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Fuel Subsidies and Unemployment: A CGE Model Applied to Iran

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Fuel Subsidies and Unemployment: A CGE Model Applied to Iran

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Abstract

This study analyzes the effects of eliminating fuel subsidies on the labour market, focusing on oil producing countries with significantly unerpriced fuel commodities. The Islamic Republic of Iran is used as a case study. Two alternative options are analyzed, with the extra revenue from subsidy elimination redistributed back to household as extra income versus directing the revenue into increased investment. A purpose-builit static and dynamic CGE model is deployed in conjuntion with a unique Social Accounting Matrix (SAM) of Iran. It is shown that the current structure of the economy is heavily biased towards industries that are crude oil and fuel intensive in production. Redistributing the extra revenue back to households would not be enough to overcome these distortions. The labour market suffers under such a scenario, even though Real GDP and household welfare rise. Industries contract due to the Dutch Disease effect and the more expensive inputs, causing overall production and employment to decline. Channelling the extra income into investment, however, improves the labour market's fortune dramatically in the long run. Firstly, there is increased capital accumulation due to the rise in investment. Secondly, the structure of the Iranian economy shifts. Capital is directed towards non-fuel or crude oil intensive industries, allowing the economy to adjust away from its current reliance on industries dependent on these inputs. Consequently, employment of all types of labour in the economy experience a marked rise.

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I.1 Introduction

This study analyzes the effects of removing fuel subsidies on the labour market in an oil-producing country with significantly underpriced fuel commodities, using the Islamic republic of Iran as a case study.

Large fuel subsidies place significant stress on budgets of many governments across the glob, and there have been several attempts at reforming them at the national level. One of the main challenges that countries need to account for when tackling fuel subsidies is their effect on the labour market. Any potential reforms to fuel subisidies have to take into account the possible ramfications on jobs in the local economy, particularly if high unemployment is a significant issue.

There are several ways in which the removal of fuel subsidies in an oil producing country could potentially impact the domestic economy generally and the labour market specifically:

1. Local prices of fuel would increase dramatically with the removal of the subsidies. The ramifications of this are complex: On the consumption side, the amount of income spent by households per unit of fuel would rise, potentially causing a decrease in the purchasing power of households and putting a damp on total domestic consumption (an income effect), which in turn could feed to a reduction in employment. However, the amount of fuel consumed by households- which is arguably highly distorted given the current very low prices- could decrease substantially (substitution effect). Indeed, there could be a substitution effect away from fuel towards other goods, thus alleviating pressures on fuel production and boosting demand for the alternative commodities and workers employed in their production.

2. Fuels are an important intermediate input in industries' production structure. Possible effects include:

a. The increasing cost of fuel inputs could make production in fuel-intensive industries (e.g. transportation or the chemical industries) increasingly prohibitive cost-wise (income effect).

b. The increase in fuel costs, however, could cause these industries to innovate and become more fuel efficient. Indeed, current production is probably extremely skewed towards fuel inputs, and the higher fuel costs could force these industries to employ to a greater extent new fuel-saving technologies.

c. Higher fuel costs could lead to a shift away from fuel use towards other factors of production. This could switch demand away from fuels towards increased utilization of labour, thus boosting employment (substitution effect).

3. The removal of the subsidies would free up a substantial amount of government revenue. Firstly, crude oil would be sold at its border price locally, hence alleviating domestic subsidies. In addition, the increase in local crude oil prices could also potentially decrease the demand for crude oil locally, thus freeing up more crude for exports at border prices, further filling up the government coffers. This increase in government revenue could potentially be used to generate extra savings and investment in the economy. Alternatively it could be returned to households in the form of rebates or tax cuts.

   a. If the extra revenue is to be channeled into increased savings and investment, this could provide a boost to the local economy and increase GDP. The boost in Investment, GDP and the diversification away from the fuel intensive sectors could potentially create an increasing number of jobs, thus going a long way towards solving the unemployment problem.

   b. Alternatively, returning the extra revenue to households through tax cuts and rebates could substantially increase domestic consumption in the economy. This in turn could provide a boost to GDP and the increase in demand could create extra nationwide jobs. However, the supply response would be critical, as this has to be balanced against the possibility that most of this increased consumption is concentrated on imports, thus failing to create growth in local industries.

4. The potential increase in crude oil exports could create a significant appreciation of the exchange rate, causing a classic Dutch Disease case, where local industries end up being less competitive with those abroad. Thus there could be an expenditure switching effect towards foreign goods. Coupled with the price increase in intermediate fuel inputs, this could lead to a double blow to local industries and their labour force, causing them to contract.

5. Finally, the potential increase in GDP growth, ceteris paribus, would imply a rise in total demand for fuel in the economy.

There are four objectives that this study aims to investigate in relation to the removal of crude oil and fuel subsidies in an oil producing country with artificially reduced fuel prices. First and foremost is to examine the impact on the labour market, where the impact on oppurtunities for jobs will be analyzed. Closely linked are the effects on GDP and consumer welfare, where the aim is to model and study the analytic effects on total output growth and the welfare of households. Finally, the effects on local consumption of crude oil and fuels is also of interest. Being the main highlight of this study, there will be particular focus on the effects on the labour market.

Although interrelated, the effects of the above listed factors could evidently move in different directions, with the effect on labour markets, GDP, consumer welfare and the level of fuel consumption being a priori ambiguous. Furthermore, an improvement in one of these objectives does not necessarily mean progress in the others. For example, rebating the increased government revenue to consumers could potentially increase their welfare and GDP, but it could potentially hurt local industries and employment through higher fuel input prices and the Dutch Disease effect. On the other hand, channeling the revenue into extra investment could boost GDP and employment while leaving consumers less well off due to the rise in fuel prices.

The case of Iran

The Islamic republic of Iran provides an ideal case study to examine these issues. One of the major challenges facing the Iran's economy is the enduring problem of high unemployment. Indeed the leadership of the republic has identified unemployment as its greatest worry.[2] Jobless rates reached an official figure of 12% in 2006 (International Monetary Fund, 2007a), with unofficial estimates indicating much higher values. This problem can potentially grow in severity given the huge anticipated increase in the labour supply. Annual growth in the labour force reached a high of 5% in 2003, with the increase estimated to continue at an annual rate of 2.5-3.0% over the following years (World Bank, 2003).

Given these factors, the World Bank (2003) forecasts Iran to require an annual real GDP growth of 6.5% simply to maintain unemployment at the 2003 levels of 16%, while GDP growths of 10% and a rise in Savings and Investment to the magnitude of 10% of GDP are needed to bring unemployment levels down to a more acceptable level of 10%. Such high jobless and labour force entry rates could be harbingers of serious economic and social instability.

The World Bank's (2003) comprehensive report on the Iranian economy has identified targeting the high subsidy rates on crude oil and petroleum commodities as one of the most important potential reforms that could help alleviate the problem of unemployment. Crude oil is sold in the domestic market at artificially low prices to produce refined fuels. While 42% of crude oil output is consumed locally (with the rest being exported), only 10% of total crude oil revenue comes from local sales.[3] Since crude oil is primarily used locally as an intermediate input in the production of fuel goods, this in turn leads to fuel goods being sold at extremely low prices domestically when compared to international prices (the border price of gasoline, for example, was 2.8 higher in 2001/2002 than local prices). The demand for cheap fuel is so high that Iran needs to import and subsidize a considerable amount of its gasoline (around 45% of the total) because its refining capacities are inadequate to meet total demand. Crude

[2] Speech by President Khatami quoted in Iranmania.com citing AFP, September 23, 2002. Quoted in The World Bank (2003).
[3] All data in this section, unless otherwise specified, are taken from World Bank (2003).

oil and energy subsidies were estimated to be 10% of total GDP (70 trillion Rials) in 2001/2002, the highest in the world in absolute and relative terms.

Indeed, the distortions present in the economy due to the crude oil and fuel subsidies are vast and multifaceted, with the current conditions prevalent in the economy being potentially far away from the equilibrium that would attain if the subsidies were removed. This study's aim is to use Iran as a case study to analytically draw out the underlying factors at play on the labour market in particular and the economy in general when large fuel and crude oil subsidies are removed, highlighting the important factors driving the results wherever possible.

The most viable option for analyzing such a complex problem is a computable general equilibrium (CGE) modelling approach. This study advances previous studies of fuel commodities and the labour market in oil producing countries in several respects. It is to our knowledge one of the first CGE studies that explicitly focuses on the effects of fuel and crude oil subsidies on the labour market in an oil producing country generally and Iran specifically. A unique Social Accounting Matrix (SAM) of the Iranian economy for the year 2001 is constructed. The SAM includes data on several types of labour and fuel commodities, features which allow for a more detailed assessment of the conditions and interactions between the labour market and fuel goods in the economy. The model developed is specifically catered to take account of these features. Factors of production and fuel inputs in production receive particular attention in the analysis. Due to their importance, the energy and crude oil industries have their own unique production structure. We also employ a dynamic CGE setting in order to gauge the intertemporal and transitional effects of the policy simulations, a feature which could be important in assessing the Investment effects of the removal of the subsidies.

I.2 The Social Accounting Matrix

This study develops a unique Social Accounting Matrix based on 2001 data that has been specifically constructed for its purposes.[4] Iranian Input-Output tables for the year 2001 combined with a previously existing SAM by Asgari (2005) are used to generate a SAM that specifically caters to the focus of this study.

Commodities and Activities Sectors

Production activities receive their income (activities' rows) from the commodities they produce, while they allocate their purchases (columns) between intermediate commodity inputs, factors of production (value-added) and taxes due on activities. Commodities, on the other hand, receive income from institutions consuming commodities (particularly households and the government) as well as Investment payments to Investment commodities. Two specific commodities, transportation and retail services, also receive income from the transactions accounts (margins). The commodities in turn allocate their expenditure to the activities that produce them, transaction costs, the rest of the world as payment for imports, as well as commodity taxes paid to the government.[5]

The SAM we develop has 29 commodities' sectors (2 agricultural, 6 manufacturing, 1 crude oil, 9 energy and 11 services) and 22 activities sectors (2 agricultural, 8 manufacturing, 1 crude oil, 2 energy and 9 services). Given the important role energy plays in the study, the energy commodities sector has been disaggregated quite significantly and is composed of the 'fuels' sectors, the electricity sector, and the utility gas sector. The 'fuels' sectors have been further decomposed into seven sectors: Motor Spirit (gasoline), burning oil (kerosene), fuel oil, gas oil, liquefied gas, other fuel and finally 'lubricants, coke and petroleum oil'. The activities sector is not as detailed due to data limitations, with only two energy production sectors present (the fuel production sector and the electricity, utility gas and water production sector).

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[4] More detailed specifics on the construction and data sources of the SAM are given in the appendix, where the SAM in its entirety can also be found.
[5] For a more extensive elucidation for the different payments and income transactions in a SAM, see Lofgren et al. (2002).

Factors of Production

We distinguish 7 primary factor input categories, with labour disaggregated along 4 sectors according to occupation. Labour sub-groups are composed of unskilled labour, skilled labour, agricultural mixed income labour and non-agricultural mixed income labour. Unskilled labour corresponds to major group 9 (Elementary occupations) in the International Standard Classification of Occupations (ISCO-88), with skilled labour comprising the other groups (0, 1-8).[6] Mixed-income refers to individuals in self-employment, or more specifically employment in enterprises owned by households that are not corporations.[7] Given that the labour market is one of the main foci of the study, this disaggregation allows us to assess unemployment and wages implications for several different categories of labour. The remaining primary factors are agricultural land, capital and the natural resource factor of crude oil and natural gas (which for brevity's sake will be referred to as crude oil).

All factors of production receive their income from the activities sectors they are utilized in. This income is then allocated to payment to taxes, households, enterprises, the foreign account and the government sectors that own the factors of production.

One particular factor, crude oil, deserves a more detailed analysis. Since the behavior of the crude oil sector plays a crucial role in the analysis of the economy, it was important to treat this natural resource separately and not lump it with capital as one primary factor. Any rent payment (profit) from the oil sector beyond the payment to fixed capital and labour can be identified as rent accruing to this natural resource, with the income of this rent going directly to the government or the oil fund set up by the government (which will be discussed in detail below). This seems like a natural formulation given that the crude oil sector is nationally owned and the revenues of the Iranian National Oil company are the only ones reported in the state budget, unlike other state owned enterprises (which have their own distinct SAM entry, expanded on below). Hence the government is the residual claimant to all rent accrued to the sector after the other factors of production have been paid off.

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[6] For more information on (ISCO-88), see International Labour Office (1994).
[7] For more information on mixed income see Commission for European Communities et al. (1993), Paragraph VII.E.7.81.

Institutions and Other Accounts

The institution account includes households, enterprises, the government and the oil fund. Households are comprised of two blocks, the rural and the urban households. Households receive their income from the primary factors of production and transfers from other institutions (including the government). They allocate their expenditure to government income taxes, consumption of commodities (calculated at purchaser prices), transfers to other institutions and savings.

The enterprises account is subdivided into government and privately owned enterprises. They receive their income from factors of production and government transfers, and their payments go to household transfers as well as savings. The government account has a similar setup except that it also allocates expenditure to commodities consumed, while it also receives income from the tax accounts. Tax accounts are subdivided into income tax, import tariffs and subsidies, production tariffs and subsidies, as well commodities taxes and subsidies.

An important institution in the model is the Oil Fund. This institution has been set up by the Iranian government to receive parts of the extra income that might accrue due to changes in the crude oil market (due to e.g. increased world prices). This study tries to mimic this setup as closely as possible. In our SAM, the oil fund receives its income from the crude oil factor of production and allocates its payment between savings and transfers to households. This fund will play an important role in the simulations as any extra revenue from changes in the crude oil sector could potentially be poured in this fund and then redistributed back to the households.[8]

Finally, the SAM includes a Savings-Investment account and the rest of the world (foreign) account. The Rest of the World account receives income from its exports to the domestic economy (domestic imports), factors of production payments heading abroad and transfers from institutions. Its expenditure goes on imports (local exports), factors of production payment from abroad to domestic owners, transfers to other institutions, as well as its savings in the local economy. The Savings-Investment account's receipts arise from the savings of household, government, enterprises, the oil

[8] Further analysis of the oil fund will be given in the simulation section.

fund and the foreign account. Its expenditure is allocated to Investment goods in the economy.

Crude Oil and Fuel Subsidies

The most important entry in the tax accounts, and indeed the whole SAM, is the subsidy on the crude oil commodity sold locally within the Iranian economy. This subsidy is implicitly present in the original sources and no where calculated explicitly. The reason for this is that crude oil commodities accounts are calculated using different prices locally and when sold abroad. The original sources simply input the payments to the crude oil commodities sector using domestic (subsidized) prices when sold locally and international prices when sold abroad, and the amount of the local crude oil subsidy is overlooked. Indeed Iranian National Statistics generally employ a similar procedure in their accounts, where the subsidy is not accounted for and its exact amount is not calculated. Hence this subsidy had to be made explicit in order to carry out the analysis.[9] Once this is done the enormity of the subsidy becomes apparent, with the crude oil subsidy making up roughly 9% of GDP (65 trillion Rials), and the local price being one sixth of that at the border. Another important subsidy is that placed on imported petroleum goods. As mentioned previously, Iran imports a substantial amount of its petroleum consumption (around 45%), and so these imports have to be subsidized to be sold at local prices (where border prices are 2.8 times those at home).

[9] Details of how the subsidy was calculated are given in the appendix.

I.3 The Static model

The model employed is neo-classical in nature and is based on the theory of a Walrasian general equilibrium within a small open economy. In this section the model is static: there is only one equilibrium showing the final effects of policy implementations on the economy with no inter-temporal dynamics. Particular features include an explicit treatment of transaction costs for imports, exports and domestically produced commodities that enter the market sphere. There is also separation between production activities and commodities produced, with each activity able to produce multiple commodities and the possibility that a particular commodity can be produced by several activities. Hence the act of producing the goods (activities) and the goods themselves (commodities) are separated. The model takes its starting point from the Standard CGE model developed at the International Food Policy Research Institute (IFPRI) by Lofgren et al. (2002) [10], considered the benchmark model in the current literature. The model is then extensively modified to take account of the specific features of this study. Of particular importance are the oil industry structure, the energy industries structure and the role that energy and factor inputs play in production.[11] .

[10] This section only mentions in passing the standard features that are already present in the IFPRI standard CGE model. For a more detailed analysis of those features please see Lofgren et al. (2002).
[11] The full static model equations are presented in GAMS code in the appendix.

I.3.1 Production (Activities)

I.3.1.1 Non-Oil, Non-Energy Production Sectors

The analysis given takes a bottom-up approach, where we begin describing the structure at the bottom of the production nest and subsequently move up. The inputs in production are broadly divided into three categories: factors of production (value-added), intermediate commodity inputs and energy inputs. Each category is further subdivided into its own unique setup. In what follows we give a detailed account.

