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Economic Aspects of Increasing Energy Prices to Border Price Levels in the Islamic Republic of Iran

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Middle East Department

Middle East and North Africa Region

ISLAMIC REPUBLIC OF IRAN

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Table of Contents

List of Tables

ISLAMIC REPUBLIC OF IRAN

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EXECUTIVE SUMMARY

The Government of the Islamic Republic of Iran is considering addressing the significant misalignment between domestic energy prices and their opportunity costs as one of the most important pillars of its economic reforms. This study examines the rationale of the reform, and makes an attempt at a quantitative measurement of the possible micro and macro economic impact of this price adjustment. The study uses an input-output approach to measure, at the sectoral and general level, the price effect of raising energy prices to border prices, and uses the latest household survey to gauge the welfare impact on the different rural and urban income groups. It also presents comparative schemes of partial compensation of the consumers' welfare losses due to this price adjustment, and outlines a schedule of the use of the implied significant fiscal revenues, thus generated, to cover the economic and social costs expected from the implementation of the other planned economic reforms, such as privatization and financial sector reform. The study examines the macro-economic impact on the external balances and also outlines a fiscal framework for a more productive use of the implied fiscal savings.

- Border prices of energy products were used as the benchmark for price adjustment. They represent the opportunity costs of domestic use, since the country does not face an export quota and, on average, produces under its OPEC output quota: any oil and gas quantity that could not be consumed domestically could be exported at the international price.

- Using an average exchange rate of 5,000 rials per dollar, and the prevailing energy prices as of June 1999, the average border energy price, weighted by output shares, is estimated to be around 2.7 times the average domestic price of energy products. Using these border prices, energy subsidies represent about 38 trillion rials, or 9.5 percent of Iran's estimated GDP for the year 1999/2000. Increases in international prices, and/or changes in the nominal exchange rate would proportionately affect this level of subsidies.

- The important fiscal revenues that could be freed by this price adjustment are the main, if not the only, identifiable and feasible source of financial resources that could cover the social and economic costs that would be entailed by the rest of the reforms envisaged by the Iranian Government. This places energy price reform at the top of the reform agenda and indicates that it is a binding constraint in the sequencing of the whole economic reform program in Iran.

- Micro-effects: apart from the energy sectors themselves, only eight of the forty three aggregated sectors of the input-output table would experience price increases of more

than 20 percent. These comprise essentially construction materials (brick, gypsum, and cement), and passenger and merchandise transport.

- The importance of the different goods' price increases on consumers' cost of living depends on the relative shares of these goods in the consumers' budget. The calculations show that, in aggregate, the impact of energy price rises is estimated to add 13 percent to the price level ruling at the beginning of their implementation. This represents also the loss of consumer surplus or increase in the cost of living of a representative household.

- Using the expenditure patterns of the different quintiles of urban and rural households, calculations show that the increase in energy prices would be, without compensating action from the Government, strongly regressive. It shows also that the proportionate burden would be heavier on rural households. The proportionate impact on the poorest rural quintile would be double that of the best off urban quintile.

- External balance effects: on the external balance side, it should be expected that the adjustment in energy prices would be favorable on the trade balance. For exports, while the price increase effect of energy goods should be of limited impact on the costs of exports --due to the limited size of non-oil exports and their low energy intensity-- the volume effect from energy savings could be sizable, both from the consumption substitution effects and the improved industrial energy efficiency, as well as from the potential shift towards more energy efficient technologies. On the import side, the increase in energy prices would translate into an increase in the costs of domestic goods and would contribute to the de-protection of domestic production in favor of competing imported goods. However, this effect should be mitigated by at least two characteristic factors of the Iranian economy: first, sectors that are highly affected by energy price increase are mostly non-tradable sectors; and second, among those impacted tradable sectors, much of the protection lost through higher input costs could be recuperated through an appropriate tariff adjustment, since the average tariff rate in these sectors is significantly low.

- Inflation Effects: there would be a one time impact on the weighted general expenditure price level of about 13 percent for a full adjustment of energy prices to border prices taking into account the parameters mentioned above. If this increase in energy prices were phased in over 3 years, for example, then three successive 4 percent one time impacts on the general price level should be expected for each year. These rates represent an upper bound for the expected impact, since any consumption switching away from the goods with higher prices will tend to reduce their weights and with it the expected overall impact. More importantly, to the extent that part of the subsidies would be saved, the fiscal deficit would be reduced, and with it there would be a better possibility for monetary restraint to exert sustained downward pressure on inflation.

- Fiscal effects: the 9.5 percent of GDP increase in Government revenues, that would result from the increase of energy prices to border prices, would bring the share of Government revenues in total GDP to about 35 percent. At higher oil prices than those prevailing in June 1999, and at the unified exchange rate close to the free market TSE exchange rate planned for March 2000, the share of Government revenues could reach above 45 percent of GDP. This reveals the real atrophy of the size of the Government of the IRI compared to the 25 to 30 percent of GDP shares in comparator oil countries with the same GDP per capita range, and underscores the need for the authorities to formulate a medium term fiscal term strategy to better mange these extra resources, and so lead to a strategic shift toward a more private sector driven economy.

- Use of resources: revenues above the current level of spending could be used towards facilitating such a shift in two ways: Firstly, part of these resources could be used in a clear and enforceable phased way to finance: (a) the *social* and *economic* costs linked to the rise of oil prices itself, including a partial compensation of the consumer for their welfare loss, and, at the level of enterprises, the possibility of financial support to accelerate the technological upgrade towards a more energy efficient production system; and (b) the social and economic costs of the whole reform process, including the reform of the pricing system, privatization, and the reform of the financial sector. The financing for the support to these reforms should involve mainly a phased support to strengthen the overall social safety net system so that it could address the transitory labor layoffs due to privatization and pricing system reform. It should, on the other hand, finance any recapitalization of banks that the financial sector and public enterprise reform may entail.

- Secondly, the remaining part of the resources obtained from energy price adjustment and the incremental resources, that would accumulate as the above transitory expenditures are phased out, should contribute to augmenting public savings in the form of a fiscal surplus. On the one hand, this fiscal surplus would minimize the costly impact of fiscal fluctuations linked to variable oil prices, which are often the origin of disruption of public investment programs, with high costs in terms of investment efficiency, economic growth and employment. On the other hand, these savings could be channeled to the rest of the economy to supplement private savings in the financing of private sector activities.

- Phased social costs compensation scheme: within an integrated program of using the increased Government revenues, the study suggests that approximately 50 percent of the increased revenue could be initially devoted to give rapidly dispersing support to the household sector in compensation for their loss. Three alternative compensation schemes were examined. The first considers the exact compensation for their welfare loss of the lowest three quintiles. The second considers a flat rate compensation for the lowest three quintiles. The third considers a flat rate compensation for all groups of households. These three schemes were then ranked against four criteria that included: (i) social benefits that arise from the redistribution of income and reduction of poverty; (ii) economic benefits that arise from the use of the extra revenues in financing costs of other reforms, and extra public savings; (iii) political support by identifying the gainers and the losers and considering the balance of their political weight in favor or against the energy price reform; and (iv) the ease of the implementation of the scheme.

- Regarding the phasing of the price reform and the compensation process: an arbitrary, but more realistic, phasing process would consist of a three year, equally spread price adjustment period, and a five year span for the implementation of the compensation process. The spread of the price adjustment over three years may be more acceptable to the authorities as it smoothes out the shock and minimizes the risk of pervasive disruption, and, at the same time, allows for the progressive setting up of the accompanying compensation process. The spread of the compensation process over five years includes a two year phase of a flat rate compensation for all, followed by a flat rate compensation targeted for the three poorest quintiles, and thereafter, the consolidation of the transfers specifically related to the impact of energy prices with the general social safety net structure that should be rebuilt by then. The perceived advantages of such a scheme are that: (i) it would be easy to implement rapidly through a voucher system equivalent to what was used before in the 1980s; (ii) it would be an income redistributive scheme because it favors the poor; and (iii) it would have the advantage of deflecting some of the potential discontent of those in the upper classes for whom voice and political weight is generally higher.

A Phased Energy Price Increase and Energy Resources Allocation Scheme (billion rials)

Year	**Revenue**	**Type of Compensation Scheme Used**	**Compensation**	**Additional transfer - other SSN schemes**	**Support for economic costs of reforms (to be specified)**	**Additional potential fiscal savings**
2000-01	12728	Flat compensation for all	6613	2000	1000	3115
2001-02	25457	Flat compensation for all	13226	2500	2000	7731
2002-03	38185	Flat compensation for low 3 Q	12000	6000	5000	15185
2003-04	38185	Flat compensation for low 3 Q	12000	6000	5000	15185
2004-05	38185	Transfer to consolidated SSN	0	15000	1000	31185
2005-06	38185	Transfer to consolidated SSN	0	12000	0	35185

By 2005-06, it is expected that the consolidated allocation to the social safety net would reach about 12,000 billion rials, with the possibility of phasing it out as the reforming of the economy starts to bring better results in terms of growth and employment. Other expenditures in support of the economic costs of the reform process (estimated at 15,000 billion rials over the 5 years reform period) would have been, by then, brought to closure. This should leave about 35,000 billion rials to be shared between fiscal surplus and additional Government public capital accumulation. The authorities clearly need to develop a binding fiscal framework so as to be able to effectively plan and manage these resources

1. Introduction

The Government of the Islamic Republic of Iran is considering the impact on the economy of raising the prices of energy products to cover opportunity costs. For oil and gas products this would imply raising prices to border levels, while for electricity this would imply raising prices to full cost recovery levels. Such a program would have a number of important economic effects which would depend in large part on how the additional revenue to the Government were allocated. Important among these effects would be:

1. Social impacts from the effects of the rise in energy prices on the different income groups of households, which could be mitigated by redistributing part of the increased Government revenue;
2. Sector impacts resulting from the increase in costs and associated reduction in competitivity that this would bring about, via the increases in prices required to cover the increases in costs. Positive sector impacts would come about from the diversion of some of the revenue to supporting improvements in efficiency, via investment in improved technologies etc;
3. Further cost and price impacts arising from the reaction of wages and the cost of capital to the increase in energy prices. These would be affected by Government policy cost of living of households and of support to firms;
4. Macroeconomic effects depending on the allocation of the increased Government revenue – if some of the revenue were left unspent then the budget deficit would be decreased, with consequent reduction effects on the money supply and inflation;
5. Effects on the use of energy resulting from: consumers switching away from energy using end uses as their relative price rose; and the substitution by producers away from the now more expensive energy input to technologies which were less energy intensive. These effects would free more energy products for exports, while also reducing the impacts of the price rises on the household cost of living.

In addition to the above dimensions of an overall strategy concerning energy price increases, the Government would need to consider both the phasing of the increase and the education of the public to the total impacts of all the changes, not just to the increases in energy and other prices resulting from the change.

The mechanism for returning part of the increased Government revenue to consumers, which could include a redistribution effect to the poorer members of society, would depend both on the mechanism available to identify the poor, and on the mechanism available to transfer such resources to the poor. The lower the administrative cost of both identifying and transferring resources the more effective such a policy would be.

In such a program, where there are a number of issues, it is important to keep all aspects in mind in determining overall strategy for handling the proposed changes. This paper sets a framework for considering the issue of increasing energy prices and also, where possible, attempts a quantification of their potential impacts. This exercise is undertaken both to illustrate the key aspects of the methodology for such an evaluation, but also to give a reference point to the order of magnitude of the problem and how solutions might be tailored to address the crucial issues of energy price reform in Iran.

2. Current and Future Energy Prices

Energy prices in the Islamic Republic of Iran have for several years been below opportunity costs as measured by the border price of the traded items, and the production costs of the non traded items. Such a divergence between domestic prices and opportunity costs creates a welfare loss for the economy[1].

