislation doesn't plan to allow a substantial share of domestic compliance using credits for certain emission reductions ("offsets") achieved abroad.

However, a check of the mitigation measures under consideration for the national action plan reveals that Israeli policymakers favor "moral suasion" actions much more than market-based incentives such as carbon tax or cap-and-trade. In January 2010, the Minister of Environmental Protection endorsed Israel's declaration in Copenhagen in a letter to the Executive Secretary of the UNFCCC. In it the Israeli government declares its association with the Copenhagen Accord, and sets out the path to achieve the announced mitigation goal through the incorporation of 10% renewable energy in electricity generation and 20% reduction in electricity consumption by 2020. Among the proposed measures to reach 20% reduction in electricity consumption are: energy savings in the home and in government structures, green building, higher energy efficiency standards for electrical appliances, information programs on the wise use of electricity and the establishment of an energy efficiency fund. The Ministry of National Infrastructure (MNI) encourages energy efficiency in the following ways (INFCCC, 2010):

- Market transformation. — In 2009 a major energy conservation campaign was inaugurated by the MNI, the MoEP and the Israel Electric Corporation (IEC) to raise awareness of energy efficiency among the general public. Major emphasis was placed on raising public awareness of energy conservation in purchasing new appliances.
- Resource acquisition. — The MNI accompanies and supports specific energy consumers in order to improve the energy efficiency of their equipment and buildings.
- Data analysis. — The MNI is upgrading its data collection and analysis capacity in order to improve the decision-making process in this area.
- Assimilation of the Performance Contracting Method. — The MNI assimilates and encourages large and small energy efficiency projects. The support granted depends on the achieved level of energy savings.
- Tenders. — In 2009 and 2010 the MNI published numerous tenders on energy efficiency, including a pilot project for the distribution of energy-efficient light bulbs, consulting on energy efficiency in hotels, energy efficiency in buildings serving government ministries, small-scale energy-efficiency projects, and more.

Evidently, any domestic climate policy that Israel is likely to adopt will have associated policies such as standards and subsidies to encourage energy efficiency. Coal tax is the only market-based incentive in the plan. However its main objective is funding policy incentives to promote energy efficiency, rather than affecting the composition of fuels for electricity production. Fuel composition in Israel is decided by policymakers at MNI, IEC and PUA (Israel Public Utilities Authority — Electricity). Because electricity is produced by a government monopoly, the IEC, at stations planned in advance, the major impetus for fuel switching is the regulator, driven mainly by energy security considerations rather than green policy needs.

Nor is the initial goal of incorporation of 10% renewable energy in electricity generation any longer in plan. The electricity sector in Israel is ruled by IEC, which enjoys a strong political lobby against any attempt to increase the use of renewables or to move to nuclear reactors in an effort to challenge its market power.

Despite Israel's progress in climate change during the last decade, many gaps remain in research, technology, policy and public awareness (INFCCC, 2010). Most gaps fall into four broad categories: fragmentation and duplication of authority for legislation and administration among different stakeholders, multiple and conflicting interests among stakeholders, financial constraints including inadequate incorporation of external costs, and inadequate data, information and awareness.

Summary and Conclusions

Israel, like many other small open economies, is struggling to make the appropriate policy response to reduce GHG emissions. Because so little real action has been taken on climate change to date, an opportunity remains for an efficient and practical policy to be adopted.

In the current research we adapted the CGE model to the Israeli economy in order to study the effects of green tax reforms on environmental quality and the economic burden of the tax system. To this end, a consistent and balanced disaggregated SAM for Israel in 2004 and benchmark projections for 2020 are constructed. In addition, labour-capital CES for various sectors of Israel's economy are empirically evaluated to improve the reliability of results.

Our counter-factual analyses simulate imposition of carbon emission tax coupled with coal tax on the revenue neutral basis.

The main conclusions are the following. First, the results show that levying a coal tax, as proposed for the next year's budget, coupled with a carbon tax at level of EURO 15 per ton of CO_2-equivalent, allows Israel to reach the Accord target of 20% below the BAU emission path by 2020 at a total cost of 0,5% reduction of GDP. Secondly, the macroeconomic impact of the tax will not be very strong, as GDP decreased by less than half a percent. On general economic grounds, a strong point can be made to support market-based policies as a singular tool of choice for achieving better environmental quality and a lower inefficiency level to the Israeli economy.

If Israel actually wishes to move to a greener economy, which serves its international and national interests alike, carbon pricing that would bind emitting sources is the most effective route. This perspective appears to be supported by the literature on optimal tax and compliance theory because a carbon tax will be more difficult for taxpayers to dodge through tax planning efforts. In addition, a carbon tax will more transparently raise the price of carbon and incentivize firms to use low or nil carbon-based energy sources. There is still an opportunity for climate change policy to take an efficient and practical form, but leadership will be needed to keep the opportunity from being lost.

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