Intermediate Inputs

The aggregate intermediate input is composed of the individual intermediate goods via a Leontief production structure, where the ratios of intermediate inputs per unit of output are fixed (section A in figure 6). This is a widely employed formulation based on the available empirical evidence[12], which indicates that there is very low substitutability between the different inputs in production. Either domestic or imported goods could be used in each of the individual intermediate commodities. We model this through a CES aggregation function (usually referred to as an Armington function when applied specifically to the imperfect substitution between imports and domestic goods).

Value Added (Primary Factors of Production)

The aggregate value added input is made up of the individual factors of production, which in the current model are divided into capital, skilled labour, unskilled labour, agricultural (mixed-income) land, agricultural labour mixed-income, and non-agricultural labour mixed income (section B in figure 6). We assume that there is imperfect substitutability between the factors of production modeled through a Constant Elasticity of Substitution (CES) function. This is intended to capture the substitution effect between the different factors (e.g. between unskilled labour and capital) when policy changes are introduced in the model.

[12] See, for example, de Melo and Tarr (1992).

Energy Inputs

The aggregate energy input is composed of nine individual energy goods: electricity, utility gas and the seven 'fuel' commodities of Motor Spirit (gasoline), burning oil (kerosene), Fuel oil, gas oil, liquefied gas, other fuels and finally 'lubricants, coke and petroleum oil'. As in the value added sector, there is constant elasticity of substitution between the different energy inputs to capture the potential substitution between them when there is an increase in fuel prices (section C in figure 6). Each individual energy commodity could either be bought locally or abroad, with domestic goods and imports being imperfectly substitutable through an Armington function similar to that employed in the intermediate inputs section.

Composite Production Function (Top of Production Nest)

We now turn to the interaction between the three broad input categories of aggregate value added, aggregate energy inputs and other intermediate inputs. There are two aggregation levels: Firstly, at the lower level, there is imperfect substitution between aggregate value added and the aggregate energy input, modeled through a constant elasticity of substitution (section D in figure 6). This feature is important to capture the long term substitution effects between factors of production and energy inputs. One possible critical consequence of the increase in crude oil and fuel prices is a shift away from the reliance on energy towards increased utilization of primary factors of production. Production would become more 'energy-efficient'. If there is a strong enough shift from the reliance on energy to value added factors then there could be a potential increase in the employment of labour. The current setup is the most appropriate to account for this effect.[13]

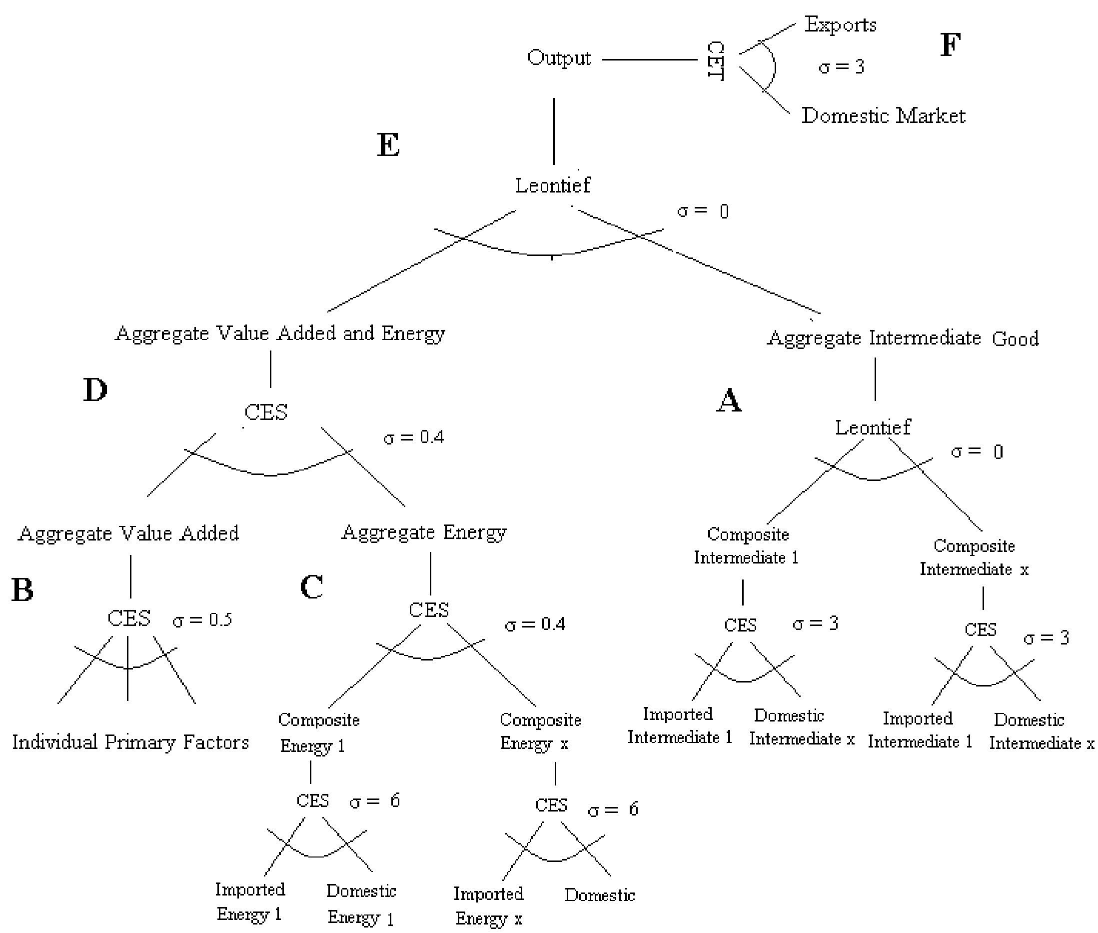
At the top of the production nest, the above resulting aggregate amount of fuel and value added have a Leontief fixed coefficient function with respect to the aggregate intermediate input (section E in figure 6). Hence the aggregate amount of fuel and value added enter in fixed proportions when compared with the aggregate intermediate input. Finally, the resulting output could be potentially sold in domestic or foreign

[13] For a paper that utilizes a similar construction for the substitution between energy goods and value-added, see Faehn et al. (2004).

markets (section F in figure 6). The standard methodology for representing the choice between domestic and foreign markets for local producers is through a Constant Elasticity of Transformation function, where there is imperfect substitutability between sales in the two markets. Figure 6 gives a detailed diagrammatic explanation of the production structure.

Figure 1

Production Structure for Non-Oil and Non-Energy Industries

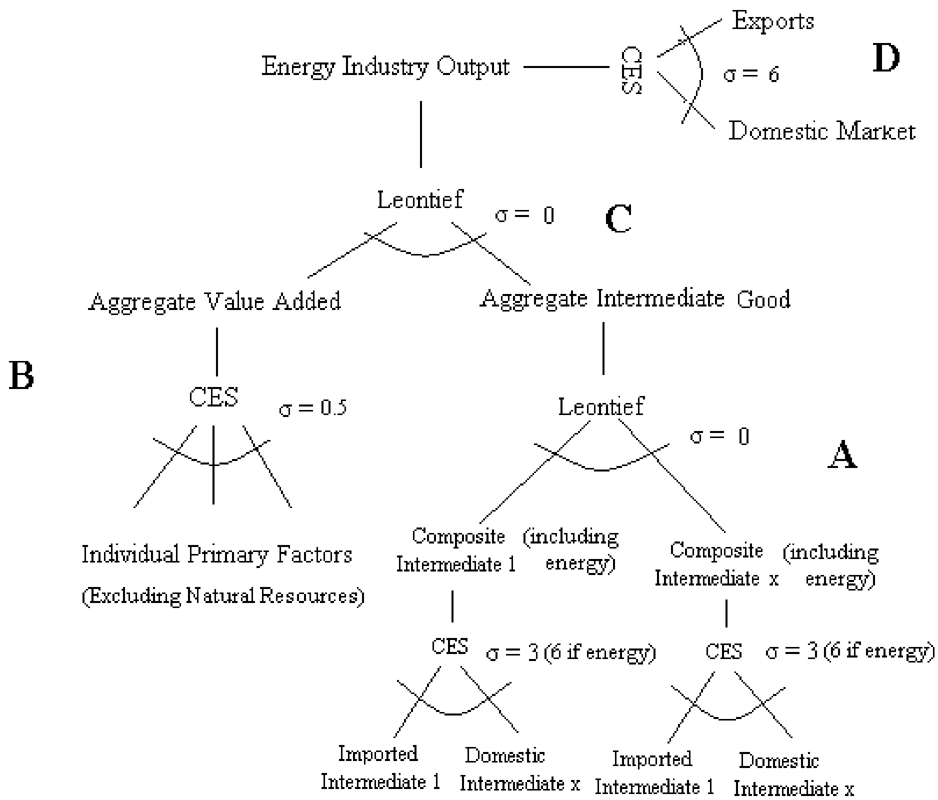


I.3.1.2 **The Energy Sectors**

The main difference between the energy sectors and the structure described above is the lack of substitutability of energy goods in production. Neither are individual energy goods substitutable between each other, nor is the aggregate energy input substitutable with aggregate value added. In fact, individual energy goods are treated just like any other individual intermediate input. They enter into the Leontief structure defining the aggregate intermediate good just like any other individual intermediate commodity (section A in figure 7). This is intended to capture that there is roughly a fixed physical relationship between the commodity inputs into production. For example, a certain amount of crude oil is required to produce a certain amount of gasoline. A Leontief setup also shapes the way that the aggregate intermediate good (which includes energy goods) interacts with the aggregate Value added good at the top of the production function nest, implying no substitutability between the two (section C in figure 7).

There is imperfect substitution between the individual factors of production at the bottom of the aggregate value-added technology nest (section B in figure 7), just like in the previous non-fuel production section. Also similar to the previous formulation is the presence of imperfect substitutability between local and imported goods in each of the individual intermediate inputs through Armington Elasticities. For the producers, a constant elasticity of transformation characterizes the choice of selling to exports versus to the local markets (section D in figure 7). The production structure, similar to that employed in Jensen and Tarr (2003), is given in Figure 7.

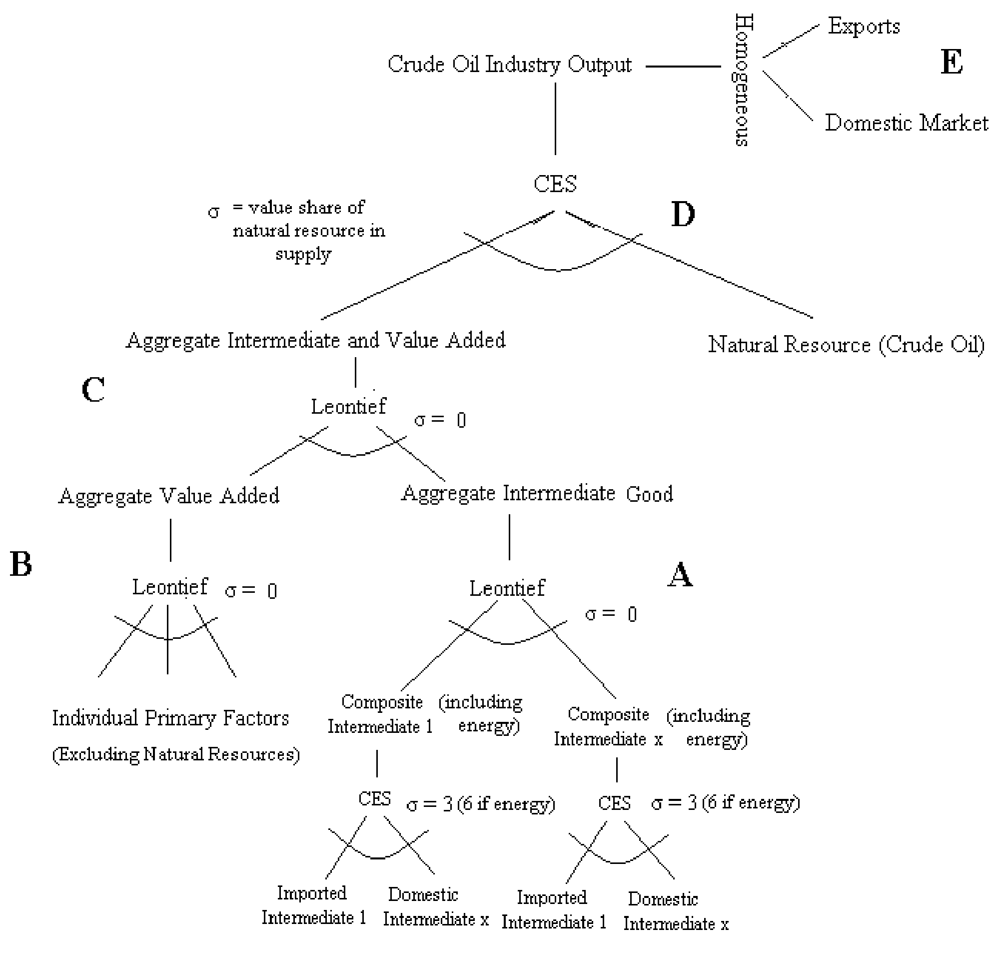
Figure 2
Production Structure for Energy Industries



I.3.1.3 **The Crude Oil Production Sector**

The third of the major production sectors, the crude oil sector, has its own unique production structure, mainly due to the presence of the primary factor of natural resources (crude oil). Like in the energy production sectors, energy goods are treated like any other intermediate good and have a Leontief formulation within the aggregate intermediate good (section A in figure 8). Primary factors with the exclusion of the crude oil natural resource make up aggregate (non-crude) value-added, with the difference from the previous setups being that there is no substitution between the individual primary factors (Leontief structure; section B in figure 8). This non-crude aggregate value-added then combines with the aggregate intermediate good via a Leontief setup to create a new aggregate nest which amalgamates both intermediate goods and value added (section C in figure 8). Finally, there is imperfect substitutability between the natural resource (crude oil) and the aggregate nest which combines both intermediate goods and value added, with the elasticity of substitution depending on the value share of the natural resource in the crude oil supply (section D). Figure 8 gives a diagrammatic depiction of the oil sector, which is similar to that used in Rutherford and Paltsev (2000). One further crucial difference between the crude oil sector and other sectors is that the good produced is homogenous, with exports or domestic sales being perfectly substitutable from the viewpoint of the crude oil producer (Section E). Imports and local commodities continue to be imperfectly substitutable in the individual intermediate inputs through Armington functions.

Figure 3
Production Structure for Crude Oil Industry



I.3.2 Other Economic Agents

Household consumption is allocated to commodities according to a Linear Expenditure Demand System (LES), which is derived from the maximization of a Stone-Geary utility function. As in the case of intermediate inputs in the production section, there is also imperfect substitutability between imports and domestic goods consumed through an Armington function.

Government consumption on the other hand is assumed to be constant in quantities and composition, while levies imposed by the government take the form of ad valorem tax rates. The country is assumed to be a small open economy, and hence it is a price taker on the world market with no terms of trade influences. Investment takes the form of expenditure on Investment commodities, with total savings of institutions equaling total expenditure on Investment goods.

I.4 Elasticities

The elasticities used have been collected from several sources in order to reflect the best available empirical evidence on the Iranian economy. The main studies employed are: 1. Ahangarani (1999) who estimated a system of demand functions for Iran; 2. Hope and Singh (1995), who estimated a set of energy elasticities for several developing countries; 3. Jensen and Tarr (2003), who conducted a previous study on the modelling of the fuel sector in Iran in a CGE model setting; and 4. The World Bank (2003), a comprehensive study on the effects of fuel subsidies on the Iranian economy.

These studies suggest central estimates of 1 for expenditure elasticities of most goods. Some essential household goods, (mainly energy commodities, food, water, and housing) are reported to have an expenditure elasticity of less than 1. We choose 0.5 for these goods, in line with The World Bank (2003). The Frisch parameter, which measures the elasticity of the marginal utility of income with respect to income, is set at -1.

Most studies estimate energy demand elasticities in production between -0.2 and -0.7 (e.g. Hope and Singh, 1995). We choose an intermediate value of -0.4 for the elasticity of substitution between the different energy intermediate inputs and for the elasticity of substitution between the aggregate intermediate energy good and aggregate value added. Data on the elasticity of substitution between the different factors of production is unavailable. We set the elasticity of the substitution at a default rate of 0.5, based on data from Bautista et al. (1999).

For the remaining elasticities, we use estimates employed in similar analyses, such as de Melo and Tarr (1992) Rutherford, Rutström, and Tarr (1997), and Jensen and Tarr (2003). The output aggregation elasticity (which governs the rate of substitution between different activities that produce the same commodity) is set at six. A value of three is employed for the Armington elasticity of substitution between domestic and foreign varieties in demand for both final and intermediate goods. For energy products, which are relatively homogeneous, a value of six is chosen. Crude oil is considered to be a completely homogenous commodity with perfect substitutability between exports and domestic sales.