In recent years the Government has increased energy prices somewhat, but they are still very substantially below opportunity costs. Table 1 shows the position from the period 1995/96 to the present day[2] for petroleum products:

The table shows that, despite large domestic percentage increases, petroleum product prices have stayed very low relative to the border prices – gasoline has made the largest move towards closing the gap but even so cost less than half the border price at the beginning of the fiscal year 1999/2000. These price increases have been more rapid than the general price index, but the difference has not until the present been very substantial. The prices for petroleum products will stay fixed throughout the year 1999/2000, while general prices are expected to increase further during the year.

1. Consumers value a marginal barrel of oil (say) priced at existing levels equally to the amount of other goods that such a sum of money would buy. If the marginal barrel of oil were exported (which is possible since Iran has a production quota and not an export quota) then the higher price received would enable more of these other goods to be purchased and given to consumers, thus increasing welfare. Hence the domestic price should be equal to the border price, rather than set equal to production costs or some other value below the border price. The actual allocation of the difference between a sale price based on opportunity costs and the production cost should be determined by the government so as to maximize the overall benefits to the economy.

2. Fiscal year 1995/1996 starts March 21, 1995 and ends March 20, 1996. International prices converted to domestic at a weighted average exchange rate prior to 1997/98, and by 5000 rials/$ exchange rate thereafter. The TSE exchange rate has depreciated to 7,500 rials/$ by end May. The model is linear and changes in exchange rates could be simulated by simple linear projection.

Table 1: Islamic Republic of Iran: Estimated Domestic and International Prices for Petroleum Products

	1995/1996	1996/1997	1997/1998	1998/1999	1999/2000
Domestic prices (Rls/liter)					
Gasoline	100.0	130.0	160.0	200.0	350.0
Kerosene	20.0	30.0	40.0	60.0	100.0
Gas oil	20.0	30.0	40.0	60.0	100.0
Fuel oil	10.0	15.0	20.0	30.0	50.0
International Prices (Rls/liter)					
Gasoline	297.0	413.0	649.2	497.6	738.0
Kerosene	299.0	416.0	653.2	500.7	742.5
Gas Oil	276.0	384.0	603.9	462.9	686.5
Fuel Oil	170.0	236.0	371.5	284.8	422.3
Ratio of Domestic to International Prices(%)					
Gasoline	33.7	31.5	24.6	40.2	47.4
Kerosene	6.7	7.2	6.1	12.0	13.5
Gas Oil	7.2	7.8	6.6	13.0	14.6
Fuel Oil	5.9	6.3	5.4	10.5	11.8
CPI at Year Start	307.5	419.8	492.7	587.9	708.9

Source: Ministry of Oil.

Calculations have been made by the Government as to the level of domestic prices that would be required, at the beginning of the fiscal year 2000/2001, to bring all energy prices up to their opportunity cost based on an exchange rate of 5000 rials/US$. Table 2 compares the actual energy prices in 1994/5, 1999/2000 and the target for the start of 2000/2001 for all products, including gas and electricity. Further changes in the international prices of petroleum products and gas, and of the exchange rate would modify these prices further, and a more rapid rate in domestic inflation during the current year would impact on the electricity price that covers the full costs of production.

Table 2: Proposed Energy Prices at the Beginning of 2000/2001

	94/95	99/00	00/01	% increase in energy prices 99/00 – 00/01
Gasoline (Rls/liter)	50.0	350	750	114%
Kerosene (Rls/liter)	15.0	100	500	400%
Gas Oil (Rls/liter)	10.0	100	500	400%
Fuel Oil (Rls/liter)	5.0	50	300	500%
Electricity (Rls/kWh)	26.5	85	185	118%
Natural Gas (Rls/m3)	12.7	50	180	260%

Source: Ministry of Energy

Table 2 makes clear the great magnitude of the increase in energy prices required to raise them to opportunity costs (electricity prices are based on costs of fuel inputs at their new prices). The average energy price increase contemplated, weighting by output shares shown in table 3 below, is around 270 percent. Such a large increase in prices would also result in a very large increase in government revenue, unless there were dramatic substitution away from energy using goods and energy using technologies. Table 3 shows the domestic consumption of energy products in 1999/2000 and the gain in revenue to the government that would ensure from raising prices to the target levels for 2000/2001 if quantities demanded stayed at 1999/2000 levels:

Table 3: Demands for Energy Products and Increased Government Revenue from the Proposed Price Rise

	Consumption in 1999/2000	Shares of energy in total output*	Revenue from price increase (billions of rials)
Gasoline (billions of liters/year)	12.0	0.72%	4800
Kerosene (billions of liters/year)	10.6	0.24%	4240
Gas Oil (billions of liters/year)	25.0	0.61%	10000
Fuel Oil (billions of liters/year)	15.1	0.41%	3775
Electricity (billion kWh/year)	81.6	0.72%	8165
Natural Gas (billion m3/year)	55.5	0.21%	7215
Total		2.91%	38185

Source: Ministry of Energy.

* Shares of sales in total sales of economy for the year of the input output table.

The total increase in revenue to the Government would be of the order of 9.5 percent of the country's Gross Domestic Product of 401000 billion rials as estimated for 1999/2000 (and a bwer proportion of total sales direct and indirect). It would also be a somewhat smaller percentage of the Gross Domestic Product of 2000/2001 (the year for which the increase is proposed) because of the rise in the current value of GDP during the current year. Everything else being equal, this share is linear to the change in the exchange rate used for the conversion of the boarder price.

A practical difficulty with raising administered prices to border prices levels (the level to which they would automatically adjust in a competitive market) is that the international prices of oil and oil products are highly volatile, exhibiting both seasonal and longer term variations. The government could either try to track these varying prices or could design a scheme in which adjustments were made periodically. Following price changes as rapidly as happens in competitive markets would be unworkable, so some adjustment scheme would be needed. The government would also have to bear in mind that fluctuations in prices would produce fluctuations in budget revenues, which would have substantial impacts on fiscal planning. It would not be sensible to adapt a scheme which would allow price, and hence revenues, to fluctuate too greatly. On the other hand, if there are longer term trends, up or down, in oil prices, then this should be reflected in the domestic price to indicate the increasing or decreasing value of the resource. Many countries have faced similar problems in setting up heritage or revenue funds designed to stabilize the economy's performance in the face of fluctuation natural resource revenues. A common practice has been to base the domestic price on a moving average of past prices, so as to smooth its movements over time. The frequency at which the price is reset then becomes more of an administrative convenience. A key issue is the length of time over which the moving average should be taken. If there is a clear cyclical pattern to prices then the average can be taken over the length of the cycle. Where the cycle is irregular the cycle length may need to be determined by experimenting with simulating the effects on past revenues of using different durations for the average. Seasonal variations can be superimposed on such prices, as is often done with electricity prices by state owned utilities, if the country wishes to reflect international regular seasonal variations.

3. The Impact of Energy Price Increases on the Cost of Living

3.1 The Methodology of Calculating the Impact of Energy Price Increases

The most immediate and publicly visible impact of the proposed increases in energy prices would be on the cost of living for households, who would now find themselves facing increased expenditures on energy goods, and on non-energy goods whose prices had to increase to offset the increase in their energy costs and the other inputs whose costs in turn have been affected by energy price rises. These effects would take time to filter through the economy, with the consumers noticing first the impact effect of the change on energy goods that they themselves purchase (for example electricity). This would be followed by the first round effects of the price rises of goods reflecting their own purchases of energy (for example transport costs affected by fuel price increases). The impact and first round effects on the final prices are together known as the "direct" effect. Finally, there will follow the "indirect" effects where the prices of goods reflect increased costs from the inputs of other goods themselves affected by energy prices (for example processed foodstuffs affected by the increase in transport costs). The prices of all goods could be expected to rise to a greater or lesser extent – the smaller the share of energy used in the production of a consumer good (directly and indirectly) the less the proportionate increase in final prices.

The calculation of the incremental effects on sector prices and the overall cost of living, caused by the proposed increase in energy prices, can in principle be calculated by combining an input output table, which shows the input structure into the production of all final goods, and a consumer expenditure survey, which shows the amounts of each final good purchased by consumers. Ideally, such a calculation should be based on an input output table and a consumer survey both based on the start of the year 2000/2001. Neither of these exist and so calculations must be made on the basis of the most recent available. This injects a degree of imprecision into the results, since both will have changed between the years for which they were compiled and the beginning of 2000/2001. Appendix A describes in detail the theoretical framework used for such a calculation, and the way in which it can be adapted to give estimates of the incremental impact of the energy price changes on the current price levels.

An additional aspect that must be considered is the impact of higher prices on the general cost of factors, particularly the wage rate. To the extent that wages responded to the higher prices, costs of production would rise further, thus pushing the general price level higher, although this effect would certainly take time. The extent to which wages would rise, as households tried to compensate for the increased cost of living, would depend on three important factors:

1. Government policy with respect to wage increases;
2. The extent to which households were compensated by some form of transfer from the higher Government revenues;

3. The incremental effect on the money supply related to the extent to which the Government used part of the revenue to decrease the budget deficit and hence reduce the money supply.

The first two effects would also be reinforced by an effective campaign of public education – if workers understood both that they would be receiving some offsetting compensation, and that the overall aim of the scheme is to improve the longer term growth rate of the economy, they would be more willing to forgo the wage increases they might otherwise have sought.

3.2 Estimated Impact of Energy Price Increases on Other Prices and on the Aggregate Cost of Living

Using the method described in Appendix A, the impact of the energy price changes shown in table 2 are calculated to have, in the absence of any reaction by labor or other factor prices, the effects on the prices of final goods as shown in table 4:

Table 4: Incremental Sector % Price Increases due to Energy Price Changes Implemented at the Start of 2000/2001

Sectors	Incremental Sector Price Increases	Direct Impact	Share of Direct Impact in Total Increase
Farming	3.6%	1.1%	31%
Livestock	4.0%	0.8%	20%
Other agriculture activities	2.2%	0.3%	11%
Mining	6.7%	3.8%	57%
Crude petroleum & natural gas	0.8%	0.5%	67%
Sugar	6.4%	2.5%	39%
Other food industries	6.7%	2.2%	32%
Paper, printing & publishing	8.0%	2.1%	26%
Cement	33.5%	29.7%	89%
Brick	37.6%	30.7%	82%
Gypsum and other minerals	36.3%	29.8%	82%
Glass and glassware	13.3%	9.0%	67%
Other non-metal products	12.3%	5.5%	45%
Textile	7.8%	1.5%	19%
Clothing	7.5%	1.7%	22%
Weaving and leather products	8.0%	2.2%	27%
Rubber & plastic products	13.5%	1.6%	11%
Pharmaceutical products	7.9%	1.3%	16%
Kerosene	400%	400.0%	100%
Fuel oil	500%	500.0%	100%
Gasoline	114.3%	114.3%	100%
Gas oil	400%	400.0%	100%
Liquid gas	10.1%	6.7%	66%
Other materials and chemicals	27.4%	15.7%	58%
Basic metal & steel products	10.6%	3.0%	29%
Copper, aluminum and other metals	13.1%	5.6%	43%
Metal products in construction, etc.	12.9%	3.5%	27%
Industrial machinery	8.3%	1.6%	20%
Radio, TV and other communications	6.2%	1.5%	24%
Motor vehicle equipment	11.9%	4.9%	41%
Other industrial products	6.0%	0.5%	9%
Electricity	117.6%	117.6%	100%
Water	31.0%	26.4%	85%
Natural gas	260.0%	260.0%	100%
Construction	11.7%	4.8%	41%
Trade	7.6%	5.4%	71%
Restaurant	4.6%	0.6%	14%
Hotel and motels	9.9%	6.1%	61%
Load transport	38.3%	34.3%	89%
Passenger transport	24.1%	19.1%	79%
Post and telecommunications	7.7%	5.3%	70%
Other transport and storage	22.6%	18.3%	81%
Other services	4.9%	1.9%	38%

Sources: National Statistical Office of Iran and World Bank Staff Calculations.

