Cash instead of subsidy: Assessing the impact of the Iranian energy subsidy reform on households

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ABSTRACT

The 2010 energy subsidy reform in Iran is a unique case of redistributive policy as the savings from the subsidy cut have been redirected to households as unconditional, universal cash transfer. While theoretically, the cash transfer was large enough to keep the utility of the average household at the initial level, this study explores the practical impacts of the reform. We analyze panel data on income/expenditure of Iranian households for the period 2010–2012. Since this is a universal reform, we exploit the time dimension and the intensity of energy consumption in the identification and assess the robustness of the results with sub-sample and placebo analyses. Overall, the energy subsidy reform caused a significant shrinkage (7%–9%) in households’ real consumption. The cash transfer failed to fully compensate the negative impact of the subsidy removal. The impact is heterogeneous, varying along the intensity of energy consumption, geographical location, income and the share of the cash transfer in a household’s income. A non-negligible policy accomplishment of the reform is that within its first two years poverty was mitigated in absolute and relative terms and income inequality slightly improved. Nevertheless, the government is under pressure because inflation counteracts these gains.

1. Introduction

The Iranian economy is highly subsidized especially for energy carriers, such as fuels and electricity. Discussions over the necessity of a subsidy reform have been ongoing ever since the end of the Iran-Iraq war in 1988. Over time a consensus emerged between politicians and economists that the subsidy system fails to target low-income groups. But there has been a strong resistance from the government and many economists to proceed with any reform plan. The failure of subsidy reforms in other countries such as Indonesia in 2008 that has led to strikes and riots further reinforced existing concerns. Additional concerns have been the potential pressure it might place on the poor and the lack of an effective social protection net to identify and support vulnerable groups (Dadgar and Nazari, 2011; Nabavi and Amini, 2010). Eventually, in December 2010, the government implemented a promising reform plan: the subsidy of energy carriers was removed. As compensation, a cash transfer (derived from the subsidy removal) was redirected to all households that are registered and this cash transfer is in principle sufficient to cover the incurred costs of the subsidy removal for an average household (Guillaume et al., 2011:7). The cash transfer was designed to be equivalent to the negative income effect of the energy price increase. It amounts to 405,000 Iranian Rials (IR) per person and month and is transferred to the bank account of the head of the household on a bi-monthly basis. Hence, the government did not use the energy reform for fiscal consolidation, but to curb the high energy consumption and to change the uneven distribution of subsidies, which were not pro-poor, to a more equal distribution. Moreover, the universal unconditional cash transfer freed the government from the challenge of identifying vulnerable groups. To announce the reform to the broader public, a massive media campaign was started on state TV and radio...
promoting that every family receives a fixed monthly income from the government that is proportional to family size. These media campaigns played a major role in the acceptance of the reform and its smooth implementation. By the end of 2012, nearly 98% of the population had registered for the cash transfer. The transfer had a big value for low-income groups. In 2012, it accounted for more than 40% of the income of roughly one fifth of the households in rural areas. This single aspect emphasizes that the livelihoods of a considerable part of the population became highly dependent on the cash transfer. While the unconditional compensation scheme is impressive at first sight, an overall macro-economic adjustment can be expected and it is not clear a priori whether the cash transfer really resulted in the intended smoothing of the subsidy removal. It is very likely that households are differentially affected by the reform depending on their energy needs.

Yet undoubtedly, the energy subsidy reform is a major reform in Iran and unique in terms of structure. Unlike any other preceding energy subsidy reform in other countries such as Indonesia (in the years 2003, 2005, 2008), the Philippines (in the year 2001), Mexico (in the years 2001–2002), Yemen (in the years 2005 and 2010), and Ghana (in the year 2005), it was designed to be budget neutral for the government, i.e. the savings of the subsidy removal were transferred unconditionally to all households.

Household welfare is a key concern of any economy. Addressing the dynamics of household welfare in response to the energy subsidy reform by aggregated data mask the heterogeneity of the impact. Therefore, this study aims to address the impact of the energy subsidy reform from the household perspective by analyzing a large and detailed household panel dataset. In this research, the unit of analysis is the household. To date, there is no research on the impact of the subsidy reform using disaggregated household level panel data. Contrary to the existing research, our approach is motivated by the impact evaluation literature and employs a counterfactual analysis.

Despite the redistribution efforts of the Iranian government, our findings show that the energy subsidy reform caused a significant shrinkage (7–9%) in households’ real consumption, i.e. the cash transfer failed to fully compensate the negative impact of the subsidy removal. Yet, the impact of the reform is heterogenous, depending on the intensity of energy consumption, geographical location, income and the share of the cash transfer in a household’s income, the impact varies. Remarkably, within the time span of this research (2 years after the implementation), the reform mitigated poverty in absolute and relative terms and slightly improved income inequality.

The remainder of this paper is structured as follows: In section 2, we discuss existing research about energy subsidy reforms and impact evaluation approaches for the energy sector and universal programs. Section 3 introduces the data and section 4 the identification strategies as well as the results and robustness/sensitivity checks. Section 5 descriptively explores possible effects on poverty and inequality and section 6 concludes.

2. Existing research

We know from micro-economics that theoretically speaking, cash transfers provide a superior option compared to subsidies since cash transfers allow consumers to spend on the goods and services of their choice including energy (Varian, 2006). The Iranian government wanted to maintain the purchasing power of the consumers after the subsidy removal. For this purpose, the government provided just enough compensation to offset the expected income effect and allow consumers to restore their original utility level but at the new, higher price levels for energy. Thus, under the assumption that the prices of the other goods and services are not affected by the reform, an adequate cash transfer in response to a subsidy cut will maintain the initial level of utility for the consumer. Clearly, these theoretical implications only hold if the impact of the policy change is limited to direct impacts. However, in real world settings where the prices of the other goods and services vary in response to a change in the price of energy, the neutral impact of the policy will not necessarily materialize (Breton and Mirzapour, 2016). In Appendix B we provide a detailed theoretical discussion of such dynamics including possible welfare impacts which depend among others on the share of energy expenditures in overall household expenditures, the energy intensity of the economy and the degree of subsidization (Breton and Mirzapour, 2016). With the study at hand we focus on the empirical assessment of these aspects.