The elasticities, particularly the elasticity of substitution between the different factors of production and between the aggregate value added and the aggregate energy input could potentially play a very crucial role in determining the results of the simulation. Hence we run the simulations for different possible values of the elasticities under consideration, where we highlight significant differences in the qualitative results.

I.5 Static simulation and closures

The main thrust of the simulation is to analyze the effects on the economy of removing the huge crude oil and fuel subsidies.[14] Tackling this problem requires two steps. Firstly, the rate of the subsidy on crude oil is assumed to drop down to zero. Furthermore, the subsidy rates on imports of fuels are also driven down to zero, with fuels having to sell at their border prices (after factoring in transportation costs). This is important since one of the main implications of the removal of the crude oil subsidies is that prices of locally produced fuels will rise, and hence a similar adjustment is needed in the imports market. One important point that should be mentioned is that in all simulations the level of overall crude oil production in the economy is held fixed. Iran is constrained by OPEC requirements (which apply to overall production levels and not export levels) and by limited oil production capabilities, with current crude oil production levels at their maximum potential. While overall crude oil output is fixed, the proportion of crude that can be exported versus consumed locally can vary depending on changes from the simulation.

Since the government no longer has to pay the massive crude oil and fuel subsidies under the simulations (which total approximately 68 trillion Rials in our SAM, or roughly 10% of GDP), the important question then centers around the manner in which this extra government revenue is to be utilized in the economy. We consider two alternative policy scenarios. The first option is for all revenue collected by the government to be redistributed back to households in the form of income tax reductions and/or institutional transfers. The tax rates on both rural and urban households are reduced by similar percentage points and transfers to each household from the oil fund also increase in similar proportions.[15] Hence the increased revenue from the removal of the subsidy is first channeled towards households through a tax rate reduction. If tax rates reach zero and the revenue of the subsidy is still not fully exhausted, then the leftover revenue is channeled to the oil fund, which then redistributes it as handouts to

[14] The model is simulated using the General Algebraic Modeling System (GAMS) software. For further information see Brooke et al. (1988).

[15] The model has to use both institutional transfers and reductions in tax rates. This setup is necessary because the subsidy amounts are so huge that tax rates could potentially drop all the way down to zero and still a considerable amount of the subsidy revenues will be left over. Institutional transfers from the oil fund to households are used to account for the rest of the subsidy.

urban and rural households, with the size of the handout being proportional to the (income) size of the household in question. In terms of model closures, this amounts to fixed government savings and variable tax rates in the government closure and fixed investments and variable savings in the Savings – Investment Closure. These closures can be interpreted as the increased government revenue from the removal of the oil subsidy being channeled to consumers (households) as a rebate.

The alternative policy measure is for the generated revenue to be spent on Investment. In this case, the base amount of Investment commodities (which in the Iranian economy are overwhelmingly composed of construction and industry commodities) are increased by equal percentage points. In terms of the previously of closures, this translates to fixed tax rates and variable government savings in the government account closure, while there is variable overall Investment coupled with fixed overall savings in the Savings-Investment closure. In this manner all the increase in government savings are translated into extra investment. The reasoning for employing such a closure is outlined in the World Bank (2003), whose central recommendation is that Iran increase its Investment by about 10% of GDP, particularly specifying that this extra savings and Investment should come from the removal of its crude oil and fuel sectors subsidies (which roughly amount to the same value of 10% of GDP). As mentioned previously, however, a variable Investment closure is of limited use in a static model.[16] Results will still be presented to provide a useful contrast to the dynamic model.

Two ways are used to close the labour market and to assess the effects of the removal of the fuel subsidies. In the first option, the quantity supplied of each labour type is fixed while the wage paid to each labour sector is allowed to freely move. There is full employment of each factor and fully flexible wages. In this scenario, the change in wages serve as an indication of changes in the demand for labour and hence unemployment. If the wage for labour increases, this indicates that there is a higher demand for labour and hence that unemployment is reduced.

In the alternative scenario, wage levels are fixed and the quantity employed of each labour factor is allowed to vary to equilibrate the labour markets. Hence the labour

[16] See section **Error! Reference source not found.**.

supply curves are infinitely elastic (horizontal line). Unemployed labour is explicitly allowed for here. An argument can be made for the use of either labour market closures. It could be argued, for example, that there is a large amount of slack in the Iranian economy (with unemployment exceeding 16% in 2003). This could favour keeping wages constant and letting the quantities employed of each factor vary, since such a high rate of unemployment implies that high pressures on wages do not exist. As Devarajan and de Melo (1987) point out, however, assessing changes in factor wages (i.e. keeping supplies fixed) could provide a more reliable indicator of changes in labour demand, since the results are not as sensitive to the numeraire used in the model. Hence in what follows the main results will be reported using both closures.

Indeed, if both scenarios point towards the same direction (e.g. decreased wages and decreased quantities employed) then a definite conclusion can be reached on the situation in the labour market in our model (in our example a deterioration). This is because these two closures act as boundaries, with a fixed wage implying an infinite wage elasticity of labour supply, while a fixed quantity of labour implies zero wage elasticity of labour supply. Any other modeling form of an upward sloping labour supply curve will have to assume an intermediate form between the two closures employed here. Hence if the two closures point towards the same direction, then a definite deduction regarding the effects on the labour market in our model can be reached.

Turning to other factors, capital is assumed to be fully employed and mobile between sectors, with the rental rate (wage) on capital varying in order to equilibrate the market. Land used in agriculture is assumed to be fully employed and activity specific (fixed). Crude oil is confined to one sector (the crude oil industry), with the amount of the factor used being fixed (which seems reasonable given that the output of crude oil is fixed). Looking at each factor individually, the return to each unit of the factor, regardless of the industry of employment, receives the economy wide average return. Although it would have been ideal to detail specific returns to factors in each industry, such information is unavailable for the Iranian economy.

The external balance is closed by assuming that the current account balance is fixed, with the real exchange rate moving in order to equilibriate the current account at the previous level. This is preferable to the alternative of fixing the real exchange rate while allowing the current account to fluctuate, since fixing the real exchange rate and allowing foreign savings to fluctuate can give misleading welfare results. An increase in foreign savings in the model, with all else being equal, translates into either increased investment or reduced taxes on households (depending on which scenario we are simulating). This is misleading because it neglects the costs of an increase in foreign debt in the economy. Conversely, a decrease in foreign savings, ceteris paribus, translates to either decreased investment or increased taxes on households, which gives the misleading implication that overall welfare has been reduced. Hence our simulations focus on results with a flexible real exchange rate and fixed foreign savings.[17]

Finally a convention has to be chosen for the assignment of prices versus quantities in the model, as the SAM entries represent expenditures/receipts values and does not distinguish explicitly between quantities versus prices. The model adopts the usual methodology of assigning base prices at unity with the corresponding SAM entries reflecting quantity amounts (e.g. Lofgren et al., 2002). Export commodities' prices, domestic supply of commodities' prices, activities' prices, the wages of the factors of production and the exchange rate are set at unity, with the remaining prices and the quantities set relative to the base prices chosen.

[17] The numeraire used in our simulations is the consumer price index (cpi). If the real exchange rate was to be fixed, the alternative numeraire of the producer price index for domestically marketed output (dpi) would have to be used.

I.6 Static Results

I.6.1 Base Simulation

The analysis begins by outlining a brief description of the data from the base (default) simulation, where all subsidies are kept unchanged.[18] According to our SAM and model, Iran's GDP at market prices stood at 741 trillion Rials in 2001, with exports and imports registering at 21% and 17% of GDP respectively (measured at spending). Private Consumption, Government Consumption, and Investment registered at 54%, 14%, and 21% of GDP respectively. The crude oil and natural gas sector makes up 15% of GDP and 66% of exports. Other notable industries contributing to GDP include farming (8% of Value Added), Construction (5%), Real Estate (12%), Communication and Transportation (7%), and wholesale and retail trade (14%). In terms of exports, the main contributing commodities other than crude oil are textiles, food, and tobacco (10% of exports), Industry excluding metal and equipment (8%), and agriculture, farming and forestry (4%).

The most labour-intensive industries are construction (expenditure on labour makes up 74% of value added), education (87%), public services and social security (62%), healthcare (52%), and financial intermediaries (51%). Most of unskilled labour's receipts come from the construction sector (52% of total unskilled labour receipts), followed by the public services sector (16%). Skilled labour receives most of its total income from the public services sector (19%), the education sector (17%), healthcare (7%), and industries (8%). Total income for non-agricultural mixed labour comes mostly from wholesale and retail trade (31%), communication and transportation (18%) and construction (12%).

Household income stands at 66% of GDP, with 72% of the income accruing to urban households and the rest going to rural households. The marginal propensity to save is 13% for urban households and 8% for the rural. Households expend 1.5% of their income on fuels, and this expenditure makes up 2% of total household expenditure on consumption goods. Industries spend 2% of their gross revenue (which totals 160%

[18] The results are reported in the section below.

of GDP) on fuel, and their total expenditure on fuel makes up 3% of industries' total expenditure on intermediate inputs. The least fuel efficient industries are communications and transportation (in our model setup, 1 unit of output requires 0.06 units of fuel commodities as intermediate input in this sector), chemicals and plastics (6%), minerals (3%), fuels (1%) and mining (1%).[19] It should be kept in mind that fuel expenditures by households and industries are calculated at the extremely subsidized fuel prices, and so expenditure on fuel should increase considerably if the true costs of fuel are paid.

[19] The percentages for fuel intensity are not reflective of actual conditions prevailing in the industries, due to the convention adopted of base prices being set to unity and the corresponding SAM entries reflecting quantities (see the closures section). However, they are very important in reflecting *changes* in intensity of fuel use in industries after the removal of subsidies in the simulations, as this reflects how industries adapt to the higher fuel prices by increasing their fuel efficiency in production.

I.6.2 Varying Tax Rates

The results of the policy changes are evaluated using the aforementioned criteria of GDP, consumer welfare, fuel consumption, and -above all- the effects on the labour market, where most of the discussion will be focused. On the first three criteria, redistributing the extra government revenue as tax cuts and household rebates scores quite well. Real GDP experiences an increase, household welfare as measured by Equivalent variation (EV) rises, while the total consumption of fuel commodities in the economy decreases significantly. Industries become more fuel efficient in their production while consumers also reduce their fuel consumption.

Table 1
Base Model and Policy Simulation Aggregate Results

Results for policy simulations are shown as percentage deviation from the base model. Items marked with a star * show absolute values. '*taxflexq*' refers to the closure with flexible taxes and flexible quantities of labour supplied. '*taxflexw*' refers to the closure with flexible taxes and flexible wages for labour. '*SIflexq*' refers to the closure with flexible Investment and flexible quantities of labour supplied. '*SIflexw*' refers to the closure with flexible Investment and flexible wages for labour.

On the most important criterion, reducing taxes does quite poorly. The labour market, whether measured by flexible wages or quantities employed, is affected adversely. When quantities supplied of labour are held fixed, the wages received by all labour types decrease substantially (Table 1). When labour wages are held fixed, the quantities supplied of all labour factors experience a noticeable decline as well. To understand the dynamics behind this one needs to take a closer look at the different effects within the economy.

Firstly, it is important to notice the effects of removing the subsidies on the prices of crude oil and fuel commodities (*P* in Table 2 Base Model and Flexible Taxes Policy Simulations (Commodities Results). Crude oil prices increase by around 500%, reflecting that crude oil was being sold at one sixth of its international price. All of the fuel products which are dependent on crude oil for their production experience a significant price increase as well, with their producers passing on the costs of the higher crude oil.

The income tax rates on rural and urban households drop sharply due to the redistribution of the windfall from the subsidies removal. In fact, income tax rates on both households drop to zero (they are completely abolished), and there is still some extra government income left over that is redistributed to households as rebates. Consequently, total household consumption in the economy increases due to the rise in households' purchasing power. Household consumption of all goods increase with the exception of fuel products ($C_{households}$ in Table 2 Base Model and Flexible Taxes Policy Simulations (Commodities Results), with the drop in their consumption explained by their higher prices. This overall increase in consumption explains the increase in the EV welfare of the households.

Table 2 Base Model and Flexible Taxes Policy Simulations (Commodities Results)

Results for policy simulations are shown as percentage deviation from the base model. *P* refers to prices, *X* refers to exports, and *M* refers to imports. $Q_{localind}$ refers to national output of the sector (including exports), $S_{localecon}$ refers to local sales (including imports but excluding exports), while $C_{households}$ refers to total consumption of households of the particular commodity (both locally produced and imports).

Another intriguing result is the marked rise in both aggregate real imports and exports. This is coupled with the real exchange rate experiencing a significant appreciation, giving a preliminary clue to the reason for the adverse effect on the labour market.

Although overall exports increase, the exports of all goods (*X* in Table 2 Base Model and Flexible Taxes Policy Simulations (Commodities Results), experience a decline with the exception of crude oil, which increase substantially. Indeed the crude oil makes up all the increase in exports, with all the others contracting. A classic Dutch Disease Case is witnessed. In the imports sector (*M* in Table 2 Base Model and Flexible Taxes Policy Simulations (Commodities Results), all commodities witness a substantial rise in imports.

Production wise (Table 3 Base Model and Flexible Taxes Policy Simulations (Activities Results), all industries where substitution of fuel inputs is allowed for in the production structure become more fuel efficient, with the amount of fuel input required in production (fuel intensity) decreasing by 15-30%. Indeed this increased fuel efficiency coupled with households' reduction in fuel consumption leads to overall petroleum and fuel use in the economy to drop significantly, a welcomed effect.

As alluded to previously, an increase in fuel costs causes firms to substitute expensive fuel with other factors of production. As the prices of fuel rise, firms should employ less energy-intensive capital and rely more on less energy-consuming factors of production such as labour and low energy-utilizing capital. Overall, this substitution away from fuel inputs to other factors of production tends to increase the wages/quantities employed of workers.

Unfortunately for employment, the adverse shocks experienced by the industries dominate this positive effect on labour employed. Industries experience the double shock of the Dutch disease effect and the increase in the cost of fuel inputs. The rise in the exports of crude oil makes the exchange rate appreciate, leading to a loss of competitiveness by local producers. This loss of competitiveness is further exasperated by the increased cost of fuel inputs. All non-oil exports experience a decline. Moreover, the increased consumption of local households does not translate to increased sales for local producers, as consumers focus most of their purchases on the relatively cheaper imports (expenditure switching effect). Indeed, disregarding crude oil, the only commodities that benefit from increased local consumption and do not experience a decline in National production ($Q_{localind}$ in Table 2 Base Model and Flexible Taxes Policy Simulations (Commodities Results), are agriculture, food, real estate, business services and hotels and restaurants, all non-fuel intensive industries. All the other commodities experience a decline in their total national output.

Table 3 Base Model and Flexible Taxes Policy Simulations (Activities Results)

Results for policy simulations are shown as percentage deviation from the base model. q_a refers to total activity quantities. d_x refers to quantity demanded of factor x by a sector. Subscripts *sk, un, miagl, minagl* refer to skilled labour, unskilled labour, agricultural labour mixed income and non-agricultural labour mixed income respectively. Fuel efficiency refers to the percentage of fuel inputs used per unit of activity output.

The data from the activities sector supports this, with the majority of activities experiencing a decline in their levels (q_a in Table 3 Base Model and Flexible Taxes Policy Simulations (Activities Results). Particularly hard hit are mining, chemicals, fuels, minerals, industries, and communication and transports, all fuel-intensive or export oriented industries. This decline in industry depresses the demand and wages of labour for two reasons. Overall production decreases since extra production becomes increasingly unprofitable. Furthermore, to compensate for the increasing fuel costs firms transfer some of these costs to their workers in terms of lower wages or reduced hiring. These two effects outweigh the positive fuel efficiency effect of substitution away from fuel and towards other factors of production. Indeed the demand for all types of labour (d_i in Table 3 Base Model and Flexible Taxes Policy Simulations (Activities Results), drops significantly in the industries outlined above, with the overall effect being a reduction in the wages/quantity employed of labour regardless of type. The qualitative results of all the simulations are not affected by the use of different elasticities of substitution between the factors of production and between aggregate value added and the composite fuel intermediate input.[20]

[20] Sensitivity analysis results are given in the appendix.

I.6.3 Varying Investment

As mentioned previously, static models are not well-geared towards assessing the effects of changes in Investment since capital accumulation effects are absent. However for comparison purposes, it is illustrative to present the results of varying Investment.

Table 4
Base Model and Variable Investment Policy Simulation Results (Commodities)

Results for the policy simulations are shown as percentage deviation from the base model. See Table 17 for symbols' key.

Allowing Investment to vary produces similar results to those elucidated above but with two important differences. Firstly, households no longer experience a rise in welfare, with their EV decreasing significantly (Table 1). This is expected given that they no longer receive tax reductions and rebates, while they have to pay higher prices for petroleum goods. Hence their overall welfare declines.