Table 4 shows that, apart from the energy sectors themselves, only eight of the forty three sectors would experience price increases of more than 20 percent. They are, in descending order of severity of impact: brick (38%) load transport (38%) gypsum (36%) cement (34%) water (31%) other materials and chemicals (27%) passenger transport (24%) and other transport and storage (23%). Four of these sectors are construction materials which are not purchased directly in substantial quantities by households, but which are important as productive sectors. Importantly, with the exception of chemicals, these are all highly non-tradable sectors so that the balance of trade is unlikely to be affected either by loss of their export markets or by import competition from abroad. The large impact on the transport sector is to be expected, given its heavy use of various fuels. Water and transport costs enter directly into household budgets so that these effects will be easily visible.

The table also shows which goods have a high proportion of direct impact, suggesting that the effects of the energy price increases will be passed on most rapidly into these sectors. Almost without exception, the sectors with the highest incremental price increases also have the largest proportion of direct to indirect cost impacts. For all of the above, except chemicals, around 90% of the impact comes directly from their own use of energy. This contrasts with industries such as textiles and clothing, where only 20% of the final impact of energy price rises would be felt as a direct impact. This suggests that the industries most affected will also be the quickest to feel the effects since so much comes from their direct purchases of energy.

The importance of these different price increases on consumers will depend on the relative shares in their budgets. For those goods which occupy only a small share of the budget, a large price rise will have proportionately less effect than for a good which occupied a larger share. To calculate the impact of these price increases on the total cost of living of households, and on their welfare, expenditure shares are needed. Again, current data are not available so that the most recent information available is utilized. To the extent that budget shares have changed in the interim as relative prices have changed, or for other reasons, the calculation will be only approximate. Appendix B describes how the budget shares were calculated.

Table 5 shows the budget shares in total consumer expenditure of the goods as categorized in the input output table. The shares are taken as in the year of the household survey (1994/1995) and may have changed somewhat since that date, but it is unlikely that there will have been very large shifts in the proportions in the five years since the survey was undertaken.

Table 5: Estimated Levels and Shares of Aggregate Consumer Expenditure on Different Goods (million rials)

	Aggregate Expenditure in 1994/95	Shares in Total Expenditure
Farming	2638506	4.5%
Livestock	1314478	2.3%
Other agriculture activities	144220	0.2%
Mining	3424	0.0%
Crude petroleum & natural gas	0	0.0%
Sugar	559993	1.0%
Other food industries	8699731	14.9%
Paper, printing & publishing	532736	0.9%
Cement	0	0.0%
Brick	0	0.0%
Gypsum and other minerals	0	0.0%
Glass and glassware	90342	0.2%
Other non-metal products	0	0.0%
Textile	435423	0.7%
Clothing	3205410	5.5%
Weaving and leather products	1569996	2.7%
Rubber & plastic products	222803	0.4%
Pharmaceutical products	318224	0.5%
Kerosene	245136	0.4%
Fuel oil	0	0.0%
Gasoline	141023	0.2%
Gas oil	28064	0.0%
Liquid gas	67385	0.1%
Other materials and chemical products	811365	1.4%
Basic metal & steel products	0	0.0%
Copper, aluminum and other basic products	0	0.0%
Metal products in construction etc.	77821	0.1%
Industrial machinery	2554	0.0%
Radio, TV and other communications	237353	0.4%
Motor vehicle equipment	1087707	1.9%
Other industrial products	212039	0.4%
Electricity	518693	0.9%
Water	201154	0.3%
Natural gas	97974	0.2%
Construction	177459	0.3%
Trade	12210552	21.0%
Restaurant	1109473	1.9%
Hotel and motels	253772	0.4%
Load transport	4159166	7.1%
Passenger transport	1294867	2.2%
Post and telecommunications	600770	1.0%
Other transport and storage	3875	0.0%
Other services	14978197	25.7%

Sources: Ministry of Energy, National Statistical Office of Iran and World Bank Staff Calculations

The aggregate shares show that for consumers certain goods/services stand out as occupying a dominant position in the household budgets. Particularly important are: other services (25.7%) trade (21%) other food (14.9%) load transport (7.1%) and clothing (5.5%). It is noticeable that, with the exception of load transport, none of these groups are estimated to face substantial price increases as a result of the energy price rises.

Combining the expenditure shares with the increases in prices brought about by the energy price rises gives an estimate, for the economy as a whole, of the increase in consumer expenditure that would be required to purchase the same quantities of each good as before the price rise. This is in effect the increase in the cost of living for a representative household, and can be taken as the impact on the consumer price index. The calculations show that, in aggregate, the one time impact of the energy price rises is estimated to add 13% to the price level ruling at the beginning of 2000/2001. The percentage increase is also linear to the exchange rate used in the conversion of the boarder prices.

Exchange Rate Effect on Consumer Weighted Price Impact of Adjusting Energy Prices to Boarder Prices

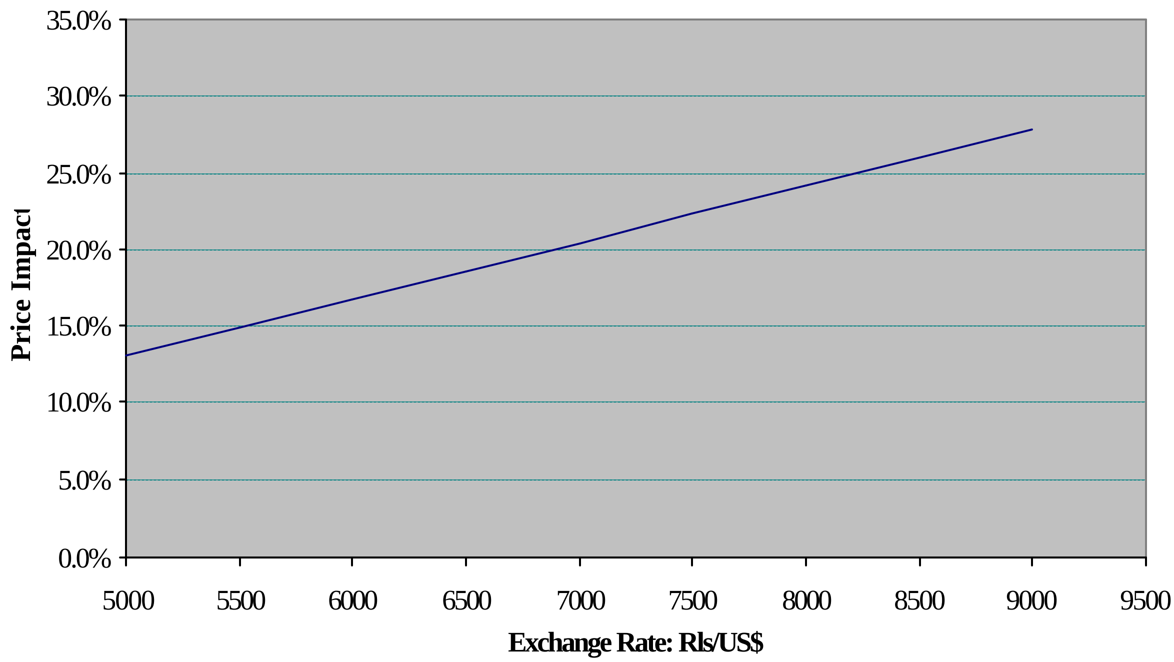

Table 6 shows the contributions of individual goods to this total cost of living increase for households. For example, the expected price increase for farming goods is 3.6%, and farming occupies 4.5% of the total budget of households, so that the contribution to the total cost of living increase of 13% is the product (0.15%) of the these two numbers. The table shows that the combination of the two effects is large for the following items of consumer expenditure: load transport (2.73%) kerosene (1.68%) trade (1.56%) services

(1.19%) electricity (1.00%) and other food (0.97%). Notably, only two of the six energy products directly impact the consumer budget to a significant extent. These six categories above account for 10.9 percentage points out of the 13% average price rise. Consumers will see virtually all the cost of living effects in these six categories of goods – other price rises are significant only in that they are part of the cause of the total rise in the prices of these categories.

Table 6: Estimated Contribution to Increase in Total Household Cost of Living

Farming	0.15%
Livestock	0.09%
Other agriculture activities	0.01%
Mining	0.00%
Crude petroleum & natural gas	0.00%
Sugar	0.06%
Other food industries	0.97%
Paper, printing & publishing	0.07%
Cement	0.00%
Brick	0.00%
Gypsum and other minerals	0.00%
Glass and glassware	0.02%
Other non-metal products	0.00%
Textile	0.05%
Clothing	0.39%
Weaving and leather products	0.20%
Rubber & plastic products	0.05%
Pharmaceutical products	0.04%
Kerosene	1.68%
Fuel oil	0.00%
Gasoline	0.28%
Gas oil	0.19%
Liquid gas	0.01%
Other materials and chemical products	0.34%
Basic metal & steel products	0.00%
Copper, aluminum and other basic products	0.00%
Metal products in construction & manufacturing	0.02%
Industrial machinery	0.00%
Radio, TV and other communicative equipment	0.02%
Motor vehicle equipment	0.21%
Other industrial products	0.02%
Electricity	1.00%
Water	0.10%
Natural gas	0.27%
Construction	0.03%
Trade	1.56%
Restaurant	0.08%
Hotel and motels	0.04%
Load transport	2.73%
Passenger transport	0.53%
Post and telecommunications	0.08%
Other transport and storage	0.00%
Other services	1.19%

Sources: World Bank Staff Estimations

In interpreting the estimated aggregate cost of living increase of 13% several qualifications must be born in mind:

1. The figure assumes that there is no wage or other factor cost increase as a result of this price rise;
2. The figure assumes that expenditure shares are the same as they were at the time of the household survey, and that they would not change as a result of the energy price increase and its impacts on other prices;
3. The increase is treated as if it were a "one shot" change. In practice, the Government is considering phasing in the energy price increases over a number of years, so that the 13 % would be spread over these years.
4. The calculation itself is only approximate since it has to be based on an input output table of 1994/1995. Changes in technology, or in relative factor use due to relative price rises, in the 5-6 year period that has elapsed since the construction of the table, limit the accuracy of the calculation.

A test of sensitivity of the calculations to these assumptions was made by assuming that the wage portion of value added would increase by a fraction of the aggregate price increase brought about by the energy price rises. The degree of "passthrough" is varied from zero (as in the base case) to 100% where wages increase at the same rate as the aggregated price increase. With complete wage passthrough, but with other elements of value added remaining constant, the aggregate price rise would be 17.5%. This figure shows that if the subsequent wage claims can be restrained by Government policies, including the return of some of the revenue to households in some form of assistance, then the total impact on the aggregate price level would be not more than a twenty percent increase.

The impact on the welfare of households of this price increase can be set at an upper limit. With no substitution between goods (zero price elasticity of demand for all goods) the increment in expenditure that would be needed to purchase the same bundle is exactly equal to the increment in money income that would be required to leave households no worse off than they were before the price increases (13% of total household expenditure). This loss of "consumer surplus" would be reduced if consumers actually switched their expenditure patterns towards relatively cheaper goods, and away from those whose prices had risen most rapidly. To estimate such effects it is necessary to have a complete set of price and income elasticities for the set of goods as classified in the input output table. Such information is lacking at present, but in period immediately after the prices would have fully worked their way through the system, the price elasticities would be likely to be small. Over time, as consumers learn to adjust their budgets, and possibly their stock of household goods that use these goods (for example switching to a more energy efficient car when replacement is due) the price elasticities would increase and the loss in welfare would be reduced. This adjustment period could overlap the phasing of price increases so that, by the time of (say) the third staged increase, consumers would be reacting more vigorously to the initial increase so that they would not feel the same welfare loss as would be the case if the full price increase were implemented in a single step.

The percentage welfare loss due to the change in the price of a single good can be approximated by:

$$\Delta CS/Y = b_0 * P * [\ 1 - 0.5* \varepsilon *P\ ] \qquad (1)$$

where:

- ΔCS = change in consumer surplus;
- Y = total initial expenditure;
- P = change in product price relative to its initial level;
- b_0 = initial share of expenditure on the good;
- ε = own price elasticity of demand (positive).