2.1. Empirical research about energy subsidy reforms

To empirically assess the impact of subsidy reforms on most existing studies use input-output tables and estimated the direct (increase in energy price) and indirect (increase in the prices of other goods and services due to the increase in the energy price) impact of the reform on households; others estimate Computable General Equilibrium (CGE) models using input-output tables; and yet others estimate demand functions and derive the price and/or income elasticities to forecast the direct impact of the reform by estimating the compensating variation (CV).

For Egypt, Abouleinein et al. (2009) investigate the impact of a subsidy removal from petroleum products on households using CGE models. They identify that the subsidy removal resulted in an increase of the Consumer Price Index of 37 percentage points implying that households lose more than one third of their purchasing power. The authors suggest a gradual removal of the subsidy and the transfer of 50 percent of the savings of the subsidy removal as cash transfer to the 20% of the lowest income households as best response. In a similar vein, Del Granado et al. (2012) review the impact of energy subsidy reforms among a selection of developing countries using input-output tables concluding that a $0.25 decrease in the per litre subsidy results in a 5 percent decrease in real income. Importantly, more than half of this impact arises from indirect channels. Following the same methodology, Anand et al. (2014) show that an energy subsidy reform in India decreases the real income by about 4 percent on average and three-quarters of this impact are direct. The absolute impact on high income groups is larger than for the low-income groups; however, in relative terms (relative to their total expenditure) they are similar.

Employing a demand function approach, Araar and Verme (2016) study unified household data to analyze the direct welfare impact of energy subsidies among five countries in the Middle East and North Africa. They show that energy subsidies are pro-rich in absolute terms but significant for the poor in relative terms. The authors used a Cobb-Douglas demand function and assumed a flat reduction of the unit subsidies by 30 percent. As a result, household welfare declines by 4–5 percent. Yet this impact is heterogenous across different types of fuels and countries. In addition, Groot and Oostveen (2019) analyzed the potential direct welfare effect of energy subsidy reforms in eleven developing countries by measuring compensating variation (CV). Using Cobb-Douglas and quasilinear specifications, they showed theoretically and empirically that CV is less than the savings from the subsidy removal and therefore a budget neutral reform can have a positive impact on welfare. Yet, this study did not consider the indirect effect of the energy price change that operates through a change in the prices of other goods and services. For Iran and employing the demand function method, Khalili Araghi and Barkhordari (2012) predict that if the government transfers 30% or more of the savings from the subsidy removal to the households, the negative impact of increased prices will be compensated up to a threefold increase. Similarly, Kafaie and Garshasbi (2016), using two cross-sectional datasets for 2009 and 2011 found that the Iranian...
cash transfer is more or equal to compensating variation for the first four income deciles in urban and the first seven income deciles in rural areas. Moshiri (2015) estimates energy demand elasticities of three energy carriers, namely electricity, natural gas, and gasoline among Iranian households in urban and rural areas for the period 2001 to 2008. The price elasticities of these three types of energy carriers are small and they tend to increase when income increases illustrating that the energy consumption of low-income households is at subsistence level. Thus, solely increasing the price of energy would not be able to curb consumption (Moshiri, 2015). Salehi-Isfahani et al. (2015) compared the two months after the implementation of the reform with the same months in the previous year and concluded that the energy reform had an immediate positive distributional impact. The reform contributed to an instant decline in poverty in both urban and rural areas. In addition, Gauthier and Tabatabai (2019) suggest that the subsidy reform has been perceived as a pro-poor policy by the government.

As the brief introduction of existing research about energy subsidy reforms has shown, most studies derive elasticities. With the paper at hand we aim at complementing the existing research by exploiting a micro panel dataset of households across Iran for a period of three years, namely 2010–2012. Thus, the unit of analysis is the household. Contrary to the existing research, our approach is inspired by impact evaluation techniques and aims to create a counterfactual analysis. To set the scene, we will introduce some impact evaluations related to universally implemented policies that informed our approach.

2.2. Related impact evaluation studies for universal programs

Since the energy subsidy reform in Iran has been universally implemented, we briefly discuss the approach of related studies that evaluate universal policies. Muyanga et al. (2010) used a three-wave panel dataset and propensity score matching (PSM) to estimate the impact of universally provided free primary education in Kenya on school enrolment, grade progression and secondary school enrolment. Lee and Wolf (2014) evaluated two old-age policy interventions consisting of a basic pension program and a long-term care insurance for the elderly in South Korea using panel data (pre- and post-treatment) and fixed- and random-effects modelling. Tran et al. (2019) investigated the impact of provincial governance on household welfare in Vietnam using fixed-effects estimation. Finally, Bleakley (2007) assessed the impact of a hookworm eradication campaign in South America on schooling, exploiting exposure risks as part of the identification strategy. Hookworms survive better in areas with sandy soils and warm weather; thus, the residents of such places are more at risk of infection and therefore benefit more from the campaign. Accordingly, Bleakley used the intensity or rate of pre-treatment infection to assess impact in a fixed-effects model framework.

Thus, the existing literature on universal policies shows that a combination of panel data with controls for observable characteristics, fixed effects and intensity measures can be used to attribute causal impacts. In what follows we will implement a similar approach.

3. Data

This research employs the annual ‘Household Income/Expenditure’ (HIE) survey of Iran for the years 1389–1391 according to the Persian calendar. This period closely corresponds to the period 2010 to 2012 according to the Gregorian calendar. Data is collected throughout the year in the form of door-to-door interviews, covering all provinces across Iran. The employed data collection method is randomized stratification and it is rotating such that each household is at most surveyed for 5 years. Although the survey takes place annually, household data in panel shape is only available for the chosen study period, i.e. the years 2010–2012, since the identification codes of the households changed over time. Therefore, conducting a panel analysis of the energy sector reform based on household level data for more than the mentioned three-year period is practically impossible. Table 1 presents the structure of the dataset. The total sample consists of 114,990 observations stemming from 62,380 households. Due to the rotating data collection, the dataset is not fully balanced across the years. We have most observations for 2011 and least for 2012. Yet, the sample size differences across the years are below half a percentage point. Importantly, nearly 45% of the households have been interviewed in all three years (2010–2012). The HIE surveys are address-based. Thus, it is likely that different household get the same identification code simply because a new household has moved to the existing address. In the sample at hand approximately 2% of the households’ codes that are present across all three years were replaced by a new household that moved to the survey address. Excluding these new households from the survey, the balanced sample contains 15,829 households. The main analysis of this article is based on the full sample (unbalanced panel dataset).