Table 5 Base Model and Flexible Investment Policy Simulations (Activities Results)

Results for policy simulations are shown as percentage deviation from base model. See Table 18 for symbols' key.

The second important difference is in the labour market. While all other types of labour experience a decline in their wages/quantities employed (albeit of a lesser magnitude than in the previous simulation), unskilled labour actually experiences a rise in these variables (Table 1). The reason for this can be deduced from the rise in the domestic output of two commodities sectors, the construction sector and the metal and equipment sectors (Table 4). This is because the overwhelming majority (over 80%) of Investment expenditure in the Iranian economy is concentrated on these two Investment goods, and hence any increase in Investment will necessarily be mainly channeled into these two goods. Thus an increase in Investment increases the output of these two sectors, which is reflected in an increase in the wages for unskilled labour and the lower decline in wages for other labour types when compared with the fixed investment scenario. A large proportion of unskilled workers are concentrated in the construction sector, and hence the increase in the output of that sector actually increases their wages. However, given the factors outlined in the previous section, mainly the loss of competitiveness in industries due to the Dutch disease effect and the increasing costs of fuel inputs, the beneficial consequences of increased Investment goods are not enough to overcome the decline in wages/quantities employed of the other labour types. These results should be treated with extreme caution, however, until further investigation is carried out using a dynamic model, as intertemporal capital accumulation could have important effects unrecognized in our one-period static model.

I.7 Dynamic Simulations

This section takes the previous static model and extends it within a recursive dynamic framework. This allows for a more detailed modeling of Investment and capital accumulation effects. Furthermore, it explicitly takes accounts of the transitional effects and costs associated with removing the subsidies, while a static model remains silent on the transition path. Closely related is the fact that a dynamic model allows for policy simulations not possible in a static model. It is unlikely that the removal of the subsidies could be implemented in reality all at one time. A dynamic model allows for a gradual phasing in of the subsidy reduction and a study of the associated transitional path over a specified period.

The extension is implemented as a recursive dynamic model[21] over a 20 year horizon, where a loop updates the evolution of the economy on a yearly basis. In essence, each year in the dynamic model resembles one equilibrium of the static model, with each subsequent year representing a new equilibrium incorporating the changes in variables from the previous year.

The modelling of Investment warrants some extra comments. Within each period, Investment takes a form similar to that in the static model, where total Investment is distributed proportionally to Investment goods. However, Investment now has a capital accumulation effect lacking in the static model. The total amount of capital in a specific period is determined by the total capital stock in addition to the Investment from the previous period after discounting for depreciation.[22] The employment of capital in the different sectors depends on the demand for capital in that sector, similar to the static

[21] An alternative way of implementing dynamic features is by using a forward looking rational expectations model instead of a recursive dynamic setting, where expectations of agents about future paths and events are explicitly incorporated in the setup (e.g. Harrison and Rutherford (1999)). This alternative method has the advantage of fully incorporating rational expectations, a feature which our model lacks. On the other hand, it suffers from the drawback that the equilibrium in the economy is uniquely and strongly determined by the expectations of agents (Yang 1999). This becomes particularly significant once one realizes the several complications and alternatives that this method opens up (such as whether the policies are announced or unannounced, or whether myopic expectations or perfect foresight are assumed, which imply significantly differing outcomes in a model involving forward looking expectations), and the fact that choices between these different alternatives are often based on ad hoc assumptions, which in turn uniquely drive the results. For these reasons a dynamic recursive model is adopted.

model. Hence capital accumulation effects are explicitly and endogenously determined in the model, unlike in the static model.

Exogenous yearly growth rates in total factor productivity, the population, and the quantity of each of the individual labour categories are included in the model. Furthermore, government consumption spending is kept constant in real terms across periods via varying the quantity of commodities consumed by the government (since commodity prices are determined endogenously in the model). Subsistence spending of households is also increased to take account of the exogenous population growth. The model is based on Thurlow (2004), with extensions to take account of the specific features of the study.[23]

To implement the dynamic simulations extra information is needed regarding the evolution of the economy over time. Population growth is set at 1.3% annually, in accordance with UNDP statistics (UN, 2007). Total factor productivity growth is based on World Bank staff estimates and set at 1% annually. Exact estimates on the rate of capital depreciation are unavailable, so we set the rate at a standard 10% annually. Although estimates for the annual overall labour supply growth is known (The World Bank (2003) estimates it at 2.5% annually over a 20 period horizon), the growth broken down along skills is not available, and so we set the growth for each labour group at 2.5%.[24]

An important question that arises is the implementation of the elasticities of substitution, particularly those for energy goods in production and consumption as well as elasticities of substitution between the different (non-crude) primary factors of production. It could be argued that in the first few years the elasticities of substitution should be quite low, since there is a lack of maneuvering space for those affected, increasing gradually over time to the long-run values used in the static model. On the other hand, it could be argued that very little is known about the evolution of elasticities over time, and that the ones employed previously should be used here throughout as well. This is especially the case since this a long-run simulation where actors will be

[23] For a more detailed assessment of the features of the dynamic part of the model, see Thurlow (2004).
[24] We also employ several other values as a cross check, including using different growth for the different types of labour. Where appropriate, results that are markedly different from the benchmark results reported are highlighted.

able to adjust over time. For this reason we report results using the same elasticities as previously used.

We do however also implement an alternative scenario where the elasticity of substitutions between (non-crude) primary factors of production, between the different energy goods, and between the aggregate energy good and aggregate value added in the relevant sectors are gradually updated over time. We implement the case where all these elasticities start at the low value of 0.2 and gradually reach their long run levels over a five year period, with the magnitude of the change distributed evenly over the five years. It is conceivable that this debate turns out to be academic with little effect in practice. The results reported below are those using the original static model elasticities throughout, with any changes between the two scenarios highlighted if appropriate.

We continue to employ the same closure rules adopted in the static model for comparison purposes. This means that once again either the quantity of supply of each labour type or the wages will be held fixed with the other varying in order to assess the effects of the policies on each labour type. In terms of policy options, we continue to implement both Investment (where extra government revenue is channeled into Investment) and Consumption (where the revenue is channeled to increased household income) closures as alternatives, but we introduce two further possibilities. As in the static model, one alternative gauges the effects of removing the subsidy completely in year one using the above two closures. The other scenario sees us reducing the subsidy gradually over a ten year period, with the amount of the subsidies reduced by 10% each year (i.e. the subsidies in the first year are 90% of the original amounts, etc). This allows us to assess the transitional and final impacts of removing the subsidies piecemeal or immediately.

I.8 Dynamic Results

The simulations of removing the crude oil and fuel subsidies are compared with the alternative defaults of keeping the subsidies intact over the twenty years. Since they are counterfactual simulations, what is most important in the analysis is the relative comparison of the base simulation results to those with the subsidies removed, with the differences in results being the focus of attention.

We begin our analysis by looking at the immediate removal of the subsidies in the first year with the extra revenue being redistributed back to households. As expected, the dynamic results confirm those of the static model. Although Real GDP and private consumption increase when compared with the default setting (Table 21 and Figure 6), industries overall experience a decline. The double blow of the Dutch Disease effect and the increasing cost of fuel inputs cause industries to contract, with the implication of wages/quantities employed of labour decreasing (Figure 7). The only difference is that in the dynamic simulation the percentage of the decrease by the 20^{th} year of the simulation when compared to the same year in the default setting is less than that in the static simulation. This is expected given that the economy has a longer time period to adjust over in the dynamic simulation. Introducing the tax gradually over twenty years does not produce any important differences in the results.[25]

[25] The simulations with a gradual change in the elasticities of substitution between the primary factors of production and between total value added and the composite intermediate fuel input does not cause any distinguishable difference in the results in all of the dynamic simulations.

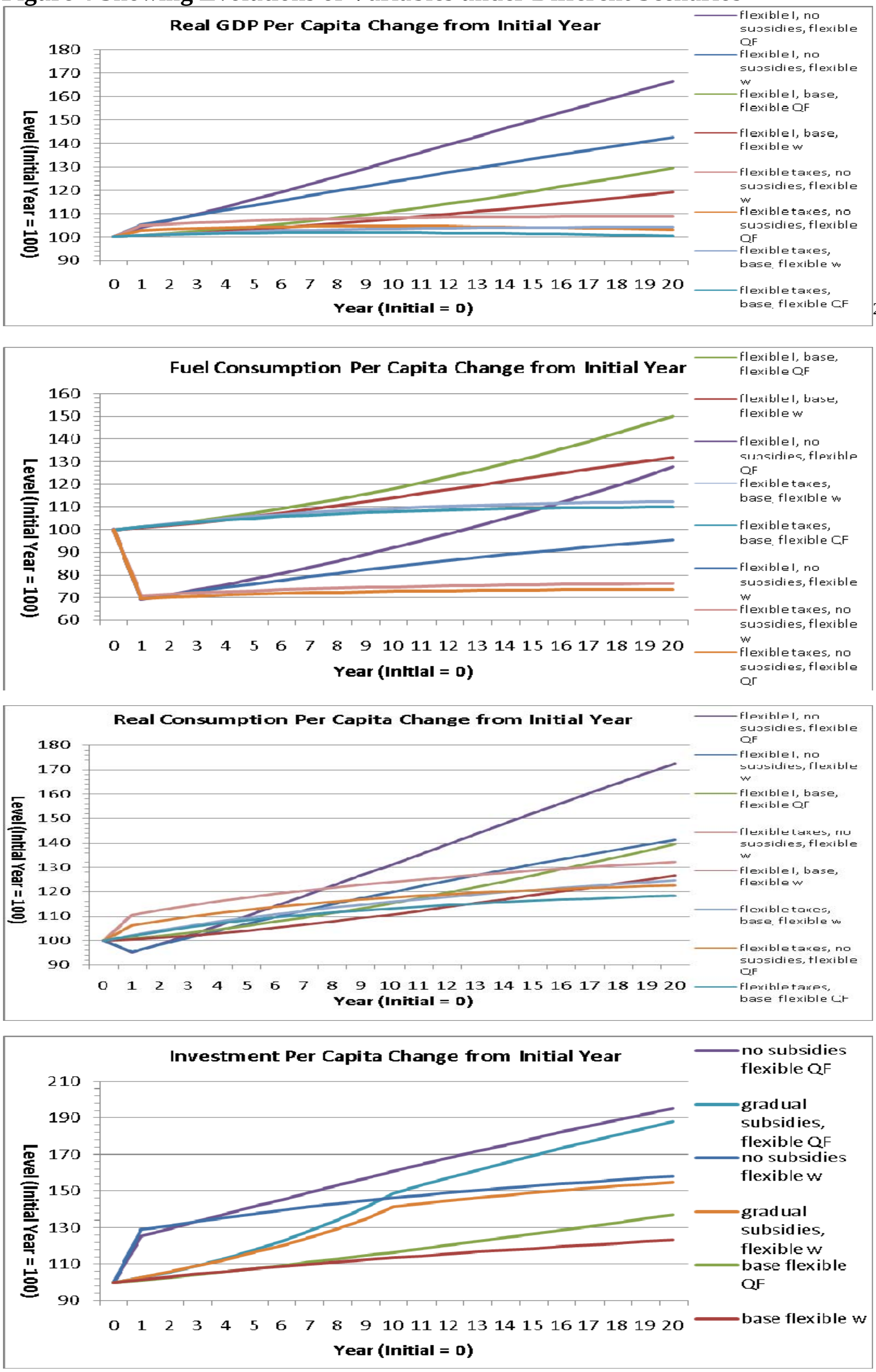
Table 6 Average Yearly Growth for Base and Alternative Policy Simulations

	Average Yearly Growth											
	Flexible W, taxes			Flexible Q, Taxes			Flexible W, SI			Flexible Q, SI		
	Base	No Subsidies	Gradual Subsidies	Base	No Subsidies	Gradual Subsidies	Base	No Subsidies	Gradual Subsidies	Base	No Subsidies	Gradual Subsidies
GDP per capita	0.2	0.4	0.4	0.0	0.2	0.2	0.9	1.8	1.7	1.5	3.3	3.0
Investment Per Capita							1.2	2.9	2.7	1.8	4.8	4.4
Consumption Per Capita	1.2	1.6	1.6	0.9	1.1	1.1	1.3	2.1	1.9	2.0	3.6	3.2
Fuel Consumption Per Capita	0.6	-1.2	-1.2	0.5	-1.3	-1.3	1.6	-0.2	-0.3	2.5	1.4	1.0
Skilled Labour W	-2.5	-3.1	-3.1				-0.9	-0.2	-0.3			
Unskilled Labour W	-5.3	-5.8	-5.8				-1.7	0.7	0.5			
Non-Agricultural Mixed Income W	2.0	1.6	1.6				4.1	5.4	5.3			
Agricultural Mixed Income W	3.3	3.2	3.2				5.5	7.4	7.1			
Skilled Labour QF				0.8	0.4	0.4				2.4	3.8	3.5
Unskilled Labour QF				-0.1	-0.3	-0.3				2.1	4.1	3.8
Non-Agricultural Mixed Income QF				1.1	0.8	0.8				3.0	4.5	4.2
Agricultural Mixed Income QF				1.7	1.5	1.5				3.7	5.5	5.2

Results show average yearly percentage change in values. *SI, taxes, W, Q* refers to closures with flexible Investment, taxes, wages and quantities of labour supplied respectively.

The results do change dramatically however when the extra revenues are channeled into Investment. We start by looking at the effects of removing the subsidies immediately. By the end of the twenty year simulation, wages and quantities employed of labour have increased substantially when compared to the default simulation of keeping the subsidies intact (Figure 7). Particularly impressive is the increase in unskilled labour when compared with the base simulation, although all types of labour register noticeable rises as well.

Figure 4 Showing Evolutions of Variables under Different Scenarios [26]



[26] To avoid cluttering, the graphs for the gradual removal of the subsidies for real GDP per capita, private consumption per capita and fuel consumption per capita are presented in the appendix.

The transition of the economy over the simulation years is revealing. For the first four years, the results are similar to those in the static model. The only type of labour that registers an increase in its wages/employment levels is unskilled labour, just as witnessed in the static model. All the other types show a lower level when compared to the default simulation. By the fifth year however, all types of labour have outstripped their counterpart default simulation values. This reveals the new insight that a dynamic simulation brings in about capital accumulation. For the first five years industry and the labour employed within it (with the exception of low skilled labour) experience a contraction for the same reasons detailed in the static section. Unskilled labour experiences an increase from the start because of the goods that Investment is spent on (particularly construction).

Over each year, however, this increased Investment when compared to the default simulation translates into increased capital accumulation. The economy now is flooded with extra capital that gradually allows industry to grow. By the fifth year industry has grown enough that the return to labour under the subsidy removal simulation outstrips the default simulation.

Increased capital accumulation is not the only story, however. The composition of the economy also shifts due to this increased Investment. Most of the new Investment is concentrated in farming, retail and estate: all non-fuel or oil intensive industries (Table 7 Investment and Value Added Share). This allows the structure of the Iranian economy to shift away from its traditional reliance on fuel and oil intensive industries and expand into other sectors. Hence the increased Investment allows not only for increased capital accumulation but also for an adjustment in the structure of the economy, with significant repercussions on GDP and welfare (as measure by private consumption). Both of those variables register impressive increases when compared with the default simulation by the end of the 20 years (Figure 6).