When the elasticity is zero then the percentage change in welfare is equal to the increase in expenditure required to purchase the same quantities divided by the initial expenditure. As the elasticity for the good rises towards unity the loss is welfare is sharply reduced, especially for large price increases.

As shown above in table 6, some six goods will be particularly important in terms of their substitutability, since they have the combination of a large budget share and a high price increase. Among these goods are kerosene and electricity, both of whose price rises relative to other goods, and which occupy a substantial share in the budget. An international study of the demand for fuels[3] suggested that for kerosene, which is purchased directly by households, the long run own price elasticity may be near to unity, while for electricity it is of the order of 0.2. These values support the idea that for these two items, which are purchased directly by consumers, and which will experience among the largest absolute and relative price rises, there can be expected to be some demand switching to relatively cheaper items.

An important consideration for the economy will be the impact of the price increases on the total demand for energy, since any reduction in domestic use will free more for export, and hence improve the balance of payments. If the Government did not return any of its extra revenue to households as income support, and if wages did not rise to compensate for the price increases then the real income of households would decline by around 13%. The impact on energy demand by consumers will then depend on this income effect and on the price effects of the changes in relative prices, of which the energy prices will be the most important.

Evidence for the economy of the Islamic Republic of Iran[4] for broad expenditure groups as shown in table 7 suggests that consumers have income elasticities of around unity for

3. Einar Hope and Balbir Singh: “Energy Price Increases in Developing Countries: Case Studies of Colombia, Ghana, Indonesia, Malaysia, Turkey and Zimbabwe”, Policy Research Working Paper 1442, The World Bank, 1995.

4. Rouyan Mashayekh Ahangarani: “An Almost Ideal Demand System for Iran”, Working Paper, 1999.

broad categories of goods, and also will be moderately sensitive to changes in the relative prices of goods. Hence, in the absence of any of the government revenue being returned to consumers, it can be anticipated that household total consumption of energy could be expected to drop by around 13% after a period of adjustment. To the extent that consumers substituted to other goods with lower price rises (lower direct and indirect energy inputs) there would be further reductions in energy demand. At the same time, the greater the switching from energy intensive products, either directly or indirectly, the less would be the Government revenue from the increased energy prices, but the less would be the need to protect consumers from the welfare losses due to the energy price increases.

Table 7: Income and Own Price Elasticities for Broad Categories of Household Expenditure in the Islamic Republic of Iran

	Food	Clothing	Housing	Furniture	Health	Transport	Recreation	Other
Income	0.82	1.24	1.17	0.95	1.05	1.32	1.54	0.74
Price	-0.65	-0.62	-0.81	-1.01	-0.80	-0.99	-1.02	-1.09

Sources: Rouyan Mashayekh Ahangarani: "An Almost Ideal System for Iran", IRDP, Working Paper, 1999.

3.3 International Experience of the Impact of Energy Price Increases on Subsequent Inflation

Many other countries, including most of the Former Soviet Union and Eastern Europe, have found it necessary to raise energy prices substantially after a period of holding them below border prices or below production costs. For example, a survey[5] in 1994 showed that for several East European countries residential electricity prices had been between 10% (Russia, Ukraine, Bulgaria) and 40-60% (Hungary, Poland, Albania, Czech Republic, Slovakia) of cost recovery levels. Subsequently, these governments have found it necessary to raise electricity prices towards cost recovery levels as the burden of financing the losses out of the central budget became insupportable.

Experience suggests that even large energy price increases have not been associated with substantial increases in the rate of inflation. Table 8 gives actual experience of four developing countries drawn from an *ex post* study[6].

5. Caroline L. Freund and Christine I.Wallich: "Raising Household Energy Prices in Poland: Who Gains? Who Loses?", Policy Research Working Paper 1495, The World Bank, 1995.

6. Einar Hope and Balbir Singh: *ibid*.

Table 8: Energy Price Increases and Change in Aggregate Inflation in Certain Countries

Country	Fuel	Fuel Price Change (%)	Change in Aggregate Inflation*	Fiscal Revenue Impact**	Change in GDP growth rate***
Malaysia	Diesel Kerosene	80.0 69.5	-3.8	2	-3.0
Indonesia	Diesel Kerosene	21.8 23.0	+0.6	18	+1.9
Zimbabwe	Diesel Kerosene	39.7 0.0	-3.2	6	+2.0
Turkey	Diesel Kerosene	33.3 23.5	+16.0	20	+1.3

* Change in annual % inflation rate from two years before the price change to two years after the price change.

** Revenue gains of governments due to energy price rises as % of total central government revenues.

*** Change in aggregate annual growth rate from two years before price change to two years after price change.

The experience of these very diverse developing countries shows that the impact of very substantial energy price increases did not generally lead to an acceleration of the rate of inflation, indeed in three out of the four countries the government was able to reduce or hold constant the rate of overall inflation during the period following the energy price rise. At the same time, three out of the four countries were able to experience an increase in the growth rate (Malaysia dropping from 6.3% to 3.3% per annum). Clearly the inflation rate following the energy price increases depends on overall macroeconomic policy, but the experience of these countries suggests that it has been possible to contain the price shocks while not dampening the rate of growth of GDP via very repressive monetary contractions.

A study[7] of a proposed increase in energy prices for the Egyptian economy came to a similar conclusion. The Egyptian government was considering an 800 percentage increase in energy prices. An independent set of consultants was commissioned by the Egyptian General Petroleum Corporation to make a study of the likely impact on the prices of different sectors in the economy and on various income groups, as well as on different industries. The methodology adopted in that study was similar to that used in this paper, in that it fed the energy prices through an input output table and combined these with expenditure surveys to obtain impacts on the different income groups, while not allowing for any price elasticity of demand for consumers or producers. Considering a planned increase of energy prices of 800 percent, the estimated increment to the consumer price index was 44 percent. By comparison, the 270 percent increase in average energy prices proposed for the Islamic Republic of Iran is estimated to produce

7. DeAnne Julius: "Energy Pricing in Developing Countries: Lessons from the Egypt Study", Energy Department Paper 3, The World Bank, 1981.

an incremental inflation of around 13 percent in the absence of any policy action by the Government to reduce this effect.

3.4 Impact of Energy Price Increases on Different Income Groups

These aggregate expenditure shares and the associated cost of living increase conceal important differences in consumption patterns across income groups. From this it follows that the same sector price rises would have different impacts on rural and urban households, and on higher and lower income households. Using data from the original household expenditure survey, which detailed expenditure for the decile groups of urban and the decile groups of rural households, estimated budget shares of all the commodities included in the input output table for five quintile groups, for each of the urban and rural populations, were calculated. These were combined with the estimated price increase to give a picture of the relative importance of the energy price increases to different groups in the country.

Appendix C gives the expenditure patterns for the urban and rural quintile groups. The tables show that for urban households the shares of items which are dominant in the in the budget also change markedly with income class. The lowest quintile (Q1) spends 28 percent of its budget on other food, while the highest quintile (Q5) spends only 8 percent; other services decline from 39 percent to 27 percent, while trade increases from 1 to 34 percent. Shares of goods whose prices would be greatly affected by energy price rises, such as kerosene and electricity both decline as income rises. These patterns are similar for the rural and urban populations.

The shares of expenditure on direct energy use by the various quintile groups are shown in tables 9A and 9B.

Table 9A: Share of Expenditure on Energy Products in Total Expenditure by Quintile of Rural Households

	Kerosene	Gasoline	Gas Oil	Electricity	Natural Gas
Q1	1.57%	0.21%	0.06%	1.08%	0.35%
Q2	1.30%	0.21%	0.04%	1.09%	0.27%
Q3	1.02%	0.27%	0.06%	0.92%	0.41%
Q4	0.90%	0.29%	0.07%	0.93%	0.36%
Q5	0.44%	0.17%	0.06%	0.44%	0.22%
All	0.73%	0.21%	0.06%	0.68%	0.28%

Table 9B: Share of Expenditure on Energy Products in Total Expenditure by Quintile of Urban Households

	Kerosene	Gasoline	Gas Oil	Electricity	Natural Gas
Q1	0.72%	0.16%	0.02%	1.22%	0.16%
Q2	0.60%	0.20%	0.01%	1.15%	0.17%
Q3	0.47%	0.30%	0.03%	1.17%	0.18%
Q4	0.36%	0.30%	0.07%	1.19%	0.15%
Q5	0.11%	0.25%	0.05%	0.75%	0.08%
All	0.30%	0.25%	0.04%	0.97%	0.12%

These tables show that the actual direct shares of energy products in household budgets are all small (households do not purchase fuel oil). Electricity is the most important in general terms, and its share declines only slowly as income rises. Kerosene is more important than electricity for the rural poor, but in both rural and urban areas its share drops rapidly as income rises.

This information on the expenditure patterns of the different income groups can be combined with the estimated prices increases to give the percentage increase in expenditure that would be required to purchase the same quantities of all goods as before the price rise. This gives the maximum value of the loss of consumer surplus expressed as a percentage of total expenditure for each group. Table 10 gives these losses for both urban and rural quintiles.

Table 10: Estimated Percentage Loss of Consumer Surplus for Different Expenditure Groups

	Q1	Q2	Q3	Q4	Q5	Total
Rural	20.5	19.5	18.4	17.4	12.6	15.0
Urban	14.1	14.4	13.3	13.0	10.7	12.0

Source: World Bank Staff estimates

The table shows firstly that the increase in energy prices would be, without compensating action from the Government, strongly regressive. For both rural and urban households, the proportionate loss in welfare due to the higher prices declines sharply as the expenditure level rises. The table also shows that the proportionate burden will be heavier on rural households, both because of their general expenditure level being lower and because of the nature of the goods that they purchase. The proportionate impact on the poorest rural group would be double that of the best off urban quintile. These results can be regarded as fairly robust despite the fact that they are based on survey data, since by splitting groups into quintiles the number of households per group is increased.

The calculations also give an upper bound to the increase in expenditure that would be required for each group to purchase the same quantities of goods. This can serve as a benchmark for any policy of Government assistance to counter some of the effects of the energy price rises. Finally, the estimation of the levels of loss for the different groups combined with estimates of the relative numbers in the rural (38 percent of total households) and urban quintiles, makes it possible to design compensation scheme aimed to ensure that specific proportions of households have a net welfare gain, or a loss no greater than a specified amount. The quantification of such a scheme is described below in section 6.

4. The Impact of Energy Price Increases on Costs for other Final Categories of Aggregate Demand

Although consumption is the single largest component of aggregate demand (63 percent) the other components will also be affected by the rise in energy prices. From the input output table the shares of all inputs to these categories are estimated, and these are combined with the estimated 1999/2000 expenditure levels, and with estimated sector price increases given in table 4, to produce estimated increase in the total input costs (excluding incremental wage and factor costs). Table 11 gives the estimated shares of the components of final demand in GDP for 1999/2000 based on the actual proportions for 1997/1998; the estimated levels of current expenditure for each of these components based on an estimated GDP for 401000 billion rials; the estimated percentage rise in costs for each component based on the above calculation; and hence the increment in expenditure that would be needed to cover these cost increase in the absence of: any switching between inputs to lower energy factors; of any switching to outputs with lower energy requirements; or of any efficiency gains in terms of more effective use of the existing factors of production.

Table 11: Impact of Energy Price Rise on Components of Final Demand (billion rials)

	Private Consumption	Public Consumption	Public Investment	Total Public Demand	Private Investment	Exports	GDP
Shares of components	64%	14.1%	11.1%	25.2%	13.8%	18.4%	100%
Expenditure 99/00	256444	56512	44396	100908	55441	73911	401000
% cost rise	13%	5%	11%	8%	11%	19%	13%
Expenditure increase	33062	2783	4872	7656	6084	13681	52130

Sources: Central Bank of Iran and World Bank Staff calculations.

