No more gas from Egypt? The Israeli gas sector between offshore discoveries and import uncertainty

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Abstract

Israel depends on Natural gas imports from Egypt for about 40% of its domestic needs, while meeting the rest from domestic production. Gas supplies from Egypt since its initiation, was erratic with multiple disruptions that has increased after the 2011 revolution in Egypt and ignited by public discontent. Despite that, Israeli policy makers viewed the gas deal with Egypt as appositive factor in preserving the peace with Egypt from one hand and it used to have no better alternatives for the Egyptian gas on the other. This however changes after recent discoveries of three major offshore fields that are expected to satisfy its domestic needs indefinitely and provide it as an exporter of gas. We use extended regional modeling framework that incorporates multiple households and endowments' ownership to investigate the uncertainty of gas imports from Egypt by shocking the price as well as the evolvement of domestic gas production as alternative. Our findings show Israel to continue importing the Egyptian gas even if its price would increase by 50% and would also do the same even if the domestic production would double.

Keywords: Natural gas, energy policy, Egypt, Israel, MyGTAP.

JEL Classification: C6, D1, D6, F1, Q4.

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1 Introduction

In 2009, major offshore natural gas deposits were discovered in Israel after historically being an energy-poor state relying on imported fossil fuels to meet its energy needs, and an energy island that is disconnected from energy infrastructure in the region, with the exception of gas supplies from Egypt (Shaffer, 2011). Since 2008, Egypt is supplying Israel with 40% of its domestically consumed natural gas. The gas is delivered through a pipeline that connects the Arab (Egypt, Jordan, Lebanon, and Syria) Gas Pipeline with Israel, which branches off from the same pipeline in Egypt.

Natural gas entered Israel's energy mix for the first time in 2004, with a domestic field (Yam Tethys) supplying its production to the market. The consumption of natural gas expanded in 2008, when the Eastern Mediterranean Gas and Oil (EMG) Company began importing natural gas from Egypt to Israel. The EMG supplied 2.5 Billion Cubic Meters (BCM) of natural gas to consumers in Israel in 2010, which was nearly 50% of the 5.3

BCM consumed in Israel in 2010, while the rest was supplied by domestic fields (Shaffer, 2011).

There is no detailed information available on the level of the preferential price paid by Israel and its difference from the world price of natural gas. However, according to Khadduri (2011), the initially agreed upon price was 3 to 3.5 dollars per million British thermal units (Btu). Khadduri (2011) also reports that in August 2009, the Israel Electric Corporation (the primary consumer of gas exports from Egypt) approved an adjusted price of 4 to 4.5 dollars per million Btu.

Approximately 425 BCM of natural gas was discovered in 2009 and 2010 close to Israel's Mediterranean coastline in different fields namely, Tamar, Dalit, and Leviathan. According to IsraelStrategist (2011), the Tamar field was the largest natural gas discovery in the world that year and is expected to meet Israel's gas needs for up to the next three decades. The Leviathan field was discovered in December 2010 representing the largest natural gas discovery in the world in the past decade, and is predicted to satisfy Israel's domestic gas needs indefinitely and will potentially be used for export. The start of production of the two fields is expected in 2013 and 2016, respectively (Ratner, 2011; Shaffer, 2013).

With the newly discovered fields of Natural gas, Israel could get into a situation where it displaces its gas imports from Egypt, which would according to Ratner (2011) bring benefits for both countries. First, there is public discontent in Egypt against the sales of gas to Israel particularly after the January revolution as Israel pays below market prices for the natural gas it imports from Egypt (Ratner, 2011). As a consequence, the gas pipelines used for transporting the Egyptian gas to Israel have been attacked more than ten times since the Egyptian revolution in January 2011, causing Israel's gas supply to be temporarily cut off (Afify and Fahim, 2011; Elyan, 2011). Therefore, ending exports to Israel would have political advantages, while sustaining natural gas exports to Israel seems doubtful in post-revolution Egypt. In addition, there might be the option of changing the agreement between the two countries in a way that increases the price paid by Israel for the Egyptian gas, which could improve Egypt's trade balance (Ratner, 2011). This could be supported by the argument that, despite these negative factors, Israeli policy makers view the gas deal with Egypt as appositive factor in preserving the peace with Egypt (Shaffer, 2013).

As a second option, Israel may decide to continue importing the cheaper Egyptian gas and using the additional production for exports to destinations such as Europe or even countries in the middle east such as Jordan. This is expected to improve Israel's energy security and generate economic benefits.

2 Objectives and Research questions

This paper uses global applied general equilibrium models that link the Israeli economy with the rest of the world including Egypt to investigate the economic implications of different scenarios related to the production and trade of the natural gas on the Israeli economy:

- What are the macroeconomic implications of increasing the price of Egyptian gas exports to Israel and equalize it to the price of gas paid by countries in the region such as Jordan?
- The recent discoveries of the three major fields of gas in Israel (Tamar, Dalit and Leviathan) are expected to begin production in 2012-2013, 2013-2013, and 2016-2018, respectively (Ratner, 2011). What are the implications this may have on the Israeli economy at large, and on the livelihoods of different household groups?
- By having the domestic fields entering the domestic market, how would be the impact on the economy should Egypt equalizes its export price to that paid by other countries in the region?

3 Methodology

To achieve the previously stated objectives with their regional, macroeconomic, welfare dimensions, we use two applied general equilibrium models that link the Israeli and Egyptian economies to the world trade and production of natural gas. To benefit from the advantages of incorporating disaggregated households' income, expenditure, transfers and ownership of endowments that have been recently brought about in the regional modeling settings, we apply the newly developed MyGTAP Model (Minor and Walmsley, 2012a). Moreover, we are also interested in seeing the welfare changes associated with the different policy experiments considered in this study in Israel. Therefore, we apply the GTAP model of (Hertel, 1997), thanks to its welfare decomposition module.

3.1 Overview of the models

GTAP CGE model is based on neoclassical theory and applies the assumptions of constant returns to scale in production, perfect competition among firms, and product differentiation by economy of origin (i.e., the Armington assumption). It has a single representative household for each region called the regional household, which collects income from return to endowment commodities and tax revenues net of subsidies. The income is then spent on private household expenditure, government expenditure, and savings applying a Cobb-Douglas per capita utility function (Hertel, 1997). Private household utility maximization is modeled as a Constant Difference of Elasticity (CDE) demand system; while domestic and imported commodities are aggregated using Constant Elasticity of Substitution (CES) and imported goods in turn are sourced from different regions also according to a CES function. Government expenditures are allocated according to a Cobb-Douglas sub-utility function (Hertel, 1997).

Producers profit maximization consider aggregation value added and intermediate inputs according to a CES technology and value added composite is a CES function of primary production factors, while the intermediate composite is a Leontief function of inputs (Brockmeier, 2001). The model closes by assuming that the demand for investment in a particular region is driven by savings and that each region's savings contribute to a global pool of homogenous savings. The allocation of these savings among regions in response to investment demand is based on the relative rates of return to capital among regions.

MyGTAP model is an extension to the GTAP model (Hertel, 1997) that modifies the original single regional household to allow for multiple households and improved government specification. It also includes inter-regional transfers, such as remittances and foreign capital incomes (Minor and Walmsley, 2012a). The included new government account of MyGTAP collects its income from taxes and foreign aid and spends it on consumption expenditure, transfers to households, foreign aid (out) and subsidies. The difference between government income and expenditure is then either a deficit or saving (Figure 1).