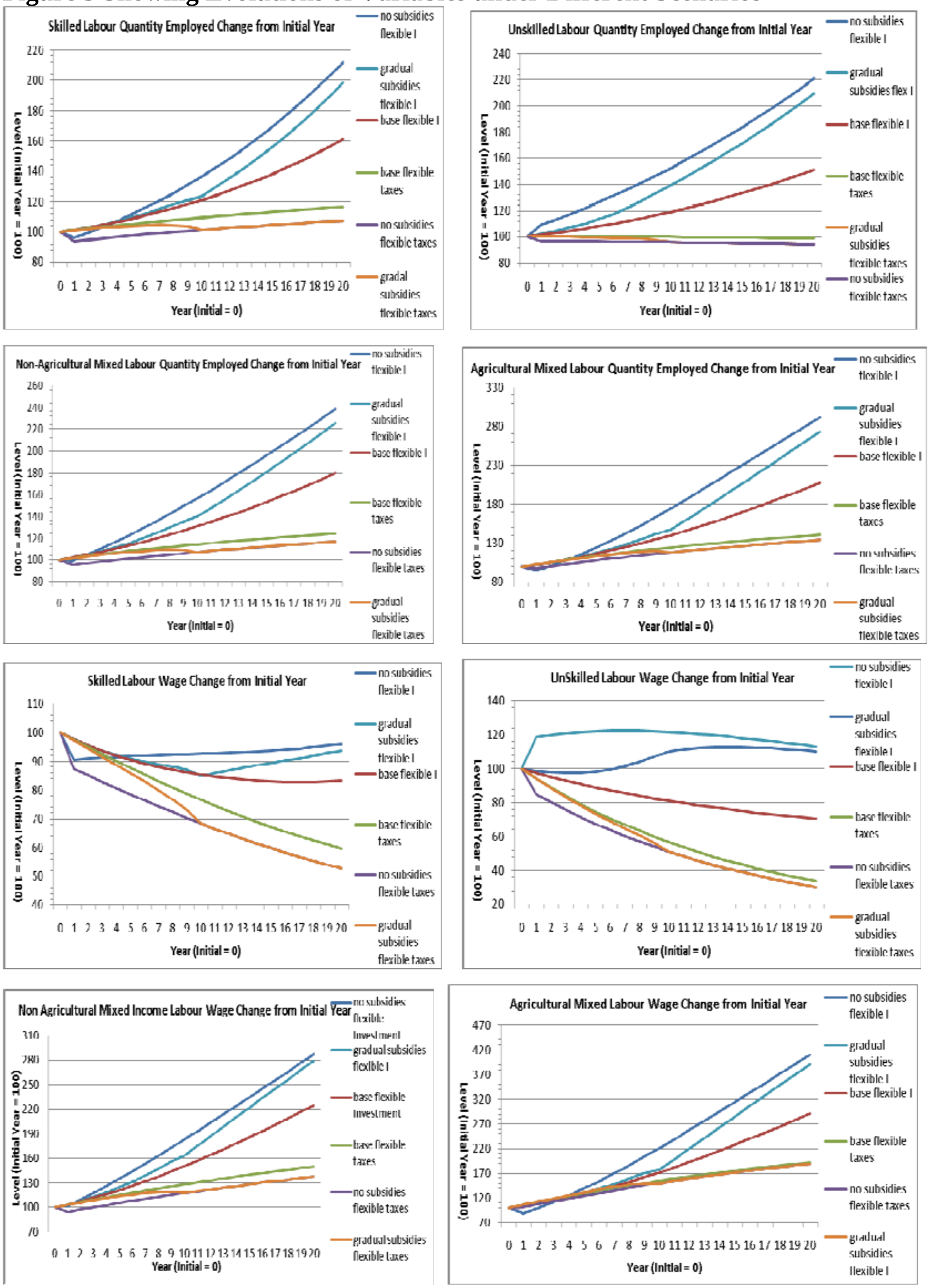
Introducing the subsidy removal gradually over ten years does not change the overall results, but it does change the transition of the economy. The initial decline experienced in the labour market is less severe, but it is stretched out longer. Because the revenue from the subsidy removal is less, the yearly increase in Investment is also lower. Hence capital accumulation and the shift in the structure of the economy happen at a lower speed. Wages and quantities employed take longer in order to catch up with the values in the default simulation. Hence the overall increase in GDP, welfare, and wages/quantities employed in labour is reduced, but the initial transition costs are lower. Indeed they are lower in two forms. The increase in the costs of the fuel goods is less felt as it is introduced gradually over ten years, and the initial decline in industry is also less severe.

Table 7 Investment and Value Added Share

	Investment Share (%)				Total VA Quantity Share at start/end of simulation				
	Flexible I, W		Flexible I, Q			Flexible I, W		Flexible I, Q	
	base	no subsidies	base	no subsidies	Initial Year	base	no subsidies	base	no subsidies
farming, forestry and horticulture	12.5	12.9	12.6	13.1	7.5	8.1	8.9	8.6	9.0
husbandry poultry and fishery	1.7	1.9	1.7	2.0	3.2	3.0	2.9	3.0	2.4
crude oil and natural gas	4.2	3.3	4.0	3.1	21.5	13.8	11.7	12.2	8.5
Mining	0.9	0.9	1.0	1.2	0.5	0.9	0.9	1.3	1.9
food , beverages , tobacco	3.8	3.7	3.7	3.4	2.5	2.6	2.7	2.5	2.1
textile, clothing and leather	2.4	2.2	2.8	2.6	2.2	2.0	1.7	2.9	2.5
wooden products and paper	0.5	0.6	0.7	0.8	0.5	0.5	0.5	0.8	1.1
chemical s and plastic	4.2	3.8	3.9	3.2	2.6	2.6	2.3	2.1	1.0
Fuel	1.6	0.7	1.6	0.7	0.9	1.0	0.4	1.1	0.4
non-metal minerals	1.9	1.9	2.0	2.3	1.2	2.3	2.5	2.8	3.8
other industries	4.8	5.4	5.0	5.9	4.2	5.1	5.7	5.9	7.3
water, electricity and gas	2.4	2.0	2.4	2.1	1.8	2.1	1.8	2.0	1.7
construction	2.2	2.9	2.1	2.7	4.2	4.4	5.3	4.5	5.6
wholesale and retail trade	19.3	19.5	19.2	19.4	13.3	14.6	14.9	16.1	16.6
hotels and restaurants	1.3	1.3	1.3	1.2	0.9	0.9	0.9	0.9	0.7
communication and transportation	6.9	7.1	7.0	7.3	6.4	7.1	7.1	8.2	8.8
financial intermediaries	3.0	3.1	2.7	3.1	2.1	6.7	7.3	4.4	6.3
real estate and business services	19.7	19.6	19.4	19.3	11.0	11.3	12.6	11.0	11.8
public services and social security	3.4	3.3	3.3	3.0	5.9	3.9	3.5	3.4	2.6
education	0.9	0.8	0.8	0.7	3.4	4.6	3.0	3.4	2.3
healthcare	2.2	2.8	2.2	2.5	3.0	2.2	3.3	2.1	2.6
others	0.4	0.4	0.6	0.6	1.2	0.3	0.2	0.9	0.8

Values other than the initial year are for the final year of the simulation (year=20). Results show share of each sector in overall Investment or total quantity of Value Added. *I*, *W*, *Q* refers to closures with flexible Investment, wages and quantities of labour supplied respectively.

Figure 5 Showing Evolutions of Variables under Different Scenarios



I.9 Conclusion

This studies aim is to simulate the removal of the large crude oil and fuel subsidies in an oil producing economy, with the attention particularly focused on the labour market. Iran was used as a case study to drawn out the main underlying factors at play in the economy. The simulation was carried out within a static and a dynamic Computable General Equilibrium framework using a 2001 SAM of the Iranian economy. The additional revenue from the subsidy removal presented two alternative options to the government: Either to redistribute it back to households in the form of tax cuts and rebates, or to utilize the additional income to increase Investment.

A main theme that emerges is that the current structure of the economy is heavily biased towards industries that are crude oil and fuel intensive in production. This is a consequence of the extremely low prices of these inputs, which over the years have created severe distortions in the economy. Redistributing the extra revenue back to households would not be enough to overcome these distortions. Indeed the wages and quantities employed of labour suffer under such a scenario, even though Real GDP and household welfare rise. Industries contract due to the Dutch Disease effect. Considerable quantities of crude oil are freed up for export as local demand for the more expensive crude oil drops, causing the exchange rate to appreciate. Industries face the further setback of the increased cost of fuel inputs. Their overall production declines, translating into a reduction in the wages and quantities of labour employed. Even though the economy experiences a decrease in fuel use and a substitution away from fuel towards other factors of production (increased fuel efficiency), these effects are not enough to outweigh the adverse shocks outlined above.

What the economy needs is for this extra revenue to be channeled into Investment. Such a simulation improves the labour market’s fortune dramatically in the long run. In the short run, the above mentioned shocks cause a contraction in the labour market, but over time it expands for two reasons. Firstly, there is increased capital accumulation because of the extra investment. Secondly, the structure of the Iranian economy shifts. The extra capital is directed towards non-fuel or crude oil intensive industries, allowing the Iranian economy to adjust away from its current reliance on industries dependent on these inputs.

One interesting possibility would be to investigate the effects of such policies on households demarcated by income levels. The SAM used here demarcated households only according to urban and rural households. It is possible that the subsidy removal would have different effects on high income versus low income households. Another fruitful endeavour could involve applying the model to data from other oil producing countries to analyze any differences in results. We leave these possibilities to future research.

I.10 Appendix

I.10.1 SAM Construction:

The data sources for the construction of the SAM are use and supply (at both producer and purchaser prices) 2001 input-output tables provided by the Statistical Center of Iran (Statistical Center of Iran (2007)) and a pre-existing SAM for the year 2001 by Asgari (2005), which incorporates both Household data from a 2001 household survey as well as input-output values. This is necessary since each of the sources on its own does not provide sufficient material to construct the necessary SAM, but when the information of both is combined an adequate SAM construction is feasible.

The disaggregation of commodities and industries in the two sources are not similar, with the Input-Output tables (147 commodities x 99 industries) having a much more detailed composition than the Asgari SAM (22 commodities x 21 industries). Hence the first step was to aggregate the Input-Output tables to correspond with the Asgari SAM.

The format of the Asgari SAM is based on that of the United Nations 1993 System of National Accounts (SNA93). This format is not conducive to the simulation of CGE models and a format closer to the standard SAM representation of Pyatt (1991) is needed. Hence the SAM was modified and rearranged to correspond to the standard SAM representation of Pyatt (1991).

A more important limitation is the absence of a fuel energy sector in the Asgari SAM, where fuels are aggregated in the “chemicals and plastic” sector in the production account and in the “other industrial products” sector in the commodities account. The SCI IO table is used to disaggregate the necessary fuel sectors.

Disaggregating the fuel industries sector requires information on the composition of the type (skill) of workers in the sector. This is not available from the SCI IO table. The assumption made here is that the skill composition of workers in the fuel production sector mirrors that in the chemicals and plastic sector, a reasonable assumption given the similar production nature of the two sectors.

A further problem arises from the fact that the different SAM entries for the sectors do not correspond exactly between the two sources. The method employed here is to take the exact values from IO tables for the disaggregated fuel sectors, with the residual values left after subtracting these values from the aggregated Asgari SAM's sectors being assigned to the "chemical and plastic" or the "other industrial products" sectors. Luckily the residual values did not differ greatly from those in the Input-Output tables. Some simple rounding of the cells was needed to ensure that the Matrix balances. Since only small adjustments were needed, this was done manually instead of having to resort to more computationally intensive methods, such as the cross entropy method of Robinson et al. (1998).

In the Asgari SAM, the mixed income sector was not disaggregated. For the agricultural sectors (farming and husbandry) it was decided to disaggregate the values based on simple assumptions derived from Dorosh et al.'s work on Pakistan (2006). 50% of the payments were assumed to accrue to land in the farming production sector (the value was 80% in the case of the husbandry sector), with the rest going to mixed income agricultural labour. This step is not necessary or of importance to the main objective of the model, but it was felt that it would give a more detailed description of the setup in agricultural activities, where land plays an important part in production.

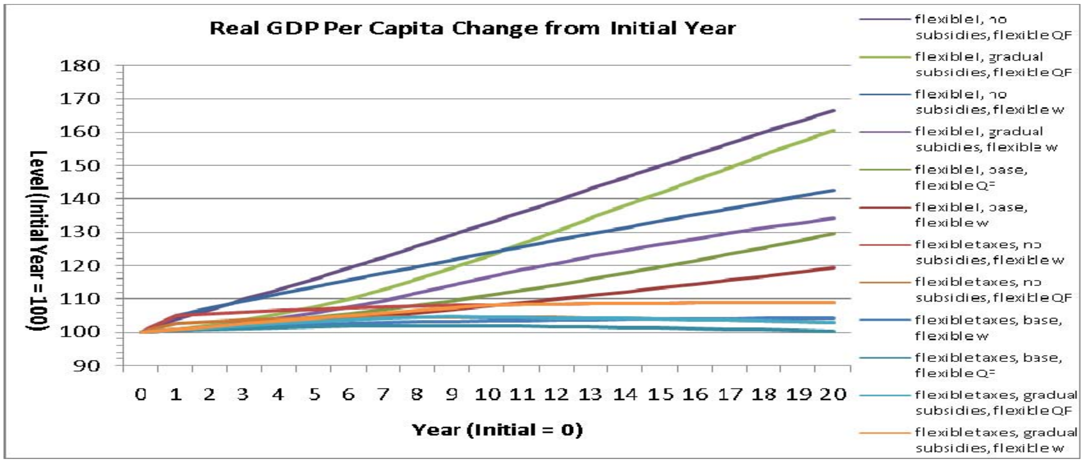
The Asgari SAM lacks information on payments to the crude oil natural resource. This information was obtained from the IO tables, which reported both payments to fixed capital and operating surplus in the sector. The operating surplus (rent) accruing to the sector is designated as income accruing to the crude oil natural resource. In turn this natural resource pays all its revenue to the government account, consistent with the fact that oil is nationally owned in Iran.

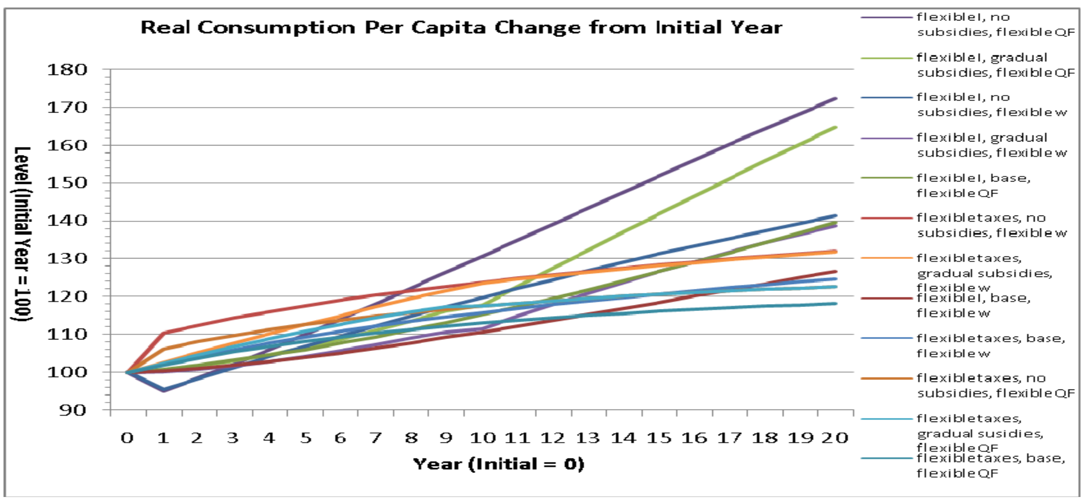
Transaction (transportation) costs in the Asgari SAM are not disaggregated as to whether they are costs of imports, exports, or domestic transaction costs. Although this is not crucial, it would be more helpful to have information on the breakdown of these transaction costs. The disaggregation was done using a simple technique of assuming that transaction costs for imports, exports, or domestically used goods are proportional to the amounts of each of these different segments. For example, the proportion of imports' transaction costs as a ratio of total transportation costs is directly proportional to the ratio of imports' when compared to the overall amount of the goods (including domestic use, exports and imports).

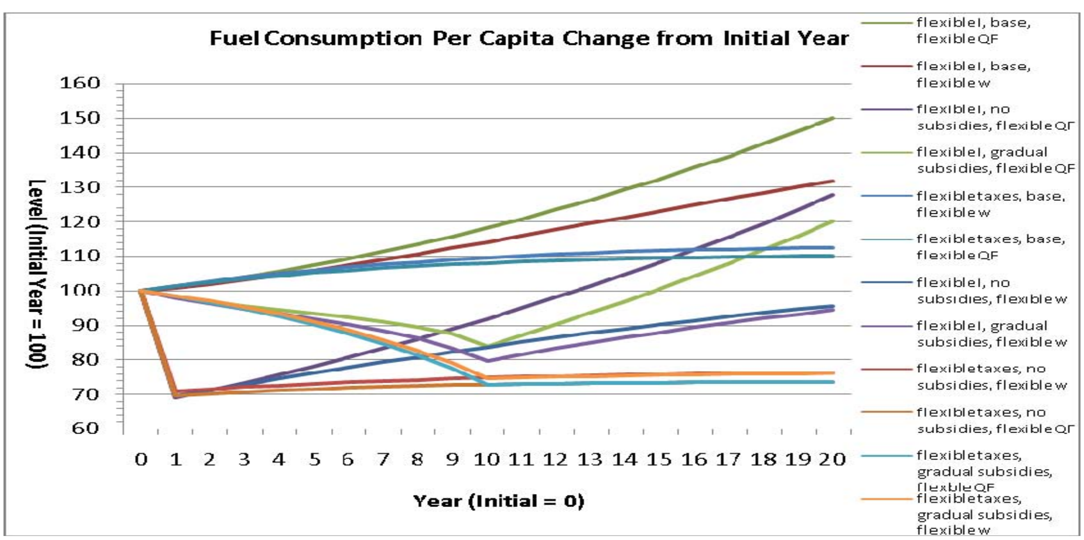
The most glaring problem with both sources is the complete absence of the crude oil subsidies, arising from the fact that crude oil commodities accounts are calculated using different prices locally and when sold abroad. As mentioned previously, the source of the huge crude oil subsidies is the fact that the crude oil commodity is sold at a massively discounted price to fuel producers locally when compared with those sold abroad. Both sources simply input the payments to the crude oil commodities sector using domestic (subsidized) prices when sold locally and international prices when sold internationally. Indeed Iranian National Statistics generally do not compute the exact amount of the subsidy. This can be seen from the fact that international revenues from the crude oil commodities sector account for roughly 90% of total revenue in the SAM and IO tables, while World Bank and Iranian data shows that roughly 40% of crude oil output was consumed locally in 2001 (with the ratio roughly holding steady over the past 5 years). Hence the discrepancy in revenue arises from the different prices that crude oil is sold at locally and abroad. This subsidy to local prices is not made explicit anywhere in either source.