The impact of the energy price increases on aggregate consumption has been described in section 3. The loss of consumer surplus (33062 billion rials) shows that the households would bear the brunt of the impact of the price rise, in the absence of some form of compensation.

The private sector would find that the costs of investment would increase by around 11 percent if the same volume were to be installed. This increase in costs should form a strong stimulus to improve efficiency, hence both offsetting part of the price rise and saving energy. It is conservatively estimated, that in the absence of specific funding to improve energy efficiency, savings of 5 percent energy use could be obtained, so that investment might face a cost increase of around 6 percent.

The Government sector undertakes both current and capital spending. For the former the increase in costs of purchasing the same physical amounts would rise by only 5 percent, since these tend to have low energy intensity, while the capital items would rise at 11 percent. These together would result in an increased cost of some 7655 billion rials. If the Government is to make the best use of its increased revenue from raising energy prices, it would be essential that it did not use part of it merely to pay its own higher costs. Given the high level of inefficiency in the use of factors in sectors which are subject to neither a "hard budget constraint" nor the discipline of a competitive environment, it should be possible to reduce costs of state activities by this amount without affecting the supply of outputs provided through these current and capital items.

The position of exports is quite distinct. Exports are dominated by crude oil and by refined products. The costs of the latter would rise sharply as a result of the energy price rises. However, since the international price will remain unaffected, the impact will be on the surplus of the sector. The surplus will be reduced but the government revenue from the higher energy price would have risen to offset it. Other export sectors, such as carpets, would be little affected by the rise in energy prices (between 7 and 8 percent cost increase) so that once efficiency gains had entered into the sector or its suppliers, the rise in export prices is likely to be small, and the impact on sales correspondingly small.

5. Macro economic effects of the Proposed energy Price Increases

5.1 Trade and Balance of Payments Effects

On the external balance side, it should be expected that, overall, the adjustment in energy prices would translate into a favorable trade balance effect.

Regarding exports, while there is little price effect due to the limited size of non-oil exports and their low energy intensity, the volume effect from energy savings could, however, be sizable, both from the consumption substitution effects and improved industrial energy efficiency, as well as through the gradual shift to more energy saving technologies (conservation effect). A 1994 World Bank study[8] in cooperation with the GOIRI estimated the industrial energy conservation potential to be close to 30 percent, of which 15 percent could be achieved through low cost energy conservation measures. A conservative estimation of only 5 percent savings on total domestic consumption would yield about 3,000 billion rials, or a 6 percent increase in oil exports.

On the import side, the increase in energy prices would result in an increase in the costs of domestic production and would generally contribute to the de-protection of domestic products and favor competing foreign goods. There are however two characteristics of the Iranian economy that should lessen to a large extent these negative impacts. Firstly, as Table 12 shows, sectors where the cost impact of higher energy prices is most important are mostly non tradable goods. Second, among the highly impacted, highly tradable sectors, outside of the energy sector, much of the protection lost through higher input costs could be recuperated through an appropriate tariff adjustment. The average tariff rate of these sectors varies, indeed, between 4 and 8 percent. These rates are in reality even lower (between 1-2 percent) considering the fact that they are calculated on the basis of the most appreciated exchange rate of 1,750 rials/$, which is less than one quarter of the TSE exchange rate. This underscores the need for considering a reform of the tariff system that harmonizes it with the rest of the reforms of the pricing system, including energy prices and the foreign exchange systems.

8. Islamic Republic of Iran: “An End-Use Energy Efficiency Strategy for Iran”. World Bank Technical Report, January 1994.

Table 12: Cost Increases and the Competitiveness of Industries

Sectors with Highest Energy Cost Impact (12% or more)	Cost Impact (%)	Energy Intensity (Energy cost/ total cost[9])	Tradability Factor (M+X)/Y	Import Substitution Index (imports/final demand)	Net Import Tax Rate
Cement	33%	13.4%	9%	6%	9%
Brick	38%	9.8%	6%	3%	17%
Gypsum and other minerals	36%	9.7%	10%	6%	10%
Glass and glassware	13%	5.3%	11%	9%	13%
Other non-metal products	12%	3.0%	4%	2%	8%
Rubber & plastic products	14%	1.01%	18%	14%	8%
Kerosene	400%	2.7%	41%	41%	0%
Fuel oil	500%	0.8%	84%	0%	??
Gasoline	114%	2.7%	34%	34%	0%
Gas oil	400%	2.8%	49%	49%	0%
Other materials and chemical products	27%	4.1%	57%	45%	4%
Copper, aluminum and other basic products	13%	3.1%	30%	8%	8%
Metal products in construction & manufacturing	13%	2.1%	19%	10%	5%
Motor vehicle equipment	12%	2.2%	40%	38%	8%
Electricity	118%	14.0%	0%	0%	-
Water	31%	12.1%	3%	0%	-
Natural gas	260%	3.3%	39%	0%	-
Load transport	38%	11.6%	11%	2%	-
Passenger transport	24%	6.5%	6%	-	-
Other Transport and Storage	23%	10.5%	3%	-	-

Source: World Bank Staff estimates.

5.2 General Price Level Effects

The calculation above has suggested that the impact on the consumer price index might be of the order of a 13 percent extra increase in the level of prices during 2000/2001 over and above the underlying inflation. If the increase in energy prices were phased in equally over 3 years (say) then each year the inflation rate would be increase by around 4 percent extra. Whether the resulting effect tends to be higher or lower than this "base case" calculation depends on several factors:

1. The magnitude of the input output coefficients at the beginning of 2000/2001. To the extent that industries have improved their energy efficiency since 1994/1995 (when it was very low as documented by the World Bank study mentioned above) the impact of the proposed energy prices rises would be smaller than calculated;
2. The elasticities of demand for various goods. To the extent that consumers switch away from those goods whose prices have risen most and which have a large share in the budget, the weights in the cost of living index are effectively changed, and the impulse to ask for wage rises would be reduced;

9 . Excluding crude petroleum and natural gas.

3. The magnitude of consumer compensation. To the extent that the Government compensates households for the loss in purchasing power, there would be less need to ask for wage rises to compensate, and the less the rate of inflation would be impacted by the wage reaction;
4. The better the public were informed both about the compensation scheme, and about the long term implications for the economy of the results of the general reforms being carried out, which should lead in the medium term to increased growth, the less the wage claims would be;
5. The larger the part of the extra revenue which is not spent by the Government, the lesser the budget deficit, and hence the greater the possibilities of monetary restraint which should exert downward pressure on prices and wages on a sustained manner;
6. Finally and most importantly, there is a risk that the public enterprises with loose budget constraints or easy access to State banks' financing, would not pass through the increase in costs in their final prices. This would lead to the accumulation of fiscal and financial arrears that end up being financed by the budget through increased monetary creation and hence inflation. Furthermore, the authorities might have already factored the potential increase in such prices into the compensation scheme of the social safety net and/or to the enterprises[10].

The experiences referred to in section 3.3 gives confidence to the idea that, with a carefully planned and executed program, the extra impact on prices of a phased introduction should be modest.

5.3 Fiscal Effects

The total increase in Government revenues that would result from the increase of energy prices to their border levels is about 401000 billion rials, or 9.5 percent of GDP. The incremental impact on Government costs of raising energy prices would be about 5 percent for current expenditures and 11 percent of capital expenditures. These impacts should and could be easily absorbed by an active program of public sector efficiency, as potential energy savings should be at least as high within the Government sector as in rest of the economy (see above). How these additional resources could be allocated and used effectively would depend largely on the adoption of a well designed medium term program, with at its heart a medium term fiscal strategy and fiscal discipline framework, without which the extra resources available from the revenue increment could be wasted in unprogrammed spending. Without a program for spending the opportunity of economic support for reform would be lost, and hence future growth would be hindered.

Measured by the proportion of expenditure to GDP (around 25 percent) the actual size of the Government of the IRI corresponds to about the average size of comparator governments in oil and mineral producing economies with similar GDP per head. Raising energy prices to border levels would raise at the same time Government revenues to

10. A monitoring scheme of the financial statements of the major public enterprises in the sectors with the greatest energy intensity use should be monitored on a monthly basis during the process of price reform. These could include the cement factories, aluminum, fertilizer, steel, car industry, etc. This could be extended to monitor the effect of other prices change, such as the exchange rate, etc.

about 35 percent of GDP. The revenues of the Government could reach well beyond 40 percent of GDP in the event of the unification of the exchange rate, when oil revenues would be transmitted to the Government at the market exchange rate, rather than at a fraction of it as of now. This reveals in fact the actual atrophy and inefficiency of the Government sector, and at the same time, when considering the large size of the public sector, the unsustainable state of the crowding-out of the private economy.

The increase in the Government revenues, be it because of the elimination of energy subsidies or other subsidies, should not entail an equivalent increase in the size of the Government. Rather, this should be the opportunity for a strategic shift toward a private sector driven economy. The revenues above the current level of spending should be used as an effective instrument of this shift in two ways. Firstly, part of these resources should be used in a *clear and enforceable phased way* to finance the social and economic costs of the reform process, including the reform of the pricing system, privatization, and the reform of the financial sector (recapitalization of banks). Secondly, the rest of these resources should be made available to the rest of the economy through an increase in public savings (stable but more efficient capital spending, and a substantial budget surplus).

Within a well targeted and designed social safety net, the Government could effectively use an amount equal to up to 6 percent of GDP from the increased revenue to finance support to the poor and those affected by the reform process. Half of this spending (3 percent of GDP) would suffice for the compensation of the lower three quintiles (60 percent) of the urban and rural populations (covering the poor and the lower middle classes) for their welfare loss due to elimination of energy subsidies. The other 3 percent could be used to strengthen the social safety net and the social security system, and would enable the Government to cover the employment costs of privatization.

The Government could also use an amount equal to one percent of GDP to cover the needs for easing the technological upgrading for some energy intensive industries, based on a well designed incentive-based system and, more importantly, to support the much needed reform of the financial sector and the potential fiscal costs of banking restructuring and bank re-capitalization (estimation for these costs could be done within the framework of a proposed study on the reform of the financial sector). Part of the social safety net expenditures, and all expenditures for easing the economic costs of reforms, would be transitory in nature, and should be phased out as the growth process picks up.

The remaining savings (equal to two percent of GDP in the short term and more in the medium run, as the above transitory expenditures were phased out) should contribute to augmenting public savings in the form of fiscal surplus. On the one hand, this fiscal surplus would contribute to eliminating the very costly impact of budget balance fluctuations, which has in the past forced the Government to frequently disrupt public investment programs, with huge costs in terms of investment efficiency, growth and employment. On the other hand, and most importantly, these savings could be channeled as credit to the rest of the economy to supplement private savings in the financing of private sector activities. A necessary condition, to ensure that these resources are optimally allocated to the most competitive and productive activities, is the efficiency of the financial sector itself, and an enforced limitation to the predatory nature of the public and other monopolistic sectors. This underscores the critical importance and urgency of financial sector and privatization reforms.

In the medium term, as transitory expenditures are phased out, the Government could consider the sterilization of part of the saved oil resources, which would ensure better stabilization and contribute to minimizing the negative impact of oil price fluctuations on the economy.

6. A Program of Support to the Household Sector to Partially Compensate for the Impacts of the Energy Price Rises: The Impact on Income Distribution

Section 3 has shown that, in the absence of any offsetting action by the government, the consumer households would experience a 13 percent loss in consumer surplus. This could be partially offset by a program of compensation. The phasing of such a scheme and its long term role in the economy are discussed below in section 7.

The macro economic considerations above suggest that an integrated program of using the increased Government revenues from the energy price increases could initially afford to devote about 50 percent of the increased revenue to give initial support to the household sector. The design of such a program can also be used to support the goals of income redistribution and poverty alleviation. In particular, because the poorest households suffer <u>proportionately</u> more from the price increase, because of their relatively greater use of those goods whose prices rise most, it would be important to ensure that they are protected to the fullest extent possible.