The survey provides a wide range of socio-economic indicators of the households ranging from household characteristics to information about household location and ownership of durable goods. In addition, the survey includes income and expenditure data. After the implementation of the subsidy reform, the survey also enquires about the receipt of the cash transfer. The rich household level information allows us to conduct a multivariate analysis that carefully accounts for confounding factors. From the dataset we construct nine expenditure categories. Details about the construction of the expenditure groups are found in appendix A. A full list of all outcome and control variables analyzed in the study at hand is presented in Table A2 of appendix A.

3.1. Description of the dataset

The median household in the sample is a 4-person household with a male head aged 50 years and with 98.4 million Iranian Rials (IR) real annual income.

Table 2 shows descriptive statistics comparing household observations prior to the subsidy reform with those after the subsidy reform. The subsidy reform was effective as of December 19, 2010; 28,808 observations of the sample are from prior to the reform and the remaining 86,182 observations are from after the introduction of the reform. As can be seen from the comparison of the background characteristics, we identify differences in age, gender of the household head, household size, marital status and home ownership. While the differences are statistically significant, they are small in magnitude and for most part identify expectable developments over time such as getting older or the passing away of older members. There is a positive change in household endowments (TV, car, mobile phone) over time; it is small in magnitude.

Table 1: Structure of the panel data.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of households</th>
<th>Sample share</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>38,285</td>
<td>33.29</td>
</tr>
<tr>
<td>2011</td>
<td>38,513</td>
<td>33.49</td>
</tr>
<tr>
<td>2012</td>
<td>38,192</td>
<td>33.21</td>
</tr>
<tr>
<td>Total</td>
<td>114,990</td>
<td>100</td>
</tr>
</tbody>
</table>


6 The precise period of overlap between the two calendars is 21 March 2010 to 20 March 2013.

7 In addition, we replicate the main analysis using the balanced sample (Appendix A, Table A6).

8 This amounts to roughly 21,127 International Dollars based on the PPP conversion factor in 2011.
but statistically significant. In turn, the population under study does not seem to be very mobile. There is no difference before and after the reform for those living in rural areas. Similarly, there is no difference in the literacy of the household head, the number of energy-intensive home appliances and household income.

In Table A3 of Appendix A, the average yearly income and expenditure across provinces is presented. On average real expenditure (income) declined over time but the actual decrease is incremental in value. The residential background characteristics differ before compared to after the reform; we assessed whether the subsidy removal and cash transfer (SRCT) can be linked to drop-out from the survey. Results are presented in Table A3 of Appendix A and show that survey attrition is not associated with the reform.

Turning to the outcome indicators the difference in means tests indicates that total expenditures and all expenditure groups except food change significantly over time. Only food expenditures remained the same after the subsidy reform, all other expenditure groups decreased. It is noteworthy that the sharpest decline can be observed in expenditures for clothing and those for furniture; both groups are durable expenditures that can be cut down in the short run.

In Table A4 of Appendix A, the average yearly income and expenditure across provinces is presented. On average real expenditure (income) declined over time but the actual decrease is incremental in value. Fig. 1 provides a graphical illustration of income/expenditure across provinces before and after the energy subsidy reform. The blue curve, representing average province level expenditures prior to the subsidy reform, superposes all other curves in most points. The average province level expenditures after the reform (grey curve) are lower in 23 of the 29 provinces. Concerning income, by and large average province level income before and after the reform overlap.