Making this subsidy explicit is the most crucial feature required in the SAM; otherwise modeling policy changes becomes impossible. Data was obtained from World Bank staff estimates regarding the allocation of crude oil output between domestic use and exports, which indicated that 42% of the crude oil output was used locally as intermediate inputs in domestic production (mainly in the fuel sector). The rest (58%) was exported abroad. Taking international oil prices as the reference, with the difference between local prices and those abroad (after accounting for transportation costs) constituting the local subsidy on the crude oil commodity, and given that the IO tables and the Asgari SAM show only 10% of crude oil revenues coming from the local market, the exact amount of the subsidy can be made explicit. The amount of the subsidy on local sales of the crude oil commodity then simply becomes the difference between the 10% and the 42% of local revenues if they were to be accounted at international prices. The enormity of the subsidy becomes apparent once this is done, with the crude oil subsidy making up roughly 9% of GDP (65 trillion Rials).

I.10.2 Gradual Subsidies Removal Graphs







I.10.3 BASE STATIC MODEL IN GAMS FORMAT[27]

***MODEL SETS

AC	global set for model accounts - aggregated microsam accounts
A(AC)	activities
ALEO(A)	activities with Leontief fn at top of technology nest

*NEW=======

AFU(A)	energy activities
AOI(A)	oil activities
ANO(A)	ALL OTHERS

*==

C(AC)	commodities

*NEW==============

CF(C)	energy commodities
CNF(C)	non-energy commodities
CO(C)	CRUDE OIL COMMODITY
CNO(C)	NON CRUDE OIL COMMODITIES
CPETROL(C)	FUEL COMMODITIES

*==

CD(C)	commodities with domestic sales of output
CDN(C)	commodities without domestic sales of output
CE(C)	exported commodities
CEN(C)	non-export commodities
CM(C)	imported commodities
CMN(C)	non-imported commodities
CX(C)	commodities with output
F(AC)	factors
INS(AC)	institutions
INSD(INS)	domestic institutions
INSDNG(INSD)	domestic non-government institutions
H(INSDNG)	households

[27] The model equations are presented in GAMS format for expositional purposes and are based on Lofgren et al.(2002), to which the reader can refer to for a more detailed analysis. Sections with new additions or changes begin with "*NEW==", with the end of each of the new sections demarcated by "*===".

CINV(C)	fixed investment goods
CT(C)	transaction service commodities
CTD(AC)	domestic transactions cost account
CTE(AC)	export transactions cost account
CTM(AC)	import transactions cost account

AAGR(A)	agricultural activities
ANAGR(A)	non-agricultural activities
CAGR(C)	agricultural commodities
CNAGR(C)	non-agricultural commodities
EN(INSDNG)	enterprises
FLAB(F)	laboUr
FLND(F)	land
FCAP(F)	capital

*NEW================

FNAT(F)	NATURAL RESOURCE (CRUDE OIL) FACTOR
FNOTNAT(F)	NON-NATURAL RESOURCE (CRUDE OIL) FACTORS

*=========================

;

***VARIABLES

CPI	consumer price index (PQ-based)
DPI	index for domestic producer prices (PDS-based)
DMPS	change in marginal propensity to save for selected inst
DTINS	change in domestic institution tax share
EG	total current government expenditure
EH(H)	household consumption expenditure
EXR	exchange rate
FSAV	foreign savings
GADJ	government demand scaling factor
GOVSHR	govt consumption share of absorption
GSAV	government savings
IADJ	investment scaling factor (for fixed capital formation)
INVSHR	investment share of absorption
MPS(INS)	marginal propensity to save for dom non-gov inst ins
MPSADJ	savings rate scaling factor
PA(A)	output price of activity a
PDD(C)	demand price for com'y c produced & sold domestically
PDS(C)	supply price for com'y c produced & sold domestically
PE(C)	price of exports
PINTA(A)	price of intermediate aggregate (non-energy intermediates if in non-oil and non-energy sectors)
PM(C)	price of imports
PQ(C)	price of composite good c
PVA(A)	value added price

PWE(C)	world price of exports
PWM(C)	world price of imports
PX(C)	average output price
PXAC(A,C)	price of commodity c from activity a

*NEW======

PFA(A)	price of aggregate energy input and Aggregate VA Composite in non-oil and non-energy industry
PQFUEL(A)	price of aggregate energy input in non-oil and non-energy industry
PVVA(A)	price of aggregate non-crude VA in oil industry
PLUMPA(A)	quantity of aggregate non-crude VA and aggregate intermediate input composite in oil industry

*===========

QA(A)	level of domestic activity
QD(C)	quantity of domestic sales
QE(C)	quantity of exports
QF(F,A)	quantity demanded of factor f from activity a
QFS(F)	quantity of factor supply
QG(C)	quantity of government consumption
QH(C,H)	quantity consumed of markted commodity c by household h
QHA(A,C,H)	quantity consumed of home commodity c fr act a by hhd h
QINT(C,A)	quantity of intermediate demand for c from activity a
QINTA(A)	quantity of aggregate intermediate input (excludes intermediate energy inputs in non-energy and non-crude activities)
QINV(C)	quantity of fixed investment demand
QM(C)	quantity of imports
QQ(C)	quantity of composite goods supply
QT(C)	quantity of trade and transport demand for commodity c
QVA(A)	quantity of aggregate value added
QX(C)	quantity of aggregate marketed commodity output
QXAC(A,C)	quantity of output of commodity c from activity a

*NEW=======

QQFUEL(A)	quantity of aggregate energy input in non-crude and non-energy activity
QFA(A)	quantity of aggregate energy input and aggregate VA Composite in non-crude and non-energy activity
QQCF(C,A)	quantity of individual energy commodity input in non-crude and non-energy activity
QLUMPA(A)	quantity of aggregate non-crude VA and aggregate intermediate input composite in oil industry
QVVA(A)	quantity of aggregate non-crude VA in oil industry
PETROLEFF(A)	percentage of fuel quantity units per unit of activity output (fuel efficiency)
FUELEFF(A)	percentage of energy quantity units per unit of activity output (energy efficiency)

*==============================

TABS	total absorption
TINS(INS)	rate of direct tax on domestic institutions ins
TINSADJ	direct tax scaling factor
TRII(INS,INSP)	transfers to dom. inst. insdng from insdngp
WALRAS	savings-investment imbalance (should be zero)
WALRASSQR	Walras squared
WF(F)	economy-wide wage (rent) for factor f
WFDIST(F,A)	factor wage distortion variable
YF(F)	factor income
YG	total current government income
YIF(INS,F)	income of institution ins from factor f
YI(INS)	income of (domestic non-governmental) institution ins

;

***PARAMETERS APPEARING IN MODEL EQUATIONS

*Parameters other than tax rates

alphaa(A)	shift parameter for top level CES function
alphaac(C)	shift parameter for domestic commodity aggregation fn
alphaq(C)	shift parameter for Armington function
alphat(C)	shift parameter for CET function
alphava(A)	shift parameter for CES activity production function

*NEW=========

alphafa(A)	shift parameter for CES QFA function
alphafuel(A)	shift parameter for CES energy intermediates function
alphavva(AOI)	shift parameter for crude oil function

*=====================

betah(A,C,H)	marg shr of hhd cons on home com c from act a
betam(C,H)	marg share of hhd cons on marketed commodity c
cwts(C)	consumer price index weights
deltaa(A)	share parameter for top level CES function
deltaac(A,C)	share parameter for domestic commodity aggregation fn
deltaq(C)	share parameter for Armington function
deltat(C)	share parameter for CET function
deltava(F,A)	share parameter for CES activity production function

*NEW=========

deltafa(A)	share parameter for CES QFA function
deltafuel(CF,A)	share parameter for energy intermediates function

deltavva(AOI)	share parameter for crude oil function

*======================

dwts(C)	domestic sales price weights
gammah(A,C,H)	per-cap subsist cons for hhd h on home com c fr act a
gammam(C,H)	per-cap subsist cons of marketed com c for hhd h

*NEW================

ica(CNF,A)	non-energy intermediate input CNF per unit of aggregate non-energy intermediate input in non-oil and non-energy sectors
icaa(C,A)	share of intermediate input C per unit of aggregate intermediate in oil and energy industries

*=========

inta(A)	aggregate intermediate input coefficient
iva(A)	aggregate value added coefficient

*NEW=======

ifa(A)	aggregate QFA coefficient
ivfa(F,A)	non-oil factor ratio in oil industry total Value added
ivvfa(FNOTNAT,AOI)	crude oil factor ratio in total value added
ivvva(AOI)	ratio of QVVA in QLUMPA in oil industry
ivvint(AOI)	ratio of aggregate intermediate inputs in QLUMPA in oil industry

*======================

icd(C,CP)	trade input of c per unit of comm'y cp produced & sold dom'ly
ice(C,CP)	trade input of c per unit of comm'y cp exported
icm(C,CP)	trade input of c per unit of comm'y cp imported
mps01(INS)	0-1 par for potential flexing of savings rates
mpsbar(INS)	marg prop to save for dom non-gov inst ins (exog part)
qdst(C)	inventory investment by sector of origin
qbarg(C)	exogenous (unscaled) government demand
qbarinv(C)	exogenous (unscaled) investment demand
rhoa(A)	CES top level function exponent
rhoac(C)	domestic commodity aggregation function exponent
rhoq(C)	Armington function exponent
rhot(C)	CET function exponent
rhova(A)	CES activity production function exponent

*NEW===========

rhofa(A)	CES QFA function exponent
rhofuel(A)	CES intermediate energy function exponent
rhovva(AOI)	CES in crude oil function exponent

*==

shif(INS,F)	share of dom. inst'on i in income of factor f
shii(INS,INSP)	share of inst'on i in post-tax post-sav income of inst ip
supernum(H)	LES supernumerary income
theta(A,C)	yield of commodity C per unit of activity A
tins01(INS)	0-1 par for potential flexing of dir tax rates
trnsfr(INS,AC)	transfers fr. inst. or factor ac to institution ins

*Tax rates

ta(A)	rate of tax on producer gross output value
te(C)	rate of tax on exports
tf(F)	rate of direct tax on factors (soc sec tax)
tinsbar(INS)	rate of (exog part of) direct tax on dom inst ins
tm(C)	rate of import tariff
tq(C)	rate of sales tax
tva(A)	rate of value-added tax

***EQUATIONS' NAMES

*Price block==

PMDEF(C)	domestic import price
PEDEF(C)	domestic export price
PDDDEF(C)	dem price for com'y c produced and sold domestically
PQDEF(C)	value of sales in domestic market
PXDEF(C)	value of marketed domestic output
PADEF(A)	output price for activity a
CPIDEF	consumer price index
DPIDEF	domestic producer price index

*NEW======

PINTADEF1(A)	Price of Aggregate Intermediate input in crude oil or energy activities
PINTADEF(A)	price of aggregate non-energy intermediate input in non-oil and non-energy activities
PVADEF1(A)	Value Added Price in Energy sectors
PVADEF(A)	value added price in non-oil and non-energy sector
PFADEF(A)	QFA price in non-oil and non-energy sector
PVVADEF(AOI)	price of QVVA
PLUMPAPDEF(AOI)	price of QLUMP(A) in oil industry
PVADEF2(AOI)	price of total VA in oil industry

*======

*Production and trade block================================

COMPRDFN(A,C)	production function for commodity c and activity a
OUTAGGFN(C)	output aggregation function
OUTAGGFOC(A,C)	first-order condition for output aggregation function
CET(C)	CET function
CET2(C)	domestic sales and exports for outputs without both
ESUPPLY(C)	export supply
ARMINGTON(C)	composite commodity aggregation function
COSTMIN(C)	first-order condition for composite commodity cost min
ARMINGTON2(C)	comp supply for com's without both dom. sales and imports
QTDEM(C)	demand for transactions (trade and transport) services

*NEW=======

LEOAGGINT(A)	Leontief aggregate non-energy intermediate demand in non-oil and energy industry
LEOAGGFA(A)	Leontief QFA demand in non-oil and non-energy industry
CESVAPRD(A)	CES value-added production function in non-oil industry
CESVAFOC(F,A)	CES value-added first-order condition in non-oil industry
CESQFA(A)	CES QFA production function in non-oil and non-energy industry
CESQFAFOC(A)	CES QFA first order condition in non-oil and non-energy industry
CESFUEL(A)	Intermediate energy input CES production function in non-oil and non-energy industry
CESFUELFOC(CF,A)	Intermediate energy input first order condition in non-oil and non-energy industry
INTDEM(CNF,A)	intermediate demand for non-energy commodity CNF from non-oil and non-energy activity
VAFOC1(AOI)	Non-Crude factor Demand FOC in oil industry
QLUMPALEO1(AOI)	Leontief Demand for QVVA in oil industry
QLUMPALEO2(AOI)	Demand for aggregate intermediate input in oil industry
AGGVAOIL(AOI)	quantity of total VA in oil industry
CESCRUDEFOC(FNAT,AOI)	CES crude oil factor first order condition in oil industry

VAPRD1(FNOTNAT,AOI) Non-Crude Factor Demand and QVVA in oil industry

CESCRUDE(AOI)	CES crude oil production function in oil industry
LEOAGGVA1(A)	Leontief Aggregate Value Added Demand in Energy Sectors
INTDEM1(C,A)	Intermediate demand for commodity C (including energy) from crude oil or energy activities
CET3(C)	DOMESTIC OUTPUT AND SALES FOR CRUDE OIL (homogenous)
ESUPPLY1(C)	EXPORT SUPPLY FOR CRUDE OIL (homogenous)

*====================================

*Institution block ===

YFDEF(F)	factor incomes
YIFDEF(INS,F)	factor incomes to domestic institutions
YIDEF(INS)	total incomes of domest non-gov't institutions
EHDEF(H)	household consumption expenditures
TRIIDEF(INS,INSP)	transfers to inst'on ins from inst'on insp
HMDEM(C,H)	LES cons demand by hhd h for marketed commodity c
HADEM(A,C,H)	LES cons demand by hhd h for home commodity c fr act a
INVDEM(C)	fixed investment demand
GOVDEM(C)	government consumption demand
EGDEF	total government expenditures
YGDEF	total government income

*System constraint block====================================

FACEQUIL(F)	factor market equilibrium
CURACCBAL	current account balance (of RoW)
GOVBAL	government balance
TINSDEF(INS)	direct tax rate for inst ins
MPSDEF(INS)	marg prop to save for inst ins
SAVINVBAL	savings-investment balance
TABSEQ	total absorption
INVABEQ	investment share in absorption
GDABEQ	government consumption share in absorption
OBJEQ	Objective function

*NEW============================

COMEQUIL(C)	composite commodity market equilibrium
PETROLEFF1(A)	fuel efficiency equation for crude oil and energy industries
FUELEFF1(A)	energy efficiency equation for crude oil and energy industries

PETROLEFF2(A) fuel efficiency equation for non-oil and non-energy industries
FUELEFF2(A) energy efficiency equation for non-oil and non-energy industries

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*===================
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***EQUATION DEFINITIONS[28]

```
*Notational convention inside equations:
*Parameters and "invariably" fixed variables are in lower case.
*"Variable" variables are in upper case.

*Price block==============================================

 PMDEF(C)$CM(C)..
  PM(C) =E= pwm(C)*(1 + tm(C))*EXR + SUM(CT, PQ(CT)*icm(CT,C));

 PEDEF(C)$CE(C)..
  PE(C) =E= pwe(C)*(1 - te(C))*EXR - SUM(CT, PQ(CT)*ice(CT,C));

 PDDDEF(C)$CD(C).. PDD(C) =E= PDS(C) + SUM(CT, PQ(CT)*icd(CT,C));

 PQDEF(C)$(CD(C) OR CM(C))..
 PQ(C)*(1 - tq(c))*QQ(C) =E= PDD(C)*QD(C) + PM(C)*QM(C);

 PXDEF(C)$CX(C)..  PX(C)*QX(C) =E= PDS(C)*QD(C) + PE(C)*QE(C);

 PADEF(A)..  PA(A) =E= SUM(C, PXAC(A,C)*theta(A,C));



 CPIDEF..  CPI =E= SUM(C, cwts(C)*PQ(C)) ;

 DPIDEF..  DPI =E= SUM(CD, dwts(CD)*PDS(CD)) ;

*NEW====================


 PINTADEF1(A)$(AOI(A) OR AFU(A)).. PINTA(A) =E= SUM(C, PQ(C)*icaa(C,A)) ;

 PINTADEF(A)$ANO(A).. PINTA(A) =E= SUM(CNF, PQ(CNF)*ica(CNF,A)) ;
```