The calculations above show that the increase in Government revenue would be 38185 billions rials, while the initial total loss of consumer surplus would be 33062 billion rials. The more that is returned to households the less would be the loss in consumer welfare, but also the less would be left for the restructuring of the economy which is essential to encourage the long run growth which would lead to all households becoming better off.

The design of the scheme whereby money is returned to households can be adjusted to achieve a combination of goals. A first scheme could have as its aim to exactly compensate a certain proportion of “losers” for the loss in consumer surplus. Typically these will exclude the richer households in society. The scheme would return different amounts to the poorer households, depending on the extent to which they had lost from the price rise, and nothing to households above some cut-off point. Such a method has lower expenditure than others; but achieves income redistribution only through the lowering of the welfare of the richer groups – it does nothing to alleviate poverty. The scheme also requires an effective and low operational cost scheme of identifying the poorer households.

A second scheme would be to return a fixed amount to all households. Depending on the amount of this flat rate compensation, a certain number of households would be no worse off than before, and the poorest would indeed be better off. The scheme is the simplest to operate since its requires no means testing; and it also achieves income redistribution in that the poor are better off than before, while the rich would be somewhat worse off. However, this flat rate scheme would be expensive because of the payments to all households. Reducing the costs by reducing the flat rate would lower the number of households that would be fully compensated and would reduce the element of income redistribution and poverty reduction.

A third scheme would combine elements of the two above. A flat rate compensation would be used for all households up to a certain income level, thus ensuring that they were all at least as well of as before the price rise, but above this there would be no compensation. Such a scheme would, in relative terms, achieve more redistribution at the same flat rate, because of the reduction of the incomes of the richer groups, and would have considerably lower direct costs. It would tend to have higher administrative costs through the need to target the lower income groups.

The advantages and disadvantages of the three schemes are summarized in table 13.

Table 13: Advantages and Disadvantages of Alternative Compensation Schemes

	Social Benefits	Economic Benefits	Political Support	Ease of Implementation
Exact compensation for lowest 3 quintiles	Neutral	Large	Poorest neutral. Richer against.	Low
Flat rate compensation for lowest 3 quintiles	Moderately positive	Large	Poorest for. Richer against.	Medium
Flat rate compensation for all groups	Moderately positive	Small	Poorest for. Richer moderately against.	High

The social benefits are those which arise from the redistribution of income and the reduction of poverty; the economic benefits are those which accrue generally to the economy from the use of the extra Government revenue not returned directly to households to compensate them for part of the energy price rise (some of this could be used for further redistribution through a targeted social safety net); the political support identifies those groups which would gain or lose under the different schemes; and the ease of implementation considers the feasibility and costs of operating each scheme.

Tables 14A and 14 B illustrate a calculation of possible effects based on the three schemes. The urban population is some 62 percent of the total population, so that each quintile contains about 7.5 million people, while each quintile of the rural population contains about 4.6 million people (assuming that household size is equal for urban and rural groups). Scheme 1 is chosen so as to exactly compensate the lowest 3 quintiles of both the rural and urban groups (some 36.6 million people) for the estimated loss of consumer surplus. Scheme 2 is chosen to give a flat rate compensation to all people, regardless of income level, while scheme 3 is designed to give the same flat rate compensation to just the lowest 3 quintiles of both the rural and urban populations. The flat rate is chosen so that the per capita amount for the 61 million population would be about 320,000 rials per annum, equivalent to US$64 at an exchange rate of 5000 rials per dollar.

Table 14A: The Impact on Rural Households of Energy Prices Increases and Compensation Schemes

Quintile Group	Per capita consumer surplus due to pre-reform energy prices (rials)	Consumer surplus for quintile group (billion rials)	Flat rate compensation to quintile group (billion rials)	Net gain to quintile group (billion rials)	Net gain as % of group total expenditure
Q1	164565	757	1508	+751	+20%
Q2	275000	1265	1508	+243	+4%
Q3	374350	1722	1508	-214	-2%
Q4	453910	2088	1508	-580	-5%
Q5	1090435	5016	1508	-3508	-9%
Total	471652	10848	7539	-3308	-5%

Source: World Bank Staff estimates.

Table 14B: The Impact on Urban Households of Energy Prices Increases and Compensation Schemes

Quintile Group	Per capita consumer surplus due to pre-reform energy prices (rials)	Consumer surplus for quintile group (billion rials)	Flat rate compensation to quintile group (billion rials)	Net gain to quintile group (billion rials)	Net gain as % of group total expenditure
Q1	227500	1729	2460	+731	+6%
Q2	379340	2883	2460	-423	-2%
Q3	450130	3421	2460	-961	-4%
Q4	624735	4748	2460	-2288	-6%
Q5	1241315	9434	2460	-6974	-8%
Total	584604	22215	12300	-9915	-5%

Source: World Bank Staff estimates.

The tables show that in absolute terms the richer quintiles benefit to a far greater absolute amount from the existing set of energy prices. The surplus for the highest income group is more than six times that for the poorest group in both rural and urban areas. If energy prices were raised to border prices all the consumer surplus (33063 billion rials) shown in the table would be removed. A scheme of giving each individual an annual sum of about 320000 rials would return 7539 billion rials to the rural area and 12300 billion rials to the urban area, at a total cost to the Government of 19838 billion rials. This would in total compensate for 60 percent of the total household loss of surplus, but would use up 52 percent of the Government's revenue gain, leaving it 18346 billion rials for other purposes. A scheme of non-means-tested compensation would have strong effects on income redistribution and poverty alleviation. The poorest quintile in the urban areas and the poorest two quintiles in the rural areas would be better off than before the rise in energy prices. The richest two quintiles in both urban and rural areas would be noticeably worse off even with the compensation.

The scheme of exact compensation for the poorest three quintiles in both urban and rural areas would cost the Government a sum equal to the households' loss of consumer surplus. This would cost the much smaller sum of 11776 billion rials, leaving the Government 26409 billion rials for other purposes. Such a scheme would leave 60 percent of the population unchanged as regards the rise in energy prices, and 40 percent worse off. The impracticalities of such a means-tested scheme (contingent on income or total expenditure levels) means that a compromise between the two approaches might need to be sought. Such a scheme could give the same flat rate payment (320000 rials) to each person in the lowest three quintiles of both rural and urban groups. This would have a total cost of 11093 billion rials, leaving 26282 to the Government. This scheme costs much the same as exact compensation for the same three quintiles but redistributes within the groups. The poorest receive more than the loss in consumer surplus while those at the upper end of the third quintile will receive less than their loss in consumer surplus. Table 15 summarizes the alternatives. The flat rate schemes do more to reduce the severity of poverty (how far the worst off are below some poverty line) than exact compensation, and may even reduce the incidence of poverty by pulling some people over the poverty threshold by more than compensating those near the threshold for their loss of surplus.

Table 15: Costs and Benefits of Alternative Compensation Schemes (billion rials)

	Non-means-tested flat rate compensation	Flat rate compensation to lowest 3 quintiles	Exact compensation to lowest three quintiles
Cost of compensation	19838	11093	11776
Share of compensation in loss of surplus	60.0%	36%	36%
Revenue remaining to Government	18346	26282	26409
Revenue remaining as share of total revenue from energy price rise	48%	69%	69%

Source: World Bank Staff estimates.

The scheme of using a flat rate for the lowest three quintiles requires some method of identifying the members of such groups, which probably does not exist at present. Exact compensation, with its requirement to means-test all members of society and to return varying amounts to the different members, is probably infeasible. The scheme proposed has three stages:

1. In the first stage, for a period of two years, all persons would receive a flat rate sum. This would be the easiest to administer since all persons have already been identified through ration schemes used earlier. A coupon, redeemable for cash at a bank, for the sum indicated, would be sent to individuals at regular intervals, perhaps quarterly.
2. After two years, in which time a method of targeting those in the lower three quintiles could be evolved, the flat rate sum would be restricted just to these groups. This would free a substantial sum for other purposes. Targeting might have to be carried out on the basis of some indicator known to be strongly correlated with income, since direct income testing would be expensive to carry out.
3. After two more years the compensation specifically related to the impact of energy price rises would be completely removed, but would be replaced by an extensive social safety net which would be designed to explicitly help those who were poorest or had special needs (unemployed, sick etc.). This period would give time to design such a scheme and to identify the individuals in need.
4.

The details of how these schemes would be funded are discussed below in section 7.

7. Phasing

The inter-related phasing of both the increase of the energy prices, and the compensation process may be critical to the efficiency, to political and social acceptance and to the feasibility of the reform of the energy price system.

While one could argue that a one shot adjustment of the energy prices of this amount may introduce a very strong shock to the economy in terms of too sharp an increase in costs and of a one year price jump, and may not allow enough time for the process of adjustment to it; an increase of energy prices spread over a long period may dilute the political will to deal with this problem, perpetuate the distortions and their effects, and hamper the speedy implementation of other reforms that are inter-related to it.

An arbitrary, but realistic, phasing process would consist of a *three year, equally spread, adjustment period*. This would permit time for the rebuilding of the social safety net structure the government intends to undertake, for defining the targeting mechanisms and refining the institutional structure for the delivery mechanisms, and would also provide a critical mass of revenues for its financing. This would lower the cost shock and, at the same time, allow for more progress in the reform of the exchange rate and trade reforms to take place, so as to lessen the effect of the external de-protection of the economy, and smooth the transition from an input-subsidy-based protection system to a tariff and competitive exchange regime based one. This would allow enterprises to adjust their output prices and inventories to the new costs. Finally, this could also allow enterprises to undertake adjustment measures ranging from more efficient energy use to technological substitution and conservation measures[11].

11. A concern with any scheme of preannounced changes in prices stretching over a substantial period is whether it would encourage substantial speculative hoarding towards the end of the first period (say) followed by black-market sales in the second period at a price below the official price for that period but above the price of the first period. Individuals will of course advance their own purchases at the end of the first period in order to stock up, but their capacity to store is not likely to be great. The intervention of “professional” speculators in the strongly administered economy of Iran is likely to be easier to detect and suppress than in a less organized society. The impact of such speculation would be to shift purchases from official suppliers from the second period to the first period, thus reducing the total revenue take of the government, as well as shifting it towards the earlier period. The impact on inflation would actually be to soften the impacts on prices, although this would not be recorded by official statistics.

Table 16: Phased Energy Price Increase and Energy Resources Allocation Scheme (billion rials)

Year	Revenue	Type of Compensation Scheme Used	Compensation	Additional transfer - other SSN schemes	Support for economic costs of reforms (to be specified)	Additional potential fiscal savings
2000-01	12728	Flat compensation for all	6613	2000	1000	3115
2001-02	25457	Flat compensation for all	13226	2500	2000	7731
2002-03	38185	Flat compensation for low 3 Q	12000	6000	5000	15185
2003-04	38185	Flat compensation for low 3 Q	12000	6000	5000	15185
2004-05	38185	Transfer to consolidated SSN	0	15000	1000	31185
2005-06	38185	Transfer to consolidated SSN	0	12000	0	35185

Source: World Bank Staff estimates.

The scheme shown in table 16 allows for a flat compensation for energy prices of about 107,000 rials for each Iranian Citizen in the first year and 214,000 rials in the second year following the energy price increases. This would amount to about 6,600 billion rials in the first year and 13,000 billion in the second year, to which should be added transfers to the general social safety net (SSN) of 2,000 and then 2,500 billion rials. Over the following two years energy compensation of 320,000 rials per person could be targeted to only the lowest three quintiles of the urban and rural population, but still through a flat non-means-tested compensation scheme, while transfers to the rest of the SSN would be increased to 6,000 and then 7,000 billion rials. The energy-price specific compensation scheme should thereafter be consolidated with the general SSN structure, and up to 15,000 billions rials in all could therefore be assigned to this SSN; it could be gradually reduced as growth and employment picked up. This reduction should gradually bring back the level of government expenditure to less than 30 percent of GDP.

