



Compensation Failure Thresholds in Energy Price Reform: Decile Welfare, Transfer Indexation, and Fiscal Dominance in Iran

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Abstract

Energy price reform in Iran may lead to welfare losses among lower expenditure deciles in the absence of a sustainable compensation mechanism, as households differ in their exposure to energy and energy-intensive transportation costs and in the inflation rates they experience. This study evaluates the welfare and distributional consequences of energy price reform and the design of cash compensation using a dynamic framework for welfare and distributional analysis at the expenditure-decile level. The framework distinguishes between the household welfare-exposure base and the fiscal base of price reform. Welfare losses are calculated using a broad basket of energy and energy-intensive transportation expenditures, whereas the capacity to finance compensatory transfers is assessed using a more conservative fiscal base. The results indicate that uncompensated reform generates welfare losses for the bottom 40 percent of the population. Under the dual-base calibration, equal non-indexed transfers and controlled indexation substantially reduce welfare losses but remain insufficient to fully protect the bottom 40 percent under a conservative fiscal base. Full promised indexation may slightly improve welfare among lower deciles but violates the fiscal sustainability constraint. The findings indicate that compensation failure arises from a mismatch between households' welfare burdens and the fiscal revenues available to finance compensatory transfers. Accordingly, energy price reform should be designed as a policy package combining adequate compensation,

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controlled indexation, and sustainable financing rather than implemented as an isolated price increase.

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Introduction

Energy price reform is among the most challenging issues in economic policymaking in Iran. On the one hand, maintaining low energy prices imposes a substantial fiscal burden on the public budget, encourages inefficient consumption, and distorts resource allocation. Evidence from the domestic literature also links subsidized energy pricing to higher consumption, budgetary pressures, and allocative inefficiency. For example, Nazeman and Haghdoost (2012) show that supplying gasoline at subsidized prices has contributed to high gasoline consumption and the associated increase in economic costs. Since energy price reform may have macroeconomic consequences through inflation, the government budget, and monetary variables, in addition to its direct effects on household expenditures, domestic evidence on the effects of oil shocks on inflation and money supply further underscores the need to consider the macroeconomic transmission channels of energy reform. For instance, Mahdavi Adeli et al. (2012) demonstrate that oil price fluctuations can affect macroeconomic variables, including inflation and money supply. The international literature on energy subsidy reform similarly emphasizes the relationship between pricing inefficiencies, fiscal burdens, and distributional effects (International Monetary Fund, 2013; Parry et al., 2021). On the other hand, increases in energy prices can rapidly translate into higher household living costs and impose a greater relative burden on lower expenditure deciles. Therefore, the central question is not simply whether energy prices should be reformed, but how such reforms should be designed so that they are defensible on efficiency grounds without imposing adverse welfare effects on vulnerable groups.

This question becomes particularly relevant when household heterogeneity is taken into account. Although households in lower

expenditure deciles may spend less on energy in absolute monetary terms than those in higher deciles, they generally allocate a larger share of their budgets to household energy, private transportation fuel, and energy-intensive transportation services. Domestic evidence on minimum subsistence expenditure on energy and the distribution of energy subsidies also highlights the need to account for differences across expenditure deciles (Mousavi & Nouri, 2025; Moeini et al., 2025). Consequently, energy price shocks can lead to a more pronounced reduction in purchasing power among lower-decile households. Formulating the problem using a representative household or aggregate indicators may conceal this heterogeneity and result in inadequate compensation mechanisms.

Cash transfers are commonly regarded as the principal instrument for mitigating the adverse effects of energy price reform. However, in an inflationary economy, nominal cash transfers do not necessarily provide sustainable compensation. If transfer amounts are not adjusted to reflect the inflation experienced by households, their real value gradually declines. Accordingly, the literature on subsidy reform and cash transfers in Iran indicates that the welfare and behavioral effects of compensatory payments depend on policy design, the real value of transfers, and their distribution across households (Salehi-Isfahani & Mostafavi-Dehzoeei, 2017; Rafiei et al., 2025). Within this analytical framework, distinguishing between nominal and real transfers, as well as between general indexation and decile-specific indexation, is essential for evaluating the welfare consequences of energy price reform.

Another factor complicating the sustainability of compensation is fiscal dominance. When the government faces budgetary constraints in financing cash compensation, the financing mechanism itself may generate inflationary pressures and erode the real value of the compensatory transfers. This mechanism is consistent with the literature on fiscal dominance and the interaction between fiscal and monetary policies (Leeper, 1991; Sargent & Wallace, 1981; Woodford, 2001). Compensation may therefore fail because of the erosion of its purchasing power, even when payments continue to be made. This paper employs the concept of compensation failure thresholds to explain this situation.

The present study evaluates the welfare consequences of energy price reform in Iran by focusing on three components: decile-level

heterogeneity, transfer indexation, and fiscal dominance. The central research question is which cash compensation design can protect the bottom 40 percent of the population under conditions of expenditure-decile heterogeneity and inflationary pressures, and under what circumstances cash compensation fails. To address this question, the study employs a dynamic framework for assessing welfare and distributional effects across expenditure deciles, incorporating household heterogeneity. Although this framework does not claim to provide a complete general equilibrium solution, it is consistent with the theoretical literature on household heterogeneity and the redistributive transmission channels of economic policies (Auclert, 2019; Kaplan et al., 2018).

The contribution of this paper lies in formulating and integrating three components that are typically examined separately: heterogeneity across expenditure deciles in exposure to energy price shocks, the erosion of the real value of cash transfers in an inflationary environment, and government fiscal constraints on the sustainability of compensation. Accordingly, the study evaluates energy price reform at the expenditure-decile level, subject to a fiscal sustainability constraint, rather than relying on a representative-household framework.

Literature Review

Studies on energy price reform indicate that removing price subsidies has two simultaneous consequences: reducing consumption inefficiencies and fiscal pressures, while increasing the welfare burden on low-income households in the absence of adequate compensation. This duality arises because higher-income households generally receive larger energy subsidies in absolute monetary terms due to their higher absolute energy consumption. However, subsidy removal imposes a greater relative burden on low-income households because energy expenditures account for a larger share of their budgets (International Monetary Fund, 2013; Parry et al., 2021). Energy price reform is therefore simultaneously a welfare, distributional, and fiscal issue.

In the international literature, the success of energy subsidy reform has been linked to institutional design, social acceptance, and compensation mechanisms. Rentschler and Bazilian (2017) demonstrate that fossil fuel subsidy reforms have encountered challenges in many countries due to political economy barriers, energy price conditions, limited implementation progress, and difficulties in securing social acceptance.

Rentschler (2016), examining Nigeria, also shows that the poverty and welfare effects of fuel subsidy reform vary across regions and that uniform nationwide compensation may be insufficient for certain areas. These findings highlight the importance of household heterogeneity and differences in the degree of exposure to energy price shocks.

Studies employing computable general equilibrium models and microsimulation approaches have also shown that energy subsidy reform without appropriate redistribution may exacerbate poverty and inequality. Cockburn et al. (2018), examining Egypt and Jordan, demonstrate that removing energy subsidies can impose a substantial burden on low-income households, whereas redistributing part of the fiscal savings through cash transfers can mitigate adverse distributional effects. Similarly, Schaffitzel et al. (2020), in their study of Ecuador, show that targeted transfers can make energy subsidy reform more socially acceptable while directing the fiscal resources released by subsidy removal toward poorer households. A common conclusion emerging from these studies is that evaluating price reform without considering the design of compensation mechanisms is insufficient for assessing its welfare consequences.

Iran's experience has received particular attention in the international literature because its energy subsidy reform was accompanied by extensive cash transfers. Breton and Mirzapour (2016) show that cash compensation could initially mitigate part of the welfare losses associated with energy consumption subsidy reform, although its sustainability depended on inflationary and fiscal conditions. Zarepour and Wagner (2022) similarly demonstrate that cash transfers in Iran initially generated positive redistributive effects, but inflation and declining purchasing power substantially weakened their protective impact. Solaymani (2021), reviewing studies on energy subsidy reform in Iran, also finds that the effectiveness of reform was more pronounced during the initial years of implementation, whereas incomplete implementation, socioeconomic challenges, and inadequate mechanisms for managing and mitigating adverse effects undermined its sustainability. Iran's experience therefore suggests that the central issue extends beyond whether compensation is provided to whether its real value and fiscal sustainability can be maintained over time.

Several domestic studies have examined the welfare costs and distributional consequences of increases in energy prices. Emamverdi et al. (2011) and Karimi and Emamverdi (2013), using the Almost Ideal

Demand System and the measures of compensating variation and equivalent variation, demonstrate that increases in energy prices impose significant welfare costs on consumers and that compensatory payments are required to restore their initial welfare levels. These studies contribute to the direct measurement of welfare losses but primarily focus on static assessments of welfare costs and compensation amounts, without explicitly incorporating the dynamic erosion of the real value of transfers in an inflationary environment.

Another group of domestic studies has examined the consequences of energy subsidy reform within broader macroeconomic and distributional frameworks. Hazeri Neyri and Hosseini-Nasab (2014), employing a computable general equilibrium model and the Hicksian equivalent variation measure, show that energy subsidy reform reduces the welfare of urban and rural households, with more pronounced welfare losses among lower expenditure deciles, particularly in rural areas, although support packages can offset part of these losses. Sadeghi Hasanvand and Amin Rashti (2020), combining a demand system, welfare indicators, the poverty line, the Gini coefficient, and a threshold model, also demonstrate that energy price adjustments are associated with welfare, poverty, and income distribution, and that improvements in a distributional indicator do not necessarily imply improvements in household welfare. Although these studies are closely related to the present research in their focus on welfare and income distribution, they do not explicitly formulate transfer indexation to decile-specific inflation and fiscal sustainability constraints as mechanisms underlying compensation failure.