[28] Each equation is demarcated from the next equation by ";" Each individual equation name is followed by "..", after which the equation is defined.

```
PVADEF1(A)$(AFU(A)).. PA(A)*(1-ta(A))*QA(A) =E= PVA(A)*QVA(A) + PINTA(A)*QINTA(A) ;


PFADEF(A)$ANO(A).. PA(A)*(1-ta(A))*QA(A) =E= PFA(A)*QFA(A) + PINTA(A)*QINTA(A) ;


PLUMPADEF(AOI).. (1-ta(AOI))*QA(AOI)*PA(AOI) =E= PLUMPA(AOI)*QLUMPA(AOI)
+sum(FNAT,(WF(FNAT)*SUM(FNATP,QF(FNAT,AOI))));


PVADEF(A)$ANO(A).. PFA(A)*QFA(A) =E= PVA(A)*QVA(A) + PQFUEL(A)*QQFUEL(A) ;

PVVADEF(AOI)..PLUMPA(AOI)*QLUMPA(AOI) =E=
QINTA(AOI)*PINTA(AOI)+PVVA(AOI)*QVVA(AOI) ;

PVADEF2(AOI).. QVA(AOI)*PVA(AOI) =E= sum(F, (WF(F)*QF(F,AOI)));


*======


*Production and trade block===============================


COMPRDFN(A,C)$theta(A,C)..
   QXAC(A,C) + SUM(H, QHA(A,C,H)) =E= theta(A,C)*QA(A) ;

OUTAGGFN(C)$CX(C)..
  QX(C) =E= alphaac(C)*SUM(A, deltaac(A,C)*QXAC(A,C)
                           **(-rhoac(C)))**(-1/rhoac(C));

OUTAGGFOC(A,C)$deltaac(A,C)..
  PXAC(A,C) =E=
  PX(C)*QX(C) * SUM(AP, deltaac(AP,C)*QXAC(AP,C)**(-rhoac(C)) )**(-1)
  *deltaac(A,C)*QXAC(A,C)**(-rhoac(C)-1);

CET(C)$(CE(C) AND CD(C) AND CNO(C))..
   QX(C) =E= alphat(C)*(deltat(C)*QE(C)**rhot(C) +
                 (1 - deltat(C))*QD(C)**rhot(C))**(1/rhot(C)) ;


ESUPPLY(C)$(CE(C) AND CD(C) AND CNO(C))..
  QE(C) =E=  QD(C)*((PE(C)/PDS(C))*
             ((1 - deltat(C))/deltat(C)))**(1/(rhot(C)-1)) ;


CET2(C)$( (CD(C) AND CEN(C)) OR (CE(C) AND CDN(C)) )..
  QX(C) =E= QD(C) + QE(C);
```

```
ARMINGTON(C)$(CM(C) AND CD(C))..
  QQ(C) =E= alphaq(C)*(deltaq(C)*QM(C)**(-rhoq(C)) +
                  (1 -deltaq(C))*QD(C)**(-rhoq(C)))**(-1/rhoq(C)) ;

COSTMIN(C)$(CM(C) AND CD(C))..
  QM(C) =E= QD(C)*((PDD(C)/PM(C))*(deltaq(C)/(1 - deltaq(C))))
                                      **(1/(1 + rhoq(C)));

ARMINGTON2(C)$( (CD(C) AND CMN(C)) OR (CM(C) AND CDN(C)) )..
  QQ(C) =E= QD(C) + QM(C);

QTDEM(C)$CT(C)..
 QT(C) =E= SUM(CP, icm(C,CP)*QM(CP)+ ice(C,CP)*QE(CP)+ icd(C,CP)*QD(CP));



*NEW===========================

CESQFA(A)$ANO(A)..
  QFA(A) =E= alphafa(A)*(deltafa(A)*QVA(A)**(-rhofa(A))
            + (1-deltafa(A))*QQFUEL(A)**(-rhofa(A)))**(-1/rhofa(A)) ;

CESQFAFOC(A)$ANO(A)..
  QVA(A) =E= QQFUEL(A)*((PQFUEL(A)/PVA(A))*(deltafa(A)/
                       (1 - deltafa(A))))**(1/(1+rhofa(A))) ;


LEOAGGINT(A)$(ALEO(A)$(ANO(A) OR AFU(A)))..  QINTA(A) =E= inta(A)*QA(A);


CESCRUDEFOC(FNAT,AOI)..
  QLUMPA(AOI) =E=
QF(FNAT,AOI)*(((WF(FNAT)*wfdist(FNAT,AOI))/PLUMPA(AOI))*(deltavva(AOI)/
                       (1 - deltavva(AOI))))**(1/(1+rhovva(AOI))) ;


LEOAGGFA(A)$(ALEO(A)$(ANO(A)))..  QFA(A) =E= ifa(A)*QA(A) ;


LEOAGGVA1(A)$((ALEO(A))$((AFU(A))))..  QVA(A) =E= iva(A)*QA(A) ;


CESCRUDE(AOI)..  QA(AOI) =E= alphavva(AOI)*(deltavva(AOI)*QlumpA(AOI)**(-rhovva(AOI))
            + (1-deltavva(AOI))*(SUM(FNAT,QF(FNAT,AOI)))**(-rhovva(AOI)))**(-1/rhovva(AOI)) ;


CESVAPRD(A)$(ANO(A) OR AFU(A))..
  QVA(A) =E= alphava(A)*(SUM(F,
                deltava(F,A)*QF(F,A)**(-rhova(A))) )**(-1/rhova(A)) ;
```

```
CESVAFOC(F,A)$(deltava(F,A)$(ANO(A) OR AFU(A)))..
  WF(F)*wfdist(F,A) =E=
  PVA(A)*(1-tva(A))
  * QVA(A) * SUM(FP, deltava(FP,A)*QF(FP,A)**(-rhova(A)) )**(-1)
  *deltava(F,A)*QF(F,A)**(-rhova(A)-1);



 VAPRD1(FNOTNAT,AOI)..
 QF(FNOTNAT,AOI) =E= ivvfa(FNOTNAT,AOI)*QVVA(AOI);


 VAFOC1(AOI)..
 PVVA(AOI) =E= SUM(FNOTNAT, WF(FNOTNAT)*ivvfa(FNOTNAT,AOI)) ;


 INTDEM1(C,A)$(icaa(C,A) AND (AOI(A) OR AFU(A))).. QINT(C,A) =E= icaa(C,A)*QINTA(A);

 INTDEM(CNF,A)$(ica(CNF,A) AND ANO(A)).. QINT(CNF,A) =E= ica(CNF,A)*QINTA(A);



 QLUMPALEO1(AOI)..QVVA(AOI) =E= ivvva(AOI)*QLUMPA(AOI) ;

 QLUMPALEO2(AOI)..QINTA(AOI) =E= ivvint(AOI)*QLUMPA(AOI) ;


 AGGVAOIL(AOI).. QVA(AOI) =E= sum(F, QF(F,AOI));


 CESFUEL(A)$ANO(A)..
  QQFUEL(A) =E= alphafuel(A)
 *(SUM(CF, deltafuel(CF,A)*QQCF(CF,A)**(-rhofuel(A))) )**(-1/rhofuel(A)) ;


 CESFUELFOC(CF,A)$(ANO(A) AND deltafuel(CF,A) AND rhofuel(A))..
  PQ(CF) =E= PQFUEL(A)
  * QQFUEL(A) * SUM(CFP, deltafuel(CFP,A)*QQCF(CFP,A)**(-rhofuel(A)) )**(-1)
  *deltafuel(CF,A)*QQCF(CF,A)**(-rhofuel(A)-1);


 ESUPPLY1(C)$(CE(C) AND CD(C) AND CO(C))..
  PE(C) =E= PDS(C);


 CET3(C)$(CE(C) AND CD(C) AND CO(C))..
   QX(C) =E= alphat(C)*(deltat(C)*QE(C)**1 +
                  (1 - deltat(C))*QD(C)**1)**(1/1);


*==========================================
```

```
*Institution block =========================================

 YFDEF(F)..  YF(F) =E= SUM(A, WF(F)*wfdist(F,A)*QF(F,A));

 YIFDEF(INSD,F)$shif(INSD,F)..
  YIF(INSD,F) =E= shif(INSD,F)*((1-tf(f))*YF(F) - trnsfr('ROW',F)*EXR);

 YIDEF(INSDNG)..
  YI(INSDNG) =E=
   SUM(F, YIF(INSDNG,F))  + SUM(INSDNGP, TRII(INSDNG,INSDNGP))
   + trnsfr(INSDNG,'GOV')*CPI + trnsfr(INSDNG,'ROW')*EXR;

 TRIIDEF(INSDNG,INSDNGP)$(shii(INSDNG,INSDNGP))..
  TRII(INSDNG,INSDNGP) =E= shii(INSDNG,INSDNGP)
         * (1 - MPS(INSDNGP)) * (1 - TINS(INSDNGP))* YI(INSDNGP);

 EHDEF(H)..
  EH(H) =E= (1 - SUM(INSDNG, shii(INSDNG,H))) * (1 - MPS(H))
                                  * (1 - TINS(H)) * YI(H);

 HMDEM(C,H)$betam(C,H)..
   PQ(C)*QH(C,H) =E=
    PQ(C)*gammam(C,H)
       + betam(C,H)*( EH(H) - SUM(CP, PQ(CP)*gammam(CP,H))
                   - SUM((A,CP), PXAC(A,CP)*gammah(A,CP,H))) ;

 HADEM(A,C,H)$betah(A,C,H)..
   PXAC(A,C)*QHA(A,C,H) =E=
     PXAC(A,C)*gammah(A,C,H)
            + betah(A,C,H)*(EH(H) - SUM(CP, PQ(CP)*gammam(CP,H))
                  - SUM((AP,CP), PXAC(AP,CP)*gammah(AP,CP,H))) ;

 INVDEM(C)$CINV(C)..  QINV(C) =E= IADJ*qbarinv(C);

 GOVDEM(C)..  QG(C) =E= GADJ*qbarg(C);

 YGDEF..
   YG =E= SUM(INSDNG, TINS(INSDNG)*YI(INSDNG))
        + SUM(f, tf(F)*YF(F))
        + SUM(A, tva(A)*PVA(A)*QVA(A))
        + SUM(A, ta(A)*PA(A)*QA(A))
        + SUM(C, tm(C)*pwm(C)*QM(C))*EXR
        + SUM(C, te(C)*pwe(C)*QE(C))*EXR
        + SUM(C, tq(C)*PQ(C)*QQ(C))
        + SUM(F, YIF('GOV',F))
        + trnsfr('GOV','ROW')*EXR;

 EGDEF..
   EG =E= SUM(C, PQ(C)*QG(C)) + SUM(INSDNG, trnsfr(INSDNG,'GOV'))*CPI;
```

```
*System constraint block=================================

 FACEQUIL(F)..  SUM(A, QF(F,A)) =E= QFS(F);

 CURACCBAL..
  SUM(C, pwm(C)*QM(C)) + SUM(F, trnsfr('ROW',F)) =E=
  SUM(C, pwe(C)*QE(C)) + SUM(INSD, trnsfr(INSD,'ROW')) + FSAV;

 GOVBAL.. YG =E= EG + GSAV;

 TINSDEF(INSDNG)..
  TINS(INSDNG) =E= tinsbar(INSDNG)*(1 + TINSADJ*tins01(INSDNG))
                 + DTINS*tins01(INSDNG);

 MPSDEF(INSDNG)..
  MPS(INSDNG)  =E= mpsbar(INSDNG)*(1 + MPSADJ*mps01(INSDNG))
                 + DMPS*mps01(INSDNG);

 SAVINVBAL..
   SUM(INSDNG, MPS(INSDNG) * (1 - TINS(INSDNG)) * YI(INSDNG))
    + GSAV + FSAV*EXR =E=
   SUM(C, PQ(C)*QINV(C)) + SUM(C, PQ(C)*qdst(C)) + WALRAS;

 TABSEQ..
  TABS =E=
   SUM((C,H), PQ(C)*QH(C,H)) + SUM((A,C,H), PXAC(A,C)*QHA(A,C,H))
  + SUM(C, PQ(C)*QG(C)) + SUM(C, PQ(C)*QINV(C)) + SUM(C, PQ(C)*qdst(C));

 INVABEQ.. INVSHR*TABS =E= SUM(C, PQ(C)*QINV(C)) + SUM(C, PQ(C)*qdst(C));

 GDABEQ..  GOVSHR*TABS =E= SUM(C, PQ(C)*QG(C));

 OBJEQ..   WALRASSQR   =E= WALRAS*WALRAS ;

*NEW=====================



 COMEQUIL(C)..
   QQ(C) =E= SUM(A, QQCF(C,A))+ SUM(A, QINT(C,A))+ SUM(H, QH(C,H)) + QG(C)
              + QINV(C) + qdst(C) + QT(C);



*==============================


*NEW===FUEL AND ENERGY EFFICIENCY=====================
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```
PETROLEFF1(A)$(AOI(A) OR AFU(A))..   PETROLEFF(A) =E=
100*SUM(CPETROL,QINT(CPETROL,A))/QA(A);

FUELEFF1(A)$(AOI(A) OR AFU(A))..       FUELEFF(A) =E= 100*SUM(CF,QINT(CF,A))/QA(A);

PETROLEFF2(A)$(ANO(A))..   PETROLEFF(A) =E= 100*SUM(CPETROL,QQCF(CPETROL,A))/QA(A);

FUELEFF2(A)$(ANO(A))..       FUELEFF(A) =E= 100*SUM(CF,QQCF(CF,A))/QA(A);
```

***********END OF MODEL************

I.10.4 Sensitivity Analysis

Table 8 Varying the Elasticity of Substitution Between Composite Value Added and Composite Fuel Input

Values are presented as percentage changes from base model.

Table 9 Varying the Elasticity of Substitution Between Individual Factors of Production

Values are presented as percentage changes from base model.

I.10.5 Full Social Accounting Matrix[29]

		Commodities						
		agriculture, farming, and forestry	husbandry , poultry and fishery	crude oil and natural gas	mining	electricity	utility gas	water
Production	farming, forestry and horticulture	76202	0	0	0	0	0	0
	husbandry poultry and fishery	0	47373	0	0	0	0	0
	crude oil and natural gas	0	0	179,785	0	0	0	0
	Mining	0	0	0	4820	0	0	0
	food and tobacco	0	0	0	0	0	2	0
	textile, clothing and leather	0	0	0	0	0	0	0
	wooden products and paper	0	0	0	0	0	0	0
	chemical s and plastic	0	0	0	0	6	3	0
	Fuel	0	0	0	0	0	0	0
	non-metal minerals	0	0	0	0	0	0	0
	other industries	0	0	0	0	39	3	0
	water, electricity and gas	0	0	0	0	17141	6512	4299
	construction	0	0	0	0	0	0	0
	wholesale and retail trade	0	0	0	0	0	0	0
	hotels and restaurants	0	0	0	0	0	0	0
	communication and transportation	0	0	0	0	0	0	0
	financial intermediaries	0	0	0	0	0	0	0
	real estate and business services	0	0	0	0	0	0	0
	public services and social security	31	0	0	0	4	0	0
	education	0	0	0	0	0	0	0
	healthcare	5	0	0	0	0	0	0
	others	0	0	0	0	525	0	0

[29]The SAM is presented in order of rows, with the column payments to each row displayed fully before introducing new rows. Hence the row entries for production sectors are given first, followed by the row entries for commodities, etc. Sections of the SAM where by construction no entries occur (e.g. intersection of production rows and institution's columns) are omitted. For a general outline of the structure of the SAM see the diagram presented in section I.2. Values are presented in billions of Rials.