The perceived advantages of this proposed scheme are several: (i) it is easy to implement this scheme in a short period of time through a voucher system equivalent to what has been used before, piggybacking on the institutional structures of past experience and minimizing the otherwise high institution building transaction cost; (ii) it is an income redistributive scheme because it favors the poor (see section 6 above); (iii) it has the advantage to deflect the potential discontent of those in the upper classes for whom voice and political weight is generally higher; (iv) this transfer to the rich is further minimized by the progressive increase in energy prices; (v) it allows for time to build and refine the SSN structure; (vi) to further improve the targeting, the authorities could also make an appeal to those in the richer quintiles to voluntarily forego the collection of these vouchers in the benefit of the rest of the SSN. The use of the second phase of the scheme could be bypassed to go directly to the transfer to the general Social Safety Net, if the structures of the SSN institutions were functional by then.

The definitive figure of the resources needed for the SSN is not yet available, and should be defined in the context of the impact as well as the time path of the rest of the reforms, including privatization, but a yearly provisioning of about 16,000 billion rials, over what now exists, could provide a basic SSN and a sufficient cushion against the social costs of the reforms. Once the reform costs were weathered, the cost of the SSN should accordingly go down to the level needed for long term support of targeted groups at need.

The scheme allows also for up to 14,000 billion rials over a four year period for covering other costs of economic reforms that should include as priorities: the budgetary needs for the restructuring of the banking system, and other economic costs of reforms.

The excess of the extra revenue over these expenditures would lead to a budgetary saving which would climb from about 3-4,000 billion rials to about 20,000 billion rials as the SSN expenditures were stabilized and the compensation for transitory economic costs were phased out. Over the next three years, these savings should help bring the budget from a deficit to a balanced status. Beyond 2004, and as efforts were made to bring down the size of expenditures to a normal level of less than 30 percent of GDP, the cumulative flow of these resources would translate into a budget surplus, part of which should be channeled to augment the financing of the private activities, and part of which could form the basis for a stabilization fund.

Table 17: Islamic Republic of Iran: General Government Fiscal Operations (billion rials) 1997/98-2002/03

	Preliminary 1377 1998/99	Budget 1378 1999/2000	Mission 1378 1999/2000	Projected 1379 2000/01	Projected 1380 2001/02	Projected 1381 2002/03
Total revenue	62,616	107,099	103,403	131,232	229,405	277,288
Oil and gas revenue	22,530	36,597	40,943	46,059	112,163	131,197
Revenue from adjusting energy prices				14,128	34,473	54,296
Non-oil revenue	40,086	70,502	62,460	71,045	82,769	91,795
Total expenditure and net lending	85,322	110,982	108,930	139,001	239,560	280,912
Current expenditures	53,825	62,694	63,573	70,780	78,608	87,119
Capital expenditures	17,655	32,823	29,892	40,209	42,691	45,305
Foreign exchange losses	5,176	3,319	3,319	4,248	19,669	2,748
Energy subsidy financed expenditure				10,718	25,318	31,287
Import valuation				-	34,105	35,545
Residual expenditure				0	25,188	64,069
Overall deficit (-) or surplus (+)	-22,706	-3,883	-5,527	-7,769	-10,155	-3,624
Overall deficit (-) or surplus (+)	-6.8%	-1.0%	-1.4%	-1.7%	-1.8%	-0.6%
Financing	22,706	3,883	5,527	7,769	10,155	3,624
Memorandum items						
Nominal GDP (at market prices)	332,680	401,055	401,055	456,185	575,799	630,189

Source: Plan and Budget Organization and World Bank Staff Estimates.

Appendix A: The Calculation of the Effect of Energy Sector Price Increases on the Aggregate Cost of Living

Theoretical Model

Sector prices can be linked to aggregate prices through the medium of an input output table. Using standard notation the relation between outputs and final demand is written:

$$y = A\,y + f \qquad (1)$$

where:

- y = vector of total outputs of the m sectors of the economy;
- f = vector of final demands for each of the m sectors;
- A = m by m matrix relating the amount of sector i used to produce 1 unit of the output of sector j.

The relationship between prices and costs is written:

$$p = A'\,p + v \qquad (2)$$

where:

- p = vector of prices per unit output of the m sectors;
- v = vector of value added per unit output of the m sectors.

Equation (2) expresses the hypothesis that prices are based on a cost plus basis: the price of a good is equal to the sum of the costs of all inputs (price times quantity as shown by the input output table) from other sectors plus value added per unit output. The price is invariant with respect to the level of output, which implies that the wage per unit output, profit per unit output, and net indirect tax per unit output are all constant. This allows final prices to be expressed as a function of the input output coefficients and the value added per unit output coefficients:

$$p = [I - A']^{-1}\,v \qquad (3)$$

The potential removal of energy subsidies on the subset of energy sectors can be treated as the imposition of an indirect tax (or negative subsidy) per unit on these sectors. Through the input output structure this will be immediately passed on into the output prices of these goods; next into the prices of goods which uses energy as a direct input; and from there into goods which use goods which use energy etc.

Equation (3) is the starting point for an investigation into the impact of changes in the unit value added coefficients on final prices. Denoting initial value added coefficients v(0) and final coefficients v(1), and initial output prices p(0) and final output prices p(1), the relationship between the initial shock, via changes in subsidies, and changes in output prices is given by:

$$\Delta p = [I - A']^{-1} \Delta v \tag{4}$$

where:

Δp = vector of changes in output prices;

Δv = vector of changes in value added factors.

The equation above considers all prices as endogenous, so that shocks come through changes in the added value vector.

In a standard input output table the initial set of the prices of each output can be taken to be unity (the inputs to a unit output are expenditures on that input) so that equation (4) also expresses the final price changes as percentage changes relative to the base year. Combining these sector price changes with sector expenditure shares in the aggregate of consumers' budgets gives the increment in aggregate prices (P) which, because the base year aggregate price is normalized to unity (all sector prices being unity) is in fact the increment in the rate of increase in the consumer price index measured relative to the base year:

$$\Delta P = \sum \Delta p_i c_i \tag{5}$$

where:

c_i = share in total expenditure of good i.

In the context of the Iranian economy the analysis has to take a different route because it is proposed that energy prices are raised to equal border prices, and are fixed at that level. This implies that these prices will not further respond to indirect impacts caused by their own changes, unlike the standard case. In the model above, for example, when the price of gasoline is raised to its border price this raises the cost of transport and other goods which are inputs to gasoline production. In the standard formulation this would increase the gasoline price further, because the wages and profits per unit (the value added) are assumed fixed. In the current case it is assumed, for the energy sectors only, that the final price is fixed, so that the surplus per unit decreases as costs increase. This formulation is consistent with the situation where the energy sectors are state enterprises for which the reduced surpluses or increased deficits could be centrally financed. To accommodate this formulation, in which final energy prices are exogenous, and the values added per unit for the non-energy sectors are exogenous, an expanded formulation of the price equation is needed:

$$\begin{bmatrix} pe \\ pn \end{bmatrix} = \begin{bmatrix} Aee' & Aen' \\ Ane' & Ann' \end{bmatrix} * \begin{bmatrix} pe \\ pn \end{bmatrix} + \begin{bmatrix} ve \\ vn \end{bmatrix} \tag{6}$$

where:

pe = prices of energy sectors (exogenous);

pn = prices of non-energy sectors (endogenous);

ve = values added per unit of energy sectors (endogenous);

vn = values added per unit of non-energy sector (exogenous);

Aee = inputs of energy sector to energy output;
Aen = inputs of non-energy sector to energy output;
Ane = inputs of energy sector to non-energy outputs;
Ann = inputs of non-energy sector to non-energy outputs.

Solving for the prices of non-energy outputs gives

$$pn = [I - Ann']^{-1} Ane' pe + [I - Ann']^{-1} vn \quad (7)$$

This equation shows that prices of non-energy sectors depend on the energy sector prices and on the values added in the non-energy sector modified by how these are passed through the relevant portions of the input-output matrix. Hence, as energy prices are altered, the equation for the changes in the levels of non-energy sector prices is:

$$\Delta pn = [I - Ann']^{-1} Ane' \; \Delta pe \quad (8)$$

Since the initial prices in an input output table are all unity, equation (8) also expresses price changes in percentage terms (relative to the base levels of the input output year). The change in non-energy sector prices depends on: the change in energy prices; the magnitude to which energy inputs are used by non-energy outputs; and the extent to which non-energy sector inputs are also used by the non-energy sectors.

From this vector of final prices of the non-energy sector and the final prices for the energy sector, the change in the cost of living (ΔP) relative to the base year from which the changes in energy prices are defined, is:

$$\Delta P = \sum \Delta pn_i cn_i + \sum \Delta pe_i ce_i \quad (9)$$

The initial cost of living is also unity, since it is a weighted average of sector prices in the base year, all of which are unity. Hence, equation (9) is the percentage change in the aggregate cost of living index.

If required, the endogenous changes in the added values per unit of the energy sectors can be found by solving (6) for ve.

The total changes in sector prices can be decomposed into "direct" effects and "indirect" effects. The direct effect on (say) steel is the impact of energy price increases on the output price of steel; in addition to this, the impact of energy prices on transport then leads to a further rise in steel prices etc. The sum of all these second round and third round etc. impacts is the indirect effect of the initial price rise. The sum of direct plus indirect effects is the total impact. From (6) the direct effects on non-energy prices (pdn) can be calculated by:

$$\Delta pdn = Ane' \; \Delta pe \quad (10)$$

These sector prices can be combined with their cost of living weights and the change in energy prices with their cost of living weights to estimate the impact of the first round effects on the aggregate price (Δ Pd); the indirect effect on consumer cost of living can then be obtained by subtracting this figure from the total cost of living (9).

$$\Delta \, Pd = \sum \Delta pdn_i cn_i + \sum \Delta pe_i ce_i \qquad (11)$$

So far the model has assumed that the components of added value are constant, with the exception of the energy sectors where the government can control prices and is willing to accept variable surpluses as costs change. A more general analysis considers a positive link from consumer prices to wages, which hitherto has been assumed to be zero. It is assumed that in each sector, in response to a change in the general cost of living, the wages per unit output of the base period would be increased by a constant fraction (λ) of this increase in the aggregate consumer price index. This passthrough creates a more complex equation for solution as derived below.

The added value of each sector can be split into wage (w) and non-wage (s) elements. It is assumed that the non-wage elements per unit of output continue to be fixed, but that the wage element increases in relation to the aggregate cost of living index. Hence, changes in prices brought about by energy price rises lead to an increase in the overall price level, which then will be passed through to some extent into higher wages. This increase in turn leads to a further rise in output prices of each sector as firms respond to cost changes. This wage-price spiral can be solved for the final prices through the medium of the input output table. The wage passthrough hypothesis is modeled as:

$$w^* = w\,(1 + \lambda\,[P - 1]) \qquad (12)$$

When λ is equal to zero (no passthrough) the adjusted wages (w*) would be the same as the original wages, but as λ tends to unity (complete passthrough) the adjusted wages would increases at the same rate as prices. Since the aggregate price index is a function of all the sector prices, which are in turn affected by energy prices, this implies that wages are endogenous. Substituting for non-energy wages into equation (7) yields a solution for non-energy prices in terms of exogenous factors:

$$pn = [I - Ann' - \lambda wncn']^{-1} [Ane'pe + wn + sn + \lambda wn(ce'pe - 1)] \qquad (13)$$

This equation collapses back to (7) as the passthrough coefficient tends to zero since the sum of the base wage (wn) and surplus (sn) is equal to added value in the non-energy sectors. The level of wages in the energy sector does not affect non-energy prices since they are absorbed into the exogenous energy prices by the endogeneity of the non-wage component. Weighting these prices and the final energy prices gives the cost of living with wage passthrough.