More recent domestic studies indicate that energy constitutes part of Iranian households' essential consumption basket and represents an important channel of inequality. Mousavi and Nouri (2025), estimating minimum subsistence requirements for energy commodities, show that energy constitutes an essential component of Iranian households' subsistence consumption basket, making it particularly relevant to assessments of vulnerable households' welfare. Moeini et al. (2025), analyzing the distribution of gasoline subsidies, demonstrate that the benefits of price subsidies are distributed unequally across households. Rafiei et al. (2025), examining the effects of fuel subsidy reform on income distribution, similarly show that fuel subsidy reform may produce asymmetric welfare outcomes across income groups when its distributional consequences are not adequately considered. This

literature reinforces the need for a decile-level approach to energy price reform, although the dynamic sustainability of cash compensation in both welfare and fiscal terms has received comparatively limited attention.

From a theoretical perspective, incorporating household heterogeneity is necessary for analyzing energy price reform. In representative-agent models, the effects of price reform and compensatory transfers are generally assessed through average aggregate welfare. However, such an approach cannot adequately explain why a uniform policy produces different outcomes for lower and higher expenditure deciles. The heterogeneous-agent literature demonstrates that consumption composition, liquidity constraints, income distribution, and differences in inflation exposure can influence the welfare consequences of economic policies (Auclert, 2019; Kaplan et al., 2018). Although the present study does not claim to solve a complete heterogeneous-agent model or a Heterogeneous Agent New Keynesian (HANK) model, it draws on the underlying logic of this literature by incorporating heterogeneity through expenditure deciles, energy-exposure indicators, and decile-specific inflation.

Another theoretical dimension concerns the relationship between fiscal policy, inflation, and the sustainability of compensation. The literature on fiscal dominance indicates that, under government fiscal constraints, fiscal policy can generate inflationary pressures and thereby reduce the purchasing power of compensatory transfers (Leeper, 1991; Sargent & Wallace, 1981; Woodford, 2001). Consequently, the evaluation of cash compensation should not be limited to the existence or nominal amount of payments. It must also examine whether transfers maintain their real value over time and whether their financing path remains sustainable.

A synthesis of the literature suggests that several findings are relatively well established. Higher-income households generally receive larger energy subsidies in absolute monetary terms, whereas subsidy removal may impose a greater relative burden on lower expenditure deciles. Cash transfers can mitigate part of the welfare losses associated with reform, but their effectiveness depends on targeting, payment amounts, and macroeconomic conditions. Moreover, nominal compensation in inflationary economies is vulnerable to erosion in real terms. Nevertheless, the principal gap in the literature concerns the simultaneous integration of these dimensions. Many existing studies either assess the static effects of price reform, examine distributional

consequences without incorporating the dynamic paths of inflation and indexation, or treat fiscal constraints as a general consideration rather than explicitly modeling them as a mechanism of compensation failure. The present study addresses this gap. Its contribution is not limited to demonstrating that uncompensated reform generates welfare losses, a finding already established in the existing literature. Rather, it examines compensation design across expenditure deciles over a dynamic 36-month horizon, distinguishes between nominal cash transfers and transfers indexed to effective decile-specific inflation, incorporates behavioral responses in energy-basket demand into welfare-loss calculations, and treats fiscal sustainability as an active constraint on transfer indexation. Within this framework, compensation failure thresholds are defined as a range of welfare-protective and fiscally sustainable indexation rates rather than a single threshold. This range indicates that compensation may fail either because insufficient indexation erodes the purchasing power of transfers or because excessive indexation, under fiscal dominance, exceeds the limits of fiscal sustainability.

Methods and Material

This study is an applied policy analysis in terms of its objective and employs a dynamic simulation of welfare and distributional effects at the expenditure-decile level. The model does not aim to predict the complete macroeconomic equilibrium path, but rather to evaluate alternative energy price reform scenarios and cash compensation designs for heterogeneous household groups. Accordingly, the framework does not involve a full solution of a dynamic stochastic general equilibrium model or a heterogeneous-agent model. Instead, it adopts a dynamic decile-level framework that simultaneously incorporates three main channels: behavioral responses in energy-basket demand to price increases, erosion of the real value of cash transfers in an inflationary environment, and fiscal sustainability constraints under fiscal dominance.

The primary unit of analysis is the expenditure decile, defined using per capita expenditure. For each decile, C_d denotes its weighted average per capita expenditure. The study adopts a dual-base framework that distinguishes between the household welfare-exposure base and the

fiscal base of price reform. The welfare-exposure base is denoted by E_d^W , while the fiscal reform base is represented by E_d^F . This distinction is necessary because increases in expenditures on purchased transportation services do not necessarily translate entirely into government revenue. Part of these increases may reflect labor costs, depreciation, profit margins, market frictions, or the indirect pass-through of energy prices.

The household welfare-exposure base, E_d^W , is used to calculate welfare losses and, in the main specification, consists of three components. The first is household expenditure on electricity, gas, and other fuels under subgroup 045, including electricity, gas, liquid fuels, and solid fuels. The second is expenditure on fuels and lubricants for personal transport equipment under subgroup 0722. The third is expenditure on purchased transportation services under subgroup 073. In contrast, the fiscal reform base, E_d^F , includes only the portion of expenditure exposure that is converted, either directly or through a specified pass-through coefficient, into revenue available for compensatory payments. In the baseline calibration, the welfare-exposure base is calculated using the broad energy and energy-intensive transportation exposure indicator, whereas the fiscal reform base follows a more restrictive definition. The specification using the broad base is reported as an optimistic case, while the household-energy-only specification is presented in the appendix as a highly conservative robustness test.

Accordingly, the welfare-exposure and fiscal reform bases for expenditure decile d are defined as follows:

$$E_d^W = C_d s_d^W \quad (1)$$

$$E_d^F = C_d s_d^F \quad (2)$$

where s_d^W denotes the energy welfare-exposure share and s_d^F represents the fiscal reform base share for decile d . Data on household expenditures and expenditure composition were obtained from the national Household Income and Expenditure Survey, and decile-level averages were calculated using sample weights (Statistical Center of Iran, 2024). Decile-specific inflation rates were incorporated into the model using the Consumer Price Index for Iranian households disaggregated by expenditure decile (Statistical Center of Iran, 2025). The main analysis reports results on a per capita basis. As a robustness

test, all calculations were repeated using total household expenditure to determine whether the findings depend on the unit of measurement.

Within the model, households are not assumed to respond passively to energy price increases. Instead, they adjust to part of the price shock by reducing consumption of the energy basket. Energy-basket demand is modeled using constant price elasticity for each expenditure decile. If the magnitude of the energy price increase under scenario s is θ_s , the relative energy price rises by a factor of $1 + \theta_s$. The price elasticity of energy demand in decile d is denoted by η_d . Consequently, the ratio of post-reform to pre-reform energy-basket consumption is given by:

$$\frac{Q_{d,s}^1}{Q_d^0} = (1 + \theta_s)^{\eta_d} \quad (3)$$

where Q_d^0 represents energy-basket consumption before the reform and $Q_{d,s}^1$ denotes energy-basket consumption after the reform. Since $\eta_d < 0$, an increase in energy prices reduces energy-basket consumption. Incorporating this behavioral component prevents the burden of price reform from being calculated solely through a mechanical accounting approach.

The direct welfare loss associated with energy price reform for each expenditure decile is derived from the area under the energy-basket demand curve. This loss, which can be interpreted as an approximation of the loss in consumer surplus or the direct compensating variation resulting from the energy price increase, is calculated as follows:

$$L_{d,s} = E_d^W \left[\frac{(1+\theta_s)^{1+\eta_d} - 1}{1+\eta_d} \right] \quad (4)$$

In the special case where $\eta_d = 0$, the expression reduces to the following simple accounting relationship:

$$L_{d,s} = \theta_s E_d^W \quad (5)$$

Thus, the direct welfare-loss formula accommodates both the absence of behavioral responses and adjustments in energy-basket consumption following a price increase within a unified framework. In this study, C_d and E_d^W are defined in terms of monthly household expenditure.

Accordingly, $L_{d,s}$ represents the monthly flow of direct welfare losses for decile d under scenario s , making it directly consistent with the monthly paths of transfers and inflation.

In addition to generating welfare losses, higher energy prices create potential revenue for the government or policymaker. However, under the study's dual-base framework, revenue available for compensation is calculated using the fiscal reform base rather than the entire household welfare-exposure indicator. Accounting for demand responses, the monthly revenue generated by energy price reform for expenditure decile d under scenario s is calculated as:

$$R_{d,s}^F = \theta_s E_d^F (1 + \theta_s)^{\eta_d} \quad (6)$$

Total monthly revenue from energy price reform in each period is obtained by taking the weighted sum of decile-level fiscal revenues. Let ω_d denote the population weight of decile d . Aggregate monthly reform revenue is then expressed as:

$$R_s^F = \sum_d \omega_d R_{d,s}^F \quad (7)$$

In the subsequent model calculations, welfare losses are measured using the welfare-exposure base, E_d^W , whereas revenue available for compensatory transfers is calculated using the fiscal reform base, E_d^F . This distinction prevents the model from overestimating the revenue available to finance compensation.

