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Impacts of Price Shocks: Price Modeling Analysis for Saudi Sectors

آثار صدمات الأسعار: تحليل نموذج الأسعار لقطاعات سعودية

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ABSTRACT

This paper investigates the impacts of increasing prices on the following sectors in Saudi Arabia: electricity, gas, water, manufacturing, agriculture, transport, storage, and communications. It evaluates the changes in producer and consumer prices and household living expenses. The Saudi Social Accounting Matrix (SAM) was developed along with a price multiplier approach used to analyze different simulations. Two findings stand out. First, there are differences in impacts according to household groups and the direction of the effects. Low-income and middle-income households were the most negatively affected by the price hikes. Second, the potential impacts of manufacturing, transport, storage, and communications price shocks are high. For a 50% increase in prices, the overall increases in cost of living for low-income households and middle-income households, as estimated with the SAM price model, are 20.59% and 6.17%, respectively. In contrast, the impacts of electricity, gas and water supply, and agriculture prices are minor, estimated at 2.05% and 2.75%, respectively. This would indicate that special attention should be given to compensatory mechanisms to minimize the adverse effects on low-income and middle-income household groups.

الملخص

تقدم هذه الدراسة نتائج لسيناريوهات زيادة أسعار القطاعات التالية (قطاع الكهرباء والغاز وإمدادات المياه، وقطاع التصنيع، وقطاع الزراعة، وقطاع النقل والتخزين والاتصالات) في المملكة العربية السعودية. وقيّمت الدراسة تغيرات أسعار تلك القطاعات على أسعار المنتجين والمستهلكين ونفقات معيشة الأسر. تم تطوير مصفوفة المحاسبة الاجتماعية السعودية (SAM) مع نهج مضاعف السعر الذي تم استخدامه لتحليل عمليات المحاكاة المختلفة. وتبرز النتائج التالية: أولاً، هناك اختلافات في الآثار وفقاً لمجموعات الأسر المعيشية، ووفقاً لاتجاه الأثر. وكانت الأسر ذات الدخل المنخفض والأسر المتوسطة الدخل الأكثر تأثراً بشكل سلبي بارتفاع الأسعار. ثانياً، إن الآثار المحتملة للصدمات في أسعار المنتجات المصنعة وخدمات النقل والتخزين والاتصالات مرتفعة. عند زيادة الأسعار لتلك المنتجات والخدمات بنسبة 50% فإن الزيادة الإجمالية في تكلفة المعيشة للأسر التي تقدر بنموذج السعر لمصفوفة الحسابات الاجتماعية هي 20.59% و6.17% على التوالي. في حين أن آثار زيادة أسعار الكهرباء والغاز وإمدادات المياه وأسعار المنتجات الزراعية ضئيلة، والتي تقدر بـ 2.05% و2.75% على التوالي. وهذا يوحي بضرورة إيلاء اهتمام خاص للآليات التعويضية للتقليل من الآثار السلبية على الأسر ذات الدخل المنخفض والمتوسط.

KEYWORDS
الكلمات المفتاحية
Social accounting matrix, input–output model, general equilibrium, technical coefficients, households living expenses, Saudi Arabian economy
مصفوفة الحسابات الاجتماعية، نموذج المدخلات والمخرجات، التوازن العام، المعاملات الفنية، نفقات المعيشة للأسر، الاقتصاد السعودي

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1. Introduction

In the past few decades, Saudi Arabia has enjoyed exponential economic growth, powered by its substantial oil revenues. During this period, rising oil revenues have allowed the Saudi government to provide some goods and services at low prices. For instance, electricity, fuel, and water are provided at low administered energy prices. In recent years, Saudi Arabia's government has increased domestic prices for some products and services to compensate for lost income as a result of international oil prices. According to official data issued by the General Authority for Statistics (GASTAT), the prices of 122 goods and services in Saudi Arabia rose year-on-year until April 2020 (GASTAT, 2020). As a result of these price shocks, the government is now struggling to implement compensatory measures, mostly to offset part of the negative impact of product and service prices on the poor.

Some of the prices of goods and services tend to have a more considerable direct impact on consumers than others due to their large share of total consumption. Consequently, it remains an open question as to whether the effects of some products and services prices are likely to be larger than others. It is also uncertain whether upper-, lower-, or middle-class households are most likely to be affected. Answering these questions may be essential for providing guidance for policymakers discussing the compensatory measures that governments could take to respond to these price increases.