Equation (8), which relates changes in the level of non-energy prices to the changes in the level of energy prices, can also be expressed in percentage changes of both for any base year if the starting price levels for that base year, from which the percentage changes for energy and non-energy prices are to be measured, are known:

$$\text{Since} = Dpn\ \Delta\ pn = Dpn\ [I - Ann']^{-1}\ Ane'\ [Dpe]^{-1}\ Dpe\ \Delta\ pe \qquad (14a)$$

$$\therefore \quad Rpn = Dpn\ [I - Ann']^{-1}\ Ane'\ [Dpe]^{-1}\ Rpe \qquad (14b)$$

where:

Rpn is the vector of percentage changes in non energy prices;
Rpe is the vector of percentage changes in energy prices;
Dpn is a diagonal matrix of the inverse of starting level non-energy prices;
Dpe is a diagonal matrix of the inverse of starting level energy prices.

If all prices have changed equiproportionately between the year of the I/O table and the starting year for the calculation, then all elements of the D matrices are equal and (14b) reduces to (8) expressed as percentage increases relative to the starting year.

Application of Model

In the present case the calculation is made more complex by the fact that energy prices are due to be raised by a large amount on the first day of 2000/2001(March 21, 2000) while the most recent input output table available is based on the year 1994/1995. This presents two difficulties:

(i) the input output and factor use coefficients are likely to have changed in the period between the compilation of the table and the date at which the calculation of the incremental inflation effect must be estimated;
(ii) the incremental costs due to the energy price rises must be compared to the general levels of prices that will rule at the beginning of 2000/2001.

There are two approaches to these problems; both involve approximations of unknown amounts.

<u>Method (a)</u>

This takes the set of prices at the start of the year 2000/2001 to be unity and then considers the impact of the projected percentage prices increases for energy products through the use of equation (8). The calculated increments in sector prices will be equal to their percentage increases because of the initial normalization to unity. This method does not need to know the change in factor prices or factor use coefficients since the date of the input output table because, whatever level they are, their contribution is assumed unchanged during the period of the energy price increment. Also, this method does not require knowledge of sector prices, other than energy prices, at the beginning of 2000/2001. Energy prices, which are needed to calculate the percentage increases contemplated, are known with certainty since they were fixed by decree at the beginning of 1999/2000. The inaccuracies of this method result from the fact that relative prices may have changed since the year of the input output table, so that setting all prices normalized to unity will impose an approximation to the relative importance of given percentage increases as they are passed through the input output structure.

Method (b) of the Ministry of Energy

This method compares two different energy price increases to the base year of the input output table, and calculates the difference in impacts on the initial prices as the increment in costs due to the price rise between 1999/2000 and 2000/2001. Essentially equation (7) is applied at three different times. The true equations can be represented as

$$pn(0) = [I - Ann']^{-1} \; Ane'pe(0) + [I - Ann']^{-1} \; vn(0) \qquad (14a)$$

$$pn(1) = [I - Ann']^{-1} \; Ane'pe(1) + [I - Ann']^{-1} \; vn(1) \qquad (14b)$$

$$pn(2) = [I - Ann']^{-1} \; Ane'pe(2) + [I - Ann']^{-1} \; vn(1) \qquad (14c)$$

where: 0 refers to the base year of the input output table, 1 to the start of 2000/2001 before the new energy prices are imposed, and (2) to 2000/2001 after the energy prices are imposed. The value added per unit changes between the base year and year 1 (reflecting changes in wages and profit margins etc.) but does not change as a result of the energy price rise to be imposed in 2000/2001. Method (a) is designed to avoid the problems introduced by the shifts in value added. Model (b) can be calibrated to past data by allowing for changes in value added and changes in energy prices, and then simulating the overall price index.

The increment in sector prices due to the proposed energy price rise is calculated as the difference in the impact between year 2 and year 0, and between year 1 and year 0 using equation (7) in both cases, with the known increases in energy prices during the two periods (which ignores the changes in values added). In fact, the increments due to the change in the values added cancel out. However, the resulting increases in prices can be interpreted as percentage increases only relative to the price levels of the year of the input output table. To give the percentage rise relative to the price levels at the beginning of 2000/2001 that would result from these increments in sector prices, the changes must be expressed as proportions of these sector prices at the start of 2000/2001 (not of their base levels of unity). Hence any inaccuracy in estimating the opening prices of non-energy goods in 2000/2001 will result in a mis-estimation of the percentage rises in sector prices and the overall cost of living. This figure will depend crucially on the accuracy of the forecasts of all prices of goods and factor prices as at the first day of 2000, excluding the proposed rise in energy prices.

The cost of living index in the middle of the year for which the input output table was constructed (September 1994) was 241, and by March 1999 it had reached 709. By March 2000 it is likely to be around 851, some 3.53 times its level of the base period. Such a figure is not very different from the increase in the average energy price during the same period (electricity rose substantially less). Hence, method (a) which relies only on the fact that relative prices have not changed greatly, is likely to be a satisfactory approximation to the calculation which would be obtained if actual sector prices were available. This is the method which is used for the calculations in the body of this paper.

Appendix B: Constructing of Quintile Expenditure Levels from Household Survey and Input Output Table

From the Household Expenditure Survey (1994) were derived expenditures by urban and rural deciles for the same 43 commodities used in the Input Output table (IO). A program was developed by the Ministry of Energy and the Institute for Research in Planning and Development to map the detailed classification used in the Household Expenditure Survey (HES) into the 43 commodity classification.

To disaggregate by income class and commodity the actual aggregate final private rural and urban consumption, we adopted the following steps:

1. We derived from the HES (urban and rural separately) the table of the shares of expenditure of each decile in total commodity expenditure.

2. We derived from the HES the shares of each commodity in total expenditure for every decile.

3. To derive the IO equivalent tables of the expenditure of each decile in total commodity expenditure, we used the HES-based table and multiplied it by the vector of urban (rural) final private consumption from the IO table.

4. The IO-based table of coefficients of the shares of expenditure per commodity for each household decile were then derived.

5. The same table was derived for quintiles following the same steps by simple addition of deciles two by two.

6. The quintile actual expenditure levels were calculated by using the aggregate figures of the urban (rural) final consumption, by first obtaining the total consumption by commodity by multiplying the actual urban (rural) aggregate private consumption by the vector of shares of each commodity, and then multiplying by the table of coefficient of the shares of expenditure per commodity in each household decile expenditure to get the actual expenditure by decile and by commodity.

Impact of Energy Price Increase on Household Expenditure by Commodity and Quintile:

7. The impact on expenditure of the energy price increase by commodity and class was obtained by multiplying back the vector of the price impacts by the matrix of coefficients calculated above (step 4).

8. To obtain the absolute effects and the welfare losses, we multiplied the matrix of price impact by the vector of actual expenditure by commodity (obtained by multiplying the aggregate figures of urban/rural final consumption by the vector of shares by commodity in total expenditure).

Appendix C: Shares in Total Expenditure by Quintile Groups

(i) Urban Households (quintile 1 is lowest income).

	Q1	Q2	Q3	Q4	Q5
Farming	7%	6%	6%	5%	3%
Livestock	3%	2%	2%	2%	1%
Other agriculture activities	1%	0%	0%	0%	0%
Mining	0%	0%	0%	0%	0%
Crude petroleum & natural gas	0%	0%	0%	0%	0%
Sugar	2%	1%	1%	1%	0%
Other food industries	22%	19%	18%	16%	8%
Paper, printing & publishing	1%	1%	1%	1%	1%
Cement	0%	0%	0%	0%	0%
Brick	0%	0%	0%	0%	0%
Gypsum and other minerals	0%	0%	0%	0%	0%
Glass and glassware	0%	0%	0%	0%	0%
Other non-metal products	0%	0%	0%	0%	0%
Textile	0%	1%	1%	1%	1%
Clothing	3%	5%	6%	6%	5%
Weaving and leather products	2%	2%	2%	3%	2%
Rubber & plastic products	0%	0%	0%	0%	0%
Pharmaceutical products	1%	1%	1%	0%	0%
Kerosene	0.72%	0.60%	0.47%	0.36%	0.11%
Fuel oil	0.00%	0.00%	0.00%	0.00%	0.00%
Gasoline	0.16%	0.20%	0.30%	0.30%	0.25%
Gas oil	0.02%	0.01%	0.03%	0.07%	0.05%
Liquid gas	0.25%	0.16%	0.13%	0.09%	0.03%
Other materials and chemical products	2%	2%	2%	1%	1%
Basic metal & steel products	0%	0%	0%	0%	0%
Copper, aluminum and other basic products	0%	0%	0%	0%	0%
Metal products in construction etc.	0%	0%	0%	0%	0%
Industrial machinery	0%	0%	0%	0%	0%
Radio, TV and other communicative equipment	0%	0%	1%	0%	0%
Motor vehicle equipment	0%	0%	0%	0%	4%
Other industrial products	0%	0%	0%	0%	0%
Electricity	1.22%	1.15%	1.17%	1.19%	0.75%
Water	1%	1%	1%	1%	0%
Natural gas	0.16%	0.17%	0.18%	0.15%	0.08%
Construction	0%	0%	0%	0%	0%
Trade	1%	3%	4%	9%	34%
Restaurant	2%	2%	2%	2%	2%
Hotel and motels	0%	0%	0%	0%	1%
Load transport	7%	10%	7%	7%	5%
Passenger transport	3%	3%	3%	2%	2%
Post and telecommunications	1%	1%	1%	2%	1%
Other transport and storage	0%	0%	0%	0%	0%
Other services	39%	36%	36%	35%	27%

(ii) Rural households

	Q1	Q2	Q3	Q4	Q5
Farming	8%	8%	7%	7%	3%
Livestock	8%	7%	7%	7%	3%
Other agriculture activities	1%	1%	0%	0%	0%
Mining	0%	0%	0%	0%	0%
Crude petroleum & natural gas	0%	0%	0%	0%	0%
Sugar	3%	3%	2%	2%	1%
Other food industries	28%	27%	25%	26%	12%
Paper, printing & publishing	2%	2%	1%	1%	0%
Cement	0%	0%	0%	0%	0%
Brick	0%	0%	0%	0%	0%
Gypsum and other minerals	0%	0%	0%	0%	0%
Glass and glassware	0%	0%	0%	0%	0%
Other non-metal products	0%	0%	0%	0%	0%
Textile	0%	1%	1%	1%	1%
Clothing	3%	5%	7%	9%	6%
Weaving and leather products	2%	3%	3%	4%	3%
Rubber & plastic products	1%	1%	1%	1%	0%
Pharmaceutical products	1%	1%	1%	1%	1%
Kerosene	1.57%	1.30%	1.02%	0.90%	0.44%
Fuel oil	0.00%	0.00%	0.00%	0.00%	0.00%
Gasoline	0.21%	0.21%	0.27%	0.29%	0.17%
Gas oil	0.06%	0.04%	0.06%	0.07%	0.06%
Liquid gas	0%	0%	0%	0%	0%
Other materials and chemical products	3%	3%	2%	2%	1%
Basic metal & steel products	0%	0%	0%	0%	0%
Copper, aluminum and basic products	0%	0%	0%	0%	0%
Metal products in construction etc.	0%	0%	0%	0%	0%
Industrial machinery	0%	0%	0%	0%	0%
Radio, TV and other communications	0%	0%	0%	1%	0%
Motor vehicle equipment	0%	0%	0%	0%	4%
Other industrial products	0%	0%	0%	0%	0%
Electricity	1%	1%	1%	1%	0%
Water	0%	0%	0%	0%	0%
Natural gas	0%	0%	0%	0%	0%
Construction	0%	0%	0%	0%	0%
Trade	0%	0%	5%	0%	45%
Restaurant	2%	2%	2%	3%	2%
Hotel and motels	0%	0%	0%	0%	0%
Load transport	13%	15%	14%	13%	6%
Passenger transport	5%	4%	3%	3%	1%
Post and telecommunications	0%	0%	0%	0%	0%
Other transport and storage	0%	0%	0%	0%	0%
Other services	16%	14%	13%	14%	8%

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