Food Markets in the Time of Conflict and Cholera

Rapid Market Assessment in Yemen (Sana'a, Hodeidah and Hajjah)

April 2018

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Authors: Oscar Maria Caccavale, Tobias Flämig, and Channon Hachandi

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For additional information, please contact:

WFP Yemen

Inge Breuer, *Head of Programme*

inge.breuer@wfp.org

Zulfiqar Ali, *Head of Supply Chain*

zulfiqar.ali@wfp.org

Ally-Raza Qureshi, *Deputy Country Director*

ally-raza.qureshi@wfp.org

WFP Headquarters

Oscar Maria Caccavale, *Economist and Market Analyst*

oscar.caccavale@wfp.org

Tobias Flämig, *Head of Economic and Market Analysis Unit*

tobias.flaemig@wfp.org

Channon Hachandi, *Supply Chain Officer*

channon.hachandi@wfp.org

Arif Husain, *Chief Economist & Deputy Director Policy and Programme Division*

arif.husain@wfp.org

Table of Contents

List of figures

List of tables

List of maps

Acknowledgements

Acronyms

CBY	Central Bank of Yemen
EFSNA	Emergency Food Security and Nutrition Assessment
EMOP	Emergency Operations
FAO	Food and Agriculture Organization of the UN
fMEB	Food Minimum Expenditure Basket
FSAC	Food Security and Agriculture Cluster
GDP	Gross Domestic Product
GPC	General People's Congress
IPC	Integrated Food Security Phase Classification
MEB	Minimum Expenditure Basket
SAR	Saudi rial
UAD	United Arabic Emirates dirham
UAE	United Arabic Emirates
USD	United States dollar
WFP	World Food Programme
YER	Yemeni rial

Executive summary

The crisis in Yemen is among the most serious and complex in the world. Over 7 million people are assisted by the World Food Programme (WFP), mostly through in-kind food assistance, but also through a commodity voucher programme[1] and nutrition activities.

In November 2017, rapid market assessments were conducted in Sana'a, Hodeidah and Hajjah to evaluate a potential scale-up of the current voucher system and the feasibility of introducing cash-based transfers to broaden the portfolio of food assistance programming.[2]

Despite the uncertainty related to the conflict, the overall market situation seemed sufficiently stable for conducting a market assessment. However, in November and December 2017, the conflict changed rapidly, leaving the humanitarian community with the challenge of understanding and quantifying the changing needs of the most vulnerable people, and quickly adapting their operations to the new situation.

This report presents three possible scenarios. The first is the 'baseline scenario', which reflects conditions up until October 2017; the second is the 'blockade scenario', which arose in November 2017 when airport and seaport access to and from northern Yemen was closed; and the third is the 'crisis scenario', referring to when armed clashes burst out in the streets of Sana'a in December 2017, which led most humanitarian organizations to temporarily redeploy some of their staff.

Under the 'baseline scenario', despite all challenges faced by the commercial sector, the market environment in the assessed locations seemed vibrant enough to support a gradual scale-up of value-based vouchers, mainly in Sana'a city. It could possibly support a gradual shift to cash-based interventions using the existing network of traders. The challenges identified were primarily associated with the substantial economic slowdown and the fragile business environment, in which the Central Bank of Yemen is split into two independent 'branches' that pursue different monetary policies, and the commercial banking system is scarcely able to support the private sector. Traders often bypass banks in favour of the more agile money-exchanger system, which is mostly based on remittance flows. Yet worrying levels of local currency depreciation challenge all business activities. UN agencies contended with significant exchange rate losses, especially before working at a negotiated exchange rate.

Nonetheless, some food importers have been able to establish strong business models and control the market almost entirely. They allow a large flow of goods to reach Yemen through three main ports of Aden, Hodeidah and Al Saleef, irrespective of depressed demand. In fact, despite the general perception that nominal prices were increasing, real prices actually stayed put for most of 2017 – a clear consequence of low purchasing power. The main food security

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[1] Commodity vouchers are distributed to WFP retailer networks in urban and peri-urban areas. Under this modality, WFP beneficiaries living in these areas redeem the vouchers distributed by WFP's cooperating partners to obtain food rations at the closest participating retail outlet linked to WFP's Yemeni food service provider.

[2] A broader trader survey was planned but remains on hold.

constraint in Yemen until October 2017 was lack of economic access to food rather than poor food availability. However, this observation only holds true for the 'baseline scenario'.

When the blockade came into force, the situation changed dramatically. The most striking effect was the almost immediate lack of fuel in the country, with diesel and petrol prices doubling in some cases, as stocks were estimated to last for just a couple of weeks. By contrast, wheat stocks were sufficient to meet consumption needs for three months, so the price rise for wheat flour was more contained. However, the combination of the rising exchange rate and fuel prices would make future food price rises more likely. According to our estimates, an increase of 1 percent in diesel prices could trigger up to a 10 percent increase in the price of wheat flour within six months in Sana'a. An appreciation of the US dollar would lead to a 3 percent increase in the same time frame. It is not clear how far the commercial sector could adapt to this scenario, as the imposed move from the Red Sea ports to Aden would force them to reorganize their supply chain, which would require political support unless they are one of the few major importers operating in Yemen. In any case, the port of Aden does not seem equipped to fully substitute the activities of the Red Sea ports on account of its limited capacity of handling containers and the milling volume potential. If operations were to shift entirely to Aden, WFP would have to evaluate the appropriateness of the current commodity voucher system.

According to WFP price monitoring, both nominal and real prices rose significantly between November 2017 and January 2018, suggesting that food supply chains have not yet adapted to the new political situation. The cost of a broader food basket is also increasing, so the use of cash-based transfers seems risky as traders may not be able to secure enough supply for WFP's caseload without the guarantee of additional profits, as is provided by commodity vouchers. Aside from this consideration, the amount transferred with value-based vouchers or the cash transfer should be adjusted every month to keep up with inflation, possibly with different transfer values tailored to each governorate (although this latter recommendation seems rather unlikely given the political situation).

In principle, the 'crisis scenario' does not appear to be conducive for the introduction of cash-based transfers, nor for the scale-up of the current commodity voucher system. However, saving lives remains the imperative for WFP, so this conclusion must be carefully scrutinized. Indeed, if the 'crisis scenario' lasted for months (or if it coincided with the 'blockade scenario'), it could become more and more difficult for WFP to maintain the current model with its blend of in-kind food assistance and commodity vouchers; this would be challenging both for WFP with the logistical difficulty of moving goods within the country but also for the private sector. By contrast, the top five food traders are probably better placed to resume their operations quickly, and as such maintaining the current network of traders could be vital to adjusting the programme rapidly if the situation were to turn into one of the other two scenarios.

The recommendations of this report also include i) advocating for a resumption of the monthly publication of the consumer price index (CPI) by the Central Statistical Office, ii) expanding price monitoring to a broader minimum expenditure basket that encompasses non-food items, iii) closely and systematically tracking changes in diesel prices and the exchange

rate, and iv) exploring closer collaboration with FAO to capture and maintain import and stock data for staple commodities.

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1. Introduction

Yemen is in the third year of a convoluted civil war, with at least three internal parties involved in the conflict, several terrorist and secessionist groups active mostly in the southern governorates, and the direct or indirect involvement of other states in the region.

The humanitarian situation has been described as one of the biggest emergencies worldwide and is forecast to require USD 2.96 billion in humanitarian aid in 2018 (OCHA, 2018). An unprecedented cholera outbreak has swept through already exhausted communities, and many people lack basic access to food. Meanwhile, the country is highly vulnerable to external shocks because of its overdependence on imported food and its lack of access to foreign currencies.

Yemen is now suffering from increasingly intense conflict, coupled with restricted and disrupted commercial and humanitarian import flows, population displacements, loss of livelihoods and income, scarcity and high prices of fuel and food, and stressed market systems.

Emergency Operation 201068 of the WFP Yemen Country Office plans to deliver assistance to 9.1 million beneficiaries through general food distribution and nutrition interventions. In November 2017, 6.8 million severely food-insecure Yemenis received WFP emergency food assistance through several different transfer modalities:[3] 6.1 million received in-kind food assistance, while the remaining 700,000 were assisted through commodity vouchers.

Given the unpredictable security and political situation in Yemen, the introduction of market-based interventions alongside traditional in-kind food distribution could give WFP additional flexibility when delivering food assistance to people in need in areas where markets are functioning. To inform WFP's programme and operational decisions, a rapid market assessment was conducted to determine the most appropriate food assistance modalities and the feasibility of market-based interventions in different governorates of Yemen.

A mission to Sana'a, with field visits to Hodeidah and Hajjah, took place in November 2017. A national data collection exercise has been planned but can only take place once the situation stabilizes. This report also uses the analysis of secondary data and key informant interviews.

There is an important caveat to this assessment: the political situation in Yemen has largely deteriorated in the four weeks between the start of the study and the writing of the report. With such a volatile situation, events could quickly unfold that significantly impact the nature and likelihood of the scenarios explored here

In the remainder of the paper, we refer to three scenarios, which are characterized as follows:

1) **'Baseline scenario',** which reflects the situation found at the start of the mission, when a) the political situation in Sana'a was relatively stable except for occasional airstrikes mostly targeting sensitive infrastructure; and b) despite significant damage to dock infrastructure such as mobile cranes, and tedious coalition-induced procedures that

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[3] WFP, EMOP 201068 and WFP internal Yemen dashboard.

delayed vessel berthing and pushed up demurrage costs, a relatively regular flow of goods was reaching Sana'a.

2) **'Blockade scenario'**, which reflects the circumstances that arose when airports and ports were closed in November 2017, namely a) airstrikes intensified in Sana'a and several other locations in northern Yemen, and armed fighting increased; b) the Red Sea ports were closed to commercial cargo in an attempt to divert commercial vessels to Aden port,[4] leaving access open to humanitarian actors only; and c) some goods became increasingly scarce, particularly fuel, with soaring prices, parallel market activities and massive queues at petrol stations.

3) **'Crisis scenario',** which depicts a situation of escalating violence, as was seen at the end of 2017 when a) violent conflict broke out in Sana'a, with street clashes erupting in many neighbourhoods and civilians trapped in the middle; b) there was a temporary shut-down of most economic activities on top of the 'blockade scenario'; and c) humanitarian activities were rolled back.

The findings in the report mostly refer to the 'baseline scenario', and occasionally to the 'blockade scenario'. The unfolding of the 'crisis scenario' in Sana'a is unpredictable and transitory; at the time of writing, this scenario seems unlikely to permit the regular implementation of emergency food assistance, and particularly not cash-based interventions.[5]

The paper is organized as follows: section 2 gives an overall picture of Yemen's economic situation, including insights into the availability of foreign currency, which is indispensable for a sustained inflow of imported food. This section also tackles food availability in Yemen, describing the trade corridors for imported food and providing some evidence for the contribution made by local food. Section 3 describes supply chain actors and their business capacity in more detail, while section 4 provides insights from different price analyses, in terms of trend analysis of a revised minimum expenditure food basket and an econometric model to understand the impact of different triggers on the price of wheat flour in Sana'a. The last section contains concluding remarks and recommendations.

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[4] Indeed, at the beginning of the blockade, Aden port was also not working for several days. However, it is reasonable to assume that the functioning of this port will not be at risk.

[5] Cash-based transfers comprise value vouchers/cash transfers and related direct operational costs (WFP, 2016).

2. Yemen's political and economic situation at a glance

2.1 Setting the stage

Yemen is in the midst of an unprecedented crisis. The situation is so complex because different types of crisis have intertwined, engendering a humanitarian catastrophe. The list of challenges faced by the Yemeni people is staggering. Although investigating these crises in detail is beyond the scope of this report, an overview of the major issues will set the stage against which we will assess how markets are functioning.

Conflict

Until November 2017, the north of the country was largely controlled by an alliance between the Houthis – a Zaydi Shia movement – and the former president Ali Abdullah Saleh, who was supported by parts of the Yemeni military and the former ruling party, the General People's Congress. Meanwhile, "*most of the south is controlled by forces that support the president, Abd Rabbuh Mansour Hadi* […], *and that are backed by a Saudi-led coalition of mainly Arab states*" (EIU, 2017). Heavy military operations between these two warring factions were ongoing at the time of the assessment in Taiz, Hodeidah and Mareb, and airstrikes hit most of northern Yemen. However, the actual control of the territory is quite fluid (Map 1): the former allies in northern Yemen started armed clashes in Sana'a city that culminated with the death of Mr. Saleh in December 2017, while some areas in the south remain under major threat from terrorism by jihadi groups (e.g. Aden) (ICG, 2017).

Cholera

The collapse of basic services has left 16 million people with inadequate access to clean water, sanitation and hygiene, contributing to an unprecedented national cholera outbreak, with more than 900,000 suspected cases and 2,192 associated deaths.[6] The governorates of Hodeidah, Hajjah and Amran have been worst affected (OCHA, 2017).

Economic slowdown

Even before the current crisis, Yemen was one of the poorest countries in the world and the poorest in the Middle East and North Africa region. Nominal GDP, forecast at USD 15.4 billion for 2017, has shrunk by 57 percent since 2013 (EIU, 2017). The export of goods (mostly oil) has collapsed completely, down by 93 percent within the same time frame, and imports have more than halved (EIU, 2017). There is now a 'twin gap' (IMF, 2017) with increasing scarcity of foreign exchange and lack of purchasing power, along with a fiscal deficit projected to reach USD 3.5 billion, and an external financing deficit of USD 2.8 billion (World Bank, 2017). The most striking result of the economic crisis is the suspension of the social welfare fund in 2015, which previously covered over 1 million households (ODI, 2013). In addition to that "*approximately 1.25 million civil servants have not received salaries or have received them only intermittently since August 2016*" (OCHA, 2017). The economic challenges are explored in detail in the next section, but it is worth noting here that "*two market systems are operating semi-independently of one another. Divided by the line of conflict, the north-west and central west of the country is supplied*

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[6] Electronic Disease Early Warning System, 5 November 2017. Source: (OCHA, 2017).

primarily by the port of Al Hodeidah, while the south-west of the country is supplied by the port of Aden" (Reach, 2017).