Table 2

Descriptive statistics.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Before reform</th>
<th>After reform</th>
<th>Diff in means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obs Mean Std. Dev.</td>
<td>Obs Mean Std. Dev.</td>
<td>p-value</td>
</tr>
<tr>
<td>Living in rural area</td>
<td>28,808 0.512 15.495</td>
<td>86,182 0.514 15.447</td>
<td>0.000</td>
</tr>
<tr>
<td>Age (head of household)</td>
<td>28,808 49.495 15.495</td>
<td>86,182 50.649 15.447</td>
<td>0.000</td>
</tr>
<tr>
<td>Household head is female</td>
<td>28,808 0.119 3.973</td>
<td>86,182 0.129 3.872</td>
<td>0.000</td>
</tr>
<tr>
<td>Household head is literate</td>
<td>28,808 0.679 3.973</td>
<td>86,182 0.680 3.872</td>
<td>0.603</td>
</tr>
<tr>
<td>Household size</td>
<td>28,808 1.821 1.821</td>
<td>86,182 1.896 1.896</td>
<td>0.000</td>
</tr>
<tr>
<td>Household head is married</td>
<td>28,808 0.885 3.973</td>
<td>86,182 0.856 3.872</td>
<td>0.000</td>
</tr>
<tr>
<td>Household income</td>
<td>28,808 97.661 85.288</td>
<td>86,182 98.640 86.625</td>
<td>0.000</td>
</tr>
<tr>
<td>House owned by the household</td>
<td>28,808 0.768 0.422</td>
<td>86,182 0.787 0.409</td>
<td>0.000</td>
</tr>
<tr>
<td>Number of rooms</td>
<td>28,808 3.399 1.130</td>
<td>86,182 3.442 1.080</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-wage income from agriculture</td>
<td>28,808 0.215 0.215</td>
<td>86,182 0.196 0.196</td>
<td>0.000</td>
</tr>
<tr>
<td>Household receives cash transfer</td>
<td>28,808 0.014 0.014</td>
<td>86,182 0.032 0.032</td>
<td>0.000</td>
</tr>
<tr>
<td>Share of cash transfer in income</td>
<td>28,808 0.014 0.014</td>
<td>86,182 0.193 0.193</td>
<td>0.000</td>
</tr>
<tr>
<td>Number of energy-intensive appliances</td>
<td>28,808 1.821 0.889</td>
<td>86,182 1.896 0.889</td>
<td>0.000</td>
</tr>
<tr>
<td>Household owns a radio</td>
<td>28,808 0.063 0.063</td>
<td>86,182 0.061 0.061</td>
<td>0.258</td>
</tr>
<tr>
<td>Household owns a TV</td>
<td>28,808 0.964 0.964</td>
<td>86,182 0.971 0.971</td>
<td>0.000</td>
</tr>
<tr>
<td>Household owns a car</td>
<td>28,808 0.267 0.267</td>
<td>86,182 0.300 0.300</td>
<td>0.000</td>
</tr>
<tr>
<td>Household owns a mobile phone</td>
<td>28,808 0.788 0.788</td>
<td>86,182 0.844 0.844</td>
<td>0.000</td>
</tr>
<tr>
<td>Household has lost a member</td>
<td>28,808 0.007 0.007</td>
<td>86,182 0.021 0.021</td>
<td>0.000</td>
</tr>
<tr>
<td>Household travelled abroad</td>
<td>28,808 0.014 0.014</td>
<td>86,182 0.032 0.032</td>
<td>0.000</td>
</tr>
<tr>
<td>Food expenditure</td>
<td>28,808 33.007 26.641</td>
<td>86,182 33.059 23.563</td>
<td>0.752</td>
</tr>
<tr>
<td>Clothing expenditure</td>
<td>28,808 10.441 14.599</td>
<td>81,417 6.825 9.051</td>
<td>0.000</td>
</tr>
<tr>
<td>Furniture expenditure</td>
<td>28,808 10.827 17.330</td>
<td>57,804 7.688 11.669</td>
<td>0.000</td>
</tr>
<tr>
<td>Health expenditure</td>
<td>28,808 37.543 41.842</td>
<td>86,182 36.289 32.608</td>
<td>0.000</td>
</tr>
<tr>
<td>Accommodation expenditure</td>
<td>28,808 10.441 14.599</td>
<td>81,417 6.825 9.051</td>
<td>0.000</td>
</tr>
<tr>
<td>Transportation expenditure</td>
<td>28,808 6.127 9.212</td>
<td>81,860 4.868 6.884</td>
<td>0.000</td>
</tr>
<tr>
<td>Communication expenditure</td>
<td>28,808 8.463 11.300</td>
<td>79,090 4.366 5.421</td>
<td>0.000</td>
</tr>
<tr>
<td>Recreational expenditure</td>
<td>28,808 3.464 6.902</td>
<td>55,423 2.464 4.690</td>
<td>0.000</td>
</tr>
<tr>
<td>Other expenditure</td>
<td>28,808 12.376 12.376</td>
<td>86,182 7.836 9.736</td>
<td>0.000</td>
</tr>
<tr>
<td>Household total expenditure</td>
<td>28,808 111.930 107.205</td>
<td>86,182 103.434 82.499</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on the HIE survey 2010–2012.

Note: All income and expenditure items are annualized, in real terms (2011=100) and in million Iranian Rials (IR). Energy-intensive home appliances are freezer, washing machine, microwave, central cooling, air conditioner and TV.

3.2. What is the value of the cash transfer?

In the sample at hand, nearly 98% received the cash transfer in 2012. This matches data at the population level (Supreme Audit Court, 2013). In 2012, 12.2% are highly dependent on the cash transfer, i.e. the cash transfer represents more than 40% of their income. The geographical distribution of this group is notable: more than 81% of those being highly dependent on the cash transfer are located in rural areas. Fig. 2 displays the share of the cash transfer in household income for rural and urban areas at the province level, in 2012. On average, the cash transfer comprises 17.8% of the income of urban households and 27.9% of rural households. The cash transfer dependency is highest for the province ‘Sistan & Balouchestan’; in the rural areas of that province, it amounts to almost half the income. It is further noteworthy that the cash transfer dependency rate of rural residents of twelve provinces is more than 30%. In none of the provinces can the share of the cash transfer in household income be considered marginal. The lowest dependency rates are found in the provinces of Tehran and Alborz, which are 12 and 15% on average, respectively. Another way to see the value of the cash transfer is to compare it with food expenditures: 12.9% of the households spend an equal or lower amount than the cash transfer on food. By 2012, only 2% of the sample at hand, i.e. 833 households, did not register to receive the cash transfer. The group is fairly equally divided between those living in urban and rural areas. The results of a logit model assessing uptake of the cash transfer are presented in Table A5 of Appendix A. Overall, the results suggest that indeed the cash transfer could be received by virtually everyone since there are no major, observable limiting or enabling factors.
Table 4

Impact of the subsidy reform across expenditure groups.

<table>
<thead>
<tr>
<th>Expense groups</th>
<th>Total expenditure</th>
<th>Food</th>
<th>Clothing</th>
<th>Furniture</th>
<th>Health</th>
<th>Accommodation</th>
<th>Transport-ation</th>
<th>Communication</th>
<th>Recreation</th>
<th>Other</th>
<th>Total expenditure (log)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A SRICT</td>
<td>-2.139***</td>
<td>2.346</td>
<td>2.139***</td>
<td>2.113***</td>
<td>1.810***</td>
<td>-2.346***</td>
<td>0.440***</td>
<td>0.524***</td>
<td>0.449</td>
<td>0.654</td>
<td>0.168</td>
</tr>
<tr>
<td>Observations</td>
<td>114,585</td>
<td>66,141</td>
<td>108,573</td>
<td>76,840</td>
<td>114,848</td>
<td>109,005</td>
<td>103,633</td>
<td>114,848</td>
<td>109,005</td>
<td>114,848</td>
<td>114,848</td>
</tr>
<tr>
<td>Panel B SRICT</td>
<td>-0.460</td>
<td>1.364</td>
<td>0.524***</td>
<td>0.478</td>
<td>0.238</td>
<td>-0.449</td>
<td>-0.654</td>
<td>-0.137</td>
<td>-0.134</td>
<td>-0.192</td>
<td>-0.250</td>
</tr>
<tr>
<td>Observations</td>
<td>81,688</td>
<td>48,339</td>
<td>77,638</td>
<td>54,881</td>
<td>81,881</td>
<td>77,773</td>
<td>73,046</td>
<td>81,881</td>
<td>77,773</td>
<td>81,881</td>
<td>81,881</td>
</tr>
<tr>
<td>Panel C Proxy</td>
<td>3.779***</td>
<td>1.109</td>
<td>0.950***</td>
<td>1.189***</td>
<td>1.015***</td>
<td>0.343</td>
<td>0.792***</td>
<td>0.058***</td>
<td>0.025***</td>
<td>0.055***</td>
<td>0.008</td>
</tr>
<tr>
<td>Observations</td>
<td>81,881</td>
<td>48,339</td>
<td>77,638</td>
<td>54,881</td>
<td>81,881</td>
<td>77,773</td>
<td>73,046</td>
<td>81,881</td>
<td>77,773</td>
<td>81,881</td>
<td>81,881</td>
</tr>
</tbody>
</table>