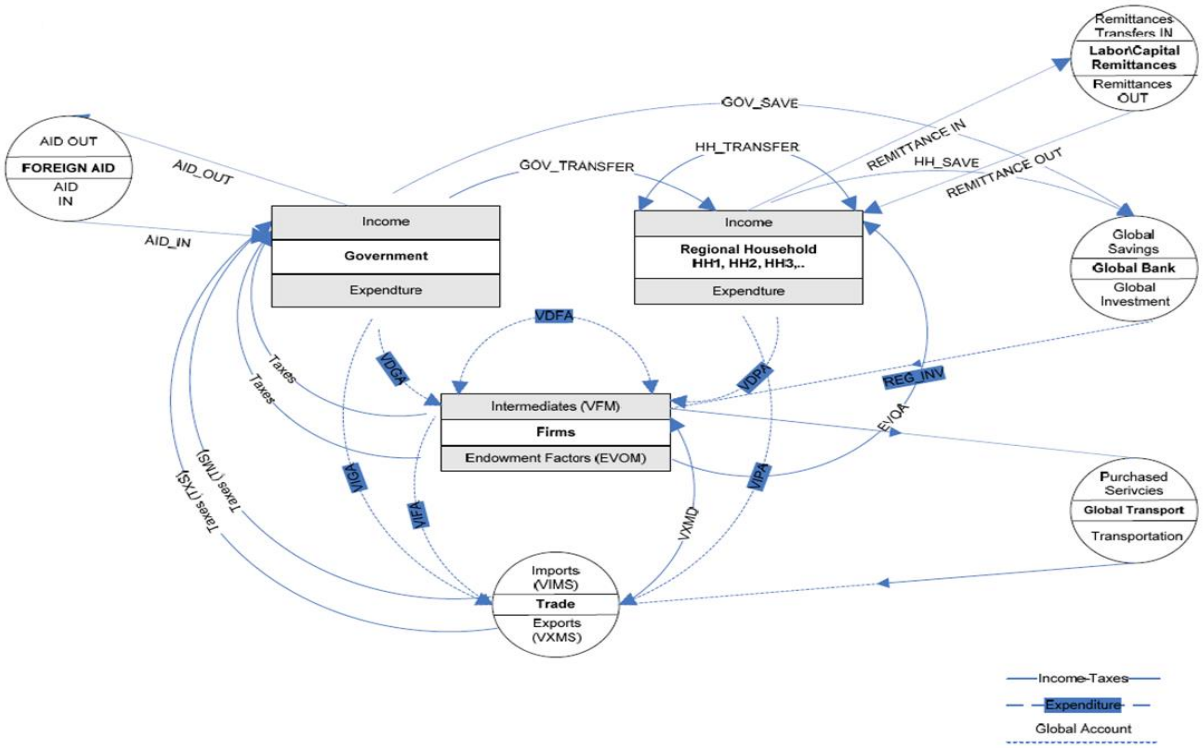

Figure 1: Income and expenditure flows in MyGTAP model.

Source: Minor and Walmsley (2012a).

Private households accrue their income from returns to owned endowment commodities including foreign remittances and capital, transfers from the government and transfers from other households, which is then spent on consumption expenditure, transfers, remittances (out) and saving (Figure 1).

3.2 Data adjustments and aggregation

This study uses an adjusted version of GTAP database that is prepared by Siddig and Grethe (2012), which assesses the implications of changes in gas trade between Egypt and Israel on the Egyptian economy. Siddig and Grethe (2012) aggregated the standard GTAP regions and commodities to 45 and 40, respectively. Afterwards, they adjusted the structures of the gas sector in the database for Egypt and Israel to reflect their

state in 2010 based on different sources of data including BP (2011), ICBS (2011), and CAPMAS (2011) among others.[3]

For the purpose of this study, the 40x45 aggregation of Siddig and Grethe (2012) is further aggregated to 16 commodities and 24 regions. The mapping between the 16x24 aggregation and that of GTAP8 Data Base is shown in Appendix 1 and Appendix 2, respectively. The most relevant sectors besides gas such as Crude-oil, Refined-oil, Gas manufacturing and distribution, and Electricity are represented separately in the sectoral aggregation. Agriculture is represented by three major aggregates, namely, 'agricultural crops', 'meat and livestock', and 'forestry and fishing'. Another three major aggregates reserved for services, four major aggregates for industries, and the rest of mining is aggregated in one sector.

As shown in Appendix (2), regional aggregation separates regions for Israel, Egypt, and the rest of MENA together. In addition there are regions for each of the major players in gas trade such as the USA and Russia, while separating the major importers of the Egyptian gas each in a region such as Italy and Belgium.

After the setup of the final aggregation of the database, a pre-simulation is applied to generate a new database following the "Altertax" approach of Malcolm (1998)[4]. Atertax is applied to introduce the difference between the average world price of gas and the preferential price that Israel pays for its imports of gas from Egypt in 2011[5]. The updated database afterwards represents the base for our simulations, to which any changes are compared.

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[3] For details on the procedure applied to update the data as well as the difference sources of data, refer to Siddig and Grethe (2012).

[4] The Malcolm (1998) approach runs a simulation where tax rates are shocked to their desired value and the updated post-simulation database is used for subsequent policy experiments. A special closure and special parameter file are applied to ensure that the rate-changing simulation leaves other cost and sales shares as little changed as possible. This closure fixes regional trade balances, whilst the parameter settings amount to Cobb-Douglas everywhere, which keeps budget shares fixed.

[5] 2011 is the last year for which prices data are available for the 4 international price sets are used for comparison to the Israeli-Egyptian price. However, the latter is fixed since that last change in the agreement price of 2009, when it was raised from US$ 3.5 to US$ 4.5 Khadduri (2011); Adiri (2013).

According to Adiri (2013), it is difficult for Israel to import natural gas from sources other than Egypt in the short run due to (1) the lack of importing infrastructure in terms of pipelines and the like and (2) any contract for importing liquefied natural gas will be unfair for the Israeli economy because it should be very short-term contract (about two years), which is mainly due to the fact that the domestic production of the new fields is expected soon. This implies that any imported national gas other than that of Egypt would be between 4 to 5 times expensive (Adiri, 2013). Accordingly, we brought these circumstances to our models by limiting the substitutability of natural gas imports among regions.[6]

3.3 Data extension for MyGTAP model

The application of MyGTAP model implies several modifications on GTAP Data Base as the regional household is to be breakdown into multiple households based on Minor and Walmsley (2012b). The additional data we use is the latest available Israeli Social Accounting Matrix for the year 2004 (Siddig et al., 2011). The SAM provides detailed information, on 10 different household groups classified ethnically to Jewish and Non-Jewish and each ethnic group is then calssified income-wise to five income quintiles. This feature allows for assessing the implications of our three policy simulations scenarios on wide range of household categories in Israel.

Additionally, the model allows the assignment of the endowments ownership share for each household and endowments based on the Israel 2004 SAM that comprises 38 different endowment commodities. These endowment commodities are classified to (1) Jewish, Non-Jewish, and foreigners; (2) according to occupation and skills; (3) according to sex to male and female for each Jewish and Non-Jewish category; and (4) foreign labor are classified to Palestinians and Non-Palestinians and each group is again classified to legal and illegal (Siddig et al., 2011).

[6] This is introduced by reducing the Armington Elasticity of substitution between imports of different regions (ESUBM) to 4.00 and that of substitution between the domestic and imported gas (ESUBD) to 3.00.

4 Simulation scenarios

Four simulation scenarios are simulated in this study in connection to the research questions raised in section 2 of the paper. Each of the four scenarios is run twice, once in the standard GTAP model and in addition in the MyGTAP model. This makes the findings of the study more comprehensive as it benefits from the advantages of both models and considers them complements to each other. The specific scenarios of the paper are the following:

Scenario1: increasing the price paid by Israel for its imports of gas from Egypt and equalizes it to that paid by other importers such as Jordan; this is done by removing the designated subsidy that was introduced in the Altertax pre-simulation. In other words, it removes the preferential price offered to Israel from Egypt; therefore this scenario will be referred to throughout the paper as "NoPrfPrice".

Scenario2: increasing the production of domestic gas in Israel by 100%, which is a conservative projection for the production in the next 2 years based on Ratner (2011) and Nobel Energy (2010). This simulation is introduced by augmenting the technology parameter of the production factors in the gas sector, based on the fact that the reserves are natural resources and would be exploited by contracts with foreign companies including but maybe not limited to Nobel Energy (Ratner, 2011). Therefore this scenario will be referred to throughout the paper as "DomFldsPrd".

Scenario3: combining Scenario1 and Scenario2 into one so as to assess the implications that the increase in the prices of imported gas from Egypt may have at the time that the domestic fields would be in production. This scenario will be referred to throughout the paper as "NoPrf-DmFlds".

