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Afghanistan's Wheat Flour Market: Policies and Prospects

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Abstract

Afghanistan is among the world's largest importers of flour. Afghan flour producers face challenges from inadequate domestic supplies of wheat and competition from imported flour, much of it from neighboring Pakistan where wheat producers and flour millers benefit from Government support. Efforts to support Afghanistan's flour-milling sector by increasing border protections—if enforceable along the country's rugged borders— would lead to higher prices that harm consumers. Similarly, efforts to boost domestic production of wheat for milling through import policies would require a difficult-to-enforce combination of flour and wheat tariffs or other restrictions that would also impose costs on consumers. Free trade, entailing unhindered wheat and flour imports, including imports from Pakistan, may lead to stronger growth in domestic flour production and consumption, with relatively small losses in farm output.

Keywords: Afghanistan, wheat, flour, production, milling, imports, tariffs, Pakistan, projections, model, elasticity.

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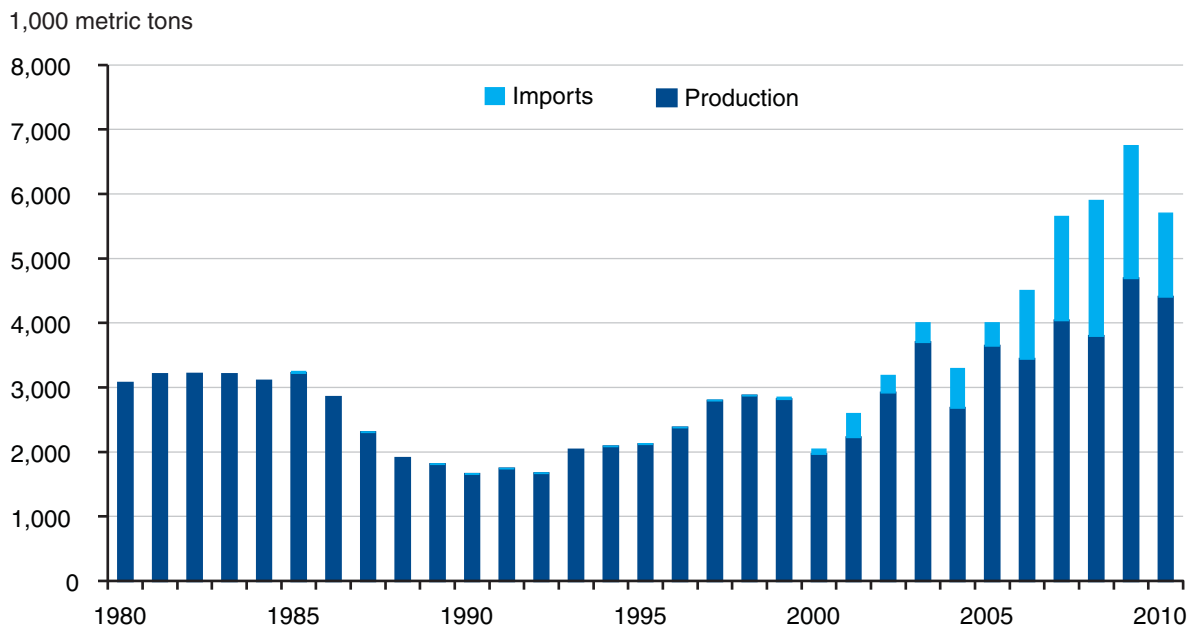
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Introduction

Afghanistan, strategically positioned between Central Asia, the Middle East, and South Asia, has emerged as one of the world’s largest importers of flour. In the post-2000 period, although flour production has increased rapidly, demand has grown even faster, spurred by a rapidly expanding population and strong economic growth (albeit from a low base). The gap between domestic supply and demand began expanding in 2001 and exploded in 2006, when flour imports first surpassed 1 million metric tons (MMT) (fig. 1). Despite its landlocked location and weak transportation links, Afghanistan’s flour imports averaged 1.6 MMT, ahead of Uzbekistan (1.5 MMT) and Iraq (1.1 MMT) (2009/10-2010/11; table 1).

Flour milling is Afghanistan’s largest official (non-opium) agroindustry, and wheat is the country’s major crop and staple food. Afghan flour producers cope with challenges stemming from low and highly variable supplies of wheat, as well as competition from imported Pakistani flour. Although the Afghan Government has at times set tariffs on flour and wheat imports to support domestic production (FAO, 2010), efforts to use border policies to shield Afghan millers from foreign competition—to the extent they are enforceable along the country’s rugged borders—can impose costs on consumers. This study focuses on the role that policy interventions aimed at protecting Afghanistan’s wheat milling and farming sectors play in shaping the country’s long-term growth prospects for domestic flour production and imports, and evaluates their potential impacts on consumers and farmers.