Note: A household-level, fixed-effects model for the period 2010 to 2012 is employed; standard errors, clustered at the household level are presented in parentheses; */**/*** indicates p-value<0.10/0.05/0.01.

4. Identification strategies and results

4.1. Empirical model

For analyzing the impact of a reform at the micro-level, impact evaluation approaches lend themselves (Gertler et al., 2016). Yet, the reform at hand poses several design challenges. Like for other impact evaluations of universal reforms, conducting a randomized experiment was not an option since the reform was simultaneously implemented throughout the country. In such cases, the most commonly applied empirical analysis approaches are before-after studies making use of fixed-effect models (Lee and Wolf, 2014; Tran et al., 2019; Yu et al., 2020; Lindstrom and Giordano, 2016).

We attempt to tackle the identification problem by combining different methods. First, we implement a panel data analysis for a three-year household panel dataset (2010–2012); we employ household-fixed effects to account for structural differences at the lowest level of observation. In addition, we account for the time trend to capture dynamic effects. Moreover, as introduced in section 4, we use a myriad of household level control variables to account for observable confounding factors. In addition, the average impact of the reform is estimated not only for one outcome variable, i.e. total expenditures, but also for each expenditure subgroup. Importantly, all expenditure variables are expressed in real terms to account for inflation. This results in the following empirical model:

\[ y_{ipt} = X_{ipt}^\prime \alpha + G_{ipt}^\prime \theta + T_t^\prime \delta + \phi \text{SRCT}_t + \epsilon_{ipt} \]

where \( y_{ipt} \) is the outcome of interest for household \( i \) in province \( p \) at time \( t \). \( X_{ipt} \) is the vector of household socio-economic characteristics (compare Table A2 in appendix A for details); \( G_{ipt} \) is the vector of geographical variables, including household specific effects, and \( T_t \) captures times dummies for the month of the interview, a time trend, and a dummy for the start of new international sanction in January 2012. The latter ensures that our impact estimates is purged of negative economic effects stemming from the sanctions. \( \text{SRCT}_t \) is the treatment variable, which is a dummy that takes the value of 1 for household observations that were collected after the implementation of the energy subsidy reform and 0 otherwise; \( \phi \) is the parameter of interest.

As a second model we apply the methodology advanced by Bleakley (2007). Instead of implementing a simple 0–1 treatment indicator, we use the intensity of treatment. We first calculate an energy consumption intensity index. The index is constructed as the ratio of the energy consumption of each household relative to the average consumption of the households located in the same geographical location in the same

Fig. 1. Income and expenditure across provinces before and after the energy subsidy reform

Source: Authors' illustration based on the HIE survey 2010–2012.
month, prior to the reform. This energy consumption intensity index $\text{intensity}_p$ is then multiplied with the 0–1 treatment indicator:

$$\text{intensity}_p \cdot \text{SRCT}_t$$

The logic behind the intensity index is that households that consume more energy tend to be affected more (in absolute terms) by the subsidy reform. In the empirical analysis we use different measures to construct the intensity of energy consumption to be able to gauge the robustness of our findings. In the intensity specifications we replace the simple treatment dummy \(\text{SRCT}_t\) with the intensity indicator $\text{intensity}_p \cdot \text{SRCT}_t$, keeping everything else equal. The standard errors of all models are clustered at the household level.

Last but not least, we assess the sensitivity and robustness of the results using supplementary analyses.

4.2. Main results

The main results are presented in Table 4. Panel A of Table 4 reports the fixed-effect estimates of the impact of the ‘subsidy removal and cash transfer’ (henceforth the acronym ‘SRCT’ is used) on nine expenditure groups and total expenditure.\(^\text{11}\) Note that we only present the coefficient estimate associated with SRCT. All the above-mentioned covariates are included in all specifications but not reported for the sake of brevity.

The results suggest that the reform has decreased total household expenditure on average by 7 million IR equivalent to nearly 6.5% of the annual expenditure. The expenditure groups that exhibit the largest decline are health, food, clothing, and other expenses. The decline in expenditures is practically meaningful and statistically significant across all expenditure groups but accommodation. The latter is the only expenditure group that shows an increase after the introduction of the reform. This is not unexpected for two reasons: First, the utility and fuel price index climbs to more than twofold of the overall price index after the reform; the utility costs (embedded in accommodation expenditure) have sharply increase after the reform. Second, since accommodation cannot be changed or adjusted readily, the possibility to cut these

Fig. 2. Cash transfer dependency/share of the cash transfer in income in 2012
Source: Authors’ illustration based on the HIE survey 2010–2012.

\(^{11}\) For the sake of brevity, we only present the coefficient associated with the reform. Detailed regression results are made available by the authors upon request.
expenses is not as big as for other costs. Households have to keep their housing and related fuel and electricity consumption that corresponds to their basic needs. It is further notable that we identify only a comparatively small reduction in transportation expenses. Again, this is unsurprising since the reform has increased the price of fuel severalfold. Thus, even if households reduce commuting and transportation, the decline in the monetary value of these expenses is small due to the increased costs per ride. Moreover, health expenditure had a sizable and significant decrease of more than 2 million IR as a consequence of the reform. In addition, the expenditure group that collects other expenditure items including on education, investment and miscellaneous expenses similarly experiences a decrease of 2 million IR (p-value≤0.01). Taken together, the contraction in expenditures such as health, education and investment may have long-run social impacts. Note that the findings are established despite controlling, across specifications, for the installment of the international sanctions, for temporal dynamics and all household level covariates including the share of the cash transfer in household income that has been distributed to counteract negative repercussions of the reform.