5 Results

This section reports the results of the three simulation scenarios. It begins the discussion with the effect on the prices of gas and the sectors that use it such as electricity and Refined-oil sectors, then it discusses the impacts on output and consumption, and it also covers the macroeconomic impact and welfare.

5.1 Intermediate demand and prices

Natural gas in Israel is neither consumed by private households nor by the government. It is only demanded by firms, where 73.26% (30.37% domestic and 42.89% imported) of the total supply is demanded by Electricity, 25.93% (19.20% domestic and 6.73% imported) by Refined-oil, and the remaining 0.78% (0.68% domestic and 0.11% imported) is demanded by the Gas manufacturing and distribution (GasManDisn) sector (Narayanan et al., 2012; Siddig et al., 2012). This implies that the intermediate demand price in the most relevant price to be looked at. Moreover, it is to be noted also that Electricity, Refined-oil and GasManDisn rely on the imported gas for 55.55%, 23.67% and 12:20% of their total gas demand (Narayanan et al., 2012; Siddig et al., 2012).

Percentage changes in the intermediate demand price of gas in Israel is shown in Figure 2. The impact of our NoPrfPrice scenario, which removes the preferential imported gas price, on the composite price of intermediate gas demand by the three sectors is found to depend on the ability of each sector to replace imported by domestically produced gas. Therefore, percentage changes in prices are higher for Electricity at 48.2%, followed by Refined-oil at 46.8% and GasManDisn at 46.3%.

It important to note that, the impact of the three scenarios on the price of gas used by the three commodities within the same category (i.e. imported or domestically produced) is always the same. For instance, NoPrfPrice increases the price of the domestic gas used by the three commodities by 45.8% and the imported gas by 50.3% and this apply also to the two other scenarios, but of course at different levels. However, the composite price of gas is then different across sectors and scenarios because what matter most with it is the composition of the demanded gas from the domestic and imported sources.

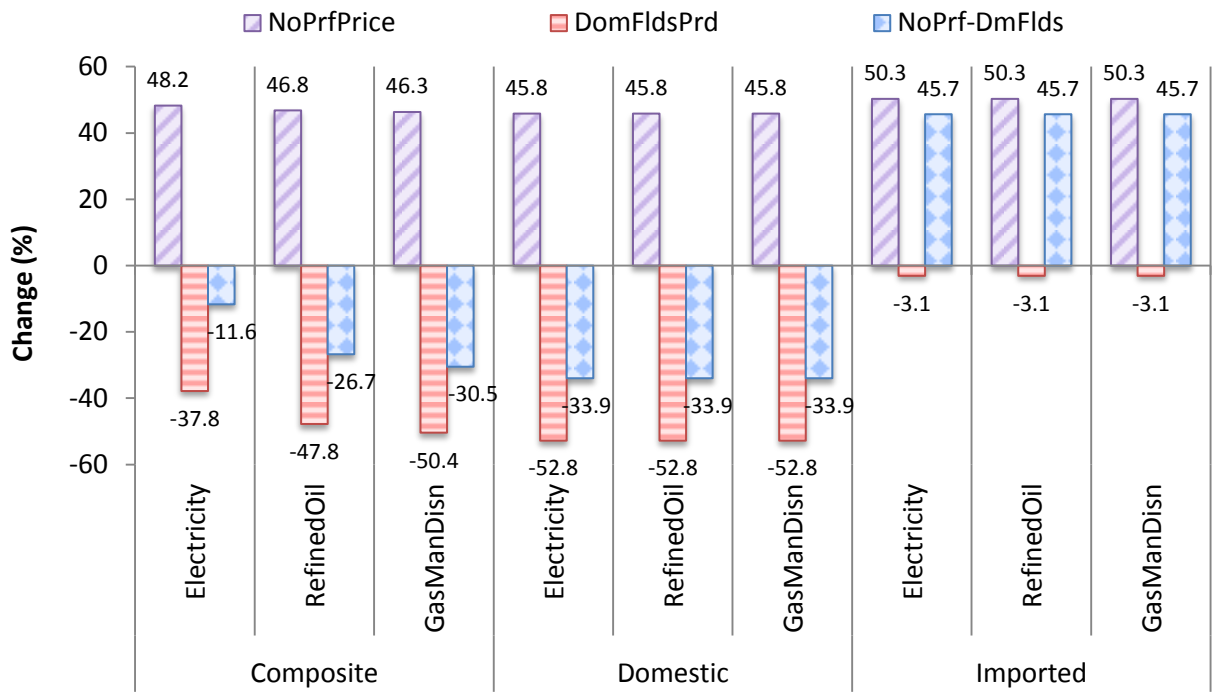

Figure 2: Intermediate demand price of gas in Israel (%)

The DomFldsPrd scenario decreases the firm demand price of gas substantially as it double the domestic production of gas, which increases the total domestic supply of gas by 1.33%. The combined scenario "NoPrf-DmFlds" on the other hand shows changes in prices that are less in magnitude than those of NoPrfPrice and higher than DomFldsPrd as the removal of the preferential price does the opposite of what the increase of the domestic supply do as far as the price paid by firms for gas is concerned.

The observed changes in the intermediate demand prices of gas of Figure 2 influences the demand for gas by the three major activities that uses gas. As shown in Figure 3, composite demand for gas will decline in NoPrfPrice by 2.3% for Electricity and GasManDisn and by 2.7% for Refined-oil. In the other two scenarios, composite intermediate demand will slightly increase mainly because the increase in the demand for domestically produced gas outweigh the declines in the demand for imported one.

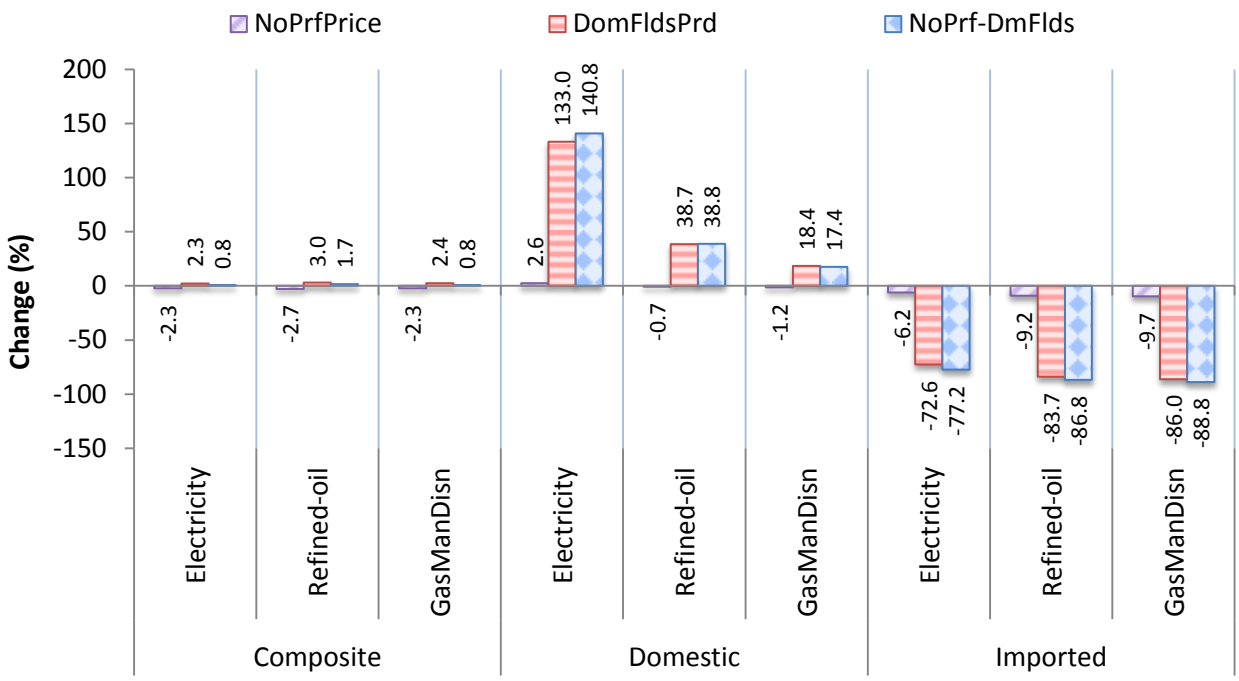

Figure 3: Changes in intermediate demand for gas in Israel (%)

Changes in the intermediate demand by the three sectors are also found to coincide with the initial shares of domestically produced and imported gas in total intermediate demand. This can be seen from the change in intermediate demand for domestically produced gas to be higher in Electricity, followed by Refined-oil, and lower for GasManDisn, while the opposite is exactly correct for the demand for imported gas by the three sectors, respectively (Figure 3).