This paper aims to provide a comparative assessment using the Saudi SAM price multiplier framework. The objective is to determine the potential impact on the cost of living for various Saudi households that would follow from an increase in different product prices. This analysis is essential in general but also for Saudi Arabia in particular. Indeed, electricity, gas, and water prices have increased rapidly in recent months in Saudi Arabia, and the population of the country has been affected. Other sectors' prices have also grown rapidly over the last few years, with direct and indirect effects for consumers and firms. The price shocks have manifested themselves as increases in the price of gas at the pump as well as through price increases for other goods and services such as kerosene, transport, and water supply.

From a methodological viewpoint, this paper uses the SAM 2017 to examine the effect of an exogenous increase of 50% in the prices of the electricity, gas, water, manufacturing, agriculture, transport, storage, and communications sectors on the cost of living for different types of household.

A vital aspect of this paper is that it relies on the form of general equilibrium models, namely, the SAM framework, instead of using an input–output (I–O) table. An SAM is mainly a data framework that operates as a double-entry square matrix, recording payments (or expenditures) in columns and receipts (or incomes) in rows for transactions made by the various activities, commodities, and agents in the economy. When SAMs are used as models to evaluate the effect

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of quantity or price shocks, they are naturally static models with fixed technical coefficients (i.e., Leontief technology) and prices. The main advantage of SAMs over I–O tables is that data from household surveys of consumption patterns and incomes can be integrated into the analysis. This feature paves the way for study and analysis of the details of different scenarios on different groups of households.

The objective here is to use a recent SAM for Saudi Arabia to assess the potential impact of the increase in four sectors' prices on the cost of living for the consumption basket of different household types. It answers the following questions: 1. If the Saudi economy faces price shocks, which sectors of the economy would be most affected? 2. What would be the distributional consequences of these shocks on households, given the patterns of consumption observed for categories of Saudi households?

The structure of the paper is as follows: Section 2 reviews the literature, Section 3 presents the SAM model for the impact of price shocks, Section 4 deals with the database and empirical application, Section 5 demonstrates policy scenarios and empirical results, and Section 6 concludes the study and reflects on its potential extensions.

2. Literature Review

Investigations of the impacts of product price issues in developing countries can be found in many areas of the literature, and they mostly suggest that increases in commodity and service prices will increase living costs and, ultimately, poverty levels. Various studies have demonstrated this analysis (Alene et al., 2009; Becerril, 2010; Estrades and Terra, 2012; Mcculloch, 2008; Rodriguez-Takeuchi and Imai, 2013; Timmer, 2004; Warr, 2008; Wood et al., 2012).

This is mostly a consequence of low- and middle-income households using most of their income for consumption. Additionally, global price shock has a more significant impact on developing countries than developed ones (Furceri et al., 2016).

There are several methods for analyzing the impact of an increase in product price issue that have been applied in previous literature, including econometric models, the I–O and SAM frameworks, and the computable general equilibrium (CGE) model.

When using the econometric model (Alene et al., 2009; Alom, 2011; Rodriguez-Takeuchi and Imai, 2013; Wood et al., 2012), it is found that an increase in product prices will contribute to a rise in the cost of living and poverty. However, the disadvantage of the econometric approach is mostly observed in the partial equilibrium model analysis focusing on the impacts on specific sectors/variables, often ignoring feedbacks and indirect effects from other sectors. In contrast with the econometric model, the general equilibrium frameworks such as I–O, SAM, and CGE can capture such responses and indirect effects from other sectors, since they have critical features of the economy-wide analysis. The analysis of sector price issues using the I–O and SAM frameworks can be found in Lee (2002), Parra and Wodon (2008), Saari et al. (2016), and Tlhalefang and Galebotswe (2013).

In the general equilibrium framework of I–O and SAM, it was found that the commodity and service price changes affect the cost of living based on the difference in the cost of production (intermediate input) and the shift in household purchasing power (final consumption). Analysis of product price using a more advanced approach, such as the CGE model, can be found in Estrades and Terra (2012), Warr (2008), and Warr and Yusuf (2014). The main advantage of using the CGE model is that it has both accounting and theoretical consistencies instead of just the accounting consistency of the SAM. However, it requires data preparation, including the estimation of various parameter/elasticity values (Misdawita and Nugroho, 2019).