Map 1 - Areas of control
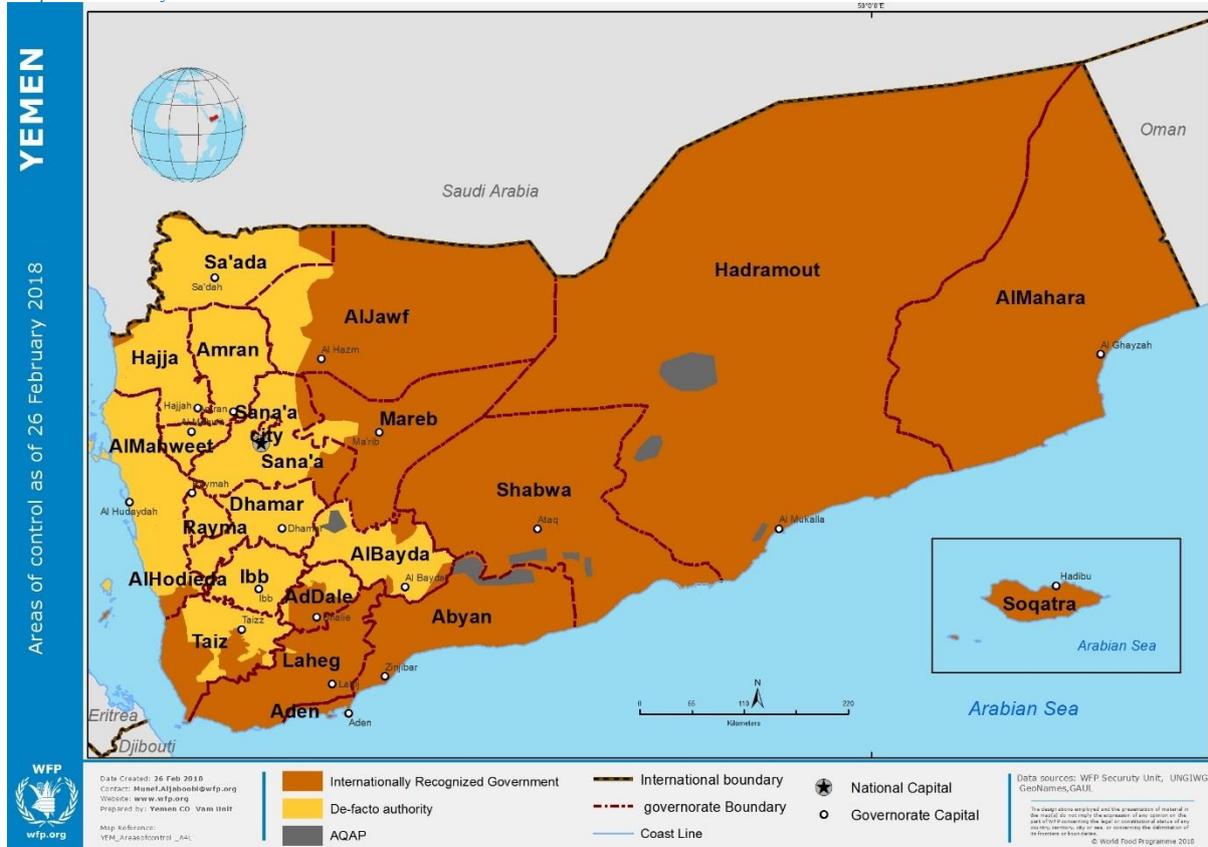
Food insecurity

The IPC Technical Working Group[7] estimated that between March and July 2017, 6.8 million people were severely food insecure in Yemen, i.e. in IPC Phase 4 *Emergency*. An additional 10.2 million were classified in *Crisis*, creating a total of 17 million food-insecure people. In November 2017, the Food Security and Agriculture Cluster reported that the severely food-insecure population may have increased to 8.4 million people[8] because of ongoing conflict, civil insecurity, disrupted livelihoods, the non-payment of public servant salaries and severe economic decline. This has led to a reliance on unsustainable and almost exhausted coping strategies as well as poor food consumption and high malnutrition rates: wasting has sur-passed emergency thresholds (>15%) in four governorates (WFP, 2017a). A further rise in the numbers of food-insecure people seems likely, particularly under the 'blockade scenario' or the 'crisis scenario'. Seven governorates, including Hajjah, were in IPC Phase 4 in November, and 10 governorates were in IPC Phase 3, including Sana'a governorate and Sana'a city.

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[7] The IPC analysis was also based on the 2017 WFP Emergency Food Security and Nutrition Assessment (EFSNA).

[8] OCHA press release, 27 November 2017.

Humanitarian assistance by WFP

In April 2017, WFP launched a twelve-month emergency operation in Yemen: EMOP 201068. In November 2017, the programme assisted 6.1 million people with in-kind food distributions and 697,000 people with commodity vouchers.[9],[10] Through the vouchers, USD 58.6 million was injected into the economy in 2017 in 23 districts using three networks of traders with over 120 retail outlets.

Due to funding shortfalls, beneficiaries have been divided into two categories. In October, all 3.4 million people in the top priority category received a 100 percent ration, giving them the full entitlement of 2,100 kcal/day. The 3.6 million beneficiaries in second category received a 60 percent ration, equivalent to 1,260 kcal/day.[11] The food basket for both in-kind and voucher-based assistance contains wheat flour, vegetable oil, pulses and sugar (Table 1). In the governorates of Sana'a, Hajjah and Hodeidah, WFP beneficiaries number 2.48 million, a quarter of whom are receiving commodity vouchers (Table 2). In Sana'a city, a third of the 595,000 beneficiaries are using vouchers.

Table 1 - Monthly food rations for households

Ration	100%	60%
Wheat flour (1kg)	75	50
Pulses (1kg)	10	5
Vegetable oil (1litre)	8	4
Sugar (2.5kg)	3	

Source: WFP, 2017

Table 2 - Beneficiaries by assistance type in Hajjah, Hodeidah and Sana'a governorates, August 2017

Modality	Beneficiaries	Share of total
GFD (100% of the ration)	638,200	26%
GFD (60% of the ration)	1,216,800	49%
CV	626,800	25%
Total	2,481,800	

Source: WFP, 2017

2.2 Economic constraints and foreign exchange shortages

The economic constraints facing Yemen are all too clear: the Central Bank of Yemen (CBY) is struggling to operate, and the malfunctioning bank system is failing to support the commercial sector through the issuance of 'letters of credit' to importers.[12]

The CBY deals with monetary policy and is also tasked with paying public sector salaries, ensuring liquidity to the bank system and paying interest on treasury bills – i.e. debt service. Yet salary payments have been delayed since mid-2016,[13] the bank is no longer able to provide support to importers, and access to deposits (also in commercial banks) has become increasingly difficult.

Although formally the CBY remains an independent body, the shift of the bank headquarters from Sana'a to Aden undermined its functioning capacity. In 2017, a significant amount of

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[9] *"WFP is now using commodity vouchers as a stand-alone modality separate from in-kind transfers and cash-based transfers. They can be converted easily to cash-based transfers to expand beneficiary choice"* (WFP, 2016).

[10] This was down from 6.5 million and 855,000 beneficiaries respectively in the previous month.

[11] The prioritization and related geographic distribution is currently under review by the WFP Country Office.

[12] *"Small volume importers also find it increasingly difficult to access letters of credit and correspondent banks"* (World Bank, 2017).

[13] The value of the monthly payments due is estimated at YER 70 billion.

Yemeni rials had been "printed in Russia and arrived in Aden to help pay public-sector salaries" (EIU, 2017) ; this risks destabilising the local currency even further with the continuous and uncontrolled exchange of the new money for US dollars and greater pressure on prices. Meanwhile, CBY in Sana'a reportedly no longer has a swift code to allow external transfers, so its operational capacity is limited.

Figure 1 - USD/YER exchange rate
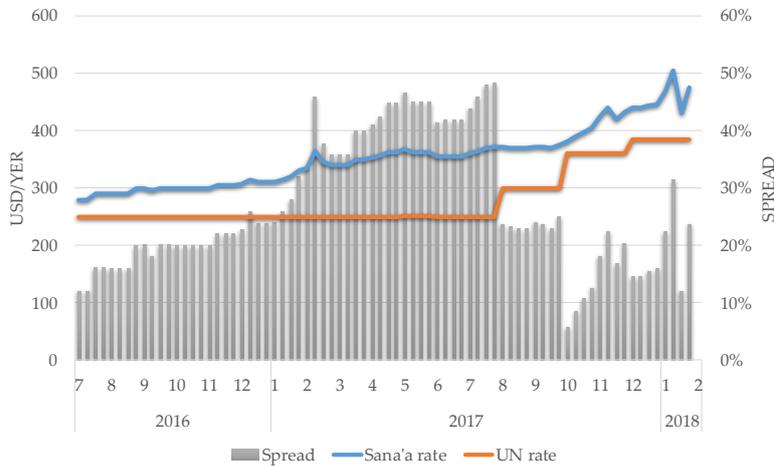
Source: WFP

Figure 2 - USD/YER depreciation, July 2016 to February 2018

Source: WFP

In the recent past, the CBY somehow managed to stabilise the Yemeni rial against the US dollar at a rate of YER 215 per US dollar[14] until March 2016, particularly by using hard currency reserves. In April 2016, the CBY devalued the official exchange rate to YER 250 to close the spread with the parallel market rate (Figure 1). Since October 2017, the rial has practically been in free fall: compared to mid-2016, it has lost more than 40 percent of its value (Figure 2). [15]

In the first half of November 2017, the cost of USD 1.00 jumped from YER 405 to roughly YER 440. At the time of the assessment, key informants said the exchange rate was likely to approach YER 500/USD in the near future, with consequences for the cost of imports and thus the prices of all goods. Indeed, the resistance level of YER 500/USD was reached in the second week of January 2018, although the announcement of an injection of cash from Saudi Arabia has temporarily boosted the Yemeni rial since then.

In this context, UN agencies face significant exchange rate losses, since they are bound to work at a negotiated exchange rate which does not necessarily capture the difference between the official and the parallel rate.

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[14] Official Fx for Central Bank of Yemen, exchange rate as at Tuesday 19 December 2017.
[15] The exchange rates in the report follow the price quotation system (USD/YER, also known as direct quotation).

In fact, the spread widened to almost 50 percent in August 2017, when the UN started nego-tiating with commercial banks for a phased departure from the CBY rate to close the gap for a short period. The reasons for the crushing exchange rate are manifold and range from the malfunctioning banking system and the large trade deficit to the conflict itself and the result-ing blockade of air and seaports in November 2017.

Protecting the value of the local currency is critical to purchasing essential goods from abroad. Since Yemen is heavily dependent on imported food, petroleum products and other non-food items, it relies on foreign currency reserves, which are predominantly in US dollars, Saudi rial (SAR), and United Arabic Emirates dirham (UAD). According to key informants, the total monthly foreign currency requirements amount to USD 260 million, including USD 80 million for wheat and other cereals, USD 40 million for soya/fodder, and USD 140 million for petro-leum products.

In order to pay foreign suppliers, importers and other businesses have moved foreign ex-change transactions almost entirely to the informal market, since the banking system can only meet around 40 percent of the forex demand through the four major banks.[16] Money exchange agents fill the gap: reportedly, 15 major money exchange companies handle between USD 5 million and USD 15 million in remittances every month. There are also 400 smaller agents, some of whom are informal (*hawala*), who could exchange up to USD 136,000 a month each.

Figure 3 - Remittances as share of GDP
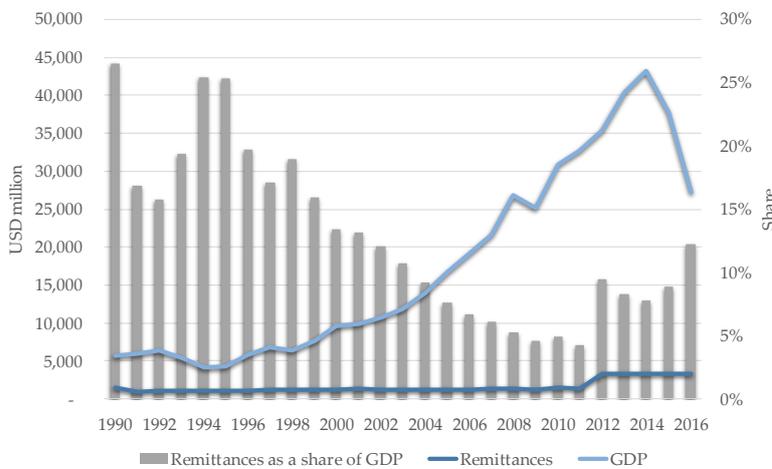
Source: World Bank

Remittances from work-ers abroad are the life-line keeping the econ-omy afloat and sustain-ing families in Yemen. They are estimated to reach USD 3.4 billion a year – or 12 percent of GDP in 2016 (Figure 3). Around 62 percent of re-mittances arrive from Saudi Arabia, and 18 percent come from the United Arab Emirates (Table 3).[17] The flow from Saudi Arabia is increasing and continues to be the dominant source, but the other Gulf states have been catching up since 2013 and now represent almost one third of all remittances to Yemen.

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[16] Namely, the International Bank of Yemen, Tadhamon International Islamic Bank, Kuwait Bank, and Cooperative & Agricultural Credit Bank (CAC).

[17] The remainder of remittances in 2016 came from Kuwait and Qatar (5 percent each), the United States of America (4 percent), Israel (2 percent), Bahrain, Libya and United Kingdom (1 percent each). Source: World Bank, Migration and Remittances data.

This means that the bulk of foreign currency does not physically enter the Yemeni market. Importers on the other side bring their proceeds in local currency to the money exchangers and obtain foreign currency credited abroad, which enables them to pay their suppliers.

The same flow applies for other currencies, e.g. for purchasing petroleum products. The fact that demand for the dollar is much higher than the supply contributes to exchange rate destabilisation.

Table 3 - Remittances by country in USD (millions), 2010-2016

	2010	2011	2012	2013	2014	2015	2016
Saudi Arabia	1,171	1,079	1,142	2,089	2,074	2,074	2,062
United Arab Emirates	104	96	102	544	558	572	590
Qatar	0	0	0	153	157	158	165
Kuwait	0	0	0	167	165	157	158
United States	101	94	99	131	132	132	132
Israel	73	67	71	69	69	69	68
United Kingdom	26	23	25	38	38	39	38
Bahrain	2	2	2	42	43	43	41
Libya	0	0	0	42	38	38	34
Others	45	40	42	70	69	70	64
Total	1,522	1,400	1,483	3,343	3,343	3,351	3,351

Source: World Bank

Figure 4 maps the currency flow through the money exchange system.