5.2 Domestic production

Looking at the three scenarios of this paper from the corner of the domestic gas production in Israel confirm that they should all increase domestic production of gas. This is due to increasing restriction on imported gas by the first, directly doubling the resources used in the production of domestic gas by the second and merging the two policies in the third. Results on the domestic output of gas show that it would increase by 1.27%, 97.07% and 100.88% due to NoPrfPrice, DomFldsPrd and NoPrf-DmFlds, respectively. These increases on the output of gas increase the domestic supply of gas in Israel and therefore are expected to influence the major users of gas in the country, which are Electricity, Refined-oil and GasManDisn. The percentage changes in the output of these three commodities are shown in Figure 4.

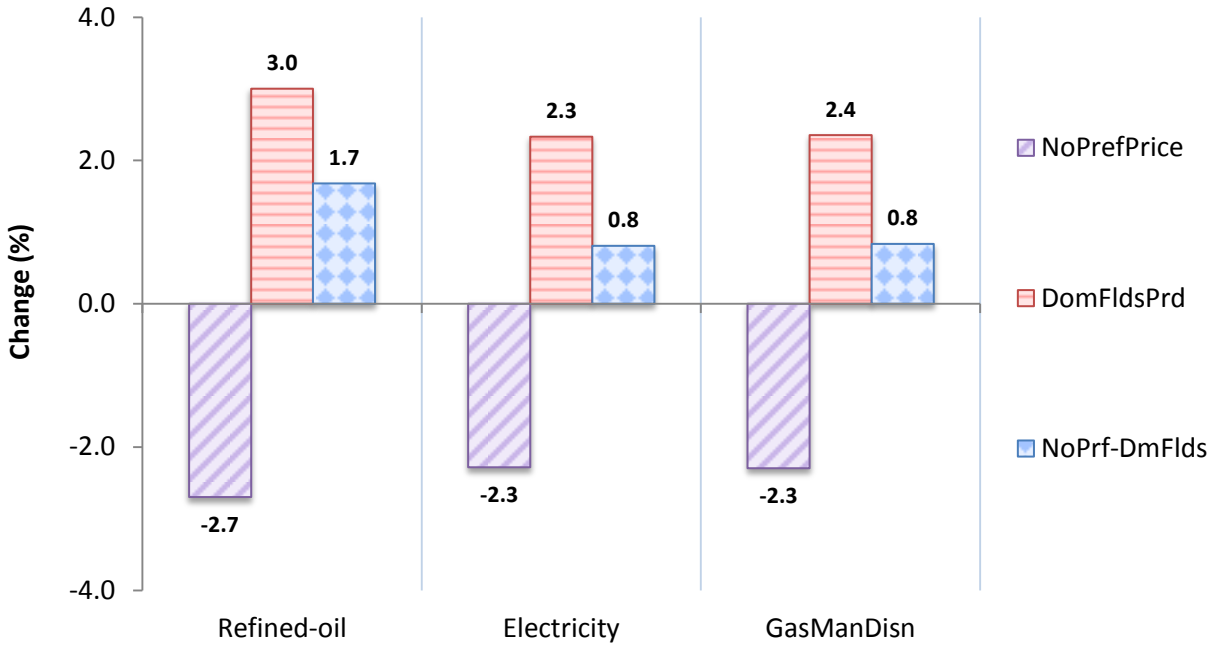

Figure 4: Changes in domestic production of major gas users in Israel (%)

Changes in the output of the three gas consumers in Israel, namely Electricity, Refined-oil and GasManDisn are found to be direct reflection on the changes in the demand for intermediate demand for gas. This is explained by: (1) gas being a major component in their cost structure; (2) gas being the only component of their cost structure that has changed due to the fact that it is directly targeted by our policy scenarios; and (3) the elasticity on intermediate input substitution of the models (ESUBT) is zero.

5.3 Macroeconomic indicators

The results on the impact of our three policies on the Gross Domestic Product (GDP) and its components from the expenditure and sources sides are shown in Figure 5. Before explain the changes, we show the initial shares of the different GDP components. From the expenditure side, the Israeli GDP is composed as follows, 55.67% is devoted to private consumption, 20.04% to investment, 24.57% to government consumption, 41.49% to total exports and 41.77% to total imports. From the sources side on the other hand, the Israeli GDP is composed as follows, 53.43% is from income to production factors, 38.35% to net tax revenue and 8.22% to depreciation.

The GDP would decline by 0.19% in to NoPrfPrice, while it increases by 0.29% and 0.27% in DomFldsPrd and NoPrf-DmFlds, respectively. These changes are explainable by the corresponding changes in the different GDP components. The largest decline for instance of the expenditure GDP components in NoPrfPrice scenarios is in the investment, which relatively has smaller share in the overall GDP, however the overall change is mainly geared by the 0.20% decline in private consumption that alone shapes 55.67% of the GDP in the base data. Similarly positive changes in the GDP are mainly due to the respective increases in private consumption by 0.31% and 0.28% in DomFldsPrd and NoPrf-DmFlds, respectively. The huge changes in the investment in the three scenarios correspond mainly to the respective changes in the gas-related sectors, namely, Electricity, Refined-oil and GasManDisn.