The SAM model can be seen as a simplified version of a general equilibrium model, and this paper contributes to the existing literature in several ways. First, this paper develops the customized SAM 2017 for Saudi Arabia: the introduction of more specific sectors helps the model analyze different impacts on the cost of living of price shocks on each sector's product. Second, this paper uses the SAM price modelling perspective: the SAM model applies the price multiplier and income distribution analysis developed by Parra and Wodon (2008). Using the SAM to analyze price issues is still limited because the framework is more commonly used with output (quantity) multiplier analysis rather than price multiplier analysis. This paper is expected to contribute to the limited literature on analysis using SAM price modelling for Saudi Arabia. It also uses the general equilibrium framework of the SAM; this framework has an advantage over the partial equilibrium model, which can only focus on the impacts of one sector and ignores feedbacks and indirect effects from other sectors (Dwyer et al., 2006; Mahadevan et al., 2017).

From an analytical perspective, SAMs have been used to study the relationship between the distribution of income and economic development (e.g., Keuning, 1996; Pyatt and Roe, 1977), growth strategies in developing economies (e.g., Pyatt and Round, 1985; Robinson, 1986), the breakdown of activity multipliers that shed light on the circuits embracing the circular flow of income (e.g., Pyatt and Round, 1985; Stone, 1981), and a combination of social, environmental, technological, and economic issues (e.g., Alarcón et al., 2000; Duchin, 1998; Khan, 1997; Resosudarmo and Thorbecke, 1996). Moreover, the SAM framework can be used for projections or simulations from CGE models, which are increasingly used for policymaking to calibrate the base year position, either implicitly or explicitly.

In Saudi Arabia, however, most studies use econometric models instead of SAM models to address economic effects. An example of the most recent ones is Anwer et al. (2017), which presents an analysis of the impacts of household electricity pricing policies in addition to fuel price reforms and found that, when facing dynamic, average-cost, or lifeline pricing, households respond by reducing their use of electricity, lowering the generation level and the use of natural gas by power utilities and making gas less of a constraint on the entire energy system. The resulting reduced power demand also tends to lower utilized power generation capacities. An additional study by Atalla et al. (2017) considers gasoline price increases. It estimates gasoline demand functions, and these are then used to calculate the potential welfare implications of gasoline price increases. The study found that a rise in administered energy prices in Saudi Arabia would affect both consumers and producers across several sectors and could have a significant positive impact on welfare in the country.

Some studies have demonstrated the construction of SAM for Saudi Arabia and use it to evaluate different policy scenarios. The most recent one, developed by Althumairi (2021), documents the Saudi SAM construction procedures and uses them to demonstrate the impacts of the increase in domestic energy prices in 2016 to compensate for the lost revenue from international oil prices tumbling in preceding years. The study found that the SAM production is expected to be the experimental basis for several future studies for the local and global economy.

3. SAM Model for Impact of Price Shocks

Algebraically, an SAM represents the flow of transactions between various sectors or institutions in an economy. The convention that is used expresses the cell T_{ij} of the SAM as the value of outflows from sector/institution j to sector/institution i. Some of the SAM model accounts have to be painstakingly exogenous (that is, expenditures can be set independent of income). This generally depends on the simulation experiment's nature, but government, capital account, and the rest of the world are often exogenous.

If n is the number of endogenous accounts and r-n is the number of exogenous accounts, summing the jth column of the SAM yields the following:

$$Y_j = \sum_{i=1}^{n} T_{ij} + \sum_{m=n+1}^{r} W_{mj} \ (1)$$

Y_j means total expenditures of sector j, and W_{mj} means total payments to the mth exogenous account made by sector j. Let P_j symbolize the price of the good produced by sector j; Q_j the overall output (in physical units) of sector j; and s_{ij} the quantity of sector i's good (in physical units) used by sector j. Equation (2) can then be rewritten as

$$P_j Q_j = \sum_{i=1}^{n} P_i s_{ij} + \sum_{m=n+1}^{r} P_m s_{mj} \ (2)$$

and dividing both sides by Q_j yields Equation (3):

$$P_j = \sum_{i=1}^{n} \frac{P_i s_{ij}}{Q_j} + \sum_{m=n+1}^{r} \frac{P_m s_{mj}}{Q_j} \qquad (3)$$