Panel B reports the impact of SRCT on the expenditure groups employing the intensity measure as introduced in Equation (2). Given that the cut of the energy subsidies, i.e. the sharp increase in the prices of fuel, gas and electricity has a direct impact on transportation and utility costs, households that have a greater share of transportation or utility costs will be affected more by the reform. Based on this observation we defined two intensity variables. First, we measure the pre-reform share of transportation costs in total expenditures as ratio to the average of the other households located in the same geographical area and being surveyed at the same time, i.e. the same pre-reform month (intensity 1).

The second intensity indicator is linked to utility costs. Due to the lack of data on utility costs (gas and electricity), we count the number of pre-reform energy-intensive home electrical appliances including freezer, washing machine, microwave, central cooling and air conditioner. These appliances are high-energy consumers and serve as a proxy for the intensity of utility costs. Thus, our second intensity measure is the ratio of the number of energy-intensive home appliances to the local average. The local average is calculated for those households located in the same area prior to the reform (intensity 2).

Panel B of Table 4 reinforces the findings of Panel A. Across expenditure categories we find a significant negative impact of SRCT. Given that the treatment variable is multiplied by the intensity measure, we cannot directly compare the coefficient estimates between Panels A and B. The coefficient estimates of Panel B show the effect at the mean of the specification suggests that the largest impact of the reform in terms of spending on human capital is compromised. First, accommodation and food expenditures are essential and on average household there is no room for adjustments in accommodation. The decrease in accommodation expenditure is trivial and insignificant as there is not much room to maneuver. Again, the findings are consistent with respect to the employed intensity measure.

Panel C of Table 4 presents the results of using the mazut price as proxy for the energy subsidy reform. Mazut is heavy and low-quality fuel, which is used in power plants as backup fuel. In cold winters, when natural gas supply cannot meet the demand due to high levels of household consumption, power plants use mazut to maintain the electricity generation. As part of the energy subsidy reform the mazut price increased from 0.09 to 2 million IR per cubic meter. Given that there is no direct channel that links the mazut price to household expenditures, it can be considered an exogenous shock. Thus, it is a fine proxy for SRCT. Across expenditure groups we find a negative and statistically significant impact except for accommodation. At the mean level, we identify a decline of nearly 6 million IR in total expenditure. This decline is mainly driven by spending less on health, food and clothing. Although the magnitude of the coefficients presented in Panel A and C cannot be directly compared, the direction of the impacts and statistical significance are very similar.

In short, across empirical specifications we find a consistent negative impact on total expenditures and 7 out of 9 expenditure groups, suggesting that indeed the subsidy reform had negative repercussions for the society at large despite the accompanying unconditional cash transfer. Note that the panel dataset constructed for the main analysis is unbalanced because it results from a rotating data collection. As discussed in section 3.1, drop-out from the survey (attrition) is not associated with the reform (Appendix A, Table A3). Thus, technically speaking, fixed-effect models remain consistent when applied to an unbalanced dataset. Yet, to rule out any potential influence stemming from the unbalanced dataset, we replicate the main analysis using the balanced sample. The balanced sample excludes households that have not been present in all three survey waves or were replaced by other households at the same address. This balanced panel includes 15,829 households. The detailed results are presented in Appendix A, Table A6. The findings are akin to the earlier established, full sample results (Table 4), showing that the energy subsidy reform led to a decline in annual household expenditures of 7–9 million IR depending on the specification.

The empirical results established so far indicate that household consumption shrinks after the introduction of the subsidy reform. To further assess how households cope with the reform, the share of each expense group in total expenditures is investigated. Put differently, we try to assess to what extent households reorganize their expenses in response to the reform. Table A7 of appendix A shows the changes in the shares of the expenditure groups. We employ the same empirical specifications as introduced above. A detailed discussion is presented in appendix D.

Overall, the analysis of the expenditure shares has two main implications. First, accommodation and food expenditures are essential and increase or remain at least at the same level. Put differently, for the average household there is no room for adjustments in accommodation and food expenses as they simply maintain their basic level of shelter and food. Second, looking into the dynamics across the other expenditure groups points at possible negative, long-term repercussions for the welfare of the households in terms of health, education, and investment (embedded in ‘other expenditure’). Putt differently, it is likely that spending on human capital is compromised.

4.3. Additional robustness check

We conducted two additional analyses to further check the robustness of the results. First, we divided the data into two subsets and conducted the analysis on the sub-samples. Second, we employed two placebo analyses prior to the implementation of the actual reform (Athey and Imbens, 2017). Detailed results are presented in Appendix E. The random sub-sample analysis supports our main findings, and the placebo analyses indicate that indeed we capture the impact of the reform on expenditures since prior to the reform we do not find any treatment effects of our placebo interventions.
4.4. Heterogeneity analysis

So far, the average impact of the energy subsidy reform on household expenditures has been discussed. Using the first specification, on average, a household loses 7 million IR due to the reform (Table 4, Column 1). This means that the total expenditures of a household shrink on average by nearly 6.5%. Here, we further inspect the heterogeneity of this impact. Table 5 presents the impact of the reform on specific subgroups of the population. In addition to the coefficient estimate associated with the reform, the pre-reform mean for the subgroup is presented and the shrinkage in total expenditure is calculated employing the coefficient estimate and the pre-reform mean is presented.