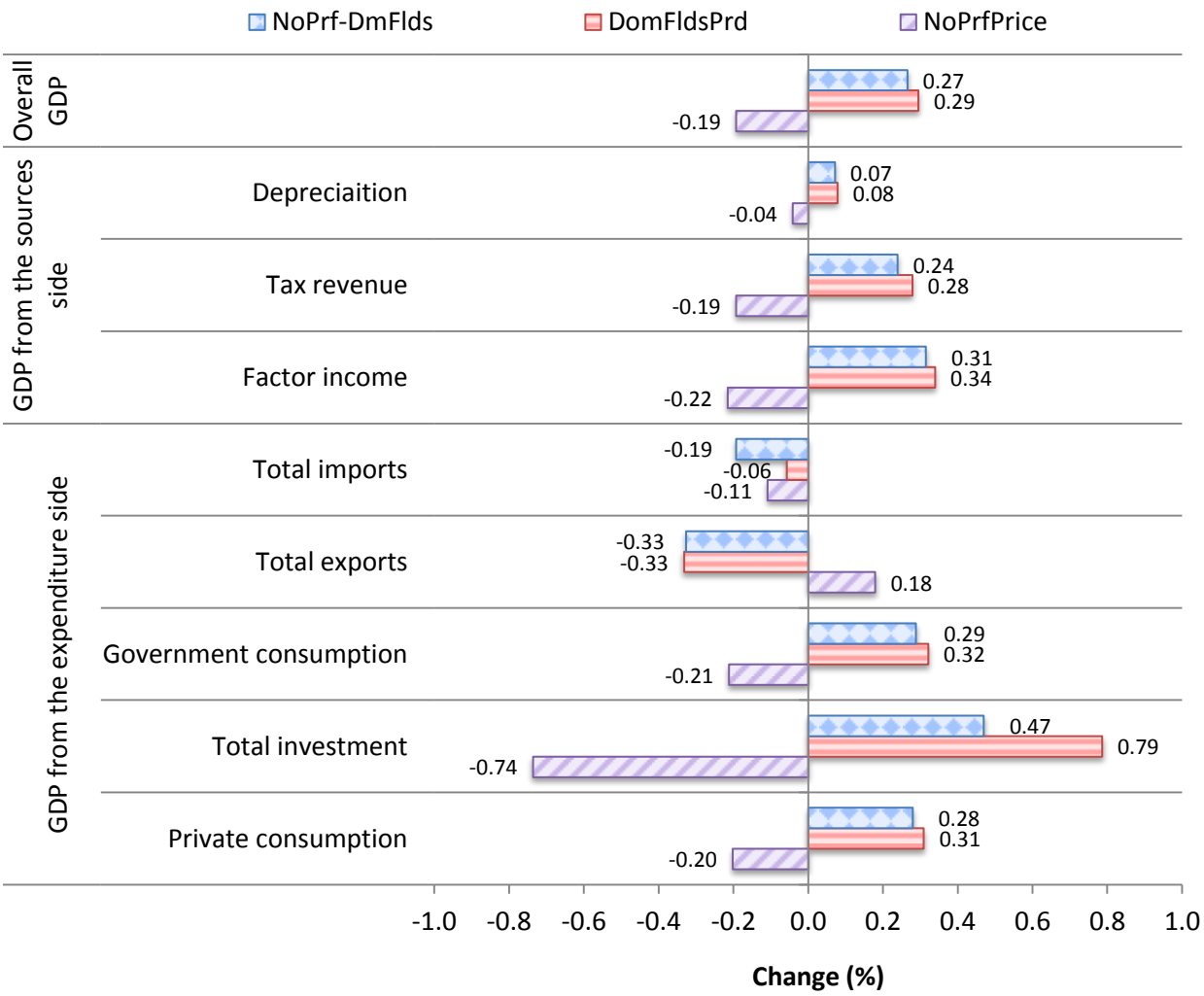

Figure 5: Changes in the Israeli Gross Domestic Product (%)

The sources side of the GDP on the other hand, shows the decline in the income to production factors (GDP at factor cost), which shapes 53.43% of the GDP to be a major explanatory variable for the overall decline in the GDP of 0.19% in NoPrfPrice scenario as it decline by 0.22%. Similarly, the government budget decline against importing unsubsidized gas from Egypt as net tax revenue falls by 0.19% also contribute to the overall retraction in the GDP. The opposite hold correct for the other two scenarios as the increase in factors income, net tax revenue and depreciation lead to increasing the overall GDP.

The overall trade balance improve in NoPrfPrice (US$ million 201) and decline in DomFldsPrd (US$ million 192) and NoPrf-DmFlds (US$ million 92) as shown in Figure 6. Israel would need to export more in quantity tern in NoPrfPrice so as to provide enough foreign currency for more expensive imports of gas. In this scenario, the price index of merchandise imports in Israel increases by 0.30%, while that of exports declines by 0.02%. This lead the volume of merchandise imports in Israel to decline by 0.41%, and that of export to increase by 0.20%, and hence create the positive change in the trade balance. Despite saving US$ million 336 and US$ million 308 from the reduced imports of gas from Egypt in DomFldsPrd and NoPrf-DmFlds , respectively, imports of other commodities such as heavy manufacturing and other-services tend to increase, leading to the respected declines in the overall balance of trade.

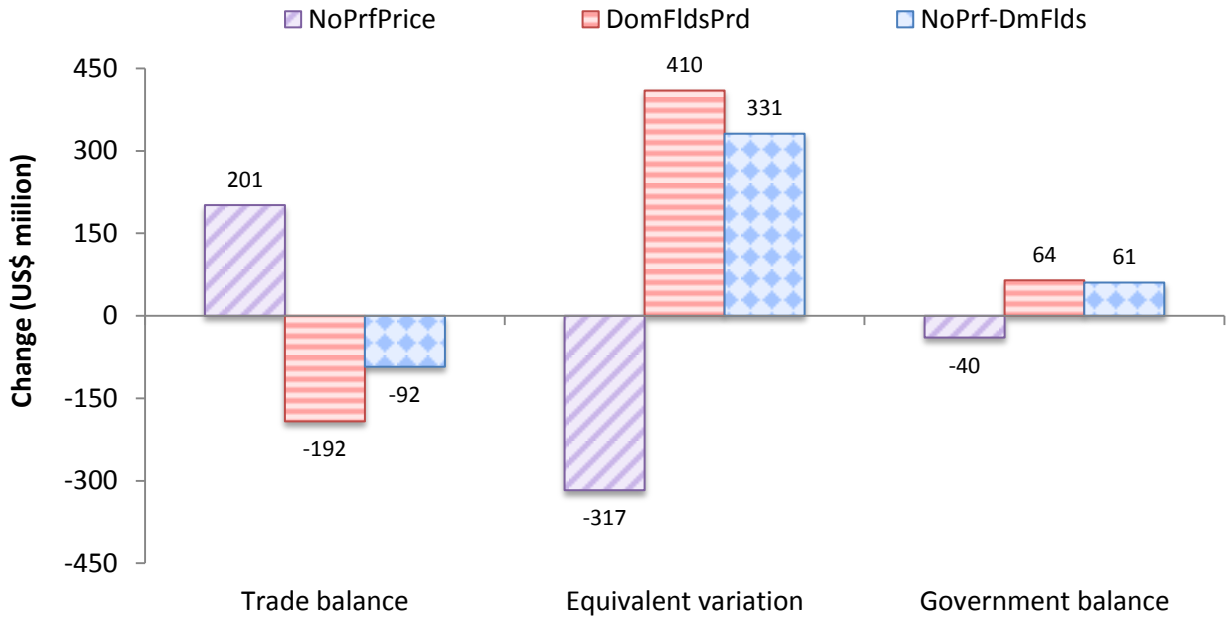

Figure 6: Changes in trade balance, EV and government balance (US$ million).

The changes in the government balance as shown in Figure 6, correspond what paid for the imported gas from Egypt, which means the Israeli government budget would responsible for paying a higher price should Egypt depart from the preferential price. Accordingly, a negative government balances is recorded in NoPrfPrice, while it is positive in the other two scenarios.

The overall welfare change as represented by the change in the Equivalent Variation (EV)[7], shows a decline of US$ million 317, which mainly driven by the negative terms of trade effect in NoPrfPrice (Figure 6). On the other hand, positive welfare changes of US$ million 410 and US$ million 331 are recorded in DomFldsPrd and NoPrf-DmFlds, respectively, which are driven by the technical change effect that constituted the entire shock in DomFldsPrd and a major component of NoPrf-DmFlds.[8]

5.4 Gas and energy trade

The changes in gas trade under the three scenarios are triggered by the changes in the price of imported gas from Egypt. The price of imported gas would increase by 50.36% in NoPrfPrice, decrease by 3.14% in DomFldsPrd and increase by 45.72% in NoPrf-DmFlds. These changes are then translated into changes in the market price of gas that increases by 45.47 in NoPrfPrice, decreases by 53.69% and 35.34% in DomFldsPrd and NoPrf-DmFlds, respectively (Figure 9). The decreases in the market price of gas in DomFldsPrd and NoPrf-DmFlds are driven by the increasing domestic output of gas.

Gas imports as a result would decrease in the three scenarios due to the increasing price of import in NoPrfPrice and the increasing domestic production in DomFldsPrd and NoPrf-DmFlds (Figure 9). The highest decline in the amount of imported gas is recorded in NoPrf-DmFlds because it compiles two components that stimulate replacing imported by the domestically produced gas. Namely, it increases the price of imported gas and increases the domestic production.

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[7] The money metric Equivalent Variation (EV) measures the welfare impact of a policy change in monetary terms and is defined as the amount of income that would have to be given to (or taken away from) the economy before the policy change so that the economy is as well off as the economy would have been after the policy change (Andriamananjara et al., 2003). If the EV for a policy simulation is positive, it implies that the policy change would improve economic welfare.

[8] Additional details on the welfare decomposition are provided latter in 5.55.5.