Represent the physical, technical coefficients for the endogenous accounts as $c_{ij}=s_{ij}/Q_j$ for i=1,....n and define $b_j = \sum_{m=n+1}^{r} \frac{P_m s_{mj}}{Q_j}$ as the rate of total payments to exogenous accounts per physical unit of sector j's output. Equation (4) can then be rewritten as

$$P_j = \sum_{i=1}^{n} P_i c_{ij} + b_j \ (4)$$

which indicates that the price of output of sector j is a weighted average of the prices of goods sector j buys, with weights assumed by the physical, technical coefficients plus exogenous outflows per unit of sector j's output. Using matrix representation, the resulting system of price equations can be written as

$$P = C'P + B \ (5)$$

where C' is the transpose of C= [c_{ij}]. The system well-defined in Equation (6) can be solved (under mild conditions [see ten Raa 2005, Theorem 2.1]) as

$$P = (I - C')^{-1} + B \ (6)$$

which is acknowledged as the Leontief price formation model.

At first sight, this price model does not seem to be very useful because the physical, technical coefficients are very rarely available. Instead, value technical coefficients a_{ij} can be computed by dividing each cell in T by the respective column sum. The matrix A= [a_{ij}] is usually referred to as the technical coefficients matrix, where $a_{ij} = \frac{T_{ij}}{\sum_{k=1}^{T} T_{kj}}$. According to Blair and Miller (1985), these value-based technical coefficients can also be given a physical interpretation using "dollars' worth of output" as a physical quantity measure. Under this interpretation, because the physical measure is equivalent to the monetary measure, all prices are equal to 1. In physical terms, the technical coefficient a_{ij} represents the dollar's worth of sector i per each dollar's worth of output of sector j. Equations (7) and (8) then become

$$P = A'P + B \ (7)$$

and

$$P = (I - A')^{-1}B = M'B \ (8)$$

One of the critical features of the SAM model is the constancy of the technical coefficients implied by the excess capacity assumption for all sectors/institutions. This means not only the endurance of the physical, technical coefficients but also the constancy of the price ratio (for details, see Miller and Blair (1985) or Moses (1974)):

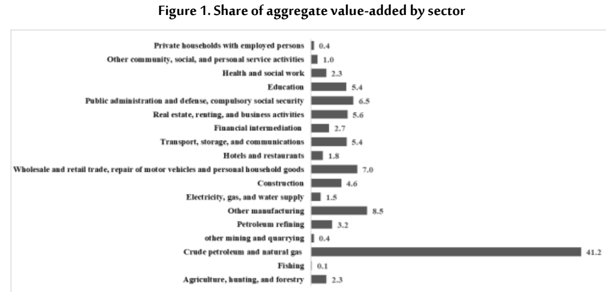
$$\Delta P = (I - A')^{-1} \Delta B \ (9)$$

This means that the effect on prices of a change in the exogenous payments per unit of output (or merely a change in exogenous per-unit costs) is given by the inverse (multiplier) matrix $M' = (I - A')^{-1}$. Because all prices are equal to 1, the absolute change in prices/costs is precisely similar to the percentage change. The economic interpretation of most of the prices in the model is straightforward. The prices of activities can be understood as producer prices, the prices of commodities as consumer prices, and the prices of production factors as rental payments for their use. The price of households can be understood as a cost of the living index because it is calculated through a weighted average of all the goods bought (inside and outside the household) plus tax payments. In this paper, we consider government accounts, capital accounts, and the rest of the world's accounts to be exogenous. Because the shock studied is an increase in the price of oil, which is usually either controlled by the government or a function of international oil prices, we also set the oil commodity account as exogenous, which means that one can model the commodity oil as a supply-constrained commodity.

4. Database and Empirical Application

The 2017 SAM for Saudi Arabia is constructed using high-quality official statistics. It includes 54 accounts: 18 production activities, 18 commodities accounts, four factors of production (two labor accounts: Saudi workers and non-Saudi workers; two capital categories: capital and capital from oil), ten institutions (six households types: low-income Saudi households, lower-middle-income Saudi households, middle-income Saudi households, upper-middle-income Saudi households, high-income Saudi households, and non-Saudi households; two accounts of enterprises: public and private enterprises; government; and the rest of the world), and four other accounts (three for taxes and saving-investment accounts). Figure 1 shows the dominance of crude petroleum and natural gas in the Saudi economy as the share of aggregate value-added by sector estimated at 41.2% among all sectors.