Cash compensation is characterized by the initial compensation adequacy parameter, λ_s , which represents the share of energy price reform revenue initially allocated to compensatory payments. Under the equal-transfer scenario, initial nominal payments are identical across expenditure deciles. Indexed-transfer scenarios also begin with this allocation rule, but payments are subsequently adjusted over time according to the specified degree of indexation. Indexation quality is represented by q_s , which ranges from zero to one. A value of zero indicates no indexation, while a value of one represents full promised

indexation to effective decile-specific inflation. At the initial stage, nominal compensatory payments are determined by the initial compensation adequacy rate.

Because baseline transfers are allocated equally across expenditure deciles under the compensation scenarios, the initial nominal payment for each decile is calculated as:

$$T_{d,s,1}^{nom} = \frac{\lambda_s R_s^F}{\sum_d \omega_d} \quad (8)$$

where λ_s denotes the initial compensation adequacy rate and R_s^F represents monthly energy price reform revenue calculated using the fiscal reform base. Therefore, total initial nominal transfers equal a share λ_s of the fiscal revenue available from price reform rather than the total welfare burden imposed on households.

The decile-specific price index is updated through each decile's effective inflation rate. Effective decile-specific inflation comprises three components: baseline decile-specific inflation, partial pass-through of the energy price shock to decile-level inflation, and inflationary pressure arising from fiscal financing gaps under fiscal dominance. Let $\pi_{d,t}^0$ denote the baseline monthly inflation rate for decile d in period t , ρ_E the coefficient of energy price shock pass-through to inflation, and ρ_F the coefficient of fiscal gap pass-through to inflation. The effective monthly inflation rate for decile d , scenario s , and period t is defined as:

$$\pi_{d,s,t}^{eff} = \pi_{d,t}^0 + \frac{\rho_E \theta_s s_d}{12} + \pi_{s,t}^F \quad (9)$$

Here, $\pi_{s,t}^F$ represents the fiscal inflation component generated through the fiscal financing gap. Let $G_{s,t}$ denote the period-specific fiscal gap and R_s^F the monthly revenue from energy price reform calculated using the fiscal reform base. The fiscal inflation component is calculated as:

$$\pi_{s,t}^F = \min \left\{ \frac{\rho_F \mu_s}{12} \left(\frac{G_{s,t}}{R_s^F} \right), \pi_F^{max} \right\} \quad (10)$$

where μ_s denotes the intensity of fiscal dominance and π_F^{max} represents the monthly ceiling on fiscal inflation. This relationship indicates that the fiscal financing gap contributes to inflation only when compensatory transfers exceed the available fiscal capacity, with the magnitude of this effect increasing as fiscal dominance intensifies.

For each period, total nominal compensatory payments are first compared with the available fiscal capacity. Let $T_{d,s,t}^{nom}$ denote the nominal transfer received by decile d in period t , ω_d the population weight of that decile, and $\kappa(\mu_s)$ the sustainable recovery capacity of reform revenue. The period-specific fiscal gap is calculated as:

$$G_{s,t} = \max\{\sum_{d=1}^{10} \omega_d T_{d,s,t}^{nom} - \kappa(\mu_s) R_s^F, 0\} \quad (11)$$

In the numerical calibration, the sustainable recovery capacity of reform revenue is specified as a decreasing function of the intensity of fiscal dominance:

$$\kappa(\mu_s) = \max\{0.25, 1 - 0.50\mu_s\} \quad (12)$$

Consequently, as fiscal dominance intensifies, the share of reform revenue available for sustainably financing compensatory transfers declines, although this capacity is bounded below by 0.25. To avoid generating implausible numerical trajectories, the fiscal inflation component in Equation (10) is subject to an upper bound. Accordingly, the model prevents the interaction among indexation, fiscal financing gaps, and inflation from producing a mechanical explosion. Instead, policies that violate fiscal sustainability constraints are classified as fiscally unsustainable.

The cumulative price index for expenditure decile d in period t is defined as:

$$P_{d,s,t} = P_{d,s,t-1}(1 + \pi_{d,s,t}^{eff}), \quad P_{d,s,0} = 1 \quad (13)$$

Real transfers, real reform-related welfare losses, and real fiscal costs are obtained by dividing their respective nominal values by the cumulative price index:

$$T_{d,s,t}^{real} = \frac{T_{d,s,t}^{nom}}{P_{d,s,t}} \quad (14)$$

$$L_{d,s,t}^{real} = \frac{L_{d,s,t}^{nom}}{P_{d,s,t}} \quad (15)$$

$$F_{d,s,t}^{real} = \frac{F_{d,s,t}^{nom}}{P_{d,s,t}} \quad (16)$$

The nominal fiscal cost arising from the fiscal financing gap is allocated across expenditure deciles according to each decile's share of total expenditure. Given the period-specific fiscal gap $G_{s,t}$, the nominal fiscal cost attributed to decile d is calculated as:

$$F_{d,s,t}^{nom} = \frac{C_d}{\sum_{j=1}^{10} \omega_j C_j} G_{s,t} \quad (17)$$

Accordingly, $F_{d,s,t}^{real}$ represents the real cost associated with unsustainable financing, which enters the welfare function after adjustment using the decile-specific price index. In the baseline scenario, this cost is allocated proportionally to each decile's share of total expenditure. Alternative allocation rules and units of measurement are also examined in the robustness analysis.

The nominal transfer path follows an indexation rule. The promised growth rate of transfers for each decile is given by $q_s \pi_{d,s,t}^{eff}$. However, the effective growth of transfers is capped because of implementation and fiscal constraints. Accordingly, the nominal transfer updating rule is specified as:

$$T_{d,s,t+1}^{nom} = T_{d,s,t}^{nom} [1 + \min\{q_s \pi_{d,s,t}^{eff}, g^{max}(\mu_s)\}] \quad (18)$$

where $g^{max}(\mu_s)$ denotes the maximum monthly growth rate of transfers. In the numerical calibration, this ceiling is determined as follows:

$$g^{max}(\mu_s) = (1 + \max\{0.10, 0.70(1 - 0.50\mu_s)\})^{1/12} - 1 \quad (19)$$

This relationship indicates that even when the promised degree of indexation is high, the implemented growth of transfers is constrained under severe fiscal dominance. This distinction is important because q_s represents the promised degree of indexation, whereas actual implementation remains subject to fiscal capacity and the ceiling on transfer growth.

The study's primary welfare indicator is the net present value of welfare for each expenditure decile over a 36-month horizon, expressed as a percentage of that decile's baseline monthly expenditure. This indicator therefore measures the discounted sum of the policy's real benefits and costs throughout the analytical horizon relative to the decile's baseline monthly expenditure. Consequently, the reported values should not be interpreted as percentages of cumulative expenditure over 36 months, since the normalization base is the decile's baseline monthly expenditure. Accordingly, dynamic welfare for decile d under scenario s is calculated as:

$$W_{d,s} = \frac{100}{c_d} \sum_{t=1}^{36} \beta_m^{t-1} (T_{d,s,t}^{real} - L_{d,s,t}^{real} - F_{d,s,t}^{real}) \quad (20)$$

where β_m denotes the monthly discount factor. A positive value of $W_{d,s}$ indicates that real transfers have offset the behavioral welfare losses associated with price reform and the fiscal costs attributed to the decile. A negative value indicates compensation failure for the corresponding decile.

The compensation coverage ratio is also calculated as the ratio of the present value of real transfers to the present value of the combined behavioral welfare losses and fiscal costs:

$$CR_{d,s} = \frac{PV(T_{d,s}^{real})}{PV(L_{d,s}^{real} + F_{d,s}^{real})} \quad (21)$$

If $CR_{d,s} \geq 1$, the corresponding expenditure decile is considered protected against the burden of reform in terms of the compensation coverage ratio. Nevertheless, the primary criterion for ranking policies

in this study is the dynamic welfare of the bottom 40 percent of the population, since the objective of compensatory policy is to protect more vulnerable groups. The welfare of the bottom 40 percent is calculated as the weighted average welfare of the first four expenditure deciles:

$$W_{B40,s} = \frac{\sum_{d=1}^4 \omega_d W_{d,s}}{\sum_{d=1}^4 \omega_d} \quad (22)$$

In addition to the welfare of the bottom 40 percent, the analysis reports average welfare across all expenditure deciles, the compensation coverage ratio for the bottom 40 percent, the proportion of protected deciles, the fiscal gap relative to reform revenue, and the fiscal feasibility status of each scenario.

To specify the fiscal constraints, $A_{s,t}$ is defined as the total nominal transfer expenditure in period t :

$$A_{s,t} = \sum_{d=1}^{10} \omega_d T_{d,s,t}^{nom} \quad (23)$$

Furthermore, $\Phi_s(q)$ denotes the fiscal feasibility indicator for scenario s at indexation level q , where $\Phi_s(q) = 1$ indicates that all fiscal sustainability constraints are satisfied and $\Phi_s(q) = 0$ indicates that at least one constraint is violated.