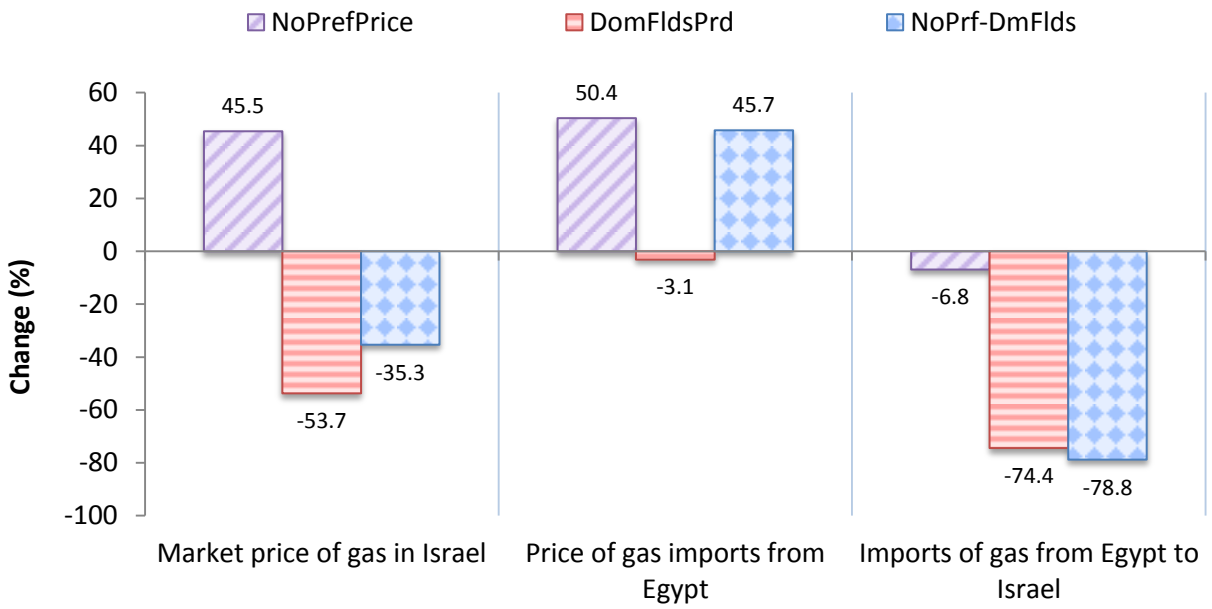

Figure 7: Changes in gas prices and trade in Israel (%).

The changes in the amount and price of imported gas in Israel would also have implications on the trade of other primary energy consumption fuel and electricity fuel mix, namely Refined-oil and coal.[9] Results shows percentage changes in the imports of Refined-oil in Israel of 1.09%, -0.27% and 0.23% in NoPrfPrice, DomFldsPrd and NoPrf-DmFlds, respectively. This clearly indicates that, Refined-oil would tend replace gas as energy source and electricity fuel in NoPrfPrice and NoPrf-DmFlds where prices of gas increases and imports decreases. Therefore, imports of Refined-oil would increase in the two scenarios. Similar results are expected for the coal commodity, which is aggregated in a large sector that account for 11% of the total Israeli imports in the base data, therefore, its changes can't be easily explained by the changes in the prices and imports of gas. Its imports show a decline by 0.30% in NoPrfPrice and increases by 0.84% and 0.83% in DomFldsPrd and NoPrf-DmFlds, respectively.

[9] According to Shaffer (2011) and Ratner (2011), The Israeli primary energy consumption is composed of oil (49.7%), coal (34.9%), gas (10.6%) and others (4.8%). The Israeli electricity fuel mix is coal (63%), gas (26%), oil (11%), and others (Ratner, 2011).

5.5 Welfare and income to households

Results on the overall welfare changes that are measured by the EV and shown in 5.3 show that the Israeli economy would experience a welfare loss of US$ million 317 in NoPrfPrice and gains of US$ million 410 and US$ million 332 in DomFldsPrd and NoPrf-DmFlds, respectively. These changes are decomposed in Figure 8 to its major components, namely, the allocative efficiency, technical change, terms of trade and investment and saving.

Allocative efficiency contributions arise when the allocation of productive resources changes due to policy changes, while terms-of-trade contributions arise from changes in the prices received from an economy's exports relative to the prices paid for its imports.[10] In addition, the EV policy change also comprises of changes in the price of investment goods (investment-saving) and technical change.

Considering the price scenario (NoPrfPrice), Figure 8 show that the welfare loss is mainly associated to the negative terms of trade effects as the price index of imports increases by 0.30% in this scenario, while that of exports decreases although very slightly by 0.002%. The allocative efficiency also contributes to the welfare loss in this scenario, which mainly occur in the Refined-oil, Electricity, Utility-construction and Heavy-manufacturing.

[10] It is assumed in the GTAP model that each region has enough market power to be able to affect international trade prices by changing its policies.

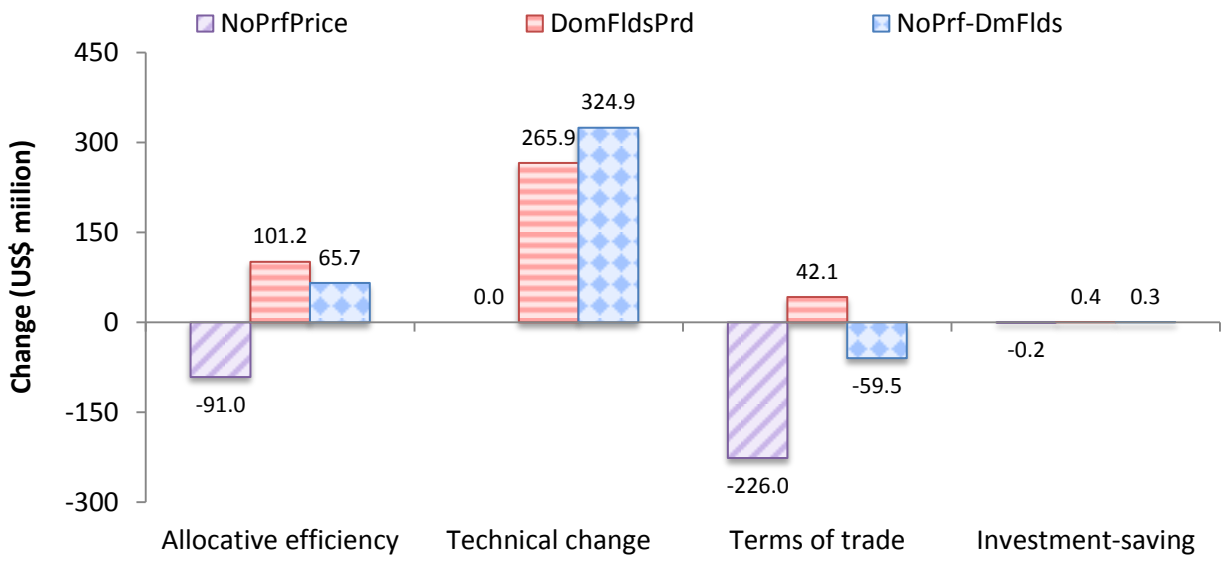

Figure 8: Decomposition of welfare changes in Israel (US$ million).

For DomFldsPrd and NoPrf-DmFlds the major driver of the welfare gain is the technical change and particularly the augmentation of the primary factors led by natural resources, but also capital and labor.

These welfare changes are reflected on the income of the different household groups as depicted by Figure 9, thanks to MyGTAP model that shows as well the impact our policy scenarios on the different households within this multiregional modeling framework. Changes on the household expenditure are almost similar to those of income, where they both decline at different levels in NoPrfPrice and improve in DomFldsPrd and NoPrf-DmFlds as Figure 9 depicts.

Richer Jewish households are the most to witness reductions in their income due to the increase in the imports price of gas. This explained by them being the owners of the resources (especially capital) used by the enterprises involved in the energy sector, particularly Gas, refined-oil and the heavy manufacturing, which retract in this scenario. The declining returns to exports in this scenario also contribute to the loss to large exporting enterprises that are mainly owned by richer Jewish households. These retractions in the household income decreases as we move down toward the Jewish households of the first income quintile, which imply the unlikelihood to own enterprises.