Figure 1
Flour supply in Afghanistan



Sources: Production and imports are author’s estimates based on FAOSTAT database, USDA PS&D database, and IGC database.

Note: Appendix 3 provides method used for computing flour production.

Table 1

Key flour importers

Country	2009/10	2010/11	2011/12 ¹
	<i>1,000 MT</i>		
Afghanistan	1779	1327	1100
Uzbekistan	1499	1415	1900
Iraq	1184	989	1400
Indonesia	1005	1062	900

¹Estimate.

Note: wheat-equivalent basis.

Source: International Grains Council (2013).

Afghan Flour Imports: Pakistan Shipments Predominate

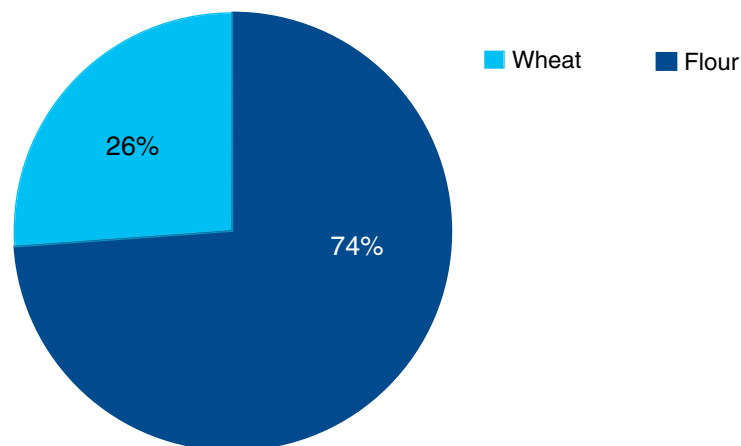
Globally, wheat grain is more heavily traded than wheat flour because of generally more restrictive trade policies on flour, which are intended to allow importing countries to retain the value-added from doing their own wheat milling. Imports and exports of wheat flour are also limited, however, by logistical challenges, including the quality deterioration associated with transporting wheat flour, which has a shorter “shelf life” than wheat grain. Afghanistan stands in sharp contrast to the international norm in its ratio of wheat grain to wheat flour imports: flour comprises approximately 74 percent of Afghanistan’s total wheat imports (2009/10-2010/11 average; fig. 2). The country relies more heavily on imports of the processed commodity, in effect leaving the value-added from milling to other countries.

Afghanistan is a landlocked country, bordered on the west by Iran, on the south and the east by Pakistan, and on the north by Turkmenistan, Uzbekistan, and Tajikistan. Afghanistan imports wheat and flour from a number of these neighboring countries, with Pakistan and Kazakhstan the leading suppliers. However, with a shared border of 1,600 kilometers and a long history of trade, Pakistan is the dominant supplier of wheat, mostly in the form of flour, to Afghanistan. The private millers and traders of Pakistan work closely with Afghan traders (Khan, 2007). Pakistani wheat flour is widely accepted by Afghan consumers because of its quality,¹ and Pakistani mills extend credit to Afghan traders seeking to purchase flour (Schulte, 2007; Khan, 2007). Kazakhstan, the largest exporter of wheat in the region and in recent years a dominant flour exporter, does not share a border with Afghanistan. The quantities of Kazakh wheat and flour that have been exported to Afghanistan arrived via circuitous routes through Tajikistan, Uzbekistan, and Turkmenistan (Khan, 2007).

Afghanistan’s Ring Road has a critical role in removing physical constraints to flour trade. Extending from Kabul to Kandahar to Hirat before looping back to Kabul, the Ring Road was designed to link major cities in Afghanistan. The road has generated economic benefits by

Figure 2

Composition of Afghan wheat imports (2009/10 - 2010/11 average)



Source: International Grains Council (IGC) (2013).