Fiscal feasibility is assessed by imposing several constraints simultaneously. A scenario is considered fiscally sustainable when the ratio of the fiscal gap to reform revenue does not exceed the specified threshold, the ratio of total transfers to reform revenue remains within the permitted limit, effective inflation does not exceed its designated ceiling, and the fiscal cost attributed to the bottom 40 percent does not surpass the allowable proportion of their expenditure. The fiscal feasibility constraints can be summarized as follows:

$$\max_t \left\{ \frac{G_{s,t}}{R_s^F} \right\} \leq g_R^{max} \quad (24)$$

$$\max_t \left\{ \frac{A_{s,t}}{R_s^F} \right\} \leq a_R^{max} \quad (25)$$

$$\max_{d,t}\{\pi_{d,s,t}^{eff}\} \leq \pi^{max} \quad (26)$$

$$\frac{PV(F_{B40,s}^{real})}{PV(C_{B40})} \leq f^{max} \quad (27)$$

where g_R^{max} , a_R^{max} , π^{max} , and f^{max} represent the fiscal sustainability thresholds specified in the model. These constraints ensure that policies that may generate higher welfare in accounting terms but are financially unsustainable are not classified as defensible policy options.

The no-reform scenario serves solely as the comparison baseline. Under this scenario, the energy price shock is zero, and net welfare relative to the baseline itself is normalized to zero. This scenario is not interpreted as a fully specified competing policy because the model does not incorporate the costs of inefficient energy subsidies, the fiscal burden of maintaining subsidized prices, or the allocative losses associated with the status quo into the welfare function. Its role is therefore limited to providing a reference point for comparing reform scenarios.

The main policy scenarios include uncompensated reform, equal non-indexed transfers, Transfers with controlled indexation, full promised indexation, and a high fiscal-dominance scenario. Uncompensated reform illustrates the welfare consequences of increasing energy prices without compensatory payments. Equal non-indexed transfers measure the effects of a fixed nominal cash payment. The controlled-indexation scenario examines a high degree of indexation and assesses whether, under a conservative fiscal base, such indexation can simultaneously offset welfare losses among the bottom 40 percent and satisfy fiscal sustainability constraints. Full promised indexation is included to illustrate the difference between accounting-based welfare improvements and fiscal feasibility, since this scenario may appear favorable for lower expenditure deciles in welfare terms but become fiscally unsustainable if it violates budgetary constraints. The high fiscal-dominance scenario represents a situation of severe fiscal pressure in which the effectiveness of compensation is weakened through inflation and restrictions on payment capacity.

The main methodological contribution of the study is the definition of compensation failure thresholds as a policy interval rather than a single point. For each combination of energy price shock intensity θ_s , fiscal dominance intensity μ_s , and initial compensation adequacy rate λ_s , a grid of indexation quality values q is evaluated. In the final numerical implementation, q ranges from zero to one in increments of 0.05. For each value of q , the welfare of the bottom 40 percent and the fiscal feasibility status are calculated. The minimum and maximum indexation levels that provide welfare protection while remaining fiscally sustainable are then defined as follows:

$$q_{\min} = \min\{q: W_{B40,s}(q) \geq 0, \Phi_s(q) = 1\} \quad (28)$$

$$q_{\max} = \max\{q: W_{B40,s}(q) \geq 0, \Phi_s(q) = 1\} \quad (29)$$

If no value of q satisfies these conditions, compensation is considered to have failed under the corresponding policy configuration. Accordingly, the defensible compensation design lies within the following interval:

$$q_{\min} \leq q \leq q_{\max} \quad (30)$$

This definition indicates that compensation failure is not attributable solely to insufficient indexation. Excessively high indexation that exceeds fiscal capacity may also push a policy beyond the fiscal sustainability boundary under fiscal dominance.

Several sensitivity analyses are conducted to assess the robustness of the findings. First, the entire model is recalculated using total household expenditure in addition to the per capita expenditure measure to determine whether policy rankings depend on the unit of measurement. Second, the main energy-exposure indicator is compared with two narrower specifications: a restrictive energy-exposure definition and a household-energy-only definition. Third, a parameter grid is examined covering energy price shock intensity, fiscal dominance intensity, initial compensation adequacy, indexation quality, the coefficient of energy price shock pass-through to inflation, the coefficient of fiscal gap pass-through to inflation, and the analytical horizon. The main robustness

criteria include the probability of non-negative welfare for the bottom 40 percent, the probability of fiscal feasibility, the ranking of reform policies, and the interval of welfare-protective and fiscally sustainable indexation.

To clarify the model implementation, Table 1 summarizes the data, behavioral and fiscal parameters, and policy grid used in the simulation. The table presents the data foundations, behavioral assumptions, and policy settings underlying the simulation. Table 2 then reports the calibration rationale and sensitivity ranges of the key model parameters, while Table 3 introduces the architecture of the policy scenarios evaluated in the study. Model validity is assessed through three approaches: the use of observed household income–expenditure and decile-specific inflation data, calibration of behavioral demand responses within an economically plausible range, and robustness testing under alternative assumptions and fiscal constraints.

Table 1. *Summary of Data, Calibration, and Final Model Settings*

Input category	Value or definition	Role in the model
Primary unit of analysis	Expenditure deciles based on per capita expenditure	Main basis for measuring distributional welfare and controlling for differences in household size
Baseline expenditure variable	C_d : weighted average per capita expenditure of decile d	Denominator of the welfare indicator and basis for comparing reform burdens across deciles
Energy-exposure indicator	s_d^W : share of the broad energy and energy-intensive transportation basket in per capita expenditure of decile d	Basis for calculating household welfare losses resulting from energy price shocks
Energy-basket expenditure	$E_d^W = C_d s_d^W$	Calculation of behavioral welfare losses from price

		reform using the welfare-exposure base
Energy-exposure indicator in the main analysis	Broad definition including household electricity and fuels, fuels and lubricants for personal transport equipment, and purchased transportation services	Main measure of energy-related expenditure exposure; narrower definitions are examined in robustness tests
Decile-specific inflation	Annual inflation rate experienced by each expenditure decile	Calculation of the erosion of the real value of cash transfers and the decile-specific price index
Main analytical horizon	36 months	Primary horizon for calculating dynamic welfare and compensation sustainability
Annual real discount rate	2%	Conversion of monthly welfare flows into present values
Price elasticity of energy-basket demand	From -0.10 in the first decile to -0.35 in the tenth decile	Incorporation of behavioral adjustments in energy consumption following price increases
Energy price shock intensity in the sensitivity grid	0.25, 0.50, 0.75, 1.00	Examination of reform effects under different magnitudes of energy price increases
Initial compensation adequacy rate	0.40, 0.70, 1.00	Determination of the initial share of reform revenue allocated to compensatory payments
Fiscal dominance intensity	0, 0.25, 0.50, 0.75, 1.00	Assessment of the effects of fiscal constraints on the real

		erosion and sustainability of transfers
Indexation quality	From 0 to 1 in increments of 0.05	Identification of the welfare-protective and fiscally sustainable indexation interval
Energy price shock pass-through coefficient to inflation	0.15 in the baseline scenario	Calculation of the inflationary component arising from energy price increases
Fiscal gap pass-through coefficient to inflation	0.25 in the baseline scenario	Calculation of inflationary pressures associated with fiscal dominance
Fiscal sustainability constraints	Ratio of fiscal gap to reform revenue, ratio of transfers to reform revenue, effective inflation ceiling, and fiscal cost attributed to the bottom 40 percent	Distinguishing feasible welfare-improving policies from welfare-improving but fiscally unsustainable policies
Robustness tests	Total household expenditure scale; restrictive, household-energy-only, and broad energy-exposure indicators; parameter grid	Examination of whether the findings depend on the unit of analysis or definition of energy exposure
Fiscal reform base	$E_d^F = C_d s_d^F$; a more restrictive definition of the revenue-generating components of reform	Basis for calculating revenue available for compensatory payments

Source: Authors' calculations.

Note: The main analysis uses decile-level per capita expenditure as the unit of measurement. All calculations are also repeated using total household expenditure to determine whether the results depend on the choice between per capita and household-

level measures. The main energy-exposure indicator is based on the broad basket of energy and energy-intensive transportation expenditures, whereas the restrictive and household-energy-only definitions are employed exclusively for robustness testing.

Table 1 demonstrates that the study's framework is not based on a single scenario. Instead, it integrates observed decile-level data, behavioral demand responses, inflation-induced erosion of transfers, and fiscal constraints within a unified structure. Nevertheless, because the model's results depend on several behavioral and fiscal parameters, the rationale underlying their calibration must be reported transparently. Table 2 summarizes the baseline values, selection rationale, sensitivity ranges, and qualitative effects of the key parameters. It shows that the principal parameters are specified as scenario assumptions and examined over alternative ranges.