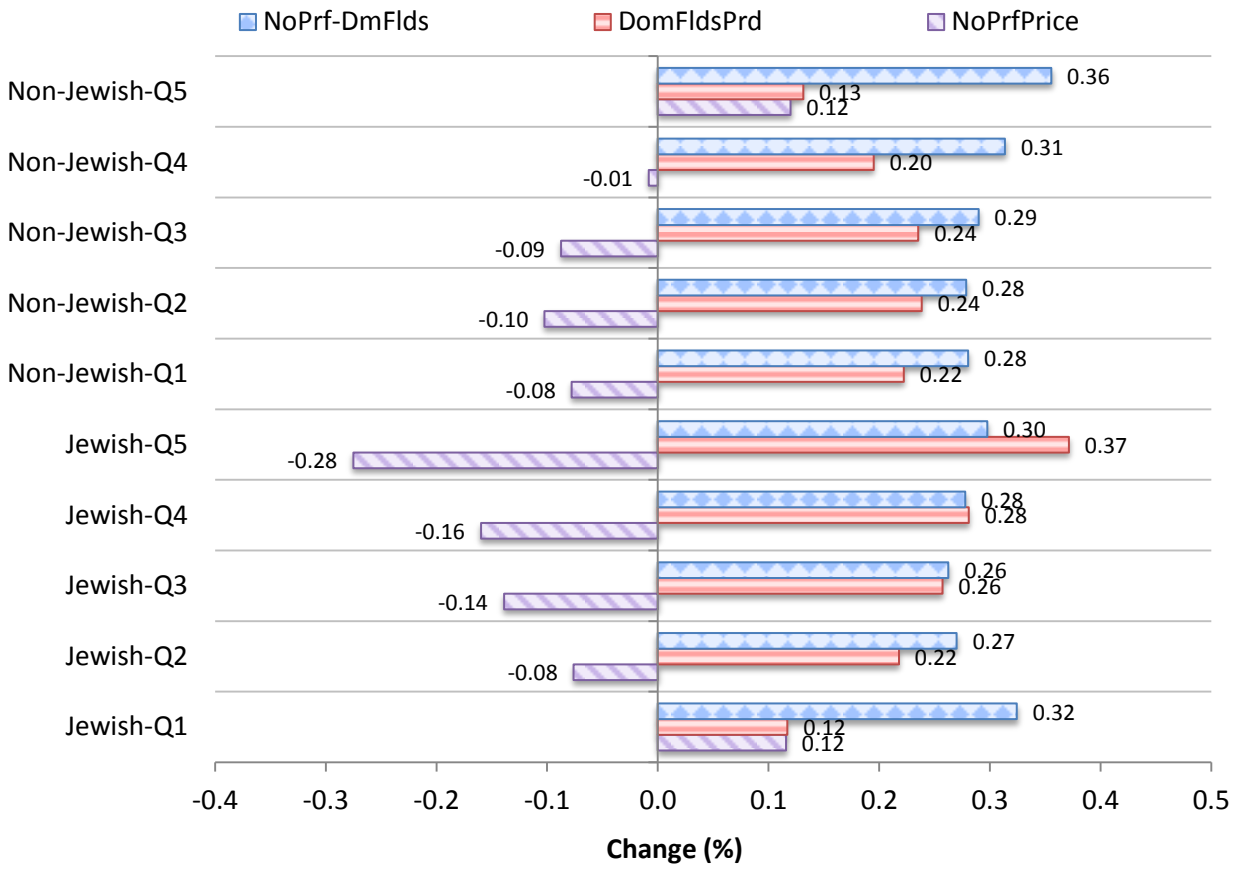

Figure 9: Changes in income of households net of depreciation (%).

By studying the changes in the different sources of household income in NoPrfPrice, we found that returns to endowments as a major source of households' income decrease for the entire Jewish households except those in the first income quintile. We also found that, the reductions are larger for the richer households and they are 0.15%, 0.23%, 0.27% and 0.51% for Jewish-Q2, Jewish-Q3, Jewish-Q4 and Jewish-Q5, respectively. These household categories own the higher shares of the capital endowment of the base data than all other categories in Israel.

Figure 9 also show households in Jewish-Q1 and Non-Jewish-Q5 as outliers as their income increase in the NoPrfPrice scenario. This is justified for Jewish-Q1 by that (1) 53% of its income comes from the government transfers that are fixed in our model closure and (2) the sources of its income from endowment is mainly composed of returns to male industrial skilled workers (17% of the entire household income), male sales and service workers (13% of the entire household income) and female clerical workers (11% of the entire household income). These labor categories are employed by

the sectors that witness production increase in this scenario such as heavy and light manufacturing.[11] Similarly for Non-Jewish-Q5 households, 25% of its endowments return accrues from Arab and others male academic professionals that are not employed by the energy-related sectors, while 22% of its endowments return accrues from Arab and others male industrial skilled workers.[12]

The impact of the other two scenarios (DomFldsPrd and NoPrf-DmFlds) on the household income is positive and mainly driven by the returns to the household endowments. This impact is shown to be higher even for NoPrf-DmFlds scenario as it combines the price impact with the technical progress, while both increases the returns to endowments. Therefore, the increase in the income to all households' categories would be the highest in this scenario with the exception of Jewish-Q5 household, for which the impact of the component of "gas price increase" is higher than other categories.

The impacts of the three scenarios on the consumption expenditure the households are found to follow similar pattern to that of household income with respect to all household categories.

6 Summary and conclusions

Until the discovery of major offshore natural gas deposits in 2009, Israel meets its entire energy needs from imports including 40% of its domestically consumed natural gas that is imported from Egypt that expanded the consumption of natural gas in Israel. The remaining 60% of natural gas to consumption in Israel was supplied by domestic fields. The imported natural gas from Egypt is coming at relatively lower price compared to other Egyptian gas destinations according to an agreement between Egypt and EMG. The price issue creates public discontent in Egypt against the sales of gas to

[11] Example: 20% and 11% of the returns to Jewish male industrial skilled workers accrue from Heavy Manufacturing and Light manufacturing, respectively. The output of the two sectors in NoPrfPrice scenario increases by 0.74% and 0.29%, respectively.

[12] Example: 5% and 8% of the returns to Arab and others male industrial skilled workers accrue from Heavy Manufacturing and Light manufacturing, respectively. The output of the two sectors in scenarios increases by 0.74% and 0.29%, respectively. At the same time 81% and 23% of the returns to Arab and others male industrial skilled workers and Arab and others male academic professionals, respectively accrue from the Other-service sector, which output increases by 0.025% in NoPrfPrice scenario.

Israel particularly after the 2011 revolution, which is reflected in the repeated attacks of the gas pipelines that transport the Egyptian gas to Israel.

The domestic discoveries of natural gas fields of Tamar, Dalit, and Leviathan on the other hand, which come into production between 2013 and 2016 bring Israel to indefinite self-sufficiency and probably start exporting the natural gas to other countries. This then beside public discontent of Egyptians brings the important question of displacing its gas imports from Egypt. Israel may decide to continue importing the cheaper Egyptian gas and using the additional production for exports to destinations such as Europe or even countries in the Middle East such as Jordan.

Accordingly we tried in this paper to investigate the economic implications; these different options may have on the Israeli economy. We applied the newly developed MyGTAP model of Minor and Walmsley (2012) as well as the standard GTAP model of Hertel (1997) together with the most updated global GTAP database (version 8.1) of that includes the recently developed Israeli IOT (Siddig et al., 2012) and SAM (Siddig et al., 2011). Using the models after setting them up to accommodate our designated database aggregation in terms of sectors and regions; we firstly, designated a scenario that equalizes the price of imported gas from Egypt to Israel to that of average world price; secondly, we preserved the status quo in terms of price and increased the domestic production to the expected level that incorporates the output of the discovered fields; and thirdly, we equalized the price to that of average world price, but simultaneously we increased domestic production to the expected level.

Our results of the first scenarios (NoPrfPrice) show the price of imported natural gas in Israel, which is mainly demanded by Electricity, Refined-oil and Gas manufacturing and distribution to increase by more than 50% and lead their total demand for imported gas to decline by more than two thirds and hence their production retract. At the macro level this will also retract total investment, final consumption and total imports, while slightly increase total exports, leading to net decline of 0.19% in the overall GDP. This also decreases the overall welfare of the Israeli household by a value equivalent of US$ million 317 and the government balance by US$ million 40. Nonetheless, the retracting imports and increasing exports will generate US$ million 201 saving in the balance of trade.

These macro findings are reflected at the individual households' level as being hardly hitting rich Jewish household groups whom income is mainly generated from enterprises returns to invested capital. At the same time, the income of lower tier of Non-Jewish households would also decline affected by the overall retraction of several sectors that reduces return to labor.