Figure 1. Share of aggregate value-added by sector



Source: Saudi SAM, 2017

The technical coefficients of the macro-SAM in Table 1 give us an overall picture of the macroeconomic profile of the Saudi Arabian economy.

Table 1. Technical coefficients for the macro-SAM, Saudi Arabia 2017 (in percentages)

	Activities	Commodities	Factors	Institutions	Capital Account	Rest of the World
Activities	0.00	0.76	0.00	0.00	0.00	0.00
Commodities	0.31	0.08	0.00	0.94	0.64	0.95
Labor	0.16	0.00	0.00	0.00	0.00	0.00
Capital	0.52	0.00	0.00	0.00	0.00	0.00
Households	0.00	0.00	1.00	0.53	0.05	0.03
Enterprises	0.00	0.00	1.00	0.24	0.04	0.02
Government	0.00	0.00	0.00	0.45	0.00	0.00
Capital Account	0.00	0.00	0.00	0.7	0.00	0.00
Rest of the World	0.00	0.15	0.00	0.14	0.27	0.00

Source: Saudi Macro-SAM, 2017.

The main objective of the SAM is organizing information about economic and social structure. Through this organizing of data, the

SAM offers a summary of the social and economic structure of the country, since it provides a synoptic description of production activities, composition, and use of household income, consumption, saving, investment, and international trade. The SAM enables the calculation of some useful economic structure indicators.

This section shows how an SAM is used to ascertain the most important characteristics of an economy. The SAM gives us information about the production structure, the composition of the value-added by sector , income distribution, consumption and savings habits, and the domestic economy's relationships with overseas markets. Thus, the essential characteristics of Saudi Arabia's economy can be inferred from the 2017 Saudi SAM.

The technical coefficients of the macro-SAM in Table 1 give us an overall picture of the Saudi economy's macroeconomics profile. Some 31% of the costs of production for activities are accounted for by intermediate inputs, 16% by labor payments, and 52% by payments to capital. The supply of commodities is satisfied at 76% by the marketed domestic output, 7.78% by the marketing margins of imported products, 0.39% by tariffs taxes, and 15.35% by imports. Households spend 43% on final consumption, 45% in savings, and 13% on transfers to the rest of the world. The government spends 51% of its income purchasing goods and services, 4% on transfers to households, 11.3% in savings, and 1% on transfers to the rest of the world. Finally, exports represent 95% of the rest-of-the-world account, 3% of external resources go to households, and 2.5% goes to private enterprises.

Table 2. Sources of incomes and expenditures, Saudi SAM, 2017 (in percentages)

	Source of income			Expenditure category		
Type of household	Labor	Enterprises	Government	Final consumption	Savings	Rest of the world
Low-income Saudi households	21.6	38.1	15.2	86.8	-24.4	13.2
Lower-middle-income Saudi households	45.7	43.2	10.4	80.1	7.8	12.2
Middle-income Saudi households	44.7	46.9	7.5	64.3	25.9	9.8
Upper-middle-income Saudi households	41.8	50.8	5.9	54.2	37.5	8.3
High-income Saudi households	19.2	74.8	3.1	28.3	67.3	4.3
Non-Saudi households	74.3	4.8	0	39.6	-21	60.4

Source: Saudi SAM, 2017.

Table 3: Expenditure categories of different household types, SAM 2017, technical coefficients

Sectors	Low-income Saudi households	Lower-middle-income Saudi households	Middle-income Saudi households	Upper-middle-income Saudi households	High-income Saudi households
Agriculture, hunting, and forestry	4.6%	3.8%	2.7%	1.9%	0.6%
Fishing	1.1%	0.9%	0.7%	0.5%	0.2%
Crude petroleum and natural gas	0.0%	0.0%	0.0%	0.0%	0.0%
Other mining and quarrying	0.1%	0.1%	0.2%	0.2%	0.1%
Petroleum refining	0.0%	0.0%	0.0%	0.0%	0.0%
Other manufacturing	37.2%	35.6%	27.9%	23.9%	12.3%
Electricity, gas, and water supply	3.3%	2.9%	2.1%	1.6%	0.7%
Construction	2.2%	1.9%	1.4%	1.0%	0.4%
Wholesale and retail trade, repair of motor vehicles and personal household goods	0.6%	0.7%	0.8%	0.9%	0.7%
Hotels and restaurants	5.3%	5.6%	4.6%	3.4%	1.5%
Transport, storage, and communications	5.8%	5.9%	4.7%	4.0%	1.8%
Financial intermediation	2.1%	2.7%	3.0%	3.4%	2.5%
Real estate, renting, and business activities	19.9%	17.2%	12.5%	9.4%	4.1%
Public administration and defense, compulsory social security	0.6%	0.7%	0.8%	0.9%	0.6%
Education	0.9%	1.3%	1.8%	1.5%	1.5%
Health and social work	1.0%	0.9%	0.9%	0.7%	0.4%
Other community, social, and personal service activities	1.1%	1.2%	1.1%	1.0%	0.6%
Private households with employed persons	0.9%	1.0%	0.8%	0.8%	0.5%
Savings	-24.4%	7.8%	25.9%	37.5%	67.0%