Figure 4 - Flow of currency exchange
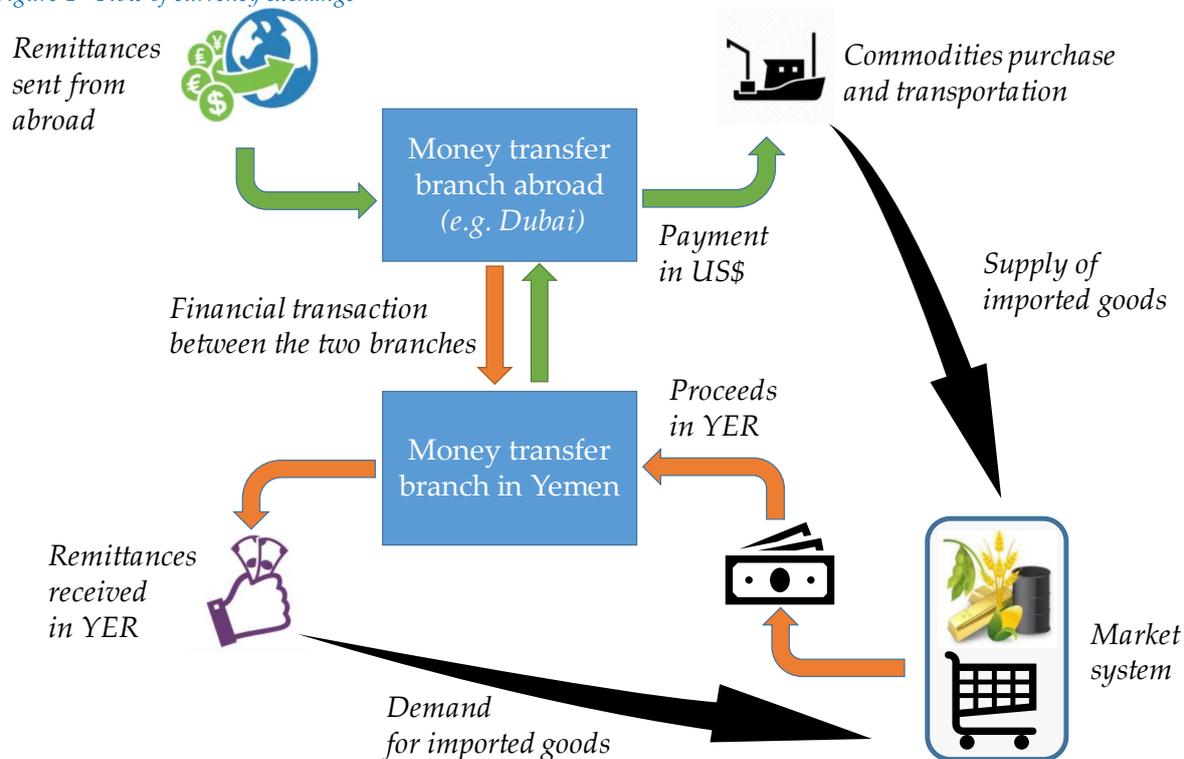
Source: Authors' interviews with key informants. Note: green arrows represent USD, orange arrows show YER, and black arrows indicate goods

There are two circuits, one for foreign currencies (mostly USD but also SAR), and one for the Yemeni rial. The former remains almost entirely in branches abroad, with limited amounts of dollars physically transferred to Yemen. Households receive the equivalent in YER of this remittance flow and spend it locally. Some remittance recipients may ask for USD, particularly in northern Yemen, but this increases the pressure on the exchange rate since dollars are scarce.

Together with other income, this money provides some purchasing power and supports the demand for goods and services. The importers, who take the bulk of the profits along the

value chain (see Figure 8 in the next section), are then able to reinvest part of their revenues to purchase goods from abroad and organize shipments in the country. Since the financial system is so weak, these traders must pay a large amount in advance, using dollars only. To do so, they obtain hard currency from money transfers. In physical terms, the money supply in YER generated through the market system turns back to the money exchangers and is eventually used to pay remittances to households, while the equivalent in dollars is transferred abroad. Other actors are also pivotal in this system, even though they are not portrayed in Figure 4. In fact, the dollars spent in the country by UN agencies and international NGOs are crucial to increasing the overall availability of dollars, thus partially compensating for shrinking oil revenues.

3. Food production, imports and stocks

Although anecdotal in nature, the assessment visits to local wholesale and retail markets in Sana'a, Hodeidah and Hajjah gave the impression of sufficient availability of both fresh and staple foods. Except for wheat and wheat flour, the retailers interviewed were confident of continued supplies. However, the visits took place before the blockade; for the following few months we have to rely entirely on WFP's price monitoring system for insights based on price availability. This section examines the situation of imported food and other sources of food including local production.

3.1 Food imports

Yemen imports large volumes of food, particularly wheat, rice, soybeans and sugar, but also most of the dairy items, oil and other processed foods consumed in the country. Even so, food imports represented just 9 percent of the value of total imports in 2015 (latest data available from UN Comtrade, see Table 4).

Table 4 - Value of cereal imports in USD (thousands), 2010-2015

	2010	2011	2012	2013	2014	2015
Wheat and meslin	708,594	961,921	983,809	1,048,449	1,060,312	811,336
Rye	-	-	-	-	-	-
Barley	-	-	4	-	0	14
Oats	482	416	505	697	276	1,433
Maize (corn)	103,146	153,173	154,374	145,381	308,394	132,741
Rice	247,631	239,182	346,284	363,140	384,409	313,330
Grain sorghum	91	-	41	-	-	35
Buckwheat, millet and canary seeds; other cereals	2,968	3,747	6,043	7,934	11,022	8,002
Total cereals	1,062,912	1,358,439	1,491,059	1,565,601	1,764,413	1,266,890
Foodstuff	1,687,552	2,045,004	2,251,924	2,343,797	3,306,275	1,725,976
Total	18,491,169	21,424,892	23,302,733	19,766,663	25,849,434	14,374,807
Cereal imports as a share of foodstuff imports	*63%*	*66%*	*66%*	*67%*	*53%*	*73%*
Cereal imports as a share of total imports	*6%*	*6%*	*6%*	*8%*	*7%*	*9%*

Source: UN Comtrade, retrieved from World Bank – World Integrated Trade Solution (WITS) website

The total value of imports plummeted in 2015, dropping by 44 percent compared with 2014 and 34 percent lower than the five-year average (2010–2014). Food imports also fell in 2015, although at a slower pace: down 28 percent from 2014 and 26 percent below the five-year average.

Considering the large volumes of imports handled by Yemen's ports before the crisis, current port capacity is unlikely to be a limiting factor on the quantity of food imported. Despite the partial destruction of port facilities, food imports represent such a small share of total imports – which have themselves fallen dramatically – that remaining capacity should be sufficient to manage them.

According to FAO data, wheat grain imports comprise the bulk of food imports, amounting to 69 percent in 2017, followed by rice (10 percent) and sugar (10 percent) (Figure 6). Annual

wheat imports averaged 2.8 million metric tons between 2008 and 2017.[18] After a peak of 3.4 million metric tons in 2014, imports fell by 18 percent in 2015 and by a further 15 percent in 2016. They partially rebounded in 2017, although data are only available for the first three quarters of the year. Assuming a monthly consumption of 250,000 mt of wheat (World Bank, 2017), the stocks in the country are estimated to have been slightly above 800,000 mt at the end of October 2017, enough to last for 3 months (or 97 days).

Figure 5 - Wheat stocks and depletion time
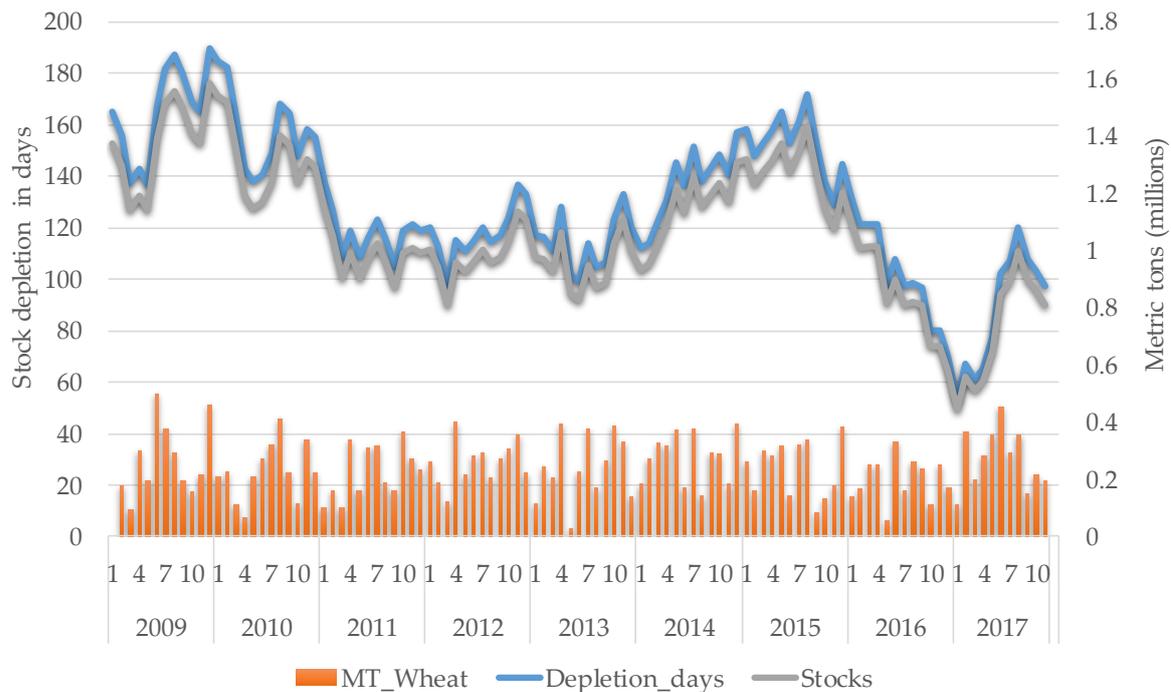
Source: Wheat imports from FAO; depletion days and stocks from authors' calculations

In section 5, we refer to the time needed to exhaust monthly final stocks as 'depletion days',[19] and we model it with wheat flour prices. At the beginning of the blockade, WFP conducted a rapid internal assessment for contingency purposes,[20] to understand the overall stocks held by traders in the country. The study revealed that wheat stocks would last for 98 days, in line with Figure 5. Stocks declined between mid-2015 and the end of 2016, which is reflected in higher price volatility (see Figure 11 and Figure 12 in section 5). Since then, and until the blockade, traders seemed to have built up their stocks, which is also seen in the relatively stable prices captured by WFP's monitoring system.

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[18] Data for 2008 to 2015 come from the Ministry of Trade and Industries government focal units, collected in 2016-17. Data for 2015 are reportedly slightly unreliable because of the conflict, while 2017 data reflect January to September only.

[19] Depletion days are calculated from the final stocks (i.e. initial stocks plus the difference between wheat imports and consumption) divided by daily requirements (i.e. 250,000/30).

[20] WFP, *Impact of the blockade on Yemen*, 12 November 2017.

Figure 6 - Food imports and grains by port

Source: FAO
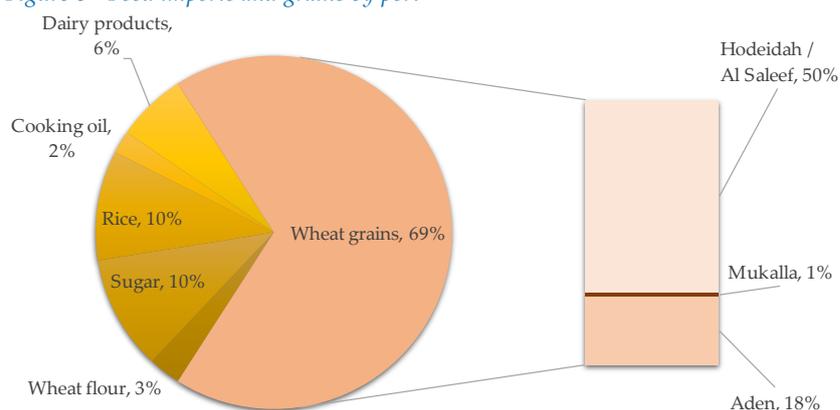
There are few entry points for imported goods into Yemen. There are only six major ports: Hodeidah, Al Saleef and Ras Isa (also called the Red Sea ports), and Aden, Mukalla and Mokha in the Gulf of Aden. The Red Sea ports[21] handle the largest volumes of imports: 61 percent of all food imports[22] to Yemen in 2017 were channelled through Hodeidah, which processed an even larger share of wheat grain imports – close to 75 percent. This may be attributed to the concentration of milling capacity in Hodeidah, the higher demand and shorter distance to the north of the country, and the low fees for handling a 20-feet container compared to other ports in the area.[23] There is little information on port capacity and commodity inflow for Mukalla. Interestingly, this port seems to manage almost all imported milk products (95 percent). In the absence of trend data, it is not clear whether this is a long-term phenomenon or whether it is related to port procedures or capacity issues. Nevertheless, despite the destruction of the mobile cranes in Hodeidah in mid-2016, which halved the turnover capacity for handling container cargo, there is little doubt of the critical role played by Hodeidah in Yemen's food supply. This is also supported by the fact that WFP moved almost 70 percent of its in-kind food assistance through the Red Sea ports in 2017.

Overland supply routes are of limited significance, although they are important for processed items such as dairy products and packaged goods. There are routes through Oman (Shahen and Hawf land access points) and Saudi Arabia (Al Wadia land access point; the routes through Sa'ada and Hajjah governorates are now closed).

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[21] These two ports are very close (70 km apart). Al Saleef has a maximum allowable draft of 13 metres and two berths, while the maximum draft is 9.75 metres in Hodeidah for 8 multi-purpose berths and 2 oil terminals. The port of Aden "*consists of the outer harbour, providing anchorage areas, the oil harbour* […], *and the inner harbour*", with maximum allowable draft spanning 10.4-14.5 metres (source: Wilhelmsen Ships Service).

[22] This includes wheat grain, wheat flour, rice, sugar, cooking oil and milk products. Source: FAO FSIS-FSTS Market Bulletin, October 2017.

[23] According to the Hodeidah Port Captain, the fees for a 20-feet container are USD 100 in Hodeidah, USD 125 in Aden, USD 145 in Djibouti and USD 160 in Djetta.

Map 2 - Yemen entry points and most important markets

3.2 Other sources of food

Besides commercial imports, wheat supply in Yemen is complemented by local production and food aid (i.e. commodities distributed by WFP which are either purchased or received as in-kind donations). Table 5 shows the relative importance of the three wheat supply sources.[24] Commercial imports make up the bulk of the available supply at slightly less than 90 percent of the total. Over the last three years, the roles played by local production and food assistance have switched: food assistance now represents almost 10 percent of the total, while local wheat production has been falling for the past two years.

Table 5 - Wheat supply sources

	2010	2011	2012	2013	2014	2015	2016	2017
Imported (φ)	2,600,205	2,858,334	2,975,933	2,955,202	3,387,049	2,775,046	2,348,337	2,866,495
Local production (τ)	265,000	232,000	250,000	233,000	192,000	165,000	96,000	90,000
Food aid (χ)	53,106	73,229	123,926	153,164	76,065	228,006	181,929	287,115
Total	**2,918,311**	**3,163,563**	**3,349,860**	**3,341,366**	**3,655,114**	**3,168,052**	**2,626,266**	**3,243,610**
Imported	89%	90%	89%	88%	93%	88%	89%	88%
Local production	9%	7%	7%	7%	5%	5%	4%	3%
Food aid	2%	2%	4%	5%	2%	7%	7%	9%

Source: (φ) FAO, (τ) USDA, and (χ) WFP. Food aid data until October 2017

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[24] Including wheat flour.

Table 10 in Annex I gives a breakdown of in-kind food distributed in Yemen between 2010 and 2017,[25] showing that wheat and wheat flour comprise an average 79 percent of the total.

The share of wheat from local production is normally below 30 percent.[26] Despite the large and widely cited import dependency, farmers in Yemen produce a range of foods such as cereals, vegetables, fruit, legumes and cash crops, as well as qat and fodder. In 2016, the biggest crops in terms of cultivated area were cereals (520,000 hectares)[27] followed by qat (167,000 hectares). According to figures from FAO, local cereal production in 2016 was 15 percent of total supply (357,000 mt vs. 2.4 million mt of imported wheat). However, since 2012 local production has dwindled, especially for cereals and vegetables. For qat, year-on-year changes in quantity and area cultivated remain rather small and sometimes positive (Figure 16 to Figure 18 in Annex I). Although it could appear as if cereals are being substituted by more profitable cash crops or qat, the data do not support this conclusion. Instead, the conflict seems to have had an impact on food production itself. This is illustrated by the downward trend in cereal yields, which is most likely caused by poorer input availability/access[28] and displacement.