Table 2. *Calibration Rationale and Sensitivity Ranges of Key Model Parameters*

Parameter	Baseline value	Selection rationale	Sensitivity range	Qualitative effect on results
Price elasticity of energy-basket demand	From -0.10 in the first decile to -0.35 in the tenth decile	Lower elasticity for lower deciles due to limited substitution possibilities and the greater necessity of energy consumption; higher elasticity for upper deciles due to greater scope for consumption adjustment	Zero, half the baseline value, baseline value, and 1.5 times the baseline value	Higher elasticity partially reduces behavioral welfare losses, although policy rankings are primarily determined by compensation and fiscal constraints
Energy price shock pass-	0.15	Scenario parameter representing	0.10, 0.15, 0.20, 0.30	An increase intensifies the erosion of the

through coefficient to decile-specific inflation		the partial transmission of energy price shocks to decile-level living costs		real value of transfers and raises the need for indexation
Fiscal gap pass-through coefficient to inflation	0.25	Scenario parameter representing the intensity of the fiscal dominance transmission channel	0.10, 0.25, 0.40	An increase lowers the maximum fiscally sustainable indexation level and raises the likelihood of compensation failure
Sustainable recovery capacity function for reform revenue	$(\kappa(\mu_s) = \max\{0.25, 1 - 0.50\mu_s\})$	Declining available fiscal capacity as fiscal dominance intensifies, with a conservative lower bound to prevent numerical collapse of the model	Capacity floor: 0.15, 0.25, 0.35; rate of capacity decline: 0.30, 0.50, 0.70	Lower fiscal capacity causes high indexation levels to become fiscally unsustainable sooner
Fiscal gap-to-reform-revenue threshold	1.5	Scenario constraint distinguishing welfare-improving but fiscally unsustainable policies from defensible alternatives	1.25, 1.50, 2.00	A stricter threshold lowers the maximum fiscally sustainable indexation level, whereas a more permissive threshold expands the

				feasible indexation range
Fiscal reform base	Restrictive fiscal base definition	Distinguishing government revenue available for compensation from household welfare exposure, since purchased transportation services do not necessarily generate government revenue	Broad base, restrictive base, household- energy- only base	A more conservative fiscal base reduces compensation capacity and increases the likelihood of compensation failure

Source: Authors' calculations.

Note: Some parameters reported in Table 2 are scenario parameters rather than structural estimates. The sensitivity ranges are presented to demonstrate that the study's findings are examined under alternative assumptions rather than being based on a single arbitrarily selected parameter value. In particular, the parameters governing fiscal dominance, fiscal gap pass-through to inflation, sustainable recovery capacity of reform revenue, and fiscal feasibility constraints are not structural estimates for the Iranian economy. They are scenario-based parameters designed for sensitivity analysis and fiscal stress testing. Therefore, the framework does not seek to produce a point prediction of the optimal value of q or to estimate the structural intensity of fiscal dominance. Its primary objective is to identify the mechanisms underlying compensation failure across a range of conservative behavioral and fiscal assumptions. Accordingly, results concerning q and μ should be interpreted as scenario-dependent outcomes conditional on the calibration assumptions rather than as definitive structural estimates.

After specifying the data, parameters, and model constraints, the next step is to define alternative policy architectures. These architectures are designed to address three distinct questions: What are the consequences of implementing energy price reform without compensation? Are equal

cash transfers sufficient to protect lower expenditure deciles? To what extent can transfer indexation improve welfare while remaining fiscally sustainable? Table 3 defines the study's main policy scenarios to address these questions.

Table 3. *Policy Scenarios Evaluated in the Model*

Scenario	Energy price increase θ	Compensation adequacy rate λ	Promised indexation quality q	Fiscal dominance intensity μ	Analytical role in the study
No reform	0.00	0.00	—	0.00	Comparison baseline rather than a fully specified competing policy, since existing subsidy inefficiencies are not incorporated into the model
Uncompensated energy price reform	0.50	0.00	0.00	0.25	Measuring the welfare burden of reform in the absence of any compensatory payments
Equal non-indexed transfers	0.50	0.70	0.00	0.50	Evaluating the effects of fixed nominal cash payments that do not preserve

					purchasing power
Transfers with controlled indexation	0.50	0.70	0.90	0.50	High-indexation scenario examining whether controlled indexation can provide welfare protection while remaining fiscally sustainable under a conservative fiscal base
Full promised indexed transfers, ($q = 1$)	0.50	0.70	1.00	0.50	Comparison scenario illustrating the distinction between full promised indexation and its fiscal feasibility
High fiscal dominance and weakened compensation	1.00	0.70	0.25	1.00	Severe fiscal stress scenario examining conditions under which compensation is weakened through inflation and

					fiscal constraints
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Source: Authors' calculations.

Note: The parameter q represents promised indexation quality. Within the study's framework, the effective growth of transfers depends on fiscal capacity and implementation ceilings. Therefore, full promised indexation does not necessarily imply complete implementation or fiscal sustainability of transfers. Under the dual-base framework, the scenarios with $q = 0.90$ and $q = 1$ are used to examine whether high indexation can simultaneously preserve the welfare of the bottom 40 percent and satisfy fiscal constraints.

Table 3 clarifies the logic underlying the study's policy comparisons. The no-reform scenario serves solely as a reference point and should not be interpreted as an endorsement of the status quo, since the inefficiency costs of subsidized energy prices and the fiscal burden of maintaining energy subsidies are not included in the model's welfare function. Uncompensated reform represents the lower bound of welfare protection. Equal non-indexed transfers examine whether nominal cash payments alone are sufficient to protect lower expenditure deciles. The scenario with $q = 0.90$ evaluates whether a high degree of indexation, under a conservative fiscal base, can simultaneously preserve the welfare of the bottom 40 percent and satisfy fiscal constraints. The scenario with $q = 1$ is also reported to illustrate the distinction between full promised indexation and its fiscal feasibility. Accordingly, the study's ultimate criterion is not the maximization of indexation but the identification of a range within which compensation provides welfare protection while remaining fiscally sustainable.

Results

The findings are presented in three sections: decile-level heterogeneity in energy exposure and inflation, policy scenario outcomes under the dual-base framework, and the range of welfare-protective and fiscally sustainable indexation rates. Table 4 shows that energy price reform operates within a distributionally heterogeneous setting. The energy-exposure indicator is 4.91 percent for the first expenditure decile and 2.00 percent for the tenth decile, indicating that the budgetary exposure of the first decile to energy price shocks is more than twice that of the

tenth decile. At the same time, inflation experienced by lower expenditure deciles is slightly higher. This pattern highlights the limitations of analyses based on a representative household or aggregate averages.

Table 4. *Energy-Exposure Indicators and Consumer Price Inflation by Expenditure Decile*

Decile	Energy-exposure indicator (%)	Consumer price inflation (%)	Number of sample observations
1	4.91	50.00	6,044
2	4.24	50.40	5,393
3	3.78	50.00	4,777
4	3.51	49.40	4,098
5	3.22	49.30	3,828
6	3.16	48.90	3,300
7	2.93	48.60	2,956
8	2.61	48.20	2,719
9	2.46	47.80	2,440
10	2.00	46.30	1,950

Source: Authors' calculations.

Note: The number of sample observations represents the unweighted count of households observed in the Household Income and Expenditure Survey. These figures do not represent the actual population of each decile or the sample weights. Sample weights were applied when calculating decile-level averages, and the weighted population share of each decile is approximately 10 percent. The energy-exposure indicator reported in this table is based on the broad definition, which includes household electricity and fuels, fuels and lubricants for personal transport equipment, and purchased transportation services.

Incorporating behavioral responses in energy-basket demand provides a more detailed assessment of the welfare burden of reform. Table 5 shows that, under a 50 percent energy price shock, the reduction in energy-basket consumption increases from 3.97 percent in the first expenditure decile to 13.23 percent in the tenth decile. Thus, higher expenditure deciles have greater capacity to adjust their consumption, whereas lower deciles exhibit less flexibility. Despite these behavioral adjustments, the welfare losses associated with reform remain

substantial for lower expenditure deciles because energy expenditures account for a larger share of their budgets.

Table 5. *Behavioral Responses in Energy-Basket Demand to a 50 Percent Energy Price Shock*

Decile	Price elasticity of energy-basket demand	Reduction in energy-basket consumption (%)	Ratio of behavioral welfare loss to accounting burden
1	-0.10	3.97	0.979
2	-0.12	4.75	0.975
3	-0.15	5.90	0.969
4	-0.18	7.04	0.962
5	-0.22	8.53	0.954
6	-0.25	9.64	0.948
7	-0.28	10.73	0.942
8	-0.30	11.45	0.938
9	-0.33	12.52	0.932
10	-0.35	13.23	0.928

Source: Authors' calculations.

Note: The ratio of behavioral welfare loss to accounting burden indicates the proportion of the mechanical burden, represented by the consumer surplus loss after consumption adjustment. A value below one indicates that part of the price shock is absorbed through reduced consumption.

Table 6 reports the main results of the policy scenarios over the 36-month horizon under the study's dual-base framework. In this table, welfare losses are calculated using the broad energy and energy-intensive transportation exposure indicator, whereas revenue available for compensation is calculated using the more restrictive fiscal base. Consequently, the results in Table 6 are more conservative than those obtained when the welfare-exposure and fiscal reform bases are assumed to be identical.

Table 6. *Main Policy Scenario Results under the Dual-Base Framework*

Scenario	Welfare of the bottom 40%	Average decile welfare	Compensation coverage ratio for the bottom 40%	Fiscal status	Protection status
No reform	0.00	0.00	—	Sustainable	Baseline
Uncompensated energy price reform	−3.32	−2.63	0.00	Sustainable	Unprotected
Equal non-indexed transfers	−1.20	−1.38	0.58	Sustainable	Unprotected
Transfers with controlled indexation, $q=0.90$	−0.06	−0.77	0.89	Sustainable	Unprotected, close to the threshold
Full promised indexed transfers, $q=1$	0.03	−0.71	0.92	Unsustainable	Fiscally unsustainable
High fiscal dominance and weakened compensation	−2.33	−2.75	0.58	Sustainable	Unprotected

Source: Authors' calculations.