Source: Saudi SAM, 2017.

Table 2 and table 3 provides data on the sources of income and expenditure of different household groups as well as their expenditure patterns. For example, low-income groups receive 21.6% of their income from labor, 38.1% as payments from private enterprises, and 15.2% as transfers from the government. They consume most of their income, 86.6% of final consumption, and 13.2% of purchases from the rest of the world. The saving is -24.40%. Table 3 shows the expenditure categories. Low-income groups spend 19.9% of their income on real estate, renting, and business activities, while high-income groups spend only 4.1%.

5. Policy Scenarios and Empirical Results

Saudi Arabia is facing a period of significant economic and social change following the government's announcement of a new vision for the next 15 years (Vision 2030, 2016). Part of this vision involves price reform, which allows for prices to increase. It is expected that this policy change will endorse greater efficiency in Saudi Arabia. For instance, an increase in energy prices might reduce the fast growth in domestic oil consumption. This paper, therefore, considers the sector's price increase. It aims to ascertain the impact of increases of 50% for the following sectors: electricity, gas, water, manufacturing, agriculture, hunting and forestry, transport, storage, and communications. The assumptions for the price simulations are described in Table 4.

Table 4. Policy simulation for price sectors

Simulation No.	Increase of 50% in the prices of the following sectors:
1	Electricity, gas, and water supply
2	Other manufacturing
3	Agriculture, hunting, and forestry
4	Transport, storage, and communications

The results of the four scenarios are detailed in Tables 5 and 6. They are intended to simulate the impact of the increase in sector prices on the cost of living for different types of households.

Table 5. Impact of an exogenous increase of 50% in the prices of electricity, gas, water, manufacturing, agriculture, hunting and forestry, transport, storage, and communications (price change)

Sector	Simulation 1	Simulation 2	Simulation 3	Simulation 4
Agriculture, hunting, and forestry	2.35	18.98	3.86	6.74
Fishing	2.85	27.41	2.16	11.04
Crude petroleum and natural gas	0.10	1.00	0.13	0.36
Mining and quarrying	2.13	19.46	1.85	6.47
Petroleum refining	1.73	13.05	1.98	4.82
Other manufacturing	2.73	17.01	7.52	8.66
Electricity, gas, and water supply	2.26	18.54	1.76	6.47
Construction	3.09	29.92	2.90	8.25
Wholesale and retail trade, repair of motor vehicles, and personal household goods	3.57	18.18	1.81	11.54
Hotels and restaurants	2.09	15.14	3.18	4.97
Transport, storage, and communications	2.12	16.96	1.78	10.98
Financial intermediation	1.75	16.75	1.72	5.26
Real estate, renting, and business activities	2.06	17.44	2.09	5.23
Public administration and defense, compulsory social security	2.77	21.90	2.24	6.82
Education	2.03	19.74	2.62	7.49
Health and social work	2.57	23.15	2.15	6.79
Other community, social, and personal service activities	3.04	20.18	2.68	7.40
Private households with employed persons	1.33	14.09	1.72	4.19
Total (Producer Price Index)	2.25	18.27	2.45	6.86

Source: Simulations results using Saudi SAM 2017 price model, 2021.

Table 6. Impact on cost of living of a 50% increase in the prices of electricity, gas, water, manufacturing, agriculture, hunting and forestry, transport, storage, and communications

Household type	Change in cost of living			
	Simulation 1	Simulation 2	Simulation 3	Simulation 4
Low-income Saudi households	3.28	30.38	4.53	8.99
Lower-middle-income Saudi households	2.88	28.02	3.91	8.48
Middle-income Saudi households	2.21	22.34	2.99	6.80
Upper-middle income Saudi households	1.78	19.05	2.34	5.76
High-income Saudi households	0.87	9.92	1.05	2.87
Non-Saudi households	1.31	13.86	1.69	4.12
Total (CPI)	2.05	20.59	2.75	6.17

Source: Simulation results using Saudi SAM 2017 price model, 2021.