Since its role is pivotal, in the next sections we refer to imported food only.

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[25] Data until October 2017.

[26] For the available data, this share was steady at 27 percent of total cereal production (2012–2016), except in 2015 when it made up 36 percent of the total.

[27] Wheat, sorghum and millet.

[28] E.g. access to fuel for irrigation was limited. In addition, fertilizers are not allowed to be imported due to sanctions.

4. Supply chain

4.1 Commercial supply chain

Despite all the challenges to the commercial sector in Yemen, the supply chain for basic goods is developed, especially in major urban settings; in fact, at the start of the assessment, markets in Sana'a city were bustling and full of goods. Some 45,000 traders are registered in the Chamber of Commerce & Industries in Sana'a, of whom 15,000 trade food, including importers, wholesalers, retailers, millers and bakeries.

In Figure 7, an indicator was developed to represent the retail supply chain, both in terms of retail development and supply chain efficiency.[29] To provide context, we also plotted data from other countries[30] where a similar exercise has been carried out.

Figure 7 - Retail Supply Chain Integration Indicator
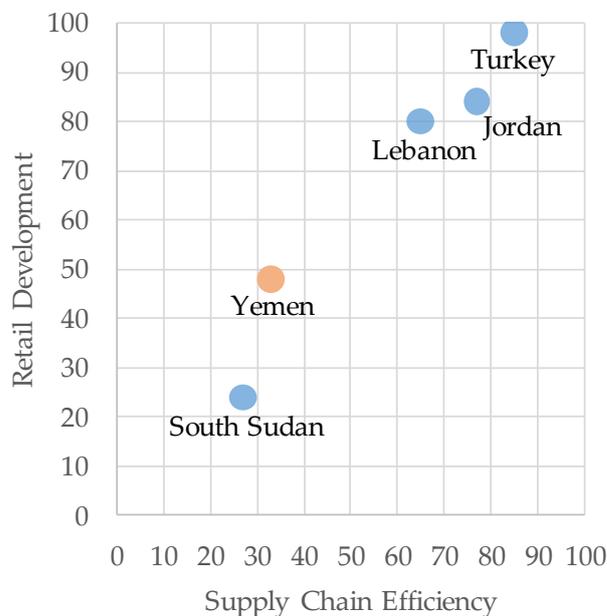
Source: WFP

In Yemen, the retail market is less formal than in Lebanon, Jordan and Turkey. Markets offer mostly dry goods with a limited range of fresh products, while competition is mostly on price and less on value-added services (e.g. service, quality and innovation in retail). Payment methods are limited and normally there are no credit options between main suppliers (importers and/or milling factories) and wholesalers, while occasionally delayed-payment arrangements up to 7-10 days may be agreed between wholesalers and retailers. In many cases however, retailers have to pay in advance before collecting goods through bank transfer, money transfer agents or in cash.

According to the Chamber of Commerce & Industries, Yemen has 200 to 300 large traders capable of importing 1,000 or more containers a year. There are 300 medium-scale traders who

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[29] The former represents the significance of the formal, regulated retail sector in the market, whereas the latter represents the maturity of the retail supply chain to deliver variety, quality, value-adding services and innovation at a competitive price. After that, qualitative assessment values are assigned from 1 to 10 on both axes, thus creating one reference point in the graph.

[30] These countries are all part of the WFP's regional bureau based in Cairo. They are interesting benchmarks either because of their geographical proximity to Yemen (Jordan, Lebanon and Turkey) or because they are similarly torn by civil war (South Sudan).

bring in between 100 and 300 containers; a further 500 small-scale importers manage fewer than 100 containers a year. However, the supply chain for imported food is dominated by five large companies.

Although it is hard to obtain clear estimates of market share, our assessment confirmed the market concentration findings of a previous study, when only four firms were found to hold almost 90 percent of market share (WFP, 2010). These companies represent a large chunk of the food market; the concentration is particularly visible for wheat.[31]

Indeed, while the wheat market remains an oligopoly, at least one major new food actor has emerged in recent years – a sign of the food sector's adaptation to the conflict economy. This is quite important, as in general, traders operating in conflict areas may either need strong political backing or face obstacles. Few traders – except perhaps for the major five – can easily adjust their supply chains from the Red Sea ports to Aden (i.e. moving from the 'baseline scenario' to the 'blockade scenario').[32] The top five importers are based in Sana'a, with branches in Aden or Hodeidah (including milling facilities) and potentially in other cities.

Wheat imports are stored in silos before milling at large mills. These have a daily milling capacity of 4,350 mt/day in Aden and 7,650 mt/day in Hodeidah and Al Saleef (Table 6). This capacity is supplemented by medium-sized mills with a capacity of 100-200 mt/day (two in Sana'a and six in Hodeidah) and small mills that could mill 10-20 mt each, but whose numbers can only be estimated; in Sana'a, they are believed to number between 200 and 300. In other words, the total monthly milling capacity could be estimated at 406,500 mt,[33] which is 70 percent more than the monthly consumption of wheat flour for Yemen.

Table 6 - Milling and silo storage capacity

Location	Company	Milling capacity (tons/day)	Silo capacity (tons)	Source
Aden	Aden Silos & Mills - Al Rowaishan Group	600	80,000	Logistic Cluster
Aden	Yemen Company for Flour Mills & Silos - Hayel Saeed Anam (Al Sanabel)	3,750	170,000	Official website
Hodeidah	Mills Company Limited - Hayel Saeed Anam (Al Sanabel)	1,500	50,000	Official website
Hodeidah	Red Sea Mills - Al Mohsen / Al Ahady	1,800	n.a.	Logistic Cluster
Hodeidah	Yemen Company for Flour Mills & Silos - Hayel Saeed Anam (Al Sanabel)	2,250	100,000	Official website
Saleef	Yemen International Food Industries Co. Ltd. - Al Habbari Group	600	150,000	Official website
Saleef	Fahem Group	1,500	120,000	WFP
Total		12,000		

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[31] According to representatives of the Chamber of Commerce and Industries, two companies trade 70 to 80 percent of the wheat grain market.

[32] This insight is confirmed by price developments up to January 2018, as described in section 5.1.

[33] Assuming 280,500 mt from large mills, 36,000 mt from medium-sized mills and 90,000 mt from small mills.

Onward distribution of wheat flour, other staple food items and fast-moving consumer goods is either through wholesalers, who mostly organize transport themselves, or through distributors who receive quotas from manufacturers and millers. The main traders control this flow of goods, especially for wheat/wheat flour.[34] The conflict economy requires more cash payment than before and thus more capital and certain levels of trust, which limits the range of potential customers. Transport from Aden to Sana'a is interrupted by 15 to 20 checkpoints, where fees are in the range of YER 5,000 to YER 10,000 per checkpoint depending on the load. There are fewer checkpoints between Hodeidah and Sana'a (around 10) and thus the fees are much less, as are the fuel costs given the shorter distance. Transport rates from Hodeidah/Al Saleef to Sana'a are around USD 39/mt[35] while from Aden they are estimated at USD 56/mt,[36] clearly making the port of Hodeidah the best choice from a cost perspective for the north.

Finally, the retail network is very diverse, ranging from large supermarkets with over 2,000 stock-keeping units (SKUs) to medium-sized outlets and small shops or commodity-specific retailers on open markets. Retailers source their goods from – even fairly distant –wholesalers, depending on location and commodity: retailers in Hajjah might source perishable goods from Sana'a or Hodeidah, while those in Sana'a might go to wholesale markets in the capital. Retailers normally stock their shops with products to cover between a week and a month of sales, and they arrange their own transport from supplier to shop. Several traders confirmed that they are not willing to dispatch food to areas affected by the conflict but would rather have traders from these locations arrange transport and take the full risk.

Profit margin analysis confirms the wheat market structure described above. Figure 8 shows the wheat grain margins based on material costs alone because data on running costs were not sufficiently accurate.

Figure 8 - Wheat profit margins
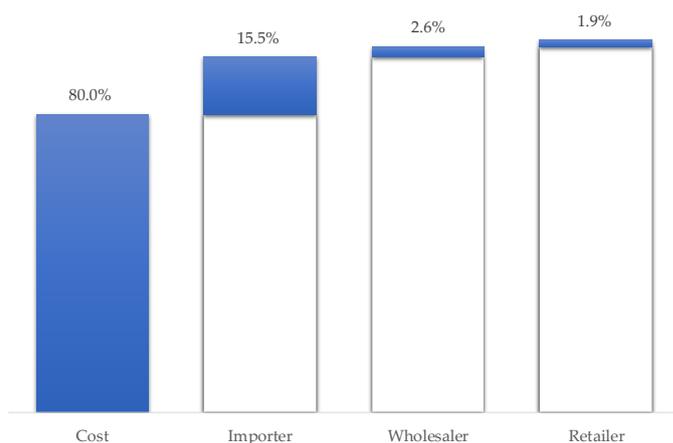
Source: WFP market assessment, key informants

To calculate supply chain margins, we added all the costs incurred by each actor along the supply chain to the cost of the commodity at source. In this case, starting from the 'free on board' (FOB) cost of wheat in Australia, we considered ocean shipping costs, port costs (including demurrage) and any other costs related to the supplier's warehouse. The data used to calculate the supply chain margin are taken

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[34] Reportedly, in addition to imposing quotas, traders have been artificially limiting the supply of wheat/wheat flour to the wholesale/retail network as a consequence of the high exchange rate volatility.
[35] Calculated using a YER 250/50 kg bag at an exchange rate of YER 405/USD.
[36] Source: WFP Supply Chain.

from one of the main wheat importers through Hodeidah and from a wholesaler and retailer in Hajjah. This generates the commodity 'cost' in Figure 8 and Table 7. From that, we calculated the importer's profit margin as the percentage difference between this cost and the price at which the importer sells wheat flour to the wholesaler. The margins for the wholesaler are similarly calculated as the percentage difference between the importer price and the price at which the wholesaler sells to the retailer. Finally, the retail margins are calculated in the same way.

The supply chain margins give an indication of which stage of the supply chain offers the most opportunity for extracting efficiencies. It is also an indicator of the levels of competition within the supply chain. The greater the competition in the supply chain segment, the lower the margin. The importers have significantly higher margins in the wheat supply chain, which reveals their strong bargaining position in the market and a lack of competition in the import sector.

Table 7 - Breakdown of wheat profit margins

Cost item	Source	US$/Mt	YER(*)/Mt	YER/50Kg	Margins (YER/50Kg)	(%)
Commodity cost		250.00	100,000	5,000		
Ocean transport + port cost	Calculation using Melbourne to Hodeidah 40,000MT Break Bulk cargo (**)	60.00	24,000	1,200		
Total commodity cost	**Cost to importer**	**310.00**	**124,000**	**6,200**		**80.0**
Import price	Selling price at Hodeidah	370.00	148,000	7,400	1,200	15.5
Wholesale price	Wholesale price at Hodeidah			7,600	200	2.6
Retail price	Retail price at Hodeidah			7,750	150	1.9

Source: WFP market assessment, key informants. (*) Exchange rate of YER 400USD; (**) worldfreightrates.com/freight

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4.2 Supply challenges

Supply chain actors, particularly retailers, highlighted several challenges to their regular supply. If wholesalers withhold wheat flour supplies because of highly volatile exchange rates and a lack of foreign currency, retailers may not be able to restock regularly. Rapidly rising buying prices force them to adjust their selling prices frequently, passing the cost on to consumers. The latter then suffer from lower purchasing power, which reduces demand. Prices are also affected by rising transport costs – a function of checkpoint fees as well as higher premiums for war insurance (currently around 7 percent), fuel shortages and fuel price surges, and demurrage costs caused by delays in the clearance process and reduced port handling capacity. Particularly during the blockade, commercial cargo was diverted to Aden port,[37] increasing the cost of shipping and lead times. The situation could worsen if the restrictions on commercial cargo are not lifted.

Reportedly, at the onset of the 'blockade scenario' a black market for wheat flour materialized, which could have been stimulated by low wheat supply, reduced milling capacity and stock hoarding by distributors.[38]

The customs fees normally paid at entry ports may occasionally be higher than the legislated fees, as both the de-facto and the legitimate government invoice duties unless the fees are split between Aden and Dhamar, the entry point to Sana'a city from the south. It has not been possible to ascertain exactly how much traders have to pay and to whom if they want to import food and circulate it within the country. In fact, traders seem to contradict each other, most likely because there is room to make *ad hoc* agreements to ease trade. While wheat grain and rice imports are exempt from customs, importers pay 5 percent for other cereals (e.g. rye, barley, maize and sorghum) and up to 25 percent for millet.[39] Surprisingly, full duties are charged in Aden and Hodeidah; in these cases, no additional customs were due in Dhamar at the time of the assessment.[40] By contrast, the tariffs on goods entering via Mukalla port are reduced to 40 percent to attract more customers, but in this case the balance has to be paid in Dhamar.

When it comes to food assistance planning, three main challenges could have an impact on the potential engagement of the retail sector. As highlighted in Figure 7, aside from some supermarkets in Sana'a, the Yemeni retail sector offers a basic range of dry goods with few fresh products – a challenge to increasing dietary diversity. Secondly, a significant portion of the

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[37] According to Hodeidah Port Captain, the number of container cargos reaching Hodeidah has been falling steadily since 2014. There were 147 in 2014, 84 in 2015, 62 in 2016 and only 27 in 2017 (data until October 2017). Meanwhile, in Aden they increased from 115 in 2015 to 140 in 2017 (source: http://portofaden.net/Statistics.aspx).

[38] See also footnote 34.

[39] Source: Yemen Customs, Section II Vegetable products. Customs tariffs for sugar are at 5 percent. For food preparations of cereals, flour, starch or milk and pastry products, tariffs are 5–10 percent. For meat, they are 10 percent, and for fish, 25 percent.

[40] Reportedly, in 2018, customs in Dhamar have started charging duties even when taxes are fully paid in Aden.

retail sector is informal, which could make it difficult to establish legal contracts with retailers. Lastly, point-of-sale checkouts are only found in supermarkets, limiting the potential for automated consumer demand analysis and stock management. This restricts the level of supply chain integration and collaborative demand forecasting and planning between manufacturers and retail outlets. It also minimizes the amount of price data that can be collected along the supply chain.[41]

5. Price analysis

In this section we investigate how prices behave when moving from the 'baseline scenario' to the 'blockade scenario' and the 'crisis scenario'. We provide some indications to determine transfer values if cash-based transfers are introduced and some insights into price generation mechanisms.

5.1 Price trends

Most prices were fairly steady in 2017 until the port blockade unleashed substantial pressure on markets; as a result, fuel prices skyrocketed during the first three weeks of November 2017. Table 8 shows the highest month-on-month price changes from the baseline (October 2017) recorded by WFP's monitoring system in November and December 2017. Data are also shown for January 2018 to give an indication of the effect on prices during the aftermath of the 'blockade' and 'crisis' scenarios: the fuel market (i.e. diesel and petrol) was out of control almost everywhere in the country, as was clear from the extraordinarily long queues at the petrol stations.