		Commodities								Total
		transportation and storage	communication	financial intermediaries	insurance	real estate	business services	public services and social security	other social services	
Production	farming, forestry and horticulture	0	0	0	0	0	183	0	0	76470
	husbandry poultry and fishery	0	0	0	0	0	171	0	0	54479
	crude oil and natural gas	0	0	0	0	0	0	0	0	179785
	Mining	18	0	0	0	0	59	0	0	4997
	food and tobacco	20	0	0	0	26	212	0	0	76861
	textile, clothing and leather	7	0	0	0	4	68	0	0	42045
	wooden products and paper	2	0	0	0	0	65	0	0	9043
	chemical s and plastic	2	0	0	0	0	82	0	0	34308
	Fuel	0	0	0	0	0	0	0	0	19023
	non-metal minerals	20	0	0	0	9	10	0	0	19558
	other industries	2	0	0	0	3	85	0	0	105403
	water, electricity and gas	0	0	0	0	49	560	0	0	29010
	construction	35	0	0	0	0	0	0	0	81521
	wholesale and retail trade	0	227	0	0	0	0	0	0	134439
	hotels and restaurants	0	52	0	0	0	0	0	0	12838
	communication and transportation	69906	8541	0	0	0	9	0	0	78746
	financial intermediaries	0	0	17838	2178	0	0	0	0	20021
	real estate and business services	0	0	0	0	84472	18362	0	8	103389
	public services and social security	418	0	0	0	0	0	58278	2	59656
	education	0	0	0	0	0	0	0	32579	32716
	healthcare	0	8	0	0	0	7	0	27434	28652
	others	471	278	0	0	1022	0	0	10139	13459

		Production						
		farming, forestry and horticulture	husbandry poultry and fishery	crude oil and natural gas	Mining	food and tobacco	textile, clothing and leather	wooden products and paper
Commodities	agriculture, farming, and forestry	7770	11778	177	3	27701	0	2092
	husbandry , poultry and fishery	62	4253	1	0	16532	6940	224
	crude oil and natural gas	0	0	460	0	0	0	0
	mining	13	23	0	31	27	0	0
	electricity	362	98	109	142	1656	1494	112
	utility gas	4	6	1	1	108	10	21
	water	679	26	29	53	43	13	4
	food , tobacco and textiles	1005	10624	314	178	6915	13716	148
	Industry excluding metal and equipment	5141	1370	1126	308	2427	1025	2219
	lubricant and coke	141	114	19	19	66	24	13
	motor spirit	114	84	9	11	18	8	5
	burning oil	13	16	0	0	17	5	2
	gas oil	332	106	28	56	113	23	10
	fuel oil	0	2	0	2	71	13	6
	liquid gas	7	18	0	1	8	3	0
	other fuels	0	2	7	8	3	2	1
	metal products and equipment	2846	127	557	198	236	151	77
	construction	11	74	8	58	33	10	7
	wholesale and retail trade	0	188	0	0	369	481	231
	repairs and household sales	232	26	2	2	67	28	17
	hotels and restaurants	249	19	31	21	116	46	15
	transportation and storage	57	27	459	151	212	57	32
	communication	10	19	67	11	20	16	18
	financial intermediaries	61	16	2	18	201	63	50
	insurance	14	20	9	3	9	6	4
	real estate	1	14	1	3	65	50	21
	business services	2344	104	27	104	584	252	126
	public services and social security	0	0	0	0	0	0	0
	other social services	640	193	51	67	80	39	23

Commodities	Production: hotels and restaurants	communication and transportation	financial intermediaries	real estate and business services	public services and social security	education	healthcare	others
agriculture, farming, and forestry	1518	192	15	99	313	145	111	21
husbandry , poultry and fishery	1909	0	0	0	92	0	108	0
crude oil and natural gas	0	0	0	0	0	0	0	0
mining	0	0	0	0	22	20	0	0
electricity	23	102	115	190	838	176	206	169
utility gas	10	111	69	19	86	29	87	66
water	7	36	26	53	58	48	53	68
food , tobacco and textiles	1614	621	90	80	1414	254	729	296
Industry excluding metal and equipment	205	5193	484	7082	4544	676	1533	1760
lubricants and coke	1	1050	5	258	8	19	45	16
motor spirit	3	2160	44	17	161	78	52	59
burning oil	6	6	1	4	3	23	17	26
gas oil	8	1075	9	4	34	59	46	44
fuel oil	0	1112	0	0	0	0	0	25
liquid gas	37	3	2	2	21	21	9	19
other fuels	0	0	2	0	4	2	0	5
metal products and equipment	27	2211	0	3076	1996	551	1170	550
construction	8	217	123	1188	132	293	51	76
wholesale and retail trade	0	0	0	0	0	0	0	0
repairs and household sales	33	4820	115	96	505	64	21	58
hotels and restaurants	0	228	40	1	350	165	19	8
transportation and storage	0	3295	83	136	419	251	565	86
communication	14	88	102	395	776	179	92	57
financial intermediaries	76	3877	816	277	228	65	73	69
insurance	6	158	173	141	18	50	61	5
real estate	2	219	46	685	214	485	418	324
business services	3	218	254	542	407	175	97	161
public services and social security	0	200	38	12	931	69	12	17
other social services	8	382	616	252	418	488	892	814

Production

		farming, forestry and horticulture	husbandry poultry and fishery	crude oil and natural gas	Mining	food and tobacco	textile, clothing and leather	wooden products and paper
Transaction Costs	Domestic	0	0	0	0	0	0	0
	Exports	0	0	0	0	0	0	0
	Imports	0	0	0	0	0	0	0
Factors of Production	Skilled Labour	1594	2497	1871	801	3214	2999	838
	Unskilled Laobur	108	169	197	105	113	105	30
	Agricultural labour mixed income	5008	3139	0	0	0	0	0
	Agricultural mixed income land	5009	12554	0	0	0	0	0
	Non agricultrual mixed income	0	0	83	77	1329	4313	664
	Capital	46895	5633	31538	2546	14841	9957	2004
	Crude oil			139957				
Taxes and Subsidies	Imports	0	0	0	0	0	0	0
	Activities	-4252	1141	2645	18	-333	197	29
	Sales	0	0	0	0	0	0	0
	Income	0	0	0	0	0	0	0
Institutions	Household Urban	0	0	0	0	0	0	0
	Household Rural	0	0	0	0	0	0	0
	Private Enterprises	0	0	0	0	0	0	0
	Government Enterprises	0	0	0	0	0	0	0
	Government	0	0	0	0	0	0	0
	Oil Fund							
Savings/ Investment		0	0	0	0	0	0	0
Rest of the World		0	0	0	0	0	0	0
Total		76470	54479	179785	4997	76861	42045	9043

		Production						
		chemical s and plastic	Fuel	non-metal minerals	other industries	water, electricity and gas	construction	wholesale and retail trade
Transaction Costs	Domestic	0	0	0	0	0	0	0
	Exports	0	0	0	0	0	0	0
	Imports	0	0	0	0	0	0	0
Factors of Production	Skilled Labour	3237	802	2874	10476	4140	8858	8952
	Unskilled Laobur	112	28	99	365	359	7443	511
	Agricultural labour mixed income	0	0	0	0	0	0	0
	Agricultural mixed income land	0	0	0	0	0	0	0
	Non agricultrual mixed income	344	0	582	4302	190	8824	22786
	Capital	15747	6059	5461	17674	9338	8831	72844
	Crude oil	0	0					
Taxes and Subsidies	Imports	0		0	0	0	0	0
	Activities	0	440	619	4533	144	1000	2521
	Sales	0		0	0	0	0	0
	Income	0		0	0	0	0	0
Institutions	Household Urban	0		0	0	0	0	0
	Household Rural	0		0	0	0	0	0
	Private Enterprises	0		0	0	0	0	0
	Government Enterprises	0		0	0	0	0	0
	Government	0		0	0	0	0	0
	Oil Fund							
Savings/ Investment		0		0	0	0	0	0
Rest of the World		0		0	0	0	0	0
Total		34308	19023	19558	105403	29010	81521	134439

		Production							
		hotels and restaurants	communication and transportation	financial intermediaries	real estate and business services	public services and social security	education	healthcare	others
Transaction Costs	Domestic	0	0	0	0	0	0	0	0
	Exports	0	0	0	0	0	0	0	0
	Imports	0	0	0	0	0	0	0	0
Factors of Production	Skilled Labour	909	10408	7940	3811	26118	23690	9999	2959
	Unskilled Laobur	49	222	248	173	2333	816	559	303
	Agricultural labour mixed income	0	0	0	0	0	0	0	0
	Agricultural mixed income land	0	0	0	0	0	0	0	0
	Non agricultrual mixed income	957	13383	135	2725	0	356	777	2738
	Capital	5155	25673	8066	81556	17342	3564	10504	2820
	Crude oil								
Taxes and Subsidies	Imports	0	0	0	0	0	0	0	0
	Activities	250	1486	363	515	-129	-95	346	-159
	Sales	0	0	0	0	0	0	0	0
	Income	0	0	0	0	0	0	0	0
Institutions	Household Urban	0	0	0	0	0	0	0	0
	Household Rural	0	0	0	0	0	0	0	0
	Private Enterprises	0	0	0	0	0	0	0	0
	Government Enterprises	0	0	0	0	0	0	0	0
	Government	0	0	0	0	0	0	0	0
	Oil Fund								
Savings/ Investment		0	0	0	0	0	0	0	0
Rest of the World		0	0	0	0	0	0	0	0
Total		12838	78746	20021	103389	59656	32716	28652	13459

		Commodities						
		agriculture, farming, and forestry	husbandry , poultry and fishery	crude oil and natural gas	mining	electricity	utility gas	water
Transaction Costs	Domestic	23268	7368	40	3717	0	0	0
	Exports	1692	104	370	588	0	0	0
	Imports	2419	13	0	440	0	0	0
Factors of Production	Skilled Labour	0	0	0	0	0	0	0
	Unskilled Laobur	0	0	0	0	0	0	0
	Agricultural labour mixed income	0	0	0	0	0	0	0
	Agricultural mixed income land	0	0	0	0	0	0	0
	Non agricultrual mixed income	0	0	0	0	0	0	0
	Capital	0	0	0	0	0	0	0
	Crude oil							
Taxes and Subsidies	Imports	-1002	9	0	95	0	0	0
	Activities	0	0	0	0	0	0	0
	Sales	0	0	-65000	0	0	0	0
	Income	0	0	0	0	0	0	0
Institutions	Household Urban	0	0	0	0	0	0	0
	Household Rural	0	0	0	0	0	0	0
	Private Enterprises	0	0	0	0	0	0	0
	Government Enterprises	0	0	0	0	0	0	0
	Government	0	0	0	0	0	0	0
	Oil Fund							
Savings/ Investment		0	0	0	0	0	0	0
Rest of the World		9687	87	0	895	56	57	0
Total		112302	54954	115195	10555	17771	6577	4299

		Commodities						
		food , tobacco and textiles	Industry excluding metal and equipment	lubricants and coke	motor spirit	burning oil	gas oil	fuel oil
Transaction Costs	Domestic	48012	31216	413	567	508	1352	417
	Exports	4187	2527	320	0	0	0	565
	Imports	2483	7207	361	484	0	0	0
Factors of Production	Skilled Labour	0	0	0				
	Unskilled Laobur	0	0	0				
	Agricultural labour mixed income	0	0	0				
	Agricultural mixed income land	0	0	0				
	Non agricultrual mixed income	0	0	0				
	Capital	0	0	0				
	Crude oil		0	0				
Taxes and Subsidies	Imports	696	4615	13	-2919	0	0	0
	Activities	0	0	0				
	Sales	0	0	0				
	Income	0	0	0				
Institutions	Household Urban	0	0	0				
	Household Rural	0	0	0				
	Private Enterprises	0	0	0				
	Government Enterprises	0	0	0				
	Government	0	0	0				
	Oil Fund							
Savings/ Investment		0	0	0				
Rest of the World		8774	35789	215	4257	0		
Total		190663	169257	5603	8979	1279	3194	4963

		Commodities							
		transportation and storage	communication	financial intermediaries	insurance	real estate	business services	public services and social security	other social services
Transaction Costs	Domestic	0	0	0	0	0	0	0	0
	Exports	0	0	0	0	0	0	0	0
	Imports	0	0	0	0	0	0	0	0
Factors of Production	Skilled Labour	0	0	0	0	0	0	0	0
	Unskilled Laobur	0	0	0	0	0	0	0	0
	Agricultural labour mixed income	0	0	0	0	0	0	0	0
	Agricultural mixed income land	0	0	0	0	0	0	0	0
	Non agricultrual mixed income	0	0	0	0	0	0	0	0
	Capital	0	0	0	0	0	0	0	0
	Crude oil								
Taxes and Subsidies	Imports	0	0	0	0	0	0	0	0
	Activities	0	0	0	0	0	0	0	0
	Sales	0	0	0	0	0	0	0	0
	Income	0	0	0	0	0	0	0	0
Institutions	Household Urban	0	0	0	0	0	0	0	0
	Household Rural	0	0	0	0	0	0	0	0
	Private Enterprises	0	0	0	0	0	0	0	0
	Government Enterprises	0	0	0	0	0	0	0	0
	Government	0	0	0	0	0	0	0	0
	Oil Fund								
Savings/ Investment		0	0	0	0	0	0	0	0
Rest of the World		8494	0	0	1058	0	40	0	341
Total		79395	9106	17838	3236	85585	19913	58278	70503

		Transaction Costs			Factors of Production						
		Domestic	Exports	Imports	Skilled Labour	Unskilled Laobur	Agricultural labour mixed income	Agricultural mixed income land	Non agricultrual mixed income	Capital	Crude oil
Transaction Costs	Domestic				0	0	0	0	0	0	
	Exports				0	0	0	0	0	0	
	Imports				0	0	0	0	0	0	
Factors of Production	Skilled Labour				0	0	0	0	0	0	
	Unskilled Laobur				0	0	0	0	0	0	
	Agricultural labour mixed income				0	0	0	0	0	0	
	Agricultural mixed income land				0	0	0	0	0	0	
	Non agricultrual mixed income				0	0	0	0	0	0	
	Capital				0	0	0	0	0	0	
	Crude oil										
Taxes and Subsidies	Imports				0	0	0	0	0	0	
	Activities				0	0	0	0	0	0	
	Sales				0	0	0	0	0	0	
	Income				0	0	0	0	0	0	
Institutions	Household Urban				107478	8511	0	0	51141	144524	
	Household Rural				32260	6189	8147	17563	13424	50093	
	Private Enterprises				0	0	0	0	0	133338	
	Government Enterprises				0	0	0	0	0	76093	
	Government				0	0	0	0	0	0	139390
	Oil Fund										567
Savings/ Investment					0	0	0	0	0	0	
Rest of the World					2891	315	0	0	0	0	
Total		131344	11319	24859	142629	15015	8147	17563	64565	404048	139957

		Taxes and Subsidies				Institutions					
		Imports	Activities	Sales	Income	Household Urban	Household Rural	Private Enterprises	Government Enterprises	Government	Oil Fund
Transaction Costs	Domestic	0	0	0	0	0	0	0	0	0	
	Exports	0	0	0	0	0	0	0	0	0	
	Imports	0	0	0	0	0	0	0	0	0	
Factors of Production	Skilled Labour	0	0	0	0	0	0	0	0	0	
	Unskilled Laobur	0	0	0	0	0	0	0	0	0	
	Agricultural labour mixed income	0	0	0	0	0	0	0	0	0	
	Agricultural mixed income land	0	0	0	0	0	0	0	0	0	
	Non agricultrual mixed income	0	0	0	0	0	0	0	0	0	
	Capital	0	0	0	0	0	0	0	0	0	
	Crude oil										
Taxes and Subsidies	Imports	0	0	0	0	0	0	0	0	0	
	Activities	0	0	0	0	0	0	0	0	0	
	Sales	0	0	0	0	0	0	0	0		
	Income	0	0	0	0	27353	9687	0	0	0	
Institutions	Household Urban	0	0	0	0	0	0	12157	21309	3912	2
	Household Rural	0	0	0	0	0	0	1616	2154	5276	1
	Private Enterprises	0	0	0	0	0	0	0	0	0	0
	Government Enterprises	0	0	0	0	0	0	792	0	0	0
	Government	7073	11279	-65000	37040	0	0	3928	12948	0	
	Oil Fund										
Savings/ Investment		0	0	0	0	41127	10234	114846	41493	32737	564
Rest of the World		0	0	0	0	29	8	0	696	0	
Total		7073	11279	-65000	37040	349074	136735	133339	78600	146658	567

		Savings/ Investme	Rest of World	Total
Transaction Costs	Domestic	0	0	131344
	Exports	0	0	11319
	Imports	0	0	24859
Factors of Production	Skilled Labour	0	3642	142629
	Unskilled Laobur	0	568	15015
	Agricultural labour mixed income	0	0	8147
	Agricultural mixed income land	0	0	17563
	Non agricultrual mixed income	0	0	64565
	Capital	0	0	404048
	Crude oil			139957
Taxes and Subsidies	Imports	0	0	7073
	Activities	0	0	11279
	Sales	0	0	-65000
	Income	0	0	37040
Institutions	Household Urban	0	40	349074
	Household Rural	0	12	136735
	Private Enterprises	0	1	133339
	Government Enterprises	0	1715	78600
	Government	0	0	146658
	Oil Fund			567
Savings/ Investment		0	-34789	206212
Rest of the World		0	0	128915
Total		206212	128915	

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