Note: The welfare-exposure and fiscal reform bases are distinguished in this table. Welfare losses are calculated using the broad energy and energy-intensive transportation exposure base, whereas compensatory revenue is derived from the more restrictive fiscal base. An unprotected status indicates that the net welfare of the bottom 40 percent remains negative over the 36-month horizon. The welfare values reported in the table represent the net present value of welfare over 36 months, expressed as a percentage of baseline monthly expenditure. Thus, the value of −3.32 for uncompensated reform indicates that the discounted welfare loss over the 36-month horizon is equivalent to 3.32 percent of the baseline monthly expenditure of the bottom 40 percent. It does not represent a percentage of cumulative expenditure over the 36-month period. It should also be noted that (q) in Table 6 represents promised indexation quality rather than necessarily indicating fully implemented indexation in every period. In the scenario with ($q=0.90$), the transfer growth ceiling becomes binding in approximately 44.2 percent of decile-period cells, whereas this proportion increases to approximately 75.6 percent under ($q=1$). Therefore, the distinction between promised indexation and the effective implemented growth of transfers is important for interpreting fiscal outcomes. Further details of this mechanism are reported in Appendix Table A3.

The results in Table 6 show that distinguishing between the welfare-exposure and fiscal reform bases substantially changes the assessment of compensation sustainability. Under the study's normalization, uncompensated reform generates a discounted net welfare loss equivalent to 3.32 percent of baseline monthly expenditure for the bottom 40 percent. Equal non-indexed transfers also remain insufficient to protect lower expenditure deciles because of the more restrictive fiscal reform base, leaving the welfare of the bottom 40 percent negative. Although controlled indexation with ($q=0.90$) substantially reduces welfare losses among the bottom 40 percent and remains fiscally sustainable, it does not fully restore their welfare to a non-negative level. In contrast, full promised indexation with ($q=1$) produces a slightly positive welfare outcome for the bottom 40 percent but violates the fiscal sustainability constraint. Therefore, under the baseline dual-base framework, neither of the two high-indexation alternatives simultaneously provides welfare protection and fiscal sustainability. This outcome constitutes compensation failure within the tested policy grid.

Table 7 reports the range of welfare-protective and fiscally sustainable indexation rates under the dual-base framework for a 50 percent energy price shock. The results indicate that when the fiscal reform base is defined conservatively, compensation failure may occur even when cash transfers and indexation are implemented.

Table 7. *Welfare-Protective and Fiscally Sustainable Indexation Ranges under the Dual-Base Framework: A 50 Percent Energy Price Shock*

Compensation adequacy rate	Fiscal dominance intensity	Welfare-protective and fiscally sustainable q range	Feasible welfare-maximizing q	Welfare at q=0	Welfare at q=1	Status
0.40	0.50	—	—	−2.11	−1.30	Compensation failure
0.70	0.00	0.90–1.00	1.00	−1.20	0.27	Narrow feasible range
0.70	0.25	0.90–0.95	0.95	−1.20	0.22	Narrow feasible range
0.70	0.50	—	—	−1.20	0.03	Compensation failure
0.70	0.75	—	—	−1.24	−0.36	Compensation failure
1.00	0.50	0.30–0.55	0.55	−0.41	1.11	Welfare-protective and fiscally sustainable range
1.00	1.00	—	—	−0.69	−0.02	Compensation failure

Source: Authors' calculations.

Note: Values of (q) were evaluated on a grid ranging from zero to one in increments of 0.05. The symbol “—” indicates that none of the indexation levels examined within the tested policy grid simultaneously produces non-negative welfare for the bottom 40 percent and satisfies the fiscal sustainability constraint. Accordingly, the reported ranges represent computational intervals within the tested policy grid rather than exact continuous mathematical thresholds.

The results in Table 7 indicate that compensation failure may occur under the dual-base framework even when cash transfers and indexation are in place. At an initial compensation adequacy rate of 0.70 and a moderate degree of fiscal dominance, ($\mu = 0.50$), none of the tested values of (q) simultaneously produces non-negative welfare for the bottom 40 percent and satisfies the fiscal constraint. An indexation level of (q=0.90) is fiscally sustainable but leaves the welfare of the bottom 40 percent slightly negative, whereas (q=1) generates a marginally positive welfare outcome but is fiscally unsustainable. Compensation

failure therefore arises from the incompatibility between welfare adequacy and fiscal sustainability.

Table 7 also shows that the solution does not necessarily involve increasing indexation without constraint. When the initial compensation adequacy rate rises to 1.00, a welfare-protective and fiscally sustainable indexation range from $q = 0.30$ to $q = 0.55$ emerges under moderate fiscal dominance. This finding indicates that a defensible policy combines more adequate initial compensation with moderate and controlled indexation, rather than relying on insufficient initial compensation accompanied by excessively high indexation.

It is important to recognize that (q) represents promised indexation quality rather than necessarily indicating the full growth of transfers actually implemented under all conditions. At higher levels of fiscal dominance, the ceiling on implemented transfer growth becomes binding, preventing promised indexation from being fully translated into higher actual payments. Consequently, under certain parameter configurations, $(q=1)$ may appear fiscally sustainable in accounting terms. However, such sustainability results from restrictions on effective transfer growth rather than the full implementation of indexation. For this reason, the study's primary evaluation criteria are not based on the value of (q) alone, but on the welfare of the bottom 40 percent and the simultaneous satisfaction of fiscal constraints.

To examine the robustness of the findings, the calculations were repeated using total household expenditure, alternative definitions of energy exposure, and alternative fiscal bases. Detailed results are reported in the appendix. The sensitivity analyses indicate that effect magnitudes depend on the unit of analysis, the scope of the energy-exposure indicator, and the definition of the fiscal reform base. Nevertheless, the central finding remains unchanged: uncompensated reform generates welfare losses, nominal transfers provide limited protection, and successful compensation requires both welfare adequacy and fiscal sustainability. The more conservatively the fiscal reform base is defined, the greater the likelihood of compensation failure.

Overall, the findings indicate that the success of energy price reform depends on the adequacy of the fiscal reform base and the design of compensation rather than on the provision of cash transfers alone.

Compensation must be sufficient to protect lower expenditure deciles, incorporate an appropriate degree of indexation in an inflationary environment, and remain within fiscal sustainability limits. Under the study's dual-base framework, compensation failure occurs when fiscal revenue available for compensation is insufficient relative to the welfare burden imposed on households. Under such conditions, even high levels of indexation cannot simultaneously satisfy the welfare protection and fiscal sustainability requirements.

Discussion and Conclusion

This study aimed to evaluate the welfare and distributional consequences of energy price reform in Iran, with particular emphasis on the design of cash compensation mechanisms. The analysis was motivated by the premise that energy price reform, even when justified in terms of economic efficiency and the reduction of pricing distortions, may impose disproportionate welfare burdens on lower expenditure deciles in the absence of adequate compensation. The findings indicate that this concern is not merely theoretical. Lower expenditure deciles allocate a larger share of their expenditures to energy and related transportation services while simultaneously experiencing higher inflation rates. Energy price reform therefore takes place within a distributionally heterogeneous environment, and analyses based on a representative household or aggregate averages cannot adequately capture the vulnerability of lower expenditure groups.

The first major finding is that uncompensated energy price reform generates welfare losses for the bottom 40 percent of the population, even after accounting for behavioral responses in energy-basket demand. Within the model, households are not assumed to be entirely passive, as they absorb part of the price shock by reducing consumption. Nevertheless, incorporating these behavioral adjustments does not alter the central finding. Because energy expenditures account for a larger share of the budgets of lower expenditure deciles, the welfare losses

associated with uncompensated reform remain substantial for these groups. From this perspective, implementing energy price reform without targeted cash compensation cannot be justified on the grounds of welfare equity.

The second finding concerns the limitations of nominal cash transfers. Equal non-indexed transfers can mitigate part of the welfare losses experienced by lower expenditure deciles, but under the dual-base framework and the restrictive fiscal base, they are insufficient to generate non-negative welfare for the bottom 40 percent. This policy has two limitations in an inflationary environment. First, the purchasing power of nominal transfers declines over time. Second, uniform nominal transfers do not account for differences in inflation experienced across expenditure deciles. Consequently, although nominal cash payments provide greater welfare protection than uncompensated reform, they are insufficient for designing a sustainable welfare compensation package. In an inflationary economy, the central issue is not simply the provision of transfers but the preservation of their real value over time.

The third finding, which represents the study's main policy contribution, is that transfer indexation must be designed within a range that simultaneously provides welfare protection and ensures fiscal sustainability. Under the dual-base framework, controlled indexation with ($q=0.90$) substantially reduces welfare losses among the bottom 40 percent and remains fiscally sustainable. However, under a conservative fiscal base, it is insufficient to provide complete welfare protection for this group. In contrast, full promised indexation with ($q=1$) produces a slightly positive welfare outcome for the bottom 40 percent but violates the fiscal sustainability constraint. Therefore, the study does not suggest that ($q=0.90$) is universally the optimal policy. Rather, the findings indicate that compensation design must balance

initial compensation adequacy, indexation quality, and actual fiscal capacity.

This finding provides a more precise interpretation of compensation failure thresholds. Compensation failure does not occur exclusively when cash transfers are absent or indexation is insufficient. It may also arise when transfers are indexed beyond the government's fiscal capacity, causing fiscal financing gaps and inflationary pressures that undermine the sustainability of the compensation mechanism itself. Policymakers therefore face a three-way trade-off involving initial compensation adequacy, indexation quality, and fiscal sustainability. Neglecting any of these dimensions may cause energy price reform to fail in welfare or fiscal terms.