Table 8 - Top 20 month-on-month price increases for fuel and cereals

Market	Commodity	Baseline Oct-17 2017w42	Blockade Nov-17 2017w46	change from baseline	Crisis Dec-17 2017w50	change from baseline	Jan-18 2018w3	change from baseline	Market	Commodity	Baseline Oct-17 2017w42	Blockade Nov-17 2017w46	change from baseline	Crisis Dec-17 2017w50	change from baseline	Jan-18 2018w3	change from baseline
Aden	Diesel	175	500	186%	325	86%	325	86%	Sa'ada	Rice	400	500	25%	500	25%	700	75%
Aden	Petrol	185	500	170%	325	76%	325	76%	Amran	Wheat Flour	160	200	25%	200	25%	240	50%
Al Hawta	Petrol	185	500	170%	320	73%	325	76%	Mareb	Rice	550	675	23%	700	27%	700	27%
Dhamar	Diesel	240	600	150%	340	42%	340	42%	Al Baidha	Rice	500	600	20%	700	40%	725	45%
Al Ghaidha	Petrol	220	500	127%	250	14%	250	14%	Al Ghaidha	Rice	500	600	20%	600	20%	700	40%
Amran	Petrol	275	600	118%	380	38%	370	35%	Ibb	Rice	500	600	20%	600	20%	650	30%
Al Hawta	Diesel	185	375	103%	325	76%	325	76%	Zungubar	Rice	500	600	20%	600	20%	650	30%
Sana'a	Diesel	270	500	85%	335	24%	325	20%	Al Baidha	Wheat Flour	160	190	19%	200	25%	200	25%
Mahweet	Diesel	225	400	78%	340	51%	400	78%	Sana'a	Wheat Flour	170	200	18%	200	18%	240	41%
Ibb	Diesel	260	450	73%	380	46%	450	73%	Hadibo	Rice	425	500	18%	500	18%	500	18%
Amran	Diesel	300	500	67%	390	30%	325	8%	Hajjah	Wheat Flour	170	200	18%	200	18%	200	18%
Ibb	Petrol	300	475	58%	360	20%	370	23%	Mukalla	Wheat Flour	170	200	18%	200	18%	200	18%
Addaleh	Petrol	200	310	55%	310	55%	400	100%	Sayoun	Wheat Flour	170	200	18%	200	18%	200	18%
Al Ghaidha	Diesel	200	300	50%	260	30%	260	30%	Al Jabeen	Wheat Flour	160	186	16%	184	15%	200	25%
Mareb	Diesel	150	225	50%	225	50%	225	50%	Dhamar	Wheat Flour	150	170	13%	200	33%	200	33%
Al Baidha	Diesel	275	400	45%	425	55%	340	24%	Mahweet	Wheat Flour	150	170	13%	180	20%	180	20%
Hodeidah	Diesel	240	340	42%	380	58%	320	33%	Addaleh	Rice	575	650	13%	700	22%	700	22%
Al Jabeen	Diesel	325	450	38%	310	-5%	360	11%	Aden	Wheat Flour	160	180	13%	200	25%	200	25%
Taiz	Petrol	300	400	33%	375	25%	375	25%	Hodeidah	Wheat Flour	152	170	12%	190	25%	200	32%
Sa'ada	Diesel	240	300	25%	500	108%	360	50%	Amran	Rice	450	500	11%	650	44%	650	44%

Source: WFP

Aden prices showed the highest month-on-month increases in November 2017 (up to 186 percent), perhaps because this market is dominated by just one trader, while Hodeidah port has ten fuel importers. The supply composition is critical to understanding fuel price volatility.

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[41] Various WFP departments and FAO all collect price data, supposedly for different purposes. This is a potentially unnecessary use of resources when synergies could be harnessed to avoid duplicating efforts and gathering incompatible information.

Reportedly, the price spikes in Aden were more driven by monopolistic behaviour, whereas in Hodeidah and in the other markets served by the Red Sea ports there was a mix of hoarding and a temporary reduction in available stocks. According to a rapid assessment conducted in mid-November, diesel was "*estimated to run out in 20 days and petrol in 10 days in the northern areas of Yemen*".[42] These temporary shocks were short-lived but have left a permanent mark. By the end of January 2018, diesel prices converged not only in Aden and Hodeidah, but also in Sana'a (Figure 9), although at a much higher level compared with the baseline.

Figure 9 - Diesel in Sana'a, Aden and Hodeidah *Figure 10 - Wheat flour in Sana'a, Aden and Hodeidah*
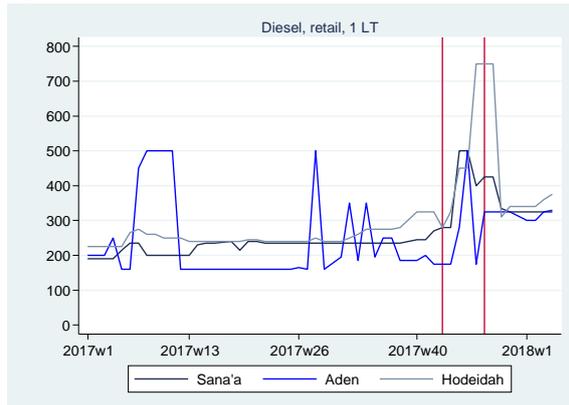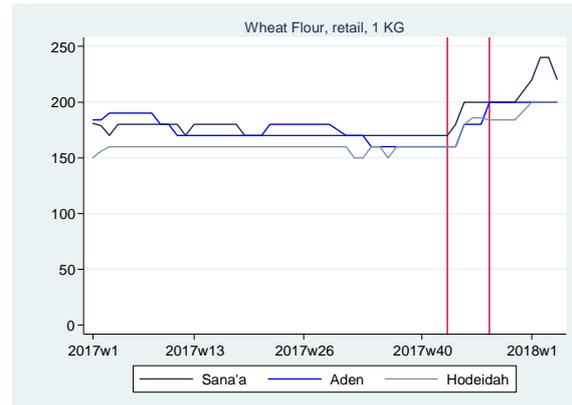
Source: WFP. The red vertical lines correspond to the onset of the 'blockade' and 'crisis' scenarios

Data from November 2017 to January 2018 seem to suggest that the importer in Aden is the price setter, and the other importers adjusted to its level. All in all, fuel prices are more stable but remain significantly higher than the baseline. The increase in food prices was generally lower; when the 'blockade scenario' came into effect, the highest price rises for wheat flour and rice were recorded in Amran and Sa'ada (25 percent). Meanwhile, in the towns visited during the assessment wheat flour prices rose by 18 percent in Hajjah and Sana'a, by 12 percent in Hodeidah and by 13 percent in Aden. Since then, prices have continued to increase in several locations including in Sana'a, where wheat flour prices rose by 41 percent in January 2018 (Table 8 and Figure 10). This confirms that transport costs (including checkpoints, drivers, fuel and truck rental) make a strong contribution in pushing up prices as wheat flour travels from Hodeidah and Aden (where the bulk of the imported wheat is milled) to Sana'a and elsewhere in the country. In January 2018, wheat flour was sold at YER 200/kg in Aden and Hodeidah, but at YER 240/kg in Sana'a (Table 8). According to our forecasts,[43] further increases are likely in the coming months, pushing markets in *Stress* or *Crisis* conditions according to the WFP Alert for Price Spikes (ALPS) indicator (Figure 19 in Annex II).[44]

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[42] OCHA, *Yemen: Impact of the closure of sea, land and airports on the humanitarian situation*, Update 2, 16 November 2017.

[43] Based on the Holt-Winters seasonal method.

[44] See http://dataviz.vam.wfp.org/economic_explorer/price-forecasts-alerts

5.2 Minimum expenditure basket

The Central Statistical Office has not released official inflation figures since 2014, so it is hard to assess the real cost of living in Yemen.[45] Most prices for non-food items have been on the rise, thereby increasing household expenditures. Figure 11 shows what has happened in Sana'a with cooking gas and diesel prices as compared with wheat flour.

Food expenditures represent an average 38 to 53 percent of household expenditure, depending on the governorate (see Table 12 in Annex III). In Aden food makes up 52 percent of household expenditure, while in Hodeidah, it is 49 percent. In Sana'a city, the share is 39 percent, while in Sana'a governorate it is 42 percent.

Figure 11 - Non-food items vs. wheat flour price increases in Sana'a

Source: WFP. The red vertical lines correspond to the onset of the 'blockade' and 'crisis' scenarios

The feasibility of moving from commodity vouchers to cash-based transfers is better assessed by analysing expenditure breakdown to understand likely expenditure patterns (for cash transfers), and to help establish the cost of a hypothetical food basket to fine-tune transfer values (for cash and value-based voucher transfers). Whenever cash is considered as a possible assistance modality, analysts must try to understand what people will buy with the money provided. Not all the cash will go on food, in spite of efforts to calculate a transfer value that covers a required intake of 2,100 kcal per person per day. Even though WFP beneficiaries are probably the most vulnerable people and may devote a larger share of their expenditures to food, they also have to fulfil other essential needs beyond food. This is true with general food distributions as well, when beneficiaries sell food – particularly vegetable oil[46] – in the market to satisfy other needs.

Because of this, we have moved away from the current food minimum expenditure basket (fMEB),[47] which is used to calculate the value of the full WFP ration of commodity vouchers and to compare the cost of the five products provided as general food distribution (wheat

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[45] To the best of our knowledge, the Central Statistical Office has stopped reporting the consumer price index, so no official inflation figures are available.

[46] During the market visits, it was easy to find WFP-branded vegetable oil on sale in Sana'a and Hajjah.

[47] The MEB in Yemen is "*an indicator of the cost of the minimum, culturally appropriate items that a Yemeni household of 7 individuals needs for one month, while meeting basic standards for nutritious food, water use and hygiene*" (Reach, 2017).

flour, sugar, vegetable oil, red beans and salt).[48] Instead, we have adopted an expenditure-based approach, using the most recent reliable data available at the governorate level. The data come from the Emergency Food Security and Nutrition Assessment (EFSNA) conducted between November and December 2016. We used the national poverty line per capita per month at YER 10,913 in 2014, inflated to YER 13,770 applying an inflation rate of 16.5 percent in 2015 and 8.3 percent in 2016.[49] Using the expenditure module in the EFSNA, we calculated the share of expenditures by expenditure group for the households falling below the governorate relative poverty lines (Table 11 in Annex III). Through this, we obtained a revised food MEB. Ideally, other items beyond food should be added to this fMEB to reflect the essential needs of the most vulnerable households but this falls beyond the scope of this assessment.[50]

The poorest people in Sana'a city spend relatively less on food than those in other governorates (39 percent), but they spend a considerable amount on services and shelter (see Table 12 in Annex III). Expenditure on qat and tobacco are also significant (11 percent). Of the 39 percent spent on food, 15 percent goes on cereals (see Table 13 in Annex III). Expenditure on food was over 50 percent of total expenditure in the governorates of Aden, Hadramaut and Raymah; in Hajjah and Hodeidah, it was 49 percent. The lowest share of expenditure on cereals was found in Aden and Mareb (15 percent each); among the other governorates, it was as high as 31 percent in Raymah.

Despite the data limitations, we calculated the revised fMEB using both nominal and real prices.[51] [52] When moving from the 'baseline scenario' to the 'blockade scenario', both the in-kind-based and the expenditure-based nominal fMEB rise dramatically, mostly driven by wheat flour (Figure 12). By contrast, the real fMEB graph in Figure 13 shows an almost flat trend since early 2017, with a slightly less prominent increase during the 'blockade scenario', and a more prominent rise thereafter, almost reaching levels seen in early 2016.

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[48] The fMEB is based on the five goods provided as in-kind assistance through the WFP food basket (with their relative weight): wheat flour (10.714 kg), sugar (0.3571 kg), vegetable oil (1.0571 litres), red beans (1.4286 kg), and salt (0.1429 kg).

[49] Sources for the consumer price index are as follows: Saint Louis Federal Reserve Economic Data for 1996–2013 (yearly averages); and the Consumer Price Index Worksheet from the Central Statistical Office for October 2015 and October 2016, which is the latest worksheet that we could access.

[50] In the absence of detailed expenditure data, a consensus-based constitution of the non-food item part of the MEB would be the most feasible approach. Cooking gas and fuel would probably be part of this MEB along with other goods and services. Price monitoring should include all MEB items.

[51] Real prices are calculated as the ratio between nominal prices and CPI.

[52] Nominal prices were deflated using the average yearly CPI described in the footnote above, and using World Bank forecast for 2017. We fully acknowledge the limitations of deflating monthly prices using yearly CPI.

Figure 12 - Cost of the monthly nominal fMEB in Sana'a
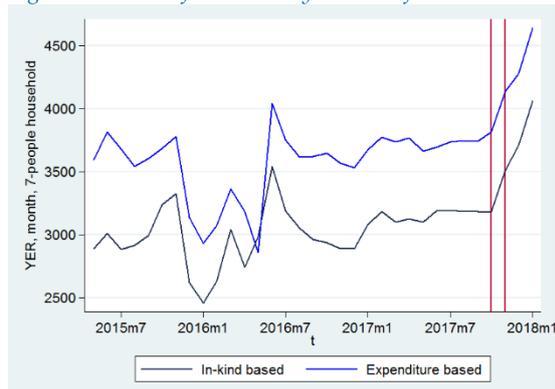
Figure 13 - Cost of the monthly real fMEB in Sana'a
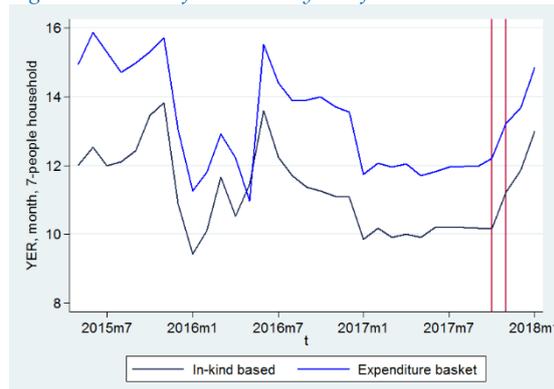
Source: WFP, authors' calculations. The red vertical lines correspond to the onset of the 'blockade' and 'crisis' scenarios

An explanation for the flat pattern until October 2017 can be found in the lack of household purchasing power that dampened demand, which left real prices unaffected by the supply constraints described in the previous section.[53] This is a sign that until the blockade, most of the food security issues in the country were related to access rather than availability.

The revised expenditure-based fMEB is notably more expensive than the in-kind based one. Moreover, it is probably an underestimation of the real expenditure of Yemeni households if meat (including poultry) and fish were factored in the analysis. In terms of programming, this could mean revising the full transfer value upwards, if cash or value-based vouchers are introduced as a food assistance modality. Looking back at the period January to November 2017, applying this revised fMEB would have meant a maximum average adjustment of 28 percent in Aden and Hadibo. In Al Ghaidha, Hodeidah, Hajjah and Mareb, the adjustment would have been slightly above 20 percent, whereas in Sana'a city it would have been 18 percent (see Figure 20 in Annex III).