The scenarios simulate the impact of a 50% increase in sector prices on the cost of living for different household types. The activities most affected by the rise in price are the "manufacturing"," transport, storage, and communications" sectors. The total potential effect is extensive, with the producer price index potentially increasing 18.27% and 6.86%, respectively, following the price shock.

This means that for every 1% increase in these activities' price, the producer price index rises 0.37% and 0.14%, respectively.

The overall increase in the cost of living to households is estimated at 20.59% and 6.17%, respectively.

The aggregate increase in the cost of living is lower than the increases for lower-, lower-middle-, and middle-income households. This is because of the large share of these households' categories in aggregate household expenditures.

In contrast, the potential impacts of electricity, gas, and water supply and agriculture, hunting, and forestry prices are minor. When these sectors' prices increase, the producer price index potentially rises 2.25% and 2.45%, respectively, following the price shock.

This means that for every 1% increase in these activities' prices, the producer price index rises 0.045% and 0.049%, respectively.

The overall increase in the cost of living to households is estimated at 2.05% and 2.75%, respectively.

The aggregate increase in the cost of living is lower than the increases for lower-income, lower-middle-, and middle-income households. This is because of the large share of those households' categories in aggregate household expenditures.

The results suggest that the impact of the manufacturing, transport, storage, and communications sectors' price increases on household expenditure could be enormous. Households spent 42.91% and 6.91% of their total consumption on these sectors' products. Moreover, manufacturing, transport, and communications products are used in many sectors of the economy, which means that the multiplier of indirect effect is enormous.

In Table 6, the simulation for "other manufacturing sector" is much higher than that for "other sector." This result is not surprising: the reason behind it is that households spent 42.91% of their consumption on manufacturing goods. In comparison, the share of aggregate household expenditure for the "electricity, gas, water", "agriculture, hunting and forestry", "transport, storage, and communications" sectors are minor: households spent only 3.11%, 3.85%, and 6.91%, respectively, on these.

Two findings stand out. First, for all simulations, low-income and middle-income households are more likely to face a more significant impact because of an increase in prices. Second, the larger consumption share devoted to manufacturing, transport, and communications products makes the shock more meaningful for households. It appears that low- and middle-income households tend to devote a higher proportion of their total income to consumption.

6. Conclusion

This paper has used a simple SAM-price-model approach to examine the impact of high price shocks on producer and consumer prices and household living expenses for various household categories in Saudi Arabia. In other words, if the Saudi economy faces price shocks, the paper analyzes which sectors of the economy would be most affected and what the distributional implications of these shocks on households would be, given the patterns of consumption observed for lower- and middle-income households as opposed to higher-income households. At least two crucial results stand out from the analysis. First, while the impact of an increase in the overall level of prices for electricity, gas, water, agriculture, and hunting and forestry would have a negative effect on the cost of living for households, the impact of an increase in manufacturing, transport, storage, and communications prices could be larger than the influence of other sectors' prices. It is estimated that the potential impacts of "manufacturing", "transport, storage, and communications" price shocks are high. For a 50% increase in prices, the overall increase in the cost of living for households, as estimated with the SAM price model, is 20.59% and 6.17%, respectively, while the impacts of electricity, gas, water, agriculture, and hunting and forestry prices are minor. Second, if one looks at the effects of price increases for various sectors, the differences in increases in the cost of living for various households are quite different. Low-income and middle-income households are likely to be more affected by price hikes than wealthier households. This would suggest that special attention should be given to compensatory mechanisms.

The results of this analysis provide some pointers and stylized facts that are worth considering when implementing policies that aim to offset part of the negative impact of higher prices for the population.

Although the paper gives details based on the Saudi SAM with a multi-sectoral framework, it is still limited in representing new elements, such as the level of aggregation for the energy sector as a dominated sector of the economy. Therefore, future studies in Saudi Arabia should focus more on disaggregation levels of the oil and manufacturing sectors. In addition, more focus should be given to the disaggregation levels of household types.

Biography

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