¹Afghanistan’s wheat tends to be low-quality in that it is low in gluten, lacks stickiness needed for flat bread baked in tandoor ovens, and has low protein content, and thus is often blended with wheat from Kazakhstan and Pakistan (USDA, 2012; Schulte, 2007).

enhancing connectivity among regions of the country. Approximately 60 percent of Afghans live within 50 kilometers of the road (USAID, 2009a). Pakistani flour passes through key wholesale markets in Kandahar and travels even into the western part of Afghanistan near the Iranian border. The majority of the flour in the Hirat markets is of Pakistani origin, while very little is from neighboring Iran. However, some Kazakh flour is routed to Hirat via the northern border post of Tourghundy, directly above Hirat. Flour movements from Hirat into the Badghis and Ghor provinces have been reported. Pakistani flour also arrives at Jalalabad/Torkham, and from there it is routed to Kabul (Schulte, 2007). In contrast to many of the other regions of the country where Pakistani flour dominates, in the Mazar area of Afghanistan, Uzbekistan and Kazakhstan account for the dominant share of imported wheat; Pakistan faces a competitive disadvantage against low-priced Uzbek flour. After arriving in Mazar, wheat and flour from Central Asia are transported to the north and central regions of Afghanistan and, to a lesser extent, to Kabul (Schulte, 2007).

In 2008, extremely tight supply situations in Afghanistan and Pakistan allowed Kazakhstan to increase its exports to Afghanistan to an unprecedented level of 1.3 million metric tons, or 34 percent of the Afghan import market. However, even then substantial price hikes were needed to bring these increased Kazakh flour shipments through the inefficient transport system from the North (Persaud, 2010). The supply situation in Pakistan eased in the following years, allowing that country to again increase its share of the Afghan import market at the expense of Kazakhstan.

Afghanistan's Milling Industry

Afghanistan's milling industry has, over the past three decades, deteriorated to the point that it is has difficulty competing with flour producers in neighboring countries. Small-scale water, diesel, and electric mills, known as "asiabs" or "zirandas," provide the vast majority of domestically produced flour in Afghanistan. The asiabs and zirandas each process 1-3 tons of wheat per day and account for approximately 90 percent of the country's flour production (USDA, 2012). These small stone/disk grinding machines, powered mostly by diesel fuel or electricity, mill wheat as whole meal without separating out the bran, implying an extraction rate of 100 percent (USAID, 2006). These traditional processors are particularly important in rural areas where underdeveloped infrastructure impedes transport (USDA, 2012). They also have the advantage of versatility in that they can process corn and other grains beside wheat (USAID, 2006).

The country's five public mills and eight commercial mills capture only a small fraction of the flour production market. During the Afghan civil war, the public mills that were built by the Soviet Union in the 1980s were partially or completely destroyed. The remaining five Soviet-constructed mills in Mazar, Kandahar, Hirat, and Pul-e-Khumri are mostly used for grain storage, while the public mill in Kabul provides flour for the Afghan National Army.

The eight commercial mills in Kabul, Mazar, Jalalabad, and Hirat, with milling capacities ranging from 80 to 500 tons per day, operate at less than full capacity, or in some instances not at all (USDA, 2012). In addition to unreliable supplies of electricity and competition from Pakistani flour, limited marketed surpluses of Afghan wheat have discouraged the growth of commercial milling activity. Although there is a paucity of empirical data on wheat sales within Afghanistan, available information indicates that rural households consume most of the wheat they grow, with little surplus production available for domestic commercial markets. In 2003, the total quantity of domestically produced wheat that was marketed may have amounted to one-fourth of the country's production (Chabot and Dorosh, 2007). In a typical year, the northern region of Afghanistan accounts for the vast majority of the relatively small quantity of wheat that is marketed. In drought years, marketed surpluses would be even lower.

Smaller scale enterprises are better suited to Afghan conditions than larger scale "modern" flourmills would be. The small-scale mills are more flexible in terms of power sources (diesel, electricity, water). Afghanistan's limited infrastructure and low farm yields also favor small-scale mills. Since yield per acre is low, a large mill would have to procure wheat over a large land area to obtain enough wheat to operate at capacity and keep costs low, difficult when infrastructure is poor. Hence, until farm productivity, road transport, and power supplies improve, the milling sector is likely to continue to be dominated by a large number of widely dispersed small-scale agro-processing units.