Figure 14 - Expenditure-based fMEB by city
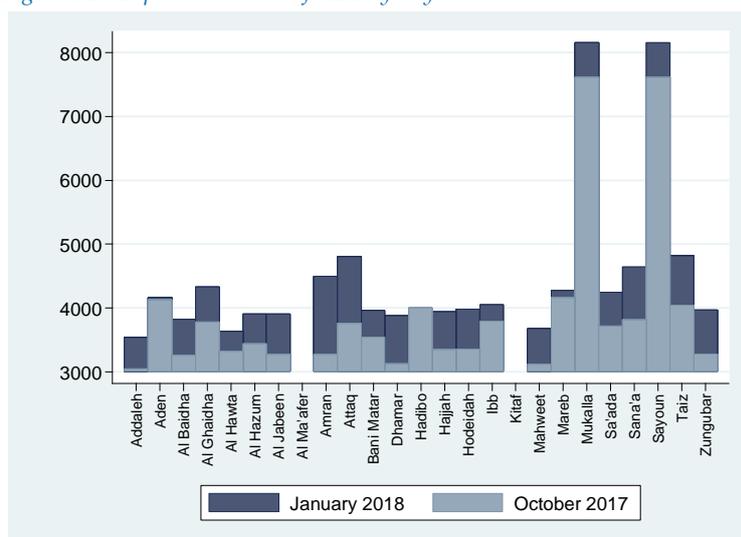
Source: WFP. Authors' calculations

The different costs of living in Yemen (Figure 14) also need to be considered when determining the transfer value. In October 2017 there were two major outliers – Sayoun and Mukalla in Hadramout governorate – where market information is limited as the area is partially controlled by Al-Qaeda groups, and the food basket seems to be extremely expensive. Other than that, someone living in Mareb or Aden in October 2017 would have needed

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[53] "*Importers also report increased difficulties in selling the purchased imports in Yemen, citing the fall in purchasing power as a primary reason*" (World Bank, 2017).

to spend more than YER 4,000 a month to fulfil their minimum food intake; in Taiz and Hadibo the threshold was slightly lower. In January 2018, the cost of the fMEB shot up almost everywhere, exceeding YER 4,000 in Attaq, Amran, Al Ghaidha, Mareb, Sana'a and Sa'ada.

Figure 15 shows how the fMEB was cheaper in Aden than in Sana'a before November 2017. In January 2018, the cost remained almost unchanged in Aden, despite the serious volatility in November and December 2017. However, in Sana'a and Hodeidah the cost of the fMEB increased dramatically, demonstrating how successful the blockade policy was in reducing the flow of goods into and from Hodeidah to the northern governorates.

Admittedly, in the current political situation it would be extremely challenging to reach a consensus among the actors in the conflict to allow for different transfer values for different governorates, even though that would be the ideal approach, at least in the medium term.

Figure 15 - Expenditure-based fMEB in Sana'a, Aden and Hodeidah
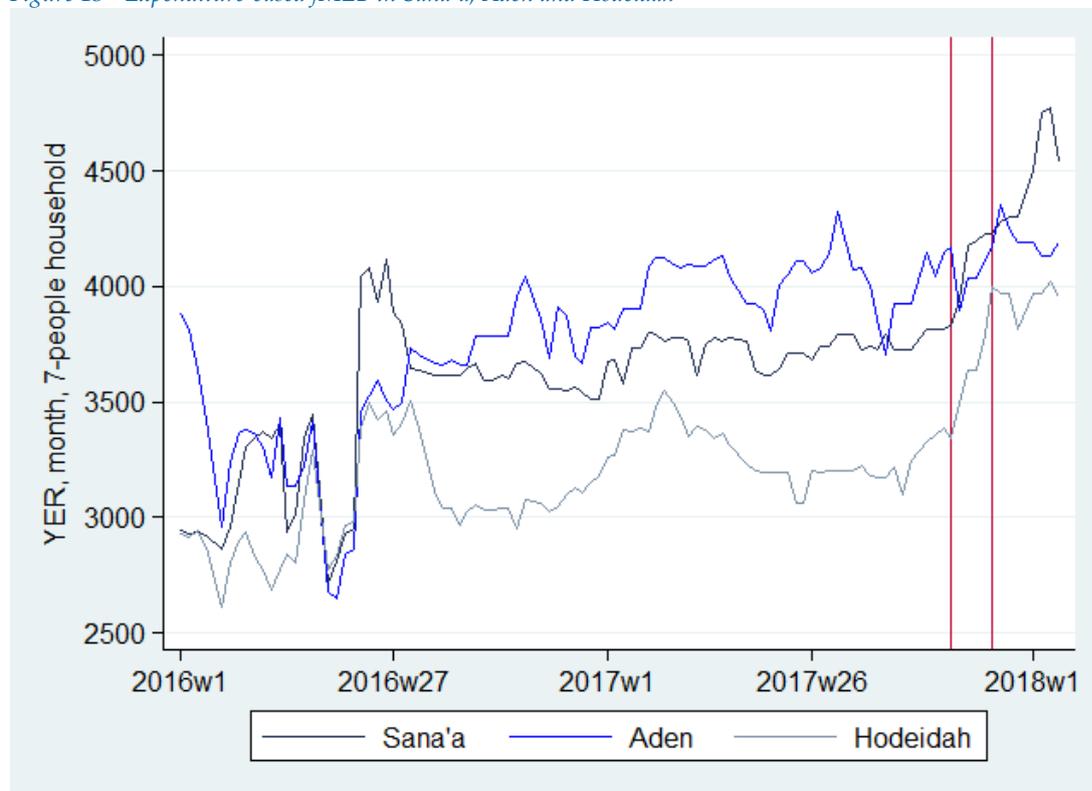
Source: WFP. Authors' calculations. The red vertical lines correspond to the onset of the 'blockade' and 'crisis' scenarios

5.3 Price triggers

Adjusting rapidly to the different scenarios is not easy for households or humanitarian organizations. The changes are unpredictable; few indicators are available and they have to be used to extrapolate as much information pertaining to the broader food security context as possible. Prices are among these indicators. We developed a simple econometric model to try to understand the effect on wheat flour prices in Sana'a (i.e. response variable) if other indicators change (i.e. triggers or impulse variables). These indicators are the exchange rate in Sana'a; diesel prices in Sana'a; wheat flour prices in Hodeidah (being the major entry point for wheat and the location of most of the key mills); and the depletion days of the monthly final stocks,

if no additional vessels arrive in the country. The latter is useful in the scenario of a full block-ade of the Red Sea ports, but it is also a good proxy to understand the overall availability of imported wheat in the country.

During the 'blockade scenario', these three triggers were paramount:

a) the Yemeni rial crashed quickly, with demand for US dollars outstripping supply;
b) people were queuing at petrol stations to fill their cars and there were fears of an eco-nomic stand-still when fuel stocks were estimated to last only two additional weeks; and
c) with no commercial vessels allowed in any of the Yemeni ports, the estimation of re-maining stocks became crucial.

All the prices/rates are weekly observations averaged over the month, except for November 2017, where we used the first three weeks only.[54] Further details on the Vector Error Correc-tion model used for the analysis are in Annex IV.

Overall, the results corroborate expectations; the drivers of rising wheat flour prices in Sana'a are diesel prices, the exchange rate and the dynamics of wheat flour prices in Hodeidah. By contrast, an increase in the number of days required to completely exhaust imported wheat stocks relaxes wheat flour prices, as economic operators adjust their expectations based on better overall availability of the commodity in the market. Table 9 shows how wheat flour prices would react in the following six months if a change occurred in one of the triggers at time zero.

None of the shocks would return to zero, meaning that the effects on the response variable are permanent. Diesel prices seem to be the major driver of wheat flour price increases, par-ticularly in the first two months when wheat flour prices would rise 2.8 percent following a 1 percent increase in the fuel price, and possibly reaching a cumulative effect of 10 percent after six months. The exchange rate also has a higher impact in the first two months (up to 2.3 percent response following an increase of 1 percent); after three months, the effect becomes more volatile, with a cumulative effect of 3 percent after six months.

Prices in Hodeidah influence price changes in Sana'a, with the biggest response occurring after two months (2.6 percent) and a cumulative impact of 7 percent after six months. This could be because traders are able to buffer their stocks or because the Aden route remains open, even though it is not convenient for most traders. The interpretation of depletion days is slightly different, because it is the only variable in levels and not in logarithms in our model.

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[54] The data source for all the prices is WFP VAM price monitoring system, while the source for depletion days is FAO, based on official custom reports. Given the difficulty in obtaining reliable data on wheat imports, we crosschecked the 2010–2015 data with the UN Comtrade database, revealing a good fit between the two sources (on average, the monthly discrepancy was just 2 percent).

Table 9 - Sana'a wheat flour price response to triggers - Orthogonal impulse response

Response variable: Wheat flour price in Sana'a

Time (in months)	Fuel price in Sana'a (diesel)		Exchange rate (USD/YER)		Depletion days (imported wheat)		Wheat flour price in Hodeidah	
	Monthly	*Cumulative*	Monthly	*Cumulative*	Monthly	*Cumulative*	Monthly	*Cumulative*
0	0.0%		0.0%		0.0%		0.0%	
+1	2.7%	*2.7%*	1.1%	*1.1%*	-0.1%	*-0.1%*	0.5%	*0.5%*
+2	2.8%	*5.6%*	2.3%	*3.4%*	-0.2%	*-0.3%*	2.6%	*3.1%*
+3	1.8%	*7.3%*	-0.9%	*2.5%*	-0.1%	*-0.4%*	0.1%	*3.2%*
+4	1.0%	*8.3%*	-0.9%	*1.5%*	-0.2%	*-0.6%*	1.6%	*4.8%*
+5	1.0%	*9.3%*	0.5%	*2.0%*	-0.2%	*-0.7%*	1.8%	*6.6%*
+6	1.0%	*10.4%*	0.8%	*2.9%*	-0.1%	*-0.9%*	0.6%	*7.2%*

Note: Authors' calculation. Source: WFP-VAM price monitoring (wheat flour, petrol and exchange rate), and FAO (imported wheat)

Each unit of change here is approximately 24 days (i.e. the standard deviation), thus an increase in the overall stocks of almost one month would timidly push wheat flour prices down by 0.1-0.2 percent each month, with a cumulative effect of just 1 percent. Interestingly, although higher wheat stocks relax wheat flour prices, the fall in wheat flour prices is not as large as the increase driven by exchange rates and fuel; this is quite normal in economic terms, as prices tend to adjust more rapidly to upward trends in the market, whereas they are slower to respond to downward trends. Another reason is that, despite all the limitations, traders dealing in wheat imports run consolidated businesses, and in the past they have proved able to import adequate food stocks as long as the ports are functioning.

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6. Concluding remarks and recommendations

An estimated 17.8 million people in Yemen are food insecure, of whom 8.4 million are thought to face severe food insecurity (OCHA, 2017). The escalation of the crisis in northern Yemen with the blockade of seaports and airports has made it more difficult to estimate the number of people in need of humanitarian assistance, also considering the lack of up-to-date assessment data.

Within just one month of the start of this study, at least three major scenarios emerged in Yemen: 1) the 'baseline scenario', referring to the situation at the end of October 2017, which had lasted since the beginning of the year; 2) the 'blockade scenario'; and 3) the 'crisis scenario' with the outbreak of violence in Sana'a.

For security reasons, our field activities have been strictly limited in terms of the markets we could visit (Sana'a, Hodeidah and Hajjah) and quality of the visits. The broader data collection planned to provide insight into market functionality across the country has had to be postponed.

At the beginning of the assessment, under the 'baseline scenario', vulnerability to food insecurity was largely an issue of economic access. This is confirmed by empirical observations of the amount and variety of goods available in the markets, particularly in Sana'a, as well as by secondary data analyses. When considering real rather than nominal prices, the price trend has clearly been stable if not declining since the beginning of 2017. Food stock estimates corroborate this finding, as importers were able to build up their stocks from the lowest level reached in December 2016 (53 days of consumption) to around 100 days in October 2017.

However, signs of pressure were evident in the markets even before the blockade. The Yemeni rial depreciated dramatically against the US dollar, adding a foreign exchange gap on top of the purchasing gap. The reasons for the depreciation are manifold and all connected to the three years of civil war. The major drivers include the split of the central bank into two practically independent branches in Sana'a and Aden; and the weak bank system – partially substituted by the parallel money exchangers system – which cannot fully support the commercial sector for imported food. In this regard, the assessment found a very thin food sector with five main importers dominating the market. These five are the least affected by the situation, whereas minor importers can barely cope with such a restricted operating environment. When it comes to developing food assistance programmes involving the commercial sector in a war-torn country, assessment should be made of the governance of markets in crisis, the major actors and how their 'constituency' has been built. When humanitarian needs are enormous, there is no doubt that the private sector – particularly the oligopoly in the food market – is in a position to support WFP's stretched supply chain with goods, in spite of the challenging operational environment. Yet this strategy comes at the cost of increasing the power of the few companies that already dominate the market. This may not be the best approach to take under all possible scenarios; other elements of market development may need to be factored in slowly, particularly in the 'baseline scenario'.
The following recommendations emerge from this study:

i. If the situation returns to the 'baseline scenario', the markets in Sana'a, Hodeidah and Hajjah seem to be functional enough to support a gradual scale-up of the current commodity voucher interventions. In these urban settings, the major criticality was related to the lack of household purchasing power – as confirmed by relatively stable real prices – which could be eased with cash-based interventions. Under this scenario, the main markets also seemed strong enough to support a careful move from commodity-based to value-based vouchers using the existing network of traders. This is in line with the findings of an inter-agency cash study published in December 2017.[55] Given the tiny share of in-kind assistance compared with total wheat supply in Yemen (9 percent in 2017), it is likely that the commercial sector will be able to cope with the drop in supply prompted by a reduction of the amount of in-kind wheat flour available. Pure cash distributions appear rather risky at the time of writing.

ii. If the 'blockade scenario' remains in place for the medium term, we need to assess the capacity of traders to reorganize their supply chain from Hodeidah to Aden, and estimate the associated cost. This can be done by evaluating the functionality of the current commodity voucher system and any bottlenecks that may exist. Ultimately, if food stocks remain satisfactory in the coming weeks/months, a gradual scale-up of commodity-based vouchers could be considered. Under this scenario, if the cost of the fMEB increases substantially, there seems to be little room for exploring cash-based transfers, since the inflationary pressure recorded in the period November 2017 to January 2018 clearly suggests a stretched supply chain, coupled with an even weaker Yemeni rial.

iii. In principle, the 'crisis scenario' – or a similarly tense situation that lasts for an extended period – would not allow cash-based transfers nor the scale-up of commodity voucher interventions. This statement is valid until the humanitarian imperative of saving lives becomes so urgent and WFP's capacity to continue with its business-as-usual programming so stretched that it would be advisable to adopt a second-best approach. In such a case, it would be vital to conduct a risk analysis[56] to understand the effects of the crisis on shop opening hours, supply chain capacity to move goods within the country, and protection of customers before passing (part of) the implementation risks of food assistance programming to the private sector.

iv. The findings of the assessment refer mostly to Sana'a, Hodeidah and Hajjah. There is little knowledge of the functionality of markets in rural settings. As soon as the situation is safe enough to send enumerators into the field, the planned trader survey may provide insights into more remote markets.

v. WFP should advocate as much as possible with the Central Statistical Office to resume the monthly issuance of the consumer price index, in order to better monitor possible negative effects of cash interventions on inflation.