On the other hand, the other two scenarios (DomFldsPrd and NoPrf-DmFlds) improve income to all household categories, which is mainly driven by the returns to the household endowments. The impact of the combined scenario (NoPrf-DmFlds) on household income is shown to be higher than the production scenario (DomFldsPrd) as it combines the price impact with the technical change, where both components increase domestic production and hence, returns to households" endowments. At the macro level however, the production scenario generates the highest increase in the overall GDP led by increase in investment, and final consumption. The production and combined scenarios improves the overall welfare and government balance, nevertheless, they generates deficits of US$ million 192 and US$ million 92, respectively.

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8 Appendices

Appendix 1: Sectoral mapping of the 57 GTAP8 sectors to 16 sectors

No.	New code	Sector description	No.	Old code	Sectors description
1	AgrCrops	Cereals, Vegetables, fruits, Oilseeds and Sugar	1	pdr	Paddy rice
			2	wht	Wheat
			3	gro	Cereal grains nec
			4	v_f	Vegetables, fruit, nuts
			5	osd	Oil seeds
			6	c_b	Sugar cane, sugar beet
			7	pfb	Plant-based fibers
			8	ocr	Crops nec
2	MeatLstk	Livestock, Meat, other animal products	9	ctl	Cattle,sheep,goats,horses
			10	oap	Animal products nec
			11	rmk	Raw milk
			12	wol	Wool, silk-worm cocoons
			19	cmt	Meat: cattle,sheep,goats,horse
			20	omt	Meat products nec
3	ForsFishing	Forestry and Fishing	13	frs	Forestry
			14	fsh	Fishing
4	Gas	Natural Gas	17	gas	Gas
5	Crudeoil	Crude Oil	16	oil	Oil
6	Foodindustr	Food industries and other food products	21	vol	Vegetable oils and fats
			22	mil	Dairy products
			23	pcr	Processed rice
			24	sgr	Sugar
			25	ofd	Food products nec
			26	b_t	Beverages and tobacco products
7	LightMnfc	Textile, Wearing apparel, Paper, Leather, wood and other manufactured goods	27	tex	Textiles
			28	wap	Wearing apparel
			29	lea	Leather products
			30	lum	Wood products
			31	ppp	Paper products, publishing
			42	omf	Manufactures nec
8	HeavyMnfc	Motor vehicles, parts and equipment	38	mvh	Motor vehicles and parts
			39	otn	Transport equipment nec
			40	ele	Electronic equipment
			41	ome	Machinery and equipment nec
9	RefinedOil	Refined Petroleum products	32	p_c	Petroleum, coal products
10	ChmRubPlas	Chemical, rubber and plastic products	33	crp	Chemical, rubber, plastic
11	OthMinMnrals	Other Mining and Mineral nec	15	coa	Coal
			18	omn	Minerals nec
			34	nmm	Mineral products nec
			35	i_s	Ferrous metals
			36	nfm	Metals nec
			37	fmp	Metal products
12	UtilConstrcn	Construction and water	45	wtr	Water
			46	cns	Construction
13	Electricity	Electricity	43	ely	Electricity
14	GasManDisn	Gas manufacture, distribution	44	gdt	Gas manufacture, distribution
15	TransComcn	Transports and communications	48	otp	Transport nec
			49	wtp	Sea transport
			50	atp	Air transport
			51	cmn	Communication

16	OthServices	Most of the Services	47	trd	Trade
			52	ofi	Financial services nec
			53	isr	Insurance
			54	obs	Business services nec
			55	ros	Recreation and other services
			56	osg	PubAdmin/Defence/Health/Educat
			57	dwe	Dwellings

Appendix 2: Regional mapping of the 129 GTAP8 regions to 24 regions

No.	New code	Region description	No.	Old code	Regions description
1	Japan	Japan	6	jpn	Japan
2	Korea	Korea	7	kor	Korea
3	China	China	4	chn	China
4	RAsia	Rest of Asia	5	hkg	Hong Kong
			8	mng	Mongolia
			9	twn	Taiwan
			10	xea	Rest of East Asia
			11	khm	Cambodia
			12	idn	Indonesia
			13	lao	Lao People's Democratic Republic
			14	mys	Malaysia
			15	phl	Philippines
			16	sgp	Singapore
			17	tha	Thailand
			18	vnm	Viet Nam
			19	xse	Rest of Southeast Asia
			20	bgd	Bangladesh
			22	npl	Nepal
			23	pak	Pakistan
			24	lka	Sri Lanka
			25	xsa	Rest of South Asia
5	India	India	21	ind	India
6	USA	United States of America	27	usa	United States of America
7	RAmerica	Rest of America	26	can	Canada
			28	mex	Mexico
			29	xna	Rest of North America
			30	arg	Argentina
			31	bol	Bolivia
			33	chl	Chile
			34	col	Colombia
			35	ecu	Ecuador
			36	pry	Paraguay
			37	per	Peru
			38	ury	Uruguay
			39	ven	Venezuela
			40	xsm	Rest of South America
			41	cri	Costa Rica
			42	gtm	Guatemala
			43	hnd	Honduras
			44	nic	Nicaragua
			45	pan	Panama
			46	slv	El Salvador
			47	xca	Rest of Central America
			32	bra	Brazil
8	Belgium	Belgium	50	bel	Belgium
9	France	France	56	fra	France
10	Germany	Germany	57	deu	Germany

No.	New code	Region description	No.	Old code	Regions description
11	Italy	Italy	61	ita	Italy
12	Netherlands	Netherlands	66	nld	Netherlands
13	Spain	Spain	71	esp	Spain
14	UK	United Kingdom	73	gbr	United Kingdom
15	REurope	European Union 25	49	aut	Austria
			51	cyp	Cyprus
			52	cze	Czech Republic
			53	dnk	Denmark
			54	est	Estonia
			55	fin	Finland
			58	grc	Greece
			59	hun	Hungary
			60	irl	Ireland
			62	lva	Latvia
			63	ltu	Lithuania
			64	lux	Luxembourg
			65	mlt	Malta
			67	pol	Poland
			68	prt	Portugal
			69	svk	Slovakia
			70	svn	Slovenia
			72	swe	Sweden
			74	che	Switzerland
			75	nor	Norway
			76	xef	Rest of EFTA
			77	alb	Albania
			78	bgr	Bulgaria
			79	blr	Belarus
			80	hrv	Croatia
			81	rou	Romania
			84	xee	Rest of Eastern Europe
			85	xer	Rest of Europe
16	Egypt	Egypt	102	egy	Egypt
17	RMENA	Rest of MENA	92	bhr	Bahrain
			93	irn	Iran Islamic Republic of
			95	kwt	Kuwait
			96	omn	Oman
			97	qat	Qatar
			98	sau	Saudi Arabia
			100	are	United Arab Emirates
			101	xws	Rest of Western Asia
			103	mar	Morocco
			104	tun	Tunisia
			105	xnf	Rest of North Africa
18	Nigeria	Nigeria	109	nga	Nigeria
19	RAfrica	Rest of Africa	106	cmr	Cameroon
			107	civ	Cote d'Ivoire
			108	gha	Ghana
			110	sen	Senegal
			111	xwf	Rest of Western Africa
			112	xcf	Central Africa
			113	xac	South Central Africa
			114	eth	Ethiopia
			115	ken	Kenya
			116	mdg	Madagascar
			117	mwi	Malawi
			118	mus	Mauritius
			119	moz	Mozambique

No.	New code	Region description	No.	Old code	Regions description
			120	tza	Tanzania
			121	uga	Uganda
			122	zmb	Zambia
			123	zwe	Zimbabwe
			124	xec	Rest of Eastern Africa
			125	bwa	Botswana
			126	nam	Namibia
			127	zaf	South Africa
			128	xsc	Rest of South African Customs
20	Russia	Russian Federation	82	rus	Russian Federation
21	Ukraine	Ukraine	83	ukr	Ukraine
22	Israel	Israel	94	isr	Israel
23	Turkey	Turkey	99	tur	Turkey
24	RestofWorld	Rest of World	1	aus	Australia
			2	nzl	New Zealand
			3	xoc	Rest of Oceania
			48	xcb	Caribbean
			86	kaz	Kazakhstan
			87	kgz	Kyrgyztan
			88	xsu	Rest of Former Soviet Union
			89	arm	Armenia
			90	aze	Azerbaijan
			91	geo	Georgia
			129	xtw	Rest of the World