The results concerning initial compensation adequacy further clarify this trade-off. When the initial compensation rate is low, lower expenditure deciles require higher indexation to maintain their welfare. Under these conditions, if the energy price shock is substantial and fiscal dominance is pronounced, no level of indexation may simultaneously preserve the welfare of the bottom 40 percent and satisfy the fiscal constraint. Conversely, when initial compensation is highly generous, the minimum required indexation level decreases, but fiscal pressures increase and the upper bound of fiscally sustainable indexation declines. Accordingly, the preferred policy design does not involve minimizing initial transfers or maximizing indexation, but rather combining adequate initial compensation with controlled indexation.

From a policy perspective, the findings do not imply that energy price reform should be abandoned. Maintaining subsidized energy prices may exacerbate allocative inefficiency, excessive energy consumption, fiscal pressures, and the unequal distribution of subsidy benefits. However, the present model does not incorporate the inefficiency costs of the status quo into its welfare function. For this reason, the no-reform

scenario serves only as a comparison baseline rather than an argument for maintaining existing policies. The policy implication is that energy price reform should be implemented alongside a carefully designed compensation mechanism. For an energy price reform program in Iran to be defensible in welfare terms, it should incorporate three features: decile-based targeting, inflation indexation, and sustainable financing.

The robustness tests indicate that the study's central finding does not qualitatively depend on the choice of the unit of analysis, the definition of the energy-exposure indicator, or the specification of the fiscal reform base, although the magnitudes of the estimated effects vary across these assumptions. As the fiscal base is defined more restrictively, the revenue available for compensatory payments decreases, compensation capacity weakens, and the likelihood of compensation failure increases. Therefore, distinguishing between the household welfare-exposure base and the fiscal reform base is not merely a technical modeling detail but is necessary for a realistic assessment of compensation sustainability.

The scientific contribution of this study can be summarized in three dimensions. First, it examines energy price reform at the expenditure-decile level, moving beyond exclusive reliance on representative-household models or aggregate averages. Second, it distinguishes between nominal compensation, real compensation, and transfers indexed to decile-specific inflation. Third, it incorporates fiscal dominance not merely as a macroeconomic characteristic of the Iranian economy but as an operational constraint on the sustainability of cash compensation. Integrating these dimensions enables the study to define compensation failure thresholds as a range of welfare-protective and fiscally sustainable indexation rates rather than as a single point.

Nevertheless, the findings should be interpreted in light of the study's methodological limitations. The model does not provide a complete solution to a dynamic stochastic general equilibrium model or a

heterogeneous-agent model. Income, labor supply, asset markets, savings, and the production path are not fully endogenized. Furthermore, substitution among all energy carriers and the production-side effects of energy price reform are not modeled within the current framework. The study does not aim to predict the complete macroeconomic trajectory following energy price reform. Instead, it seeks to rank compensation scenarios according to their welfare outcomes and identify the conditions under which cash compensation succeeds or fails to protect lower expenditure deciles. These limitations are important for interpreting the results, but they do not diminish the policy relevance of the framework, since the study's central research question specifically concerns the design of cash compensation at the expenditure-decile level.

The overall conclusion is that energy price reform in Iran can be justified in welfare terms only when designed as an integrated policy package rather than implemented as an isolated price increase. Such a package should incorporate gradual or scenario-based energy price adjustments, adequate cash transfers, targeting of vulnerable expenditure deciles, controlled indexation to decile-specific inflation, and a sustainable financing mechanism. Insufficient indexation may erode the purchasing power of transfers, while excessive indexation under fiscal dominance may itself become a source of fiscal instability. Accordingly, policy design should focus on identifying an indexation range within which cash compensation protects the bottom 40 percent of the population without violating fiscal sustainability constraints. The results of the study's dual-base framework indicate that such a range emerges only when the fiscal reform base is sufficient to finance compensation. Otherwise, even high levels of indexation cannot simultaneously satisfy the welfare protection and fiscal sustainability conditions.

Future research could extend this framework in three directions. First, household behavioral responses could be modeled by incorporating

substitution among different energy carriers and changes in consumption composition. Second, compensation financing could be examined within a broader macroeconomic framework that endogenizes the government budget, monetary base, and monetary policy. Third, the effects of energy price reform on production, employment, and investment could be analyzed using a more comprehensive general equilibrium model. Such extensions could provide a more complete understanding of the consequences of energy price reform. Nevertheless, the central finding of the present study remains that, in an inflationary economy characterized by expenditure-decile heterogeneity, the success of energy price reform depends on adequate compensation design, controlled indexation, and fiscal sustainability.

Conflict of Interest

The author declares no conflict of interest.

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Declaration of Generative AI Use

The author used ChatGPT to assist in translating the original Persian manuscript into English. The translation was subsequently reviewed and edited by the author, who take full responsibility for the accuracy and integrity of the final manuscript.

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References

- Auclert, A. (2019). Monetary policy and the redistribution channel. *American Economic Review*, 109(6), 2333–2367. <https://doi.org/10.1257/aer.20160137>
- Breton, M., & Mirzapour, H. (2016). Welfare implication of reforming energy consumption subsidies. *Energy Policy*, 98, 232–240. <https://doi.org/10.1016/j.enpol.2016.08.031>
- Cockburn, J., Robichaud, V., & Tiberti, L. (2018). Energy subsidy reform and poverty in Arab countries: A comparative CGE-microsimulation analysis of Egypt and Jordan. *Review of Income and Wealth*, 64(S1), S249–S273. <https://doi.org/10.1111/roiw.12309>
- Emamverdi, G., Haftlang, R., & Farahani, M. (2011). Evaluating the welfare cost of energy carrier price increases: The case of Iran. *Applied Economics Quarterly*, 2(4), 25–42. [In Persian]
- Hazeri Neyri, H., & Hosseini-Nasab, S. E. (2014). A computable general equilibrium analysis of welfare effects of energy subsidy reform: Hicksian equivalent variation index. *Economic Research Quarterly*, 14(2), 21–40. [In Persian]
- International Monetary Fund. (2013). Energy subsidy reform: Lessons and implications. International Monetary Fund.
- Kaplan, G., Moll, B., & Violante, G. L. (2018). Monetary policy according to HANK. *American Economic Review*, 108(3), 697–743. <https://doi.org/10.1257/aer.20160042>
- Karimi, M. S., & Emamverdi, G. (2013). Evaluating the welfare cost of the effects of energy carrier price increases on consumer welfare costs in Iran. *Quarterly Journal of Economic Sciences*, 7(23), 61–80. [In Persian]

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- Leeper, E. M. (1991). Equilibria under active and passive monetary and fiscal policies. *Journal of Monetary Economics*, 27(1), 129–147. [https://doi.org/10.1016/0304-3932\(91\)90007-B](https://doi.org/10.1016/0304-3932(91)90007-B)
- Mahdavi Adeli, M. H., Ghezelbash, A., & Daneshnia, M. (2012). The effect of oil price changes on major macroeconomic variables in Iran. *Iranian Energy Economics Review*, 1(3), 131–170. [In Persian]
- Moeini, S., Moeini, M., & Yousefian, M. (2025). Inequality in the distribution of gasoline subsidies in Iran: Evidence from household income-expenditure data (2018–2023). *Iranian Energy Economics Review*, Articles in Press. <https://doi.org/10.22054/jiee.2025.84347.2135> [In Persian]
- Mousavi, M., & Nouri, N. (2025). Estimating the minimum subsistence expenditure of the energy commodity group for Iranian households: A linear expenditure system approach. *Iranian Energy Economics Review*. <https://doi.org/10.22054/jiee.2025.83468.2124> [In Persian]
- Nazeman, H., & Haghdoost, E. (2012). Assessing the potential for fuel saving and air-pollution reduction using electric-gasoline hybrid vehicles. *Iranian Energy Economics Review*, 1(4), 169–196. [In Persian]
- Parry, I., Black, S., & Vernon, N. (2021). Still not getting energy prices right: A global and country update of fossil fuel subsidies. IMF Working Paper No. 2021/236. International Monetary Fund. <https://doi.org/10.5089/9781513595405.001>
- Rafiei, S., Seyednoorani, S. M. R., & Mohammadi, T. (2025). The distributional effects of fuel-subsidy reform in Iran. *Iranian Energy Economics Review*, Articles in Press. <https://doi.org/10.22054/jiee.2025.76720.2048> [In Persian]
- Rentschler, J. (2016). Incidence and impact: The regional variation of poverty effects due to fossil fuel subsidy reform. *Energy Policy*, 96, 491–503. <https://doi.org/10.1016/j.enpol.2016.06.025>
- Rentschler, J., & Bazilian, M. (2017). Reforming fossil fuel subsidies: Drivers, barriers and the state of progress. *Climate Policy*, 17(7), 891–914. <https://doi.org/10.1080/14693062.2016.1169393>
- Sadeghi Hasanvand, V., & Amin Rashti, N. (2020). The effect of energy carrier price adjustment, distribution and poverty indicators on the welfare index of urban society: A case study of Iran. *Economic Research and Policies*, 28(94), 67–99. [In Persian]
- Salehi-Isfahani, D., & Mostafavi-Dehzoeei, M. H. (2017). Cash transfers and labor supply: Evidence from a large-scale program in Iran. ERF Working Paper No. 1090.
- Sargent, T. J., & Wallace, N. (1981). Some unpleasant monetarist arithmetic. *Federal Reserve Bank of Minneapolis Quarterly Review*, 5(3), 1–17.