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[55] *"The primary conclusion of this study was that, based upon availability, pricing, and restocking times, food commodities, cooking gas, and hygiene items are suitable candidates for a cash based intervention"* (Reach, 2017).
[56] This risk analysis is beyond the scope of this assessment because of the unpredictability of the current situation.

vi.   If cash-based interventions are introduced, price monitoring should cover all commodities in the revised fMEB, and it should include non-food expenditures to establish the ideal transfer value for beneficiaries. If the political situation permits, different transfer values should be determined for each governorate, to better reflect differences in the cost of living.

vii.   The persistence of changes to diesel prices and the exchange rate should be monitored, as they are likely to be transmitted to wheat flour prices, and eventually to the cost of the food basket. An increase of 1 percent in diesel prices in Sana'a could push wheat flour prices up by 10 percent over a six-month period, while an appreciation of the US dollar by 1 percent leads to 3 percent rise within the same time frame. Conversely, an increase of 25 days in the depletion time of wheat stocks would relax wheat flour prices by 1 percent.

viii.   A closer collaboration with FAO should be explored regarding the capture and storage of import and stock data for staple foods, with a view to creating a jointly accessible, coherent, reliable and timely database. This database should contain information such as the number of vessels berthing, total metric tons by commodity and arrival port, as well as stock data of at least the five major importers, to be triangulated with information from official sources.

ix.   Although price monitoring can serve different objectives (WFP, 2017b), the methodology for price data collection should be harmonized within WFP – and as far as possible between UN organizations – so that resources are not wasted in parallel exercises and the information provided is reliable, consistent and timely.

x.   Given the rapid depreciation of the rial and the increasing difference between the market exchange rate and the rate negotiated with the bank by the UN, WFP should consider pegging the latter to the market exchange rate to minimize financial losses in an underfunded operation.

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Annex I - Sources of food

Table 10 - WFP in-kind commodities (in metric tons) brought into Yemen 2010-2017

Commodity	2010	2011	2012	2013	2014	2015	2016	2017	Total
Beans	4,459	3,679	3,962	12,583	9,210	1,309	0	0	**35,201**
Canned fish	0	0	0	0	0	304	0	0	**304**
Dried fruits	84	646	676	330	0	0	487		**2,223**
High energy biscuits	161	831		50	841	2,270	0	0	**4,153**
Iodised salt	462	506	489	0	1,637	1,931	0	0	**5,025**
Peas	0	0	0	0	0	0	1,970	0	**1,970**
Ready to use supplementary food	44	2,363	0	1,289	211	424	4,993	1,380	**10,703**
Rice	1,050	475	2,622	725	825	2,623	0	0	**8,320**
Split peas	420	2,425	0	1,746	2,858	24,922	12,937	26,574	**71,880**
Sugar	1,939	2,750	2,401	161	165	7,594	4,971	0	**19,981**
Vegetable oil	2,894	8,529	4,022	7,137	6,893	5,618	14,946	23,008	**73,048**
Wheat	19,839	9,005	75,915	112,457	58,466	189,416	153,495	251,758	**870,352**
Wheat flour	33,267	64,224	48,011	40,707	17,598	38,590	28,434	35,357	**306,189**
Wheat soya blend	9,449	7,513	6,771	68	6,374	20,736	17,092	12,744	**80,746**
Total	**74,067**	**102,946**	**144,869**	**177,252**	**105,078**	**295,736**	**239,326**	**350,821**	**1,490,096**
Wheat & wheat flour share of total	*72%*	*71%*	*86%*	*86%*	*72%*	*77%*	*76%*	*82%*	*79%*

Source: WFP, SAP/WINGS

Figure 16 - Local production (in metric tons) by commodity, 2012–2016

Source: FAO

*Figure 17 - Year-on-year percentage change in local production by commodity, 2012–2016*
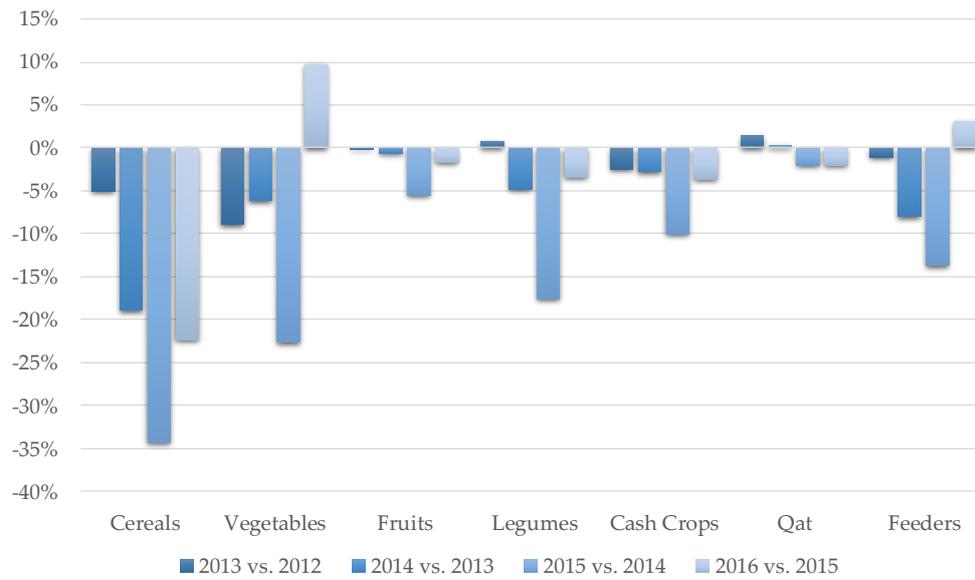

Source: FAO

Figure 18 - Year-on-year percentage change in cultivated area by commodity, 2012–2016
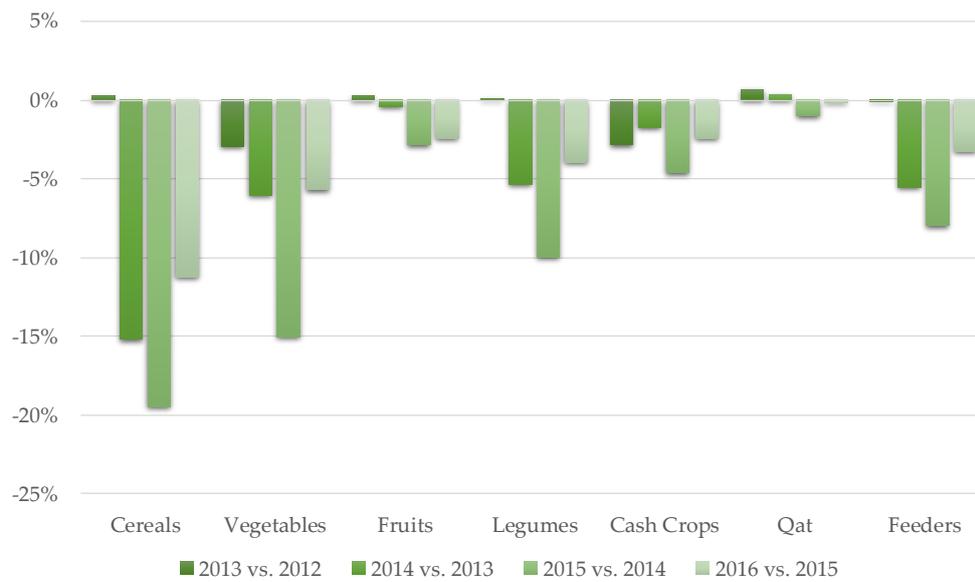
Source: FAO

Annex II - Price forecasts and Alert for Price Spikes (ALPS)

Figure 19 - Forecasts and ALPS
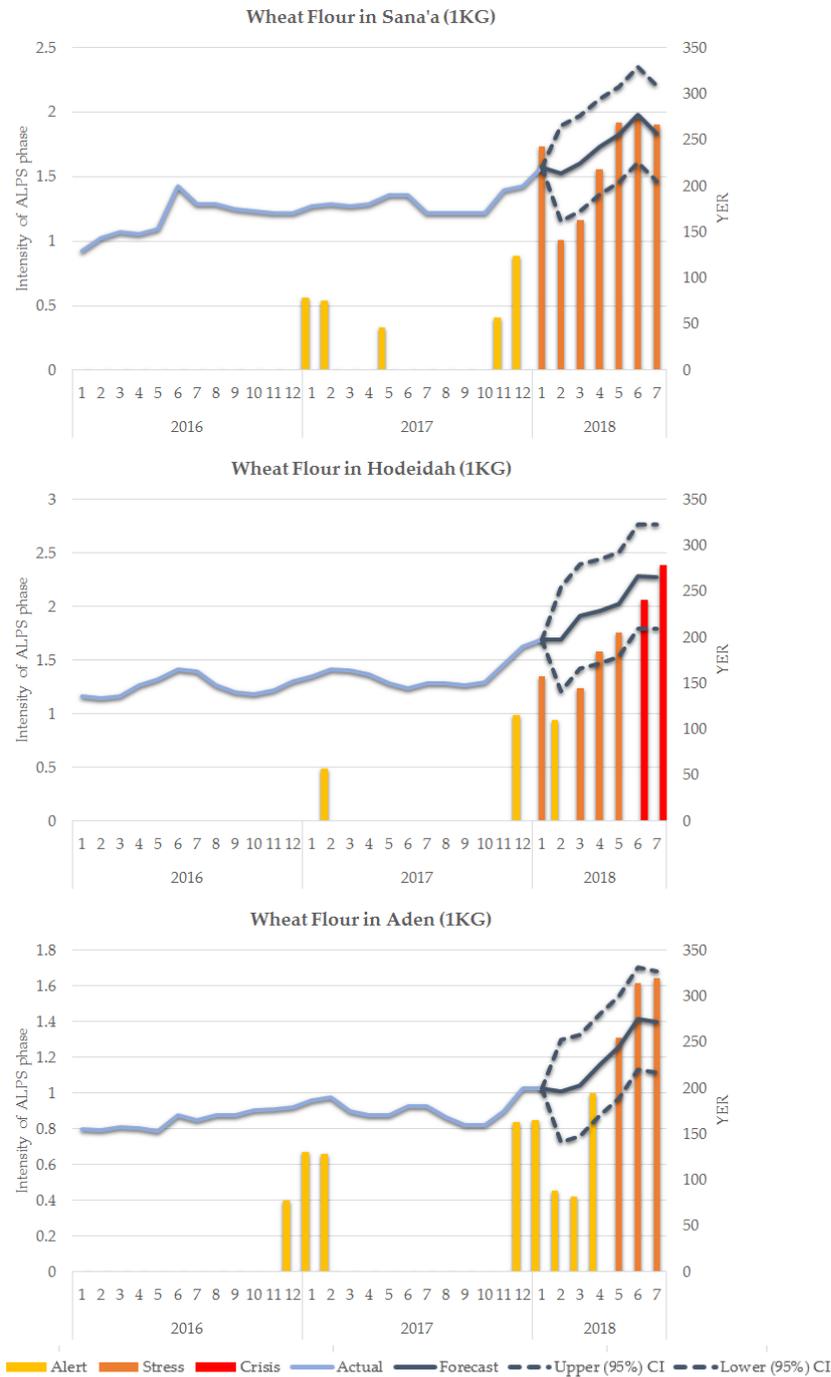
Source: WFP, http://dataviz.vam.wfp.org/economic_explorer/price-forecasts-alerts

Annex III - fMEB

Table 11 - Relative poverty lines and headcount ratio in 2016

Governorate	Relative poverty line		Head-count ratio
	YER	US$	
Abyan	249	1.00	80%
Addaleh	253	1.01	85%
Aden	261	1.04	76%
Al Baidha	302	1.21	48%
Al Jawf	280	1.12	65%
Amran	291	1.16	61%
Dhamar	244	0.98	69%
Hadramaut	232	0.93	79%
Hajjah	223	0.89	80%
Hodeidah	213	0.85	79%
Ibb	291	1.16	59%
Lahj	224	0.89	76%
Mahweet	267	1.07	69%
Mareb	297	1.19	38%
Raymah	214	0.85	83%
Sana'a	260	1.04	69%
Sana'a city	308	1.23	43%
Shabwah	194	0.78	88%
Taiz	238	0.95	76%

Source: Authors' calculations based on EFSNA 2016

Table 12 - Per capita share of total expenditure by expenditure group

Govenorate	Food	Qat & tobacco	Services	Utilities	Shelter	Other	Total
Abyan	47%	3%	25%	1%	13%	10%	100%
Addaleh	44%	9%	25%	1%	10%	11%	100%
Aden	52%	3%	25%	3%	8%	9%	100%
Al Baidha	38%	11%	21%	2%	15%	12%	100%
Al Jawf	36%	18%	17%	0%	19%	10%	100%
Amran	39%	12%	22%	2%	13%	13%	100%
Dhamar	43%	11%	17%	1%	16%	13%	100%
Hadramaut	51%	1%	28%	2%	6%	13%	100%
Hajjah	49%	7%	18%	1%	13%	11%	100%
Hodeidah	49%	12%	21%	2%	5%	11%	100%
Ibb	42%	11%	21%	1%	13%	12%	100%
Lahj	47%	6%	22%	1%	8%	16%	100%
Mahweet	47%	10%	17%	1%	14%	11%	100%
Mareb	39%	11%	25%	3%	11%	12%	100%
Raymah	53%	7%	14%	1%	15%	11%	100%
Sana'a	42%	12%	22%	0%	12%	11%	100%
Sana'a city	39%	8%	20%	14%	10%	9%	100%
Shabwah	41%	4%	26%	1%	17%	11%	100%
Taiz	38%	8%	25%	4%	10%	14%	100%