The second row of Table 5 shows that although the absolute impact of the reform is smaller in rural areas compared to the global impact (Table 5, first row), the relative shrinkage of their expenditures is larger. Unsurprisingly, households that consume more energy are affected more by the reform. The absolute magnitude of the impact on households with big houses and households that own more electrical appliances with high energy consumption is larger than the average (about 12 and 11 million IR, respectively, and a shrinkage of about 8%). The results further indicate that low-income households (per capita income being less than the median income, expenditure being less than 60% of the median expenditure, high dependency on cash transfer) are subject to less shrinkage in total consumption in absolute terms. While we identify a statistically significant negative impact on households whose per capita income is less than the median, we lose significance for households whose expenditure is less than 60% of the median and those who have a high dependency on the cash transfer. Similarly, the heterogeneity analysis indicates that the reform hits provinces with the lowest level of per capita GDP\(^\text{12}\) to a lesser extent. The identified negative effect is statistically insignificant.

Lastly, when we split the sample into three income groups and compare lower income class households (less than two thirds of the per capita median income)\(^\text{13}\) with middle income class households (two thirds to double the per capita median income) and high income class households (more than twofold per capita median income), we show again that it is not the low income class group that is affected the most by reductions in expenditure. In turn, middle class households experience a sizeable and statistically significant decrease in expenditures. This is likely the case because the intensity of energy consumption of a middle-class household is more than the intensity of lower income households. In addition, a large part of the middle-class households are civil servants and laborers who have fixed salaries and cannot pass the energy price shock through. In turn, upper class households can maintain their level of consumption as the relative impact the reform on their expenditures is negligible.

Related, it is households that have non-wage income from agriculture who lose considerably more than the average household both in absolute (−9.918) and relative terms (9% shrinkage) possibly pointing at their fuel dependency at the production site. Further note that this group of households constitutes the rural middle-class that typically owns farmland. The earnings of a rural household that has non-wage income is almost 19% more than that of other rural households, i.e. 85.79 versus 72.28 million IR. Moreover, these households are more than 55% richer than low-income households.

In short, the heterogeneity analysis shows that the major burden of the subsidy reform is carried by the middle-class households that are highly energy dependent. In turn, the cash transfer plays a crucial role in protecting lower income groups. Given that the relative value of the cash transfer is more for low-income groups and that energy consumption is lower for them (i.e. the median number of energy-intensive home appliances is 2 while the figure for low-income groups is 1), the results imply that the cash transfer managed to smoothen the impact of the subsidy reform for the poorest households.

5. Implications for inequality and poverty – an exploratory analysis

Two noteworthy aspects of each redistributive policy are the impact on income inequality and poverty. Compared to the previous analysis this part of the study is more descriptive due to data restrictions. We measure income inequality among households prior and after the reform with the Gini index. Fig. 3 illustrates the Lorenz curves before and after the reform. The vertical axis shows the cumulative share of income and the horizontal axis the cumulative share of households from the lowest to the highest income. As can be seen, the curve moved slightly towards a more equal income distribution (towards the 45°-line) after the reform; this is represented by the red line that is inside the blue line.

\[^{12}\] The following 8 provinces have had the lowest per capita GDP on average in the period 2010 to 2012: West Azarbaijan, Sistan & Baluchestan, Kurdestan, Golestan, North Khorasan, South Khorasan, Chahar-Mahal & Bakhtiari and Lorestan.

\[^{13}\] The classification was adopted from the PEW Research Center: http://www.pewsocialtrends.org/2015/12/09/the-american-middle-class-is-losing-ground/[Last accessed 05-04-2020].
Fig. 3. Lorenz curves before and after the reform
Source: Authors’ calculation. Note: The blue (red) line represents income inequality before (after) the reform. The green line is the 45°-line illustrating perfect equality. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Table 6 presents the Gini index before and after the reform in urban and rural areas. The Gini indices indicate that the income distribution has been significantly improved after the subsidy reform both in urban and rural areas with the change being more pronounced in rural areas. Average and maximum incomes in rural areas are considerably lower compared to those in cities whereas the minimum income level is comparable. Hence, with the cash transfer, the difference between the lowest and average/highest income is improved more in rural areas. Overall, the Gini index was reduced from 0.39 to 0.36. The third row of Table 6 shows the Gini indices after SRCT with the exclusion of the cash transfer from household income. It shows that income inequality would have increased significantly if the cash transfer was not a part of the subsidy reform.

As the Gini index is sensitive to changes in the middle of the distribution and does not reflect the changes at the bottom and top deciles well, we also employ the Palma index. It measures inequality as a ratio of the share of the richest 10% to the poorest 40% of the income distribution. The Palma index (Table 6) shows that the intensity of inequality is more pronounced in rural areas compared to the cities. In both areas, income inequality improved after the subsidy reform. For the sample as a whole, the Palma index reduced from 1.80 to 1.49. The third row indicates that inequality would have worsened after the subsidy reform if the subsidy removal was not accompanied by a cash transfer.

In general, it is expected that cash transfers decrease poverty. However, in this case the cash transfer was accompanied with an increase in energy prices and inflation. Therefore, concerns are valid that the subsidies removal was not accompanied by a cash transfer. To compensate this increase in price the Iranian government transfers 40,500 IR per person per month to the bank account of household heads who have registered for the cash transfer. Thus, SRCT is a unique energy reform as the government’s objective is not fiscal consolidation but redistribution. In theory, keeping all other variables constant, cash transfers lead to a higher level of utility for consumers compared to a subsidy. Hence, theoretically cash transfers are the preferred policy. However, in practice household behavior adjusts to the reform and other factors such as markets and the prices of

6. Conclusion and policy implications

This study employs impact evaluation techniques to assess the Iranian, nation-wide energy subsidy reform (SRCT) that was put into effect in December 2010. While demand estimation models rely on stylized facts and have to make assumptions about the development of the economy at large, an impact study that assesses micro-level panel data can directly reveal the impact of the policy on households.