Schaffitzel, F., Jakob, M., Soria, R., Vogt-Schilb, A., & Ward, H. (2020). Can government transfers make energy subsidy reform socially acceptable? A case study on Ecuador. *Energy Policy*, 137, 111120. <https://doi.org/10.1016/j.enpol.2019.111120>

Solaymani, S. (2021). Energy subsidy reform evaluation research – reviews in Iran. *Greenhouse Gases: Science and Technology*, 11(3), 520–538. <https://doi.org/10.1002/ghg.2064>

Statistical Center of Iran. (2024). Results of the household income and expenditure survey. Statistical Center of Iran. [In Persian]

Statistical Center of Iran. (2025). Consumer price index by household expenditure deciles. Statistical Center of Iran. [In Persian]

Woodford, M. (2001). Fiscal requirements for price stability. *Journal of Money, Credit and Banking*, 33(3), 669–728. <https://doi.org/10.2307/2673890>

Zarepour, Z., & Wagner, N. (2022). Cash instead of subsidy: Assessing the impact of the Iranian energy subsidy reform on households. *Energy Policy*, 168, 113145. <https://doi.org/10.1016/j.enpol.2022.113145>

Appendices

Appendix A. Robustness Tests of the Dual-Base Framework

This appendix reports supplementary results from the robustness tests. These tests examine whether the study's main finding, namely that successful compensation depends on the simultaneous adequacy of the welfare-exposure and fiscal reform bases, is sensitive to the specific definition of the fiscal base, the unit of analysis, or the baseline parameter configuration. The main text reports results based on the dual-base framework, in which welfare losses are calculated using the broad energy and energy-intensive transportation exposure base, whereas compensatory revenue is derived from the more restrictive fiscal base. In addition to the restrictive fiscal base, this appendix examines two alternative specifications: a broad fiscal base representing an optimistic estimate of reform revenue and a household-energy-only fiscal base representing a highly conservative case.

Table A1. *Robustness Test with Respect to the Fiscal Reform Base*

Fiscal reform base	Uncompensated reform	Equal transfers, $q=0$	Indexation, $q=0.90$	Is $q=0.90$ fiscally sustainable?	Indexation, $q=1$	Is $q=1$ fiscally sustainable?	Interpretation
Broad fiscal base, identical to the welfare-exposure base	-3.32	0.92	3.09	Yes	3.25	No	Optimistic case; controlled indexation provides welfare protection and remains fiscally sustainable
Restrictive fiscal base	-3.32	-1.20	-0.06	Yes	0.03	No	Main specification; $q=0.90$ is fiscally

							sustainable but does not provide full welfare protection, whereas $q=1$ is fiscally unsustainable
Household-energy-only fiscal base	-3.32	-2.08	-1.37	Yes	-1.31	No	Highly conservative case; compensation is insufficient at all selected indexation levels

Source: Authors' calculations.

Note: In all rows, welfare losses are calculated using the broad energy and energy-intensive transportation exposure base. The only difference across rows is the fiscal reform base, which determines the revenue assumed to be available for compensatory payments. The reported values represent the welfare of the bottom 40 percent of the population.

The results in Table A1 indicate that the more conservatively the fiscal reform base is defined, the lower the compensation capacity and the greater the likelihood of compensation failure. Under the optimistic specification, in which the fiscal reform base is assumed to be identical to the welfare-exposure base, indexation at ($q=0.90$) protects the bottom 40 percent and remains fiscally sustainable. However, under the restrictive fiscal base adopted in the main analysis, ($q=0.90$) remains fiscally sustainable but does not fully restore the welfare of the bottom 40 percent to a non-negative level. Under the household-energy-only fiscal base, even ($q=1$) is insufficient to provide welfare protection.

Table A2. Welfare-Protective and Fiscally Sustainable Indexation Ranges under the Restrictive Fiscal Base: A 50 Percent Energy Price Shock

Initial compensation adequacy rate	Fiscal dominance intensity	Welfare-protective and fiscally sustainable q range	Feasible welfare-maximizing q	Welfare at q=0	Welfare at q=1	Is q=1 fiscally sustainable?	Status
0.40	0.00	—	—	−2.11	−1.27	Yes	Compensation failure
0.40	0.25	—	—	−2.11	−1.28	Yes	Compensation failure
0.40	0.50	—	—	−2.11	−1.30	Yes	Compensation failure
0.40	0.75	—	—	−2.11	−1.46	Yes	Compensation failure
0.40	1.00	—	—	−2.11	−1.64	Yes	Compensation failure
0.70	0.00	0.90–1.00	1.00	−1.20	0.27	Yes	Narrow feasible range
0.70	0.25	0.90–0.95	0.95	−1.20	0.22	No	Narrow feasible range
0.70	0.50	—	—	−1.20	0.03	No	Compensation failure
0.70	0.75	—	—	−1.24	−0.36	Yes	Compensation failure
0.70	1.00	—	—	−1.32	−0.73	Yes	Compensation failure
1.00	0.00	0.20–0.75	0.75	−0.30	1.81	No	Welfare-protective and

							fiscally sustainable range
1.00	0.25	0.25–0.65	0.65	–0.32	1.68	No	Welfare-protective and fiscally sustainable range
1.00	0.50	0.30–0.55	0.55	–0.41	1.11	No	Welfare-protective and fiscally sustainable range
1.00	0.75	0.40–0.45	0.45	–0.53	0.49	No	Welfare-protective and fiscally sustainable range
1.00	1.00	—	—	–0.69	–0.02	No	Compensation failure

Source: Authors' calculations.

Note: Values of (q) were evaluated on a grid ranging from zero to one in increments of 0.05. The symbol “—” indicates that none of the tested indexation levels simultaneously produces non-negative welfare for the bottom 40 percent and satisfies the fiscal sustainability constraint. The column indicating whether (q=1) is fiscally sustainable assesses only the fiscal constraint and does not, by itself, imply successful compensation.

Table A2 shows that, under the restrictive fiscal base, the initial compensation adequacy rate plays a decisive role. At an adequacy rate of 0.40, even full indexation is insufficient to provide welfare protection. At an adequacy rate of 0.70, a welfare-protective and fiscally sustainable indexation range emerges only under low fiscal dominance, whereas compensation failure occurs under moderate fiscal dominance. At an adequacy rate of 1.00, a welfare-protective and

fiscally sustainable range reappears, although this range narrows as fiscal dominance intensifies.

Table A3. *Fiscal Mechanisms at Selected Indexation Levels under the Restrictive Fiscal Base*

q	Welfare of the bottom 40%	Compensation coverage ratio	Maximum fiscal gap-to-revenue ratio	Share of observations with a binding indexation ceiling	Maximum effective annual inflation (%)	Fiscally sustainable?	Protection status
0.00	-1.20	0.58	0.000	0.000	50.86	Yes	Unprotected
0.90	-0.06	0.89	1.498	0.442	81.54	Yes	Unprotected, close to the threshold
0.95	-0.00	0.91	1.572	0.597	83.18	No	Fiscally unsustainable
1.00	0.03	0.92	1.620	0.756	84.27	No	Fiscally unsustainable

Source: Authors' calculations.

Note: The fiscal sustainability threshold for the fiscal gap-to-revenue ratio is 1.5. At (q=0.90), the ratio of 1.498 remains slightly below the threshold, although the welfare of the bottom 40 percent does not become fully non-negative. At (q=0.95) and (q=1), the fiscal sustainability threshold is exceeded. Therefore, under the restrictive fiscal base, no value of (q) simultaneously provides welfare protection and satisfies fiscal sustainability in this policy configuration.

Table A3 illustrates the mechanism underlying compensation failure. Increasing (q) from zero to 0.90 substantially reduces welfare losses among the bottom 40 percent but remains insufficient to generate positive welfare. Further increases in (q) to 0.95 and 1.00 bring welfare close to zero or slightly above it, but violate the fiscal constraint. Compensation failure therefore arises from the conflict between welfare adequacy and fiscal sustainability.

Table A4. *Robustness Test with Respect to the Unit of Analysis under the Restrictive Fiscal Base*

Scenario	Welfare of the bottom 40%, per capita basis	Fiscal sustainability, per capita basis	Interpretation
Uncompensated reform	−3.32	Yes	Welfare-reducing and unprotected
Equal transfers, $q=0$	−1.20	Yes	Nominal transfers are insufficient
Indexation, $q=0.90$	−0.06	Yes	Close to the threshold but still unprotected
Indexation, $q=1$	0.03	No	Produces slightly positive welfare but is fiscally unsustainable

Source: Authors' calculations.

Note: The per capita specification constitutes the main basis of the study because expenditure-decile classification is more consistent with per capita expenditure. Results based on total household expenditure may also be reported as a supplementary robustness test. Nevertheless, the central finding remains unchanged: under the restrictive fiscal base, successful compensation requires the simultaneous satisfaction of welfare adequacy and fiscal sustainability conditions.

The overall conclusion of this appendix is that the study's findings are not dependent on optimistic assumptions regarding reform revenue. When a broad fiscal base is assumed, controlled indexation can provide welfare protection while remaining fiscally sustainable. However, when the fiscal base is defined more conservatively, the same policy may become insufficient to fully protect the bottom 40 percent. Accordingly, distinguishing between the household welfare-exposure base and the fiscal reform base is essential for a realistic assessment of compensation sustainability.