Source: Authors' calculations based on EFSNA 2016

Table 13 - Per capita share of food expenditure by food group

Govenorate	Cereals	Vegetables	Fruits	Pulses	Dairy	Meat	Fish	Poultry	Snacks	Oil & sugar	Total
Abyan	20.7%	7.2%	0.8%	1.2%	2.4%	0.5%	5.5%	2.9%	0.0%	6.4%	47%
Addaleh	28.2%	2.5%	0.4%	0.4%	2.6%	0.1%	0.1%	3.5%	0.1%	6.0%	44%
Aden	15.4%	8.9%	1.3%	4.7%	3.9%	0.2%	6.2%	4.2%	0.1%	6.7%	52%
Al Baidha	18.2%	4.8%	0.7%	1.5%	1.5%	0.9%	0.1%	5.4%	0.1%	4.9%	38%
Al Jawf	16.0%	6.9%	0.3%	1.0%	1.2%	0.2%	0.0%	5.7%	0.0%	5.1%	36%
Amran	19.7%	4.5%	1.3%	1.4%	2.5%	1.2%	0.0%	3.6%	0.0%	4.8%	39%
Dhamar	21.8%	4.4%	0.9%	1.9%	3.5%	1.2%	0.3%	3.0%	0.0%	6.1%	43%
Hadramaut	23.3%	4.7%	1.3%	2.7%	4.5%	1.1%	5.5%	2.8%	0.1%	5.4%	51%
Hajjah	26.4%	5.8%	1.0%	2.3%	2.7%	1.8%	0.8%	1.5%	0.1%	7.0%	49%
Hodeidah	18.3%	10.3%	1.1%	2.0%	1.9%	0.5%	5.0%	1.0%	0.2%	8.4%	49%
Ibb	20.4%	4.8%	0.7%	3.1%	2.7%	0.5%	0.1%	4.8%	0.1%	4.9%	42%
Lahj	23.0%	5.2%	1.1%	1.5%	3.9%	0.2%	2.1%	2.2%	0.5%	7.0%	47%
Mahweet	23.1%	4.7%	2.1%	1.9%	5.2%	1.1%	0.8%	2.3%	0.1%	5.8%	47%
Mareb	15.9%	3.5%	1.0%	4.2%	1.6%	0.8%	0.1%	6.9%	0.1%	4.7%	39%
Raymah	30.5%	3.8%	1.0%	1.5%	3.1%	0.5%	0.2%	3.5%	0.1%	8.4%	53%
Sana'a	21.8%	4.8%	0.5%	2.4%	3.5%	0.5%	0.0%	2.9%	0.1%	6.0%	42%
Sana'a city	14.7%	7.8%	0.7%	3.6%	2.9%	0.5%	0.2%	3.7%	0.1%	5.1%	39%
Shabwah	20.6%	3.5%	0.3%	1.0%	2.5%	0.2%	3.0%	3.8%	0.1%	5.9%	41%
Taiz	18.8%	4.8%	0.7%	1.3%	3.2%	0.2%	0.4%	2.7%	0.0%	6.4%	38%

Source: Authors' calculations based on EFSNA 2016

Table 14 - Caloric contribution rescaled to (approximately) 2,100 kcal

| Govenorate	Wheat Flour	Rice	Tomato	Lentils	Yellow Split Peas	Red Beans	White Beans	Palm oil	Sugar
Abyan	1540	36	4	7	7	7	10	267	216
Addaleh	1796	7	1	3	3	3	3	178	112
Aden	1267	43	7	34	55	33	40	347	276
Al Baidha	1610	25	2	10	17	10	13	231	180
Al Jawf	1551	47	1	7	7	7	7	223	248
Amran	1673	22	3	10	20	10	10	196	160
Dhamar	1645	18	3	10	17	10	13	214	172
Hadramaut	1691	18	5	10	20	13	13	178	148
Hajjah	1547	22	4	10	24	23	23	249	200
Hodeidah	1439	43	3	14	17	13	17	294	260
Ibb	1565	25	4	24	31	23	20	231	180
Lahj	1694	18	4	7	7	7	10	187	168
Mahweet	1663	18	4	10	10	10	10	214	160
Mareb	1512	14	3	30	34	33	34	240	200
Raymah	1740	11	2	7	7	7	7	187	140
Sana'a	1551	22	1	14	17	17	17	258	208
Sana'a city	1397	47	3	27	38	30	37	285	232
Shabwah	1659	18	1	7	7	7	7	249	148
Taiz	1442	25	2	10	14	10	13	329	256

Source: Authors' calculations

Table 15 - Revised fMEB weights

Govenorate	Wheat Flour	Rice	Tomato	Lentils	Yellow Split Peas	Red Beans	White Beans	Palm oil	Sugar
Abyan	0.44	0.01	0.02	0.00	0.00	0.00	0.00	0.03	0.05
Addaleh	0.51	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.03
Aden	0.36	0.01	0.04	0.01	0.02	0.01	0.01	0.04	0.07
Al Baidha	0.46	0.01	0.01	0.00	0.01	0.00	0.00	0.03	0.05
Al Jawf	0.44	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.06
Amran	0.48	0.01	0.02	0.00	0.01	0.00	0.00	0.02	0.04
Dhamar	0.47	0.01	0.02	0.00	0.01	0.00	0.00	0.02	0.04
Hadramaut	0.48	0.01	0.03	0.00	0.01	0.00	0.00	0.02	0.04
Hajjah	0.44	0.01	0.02	0.00	0.01	0.01	0.01	0.03	0.05
Hodeidah	0.41	0.01	0.02	0.00	0.01	0.00	0.01	0.03	0.07
Ibb	0.45	0.01	0.02	0.01	0.01	0.01	0.01	0.03	0.05
Lahj	0.48	0.01	0.02	0.00	0.00	0.00	0.00	0.02	0.04
Mahweet	0.48	0.01	0.02	0.00	0.00	0.00	0.00	0.02	0.04
Mareb	0.43	0.00	0.02	0.01	0.01	0.01	0.01	0.03	0.05
Raymah	0.50	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.04
Sana'a	0.44	0.01	0.01	0.00	0.01	0.01	0.01	0.03	0.05
Sana'a city	0.40	0.01	0.02	0.01	0.01	0.01	0.01	0.03	0.06
Shabwah	0.47	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.04
Taiz	0.41	0.01	0.01	0.00	0.00	0.00	0.00	0.04	0.06

Source: Authors' calculations

Figure 20 - Average required transfer value adjustment in 2017
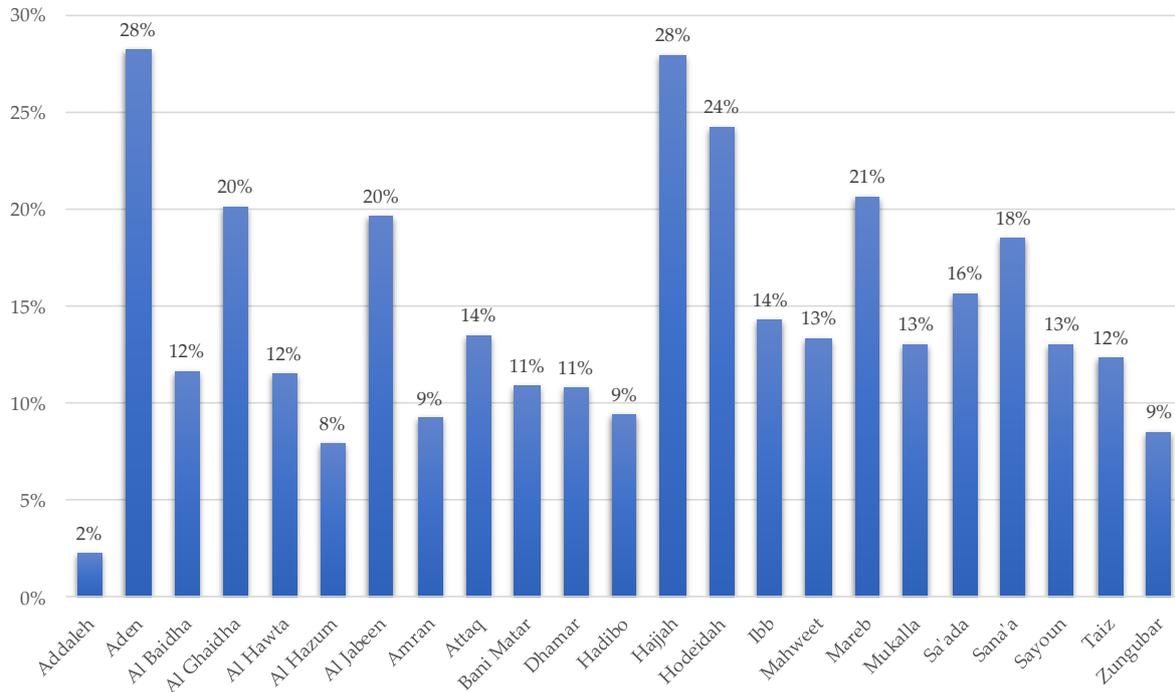
Source: Authors' calculations

Annex IV - Vector Error Correction Model

Table 16 shows the preliminary analysis required for the model presented in section 5.[57] The Augmented Dickey Fuller test was carried out on wheat flour prices in Sana'a and Hodeidah, fuel prices in Sana'a, the exchange rate in Sana'a (all transformed in natural logarithms) and wheat stocks depletion days, each with its ideal number of lags.

Table 16 - Unit root test

	# of lags		Augmented Dickey-Fuller test			
	AIC	Lag	Test Statistic	5% Critical value	MacKinnon approximate p-value for Z(t)	Order of integration
wflour_s	-1.99667	1	-2.881	-3.584	0.1687	I(0)
wflour_s	-1.99667	1	-4.615	-1.708	0.0001 ***	I(1)
diesel_s	-0.43759	2	-1.468	-3.588	0.8398	I(0)
diesel_s	-0.43759	2	-3.177	-1.714	0.0021 **	I(1)
ex_rate_s	-3.08578	3	-3.455	-3.592	0.0445 **	I(0)
depl_days	7.64667	1	-1.789	-3.47	0.7103	I(0)
depl_days	7.64667	1	-7.220	-1.665	0.0000 ***	I(1)
wflour_h	1.117956	1	-4.269	-3.469	0.0035 **	I(0)

Wheat flour and diesel prices in Sana'a, and depletion day variables are integrated of order 1 (meaning that you would need to difference them once in order to achieve stationary time-series). Hence a vector error correction model would be required if co-integration was found[58] within the variables considering the number of lags returned by the Akaike Information Criterion (AIC) (Table 17).

Table 17 - Number of lags

Selection-order criteria
Sample: 2015m9 - 2017m10   Number of obs = 26

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	50.9721				0.001857	-3.45940	-3.37579	-3.16907
1	52.7709	3.59750	1	0.058	0.001755	-3.52084	-3.42330	-3.18212
2	55.6079	5.67410 *	1	0.017	0.001535 *	-3.66215 *	-3.55067 *	-3.27504
3	55.8765	0.53724	1	0.464	0.001639	-3.60589	-3.48048	-3.17039 *
4	56.2884	0.82369	1	0.364	0.001735	-3.56064	-3.4213	-3.07676

Endogenous: wflour_s
Exogenous: diesel_s ex_rate_s depl_days wflour_h dummy _cons

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[57] Unless otherwise specified, the notations *, ** and *** imply a level of significance respectively at 10 percent, 5 percent and 1 percent.

[58] Two co-integrated series remain tied together in the long run even though both can occasionally depart from their pattern.

Table 18 - Co-integration test

Johansen tests for cointegration					
Trend:	constant			Number of obs	= 28
Sample:	2015m7 - 2017m10			Lags	= 2
maximum				trace	5% critical
rank	parms	LL	eigenvalue	statistic	value
0	42	65.003568	.	195.7382	94.15
1	53	107.469100	0.95184	110.8072	68.52
2	62	130.381910	0.80537	64.9815	47.21
3	69	148.370800	0.72333	29.0038 *	29.68
4	74	159.581490	0.55101	6.5824	15.41
5	77	162.271310	0.17480	1.2027	3.76
6	78	162.872680	0.04205		

The Johansen test confirms that the time-series have some sort of long-run dependency not to drift apart (Table 18). One of the three co-integration equations is found to be statistically significant (Table 19), while short-run relations also exist; using wheat flour prices in Sana'a as our variable of interest, all the lagged differences of the investigated variables are statistically significant. A dummy variable was also included as of April 2016, to take into account the move from a fixed to a floating rate regime.

Table 19 - VECM results

		D_wflour_s		Coef.	Std. Err.	z	P>|z|		[95% Conf. Interval]	
long-run	L1.	_ce1	-	2.5172140	0.4779715	-5.27	0.000	***	-3.4540210	-1.5804070
long-run	L1.	_ce2	-	0.1885126	0.1357903	-1.39	0.165		-0.4546567	0.0776315
long-run	L1.	_ce3		0.5434829	0.4618194	1.18	0.239		-0.3616666	1.4486320
short-run	LD.	wflour_s		0.9576625	0.3149310	3.04	0.002	**	0.3404090	1.5749160
short-run	LD.	diesel_s		0.4780469	0.1370688	3.49	0.000	***	0.2093970	0.7466967
short-run	LD.	ex_rate_s	-	0.7875940	0.3475399	-2.27	0.023	**	-1.4687600	-0.1064284
short-run	LD.	depl_days	-	0.0028457	0.0012960	-2.2	0.028	**	-0.0053858	-0.0003056
short-run	LD.	wflour_h	-	0.5685009	0.2190500	-2.6	0.009	**	-0.9978311	-0.1391708
short-run	LD.	dummy	-	0.1247504	0.1210185	-1.03	0.303		-0.3619423	0.1124415
		_cons		0.0082470	0.0164569	0.5	0.616		-0.0240080	0.0405019

Post-estimation diagnostic generally confirms that residuals are normally distributed (except for wheat flour in Sana'a) (Table 20), that no autocorrelation at lag order one and two exists (Table 21), and that the eigenvalue stability condition is met (Table 22).

Finally, causality between the variables is confirmed (Table 23).

Table 20 - Diagnostic 1 (residuals tests)

Normal distribution of residuals tests												
	Jarque-Bera test				Skewness test					Kurtosis test			
Equation	chi2	df	Prob > chi2		Skewness	chi2	df	Prob > chi2		Kurtosis	chi2	df	Prob > chi2
D_wflour_s	8.966	2	0.01130 **	-1.0581	5.225	1	0.02226 **	4.7906	3.741	1	0.05310 *
D_diesel_s	0.908	2	0.63521	-0.352	0.578	1	0.44701	2.4687	0.329	1	0.56603
D_ex_rate_s	0.441	2	0.80210	0.12011	0.067	1	0.79528	2.434	0.374	1	0.54098
D_depl_days	1.391	2	0.49876	0.49665	1.151	1	0.28332	2.5463	0.240	1	0.62410
D_wflour_h	0.125	2	0.93949	-0.09556	0.043	1	0.83645	2.7345	0.082	1	0.77430
D_dummy	3.417	2	0.18112	-0.72993	2.486	1	0.11483	3.8932	0.931	1	0.33467
ALL	15.248	12	0.22818		9.551	6	0.14489	5.697	6.000	0	0.45799

Table 21 - Diagnostic 2 (autocorrelation)

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	39.3351	36	0.32290
2	30.8598	36	0.71145

H0: no autocorrelation at lag order

Table 22 - Diagnostic 3 (stability)

Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
1	1
- 0.19718 + .8301141i	0.85321
- 0.19718 - .8301141i	0.85321
0.05049 + .7975821i	0.79918
0.05049 - .7975821i	0.79918
- 0.77015	0.77015
0.67828	0.67828
0.37966 + .5140006i	0.63901
0.37966 - .5140006i	0.63901
0.04290	0.04290

The VECM specification imposes 3 unit moduli (K=6 variables - r=3 cointegration relationships)

*Table 23 - Diagnostic 4 (causality)*

Causality test

(1) [D_wflour_s]LD.diesel_s = 0
(2) [D_wflour_s]LD.ex_rate_s = 0
(3) [D_wflour_s]LD.depl_days = 0
(4) [D_wflour_s]LD.wflour_h = 0
(5) [D_wflour_s]LD.dummy = 0

chi2(5) = 31.34
Prob > chi2 = 0.0000

H0: coefficients in specific equation are 0

Figure 21 - Impulse monthly and cumulative (dash lines) responses on wheat flour prices

Impulse: fuel price in Sana'a

Impulse: exchange rate in Sana'a

Impulse: depletion days

Impulse: wheat flour price in Hodeidah

Source: Authors' calculations