With this reform, the price of all energy carries such as gas, gasoil, natural gas, and electricity hiked up several times of the originally subsidized price. To compensate this increase in price the Iranian government transfers 40,500 IR per person per month to the bank account of household heads who have registered for the cash transfer. Thus, SRCT is a unique energy reform as the government’s objective is not fiscal consolidation but redistribution. In theory, keeping all other variables constant, cash transfers lead to a higher level of utility for consumers compared to a subsidy. Hence, theoretically cash transfers are the preferred policy. However, in practice household behavior adjusts to the reform and other factors such as markets and the prices of

**Table 7**

<table>
<thead>
<tr>
<th>Absolute poverty threshold:</th>
<th>Share of households below the poverty line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before SRCT</td>
<td>after SRCT</td>
</tr>
<tr>
<td>Per capita expenditure 1.90$ per day or less</td>
<td>0.1%</td>
</tr>
<tr>
<td>Per capita expenditure 3.10$ per day or less</td>
<td>0.6%</td>
</tr>
<tr>
<td>Per capita expenditure 5.50$ per day or less</td>
<td>4.7%</td>
</tr>
<tr>
<td>Relative poverty measures:</td>
<td></td>
</tr>
<tr>
<td>Under 60% of median expenditure</td>
<td>8.6%</td>
</tr>
<tr>
<td>Under 50% of median expenditure</td>
<td>5.2%</td>
</tr>
</tbody>
</table>

Source: Authors’ calculation.
Note: The difference in means test prior and after the reform was conducted for every poverty indicator; *** indicates p-value ≤ 0.01/0.05/0.10, respectively.
other goods and services do not remain unresponsive.

To study the impact of the reform on households, a panel data analysis has been implemented, employing the Household Income/Expenditure (HIE) surveys for the period 2010 to 2012. We analyzed total expenditure together with nine expenditure sub-groups. Since the subsidy reform and accompanying unconditional cash transfer is a nation-wide, one-time policy shift, we had to resort to a mix of identification strategies such as a myriad of fixed effects, intensity measures (Bleakley, 2007) and a proxy to tease out the causal relationship between the reform and household expenditures. In addition, we purged out confounding effects stemming from inflationary and time dynamics and from the installment of the new international sanctions to Iran. We found that the subsidy reform has a significant negative impact on household consumption, meaning that in practice the cash transfer could not fully compensate the negative repercussions of the subsidy cut. On average, the reform decreased annual household expenditure between 7 and 9 million IR depending on the employed empirical specification. This implies that the decrease in consumption ranged between 6.5 and 9%. Clothing, health and other (education, investment and miscellaneous) expenses are subject to the largest spending reductions. The robustness analyses further support the identified negative impact of the subsidy reform on household expenditure despite the accompanying cash transfer.

At the same time, the heterogeneity analysis shows that for some population sub-groups the cash transfer could attenuate the negative impact of the reform, i.e. the negative impact of the reform is not homogenously distributed across the population. Households that tend to consume more energy are subject to a more pronounced negative impact. In this regard, living in a bigger house or having more electrical home appliances are parameters that indicate a larger negative impact. On the contrary, households whose income is below the median income, or those that are highly dependent on the cash transfer, experience no contraction in their consumption. Since the cash transfer was substantial for many households, i.e. in 2012, 19% of the households in rural areas have been highly dependent on the cash transfer, the immediate redistributive effects are achieved.

This can also be seen in the inequality and poverty analyses. After the implementation of the reform, income equality has improved, i.e. the Gini and Palma indices both reduced. Furthermore, the cash transfer resulted in significant poverty mitigation both in absolute and relative terms.

Nonetheless, it is not unlikely that the achievements in terms of poverty mitigation may be eroded in the mid to long-term. Since the inception of the reform in December 2010, the cash transfer has not changed. Yet, the inflationary impact of the subsidy reform (Zarepour, 2022; Gharibnavaz and Waschik, 2015) together with the inflation induced by the international sanctions targeting the Iranian economy, including but not limited to the oil exports and the central bank (Hemmati et al., 2018; Ghorbani Dastgerdi, Yusof and Shabbaz, 2018) considerably devaluated the cash transfer. The consumer price index (CPI) presented in Table A9 in appendix A reveals that the real value of the cash transfer was less than half by the end of 2015.

The study suffers from the limitation that it has to resort to quasi-experimental impact evaluation techniques since the reform has been universally implemented ruling out an experimental evaluation. Yet, we control for confounding factors and use different techniques and methods all coming to the same conclusion of an overall negative impact of the reform on expenditures.

The foremost implications of this study are fourfold: First, ‘timing is everything’. Any reform of such dimension has to be implemented when the economy is growing, and no crisis is foreseen. In the case of Iran, the reform has been implemented when the country was in the midst of a nuclear enrichment challenge with the West and punishment mechanisms to sanction the economy of Iran were negotiated. Following the nuclear advancement strategy and simultaneously initiating the subsidy reform was a blunder and led to the, at most, limited success of the reform in the short run and questionable long-term effects due to inflation and the related devaluation of the cash transfer that accompanied the reform. Second, energy is a key element in every economy and manipulation of its price is likely to hit the heart of the economy. Energy prices are deeply linked to structural aspects of an economy, especially in the case of oil exporting countries. The Iranian economy has been set up in such a way that it is a long-term addict to low energy prices. Therefore, implementing the reform with the assumption of overall structural stability despite the reform itself affecting the very structure of the economy is prone to erroneous, ex ante predictions even in the absence of external pressures. Third, theoretically a cash transfer outperforms a subsidy policy. Yet, this does not necessarily hold for the case of a concomitant subsidy removal and cash transfer as replacement. Even in the extreme case as presented by the energy subsidy reform in Iran where all savings from the reform have been redistributed to the households as cash transfer, the reform has caused a significant reduction in household consumption. Fourth and most importantly from a human capital point of view, the redistributive measures taken by the households clearly show a reduction in human capital production. The adjustments in household spending mainly took place in food, health, and education. At this stage we can only hypothesize about the size of the cumulative, long-term impacts. But in the context of the implemented reform they are unlikely to be offset and thus will require further (costly) policy actions.

CRediT authorship contribution statement

Zahra Zarepour: Conceptualization, Methodology, Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. Natascha Wagner: Conceptualization, Methodology, Validation, Supervision, of the project, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.enpol.2022.113145.

References


17 According to the figures of the Supreme Audit Court of Iran, in 2012, the government could acquire 395,107 billion Iranian Rial from the subsidy removal while it spent 413,963 billion IR as cash transfer. In 2013, the government obtained 429,053 billion Iranian Rial and paid 430,747 billion IR.


References