Afghan Flour and Wheat Production

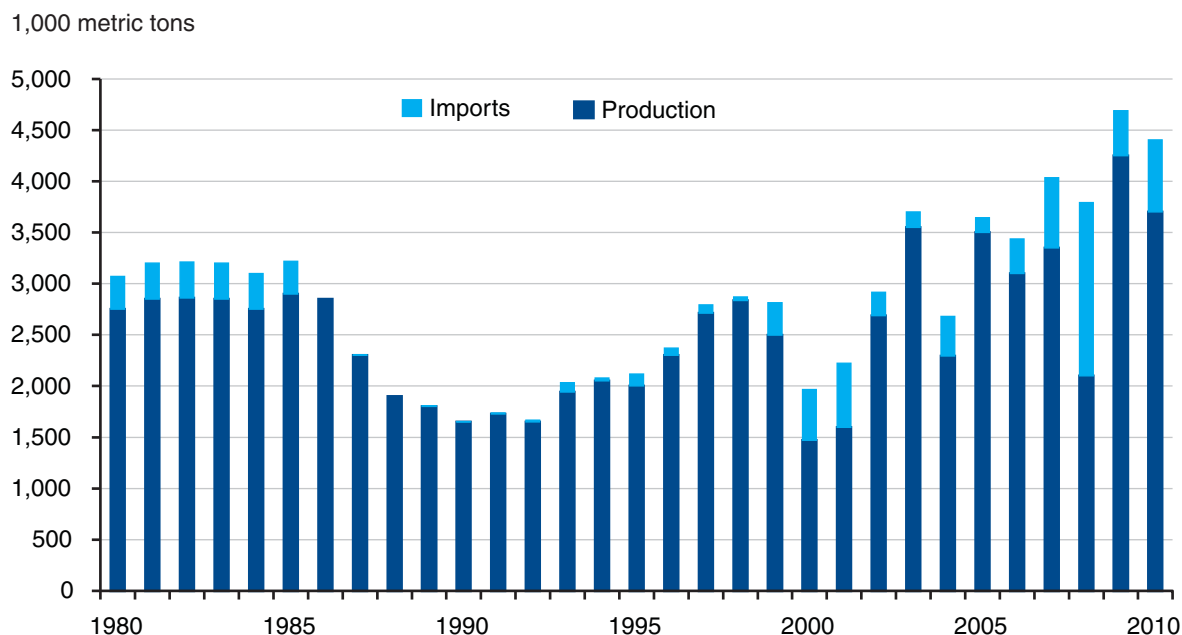
Unstable Domestic Wheat Supply

Afghan flour producers, whether small-scale, commercial, or public mills, must cope with highly variable domestic wheat supplies. During the main growing period there is little, if any, reliable rainfall, meaning that Afghanistan must depend on irrigation to meet the majority of its crop-water requirements. Winter snowfall in the mountain ranges of central Afghanistan supplies over 80 percent of the country's annual precipitation (USDA, 2008a). The primary storehouse of the country's irrigation water is in the Hindu Kush range (Rout, 2008). Snowmelt in the spring is the major source of irrigation water, running through rivers and streams that originate in the mountains. Given the absence of sufficient rainfall during the critical growing period, the timing and duration of annual snowmelt is a key factor in determining the volume of irrigation water and the length of time it is available (USDA, 2008a).

In 1980, Afghanistan produced 3.1 million metric tons (MMT) of flour (wheat-equivalent basis), relying largely on domestically produced wheat. Flour production remained stable for about 5 years afterward and then deteriorated, beginning in 1986 (fig. 1). By 1992, following years of domestic conflict, flour output was little more than half its 1980 level as decreases in the country's wheat harvests, combined with falling imports of wheat, reduced the total amount of wheat available for milling in Afghanistan (fig. 3).

The years 1993-99 comprised a period of generally rising flour production, supported primarily by expanding Afghan wheat output, driven by strong gains in yield. At 1.3 mt/ha in 1998, yield was at

Figure 3
Wheat supply in Afghanistan



Note: Appendix 3 provides method used for computing imports.

Sources: Production is from USDA PS&D database. Imports are author's estimates based on FAOSTAT database, USDA PS&D database, and IGC database and do not include flour or products as with the PS&D import estimates.

a then-historic high in Afghanistan. Nevertheless, during this period, domestic production of both the processed commodity (flour) and the raw material (wheat) remained below their 1985 peaks due to relatively slow growth in area cultivated to wheat. Moreover, the gains in flour and wheat production proved to be fragile. Successive droughts after 1998 led to substantial crop shortfalls in irrigated as well as rain-dependent areas, particularly in 2000 and 2001, when wheat production reached new lows, falling below the 1992 level. Wheat imports partially offset the poor harvests, dampening the effects on millers and consumers of the drought conditions. Consequently, flour production, despite falling, did not drop below its 1992 level as domestic wheat output did.

Afghanistan's flour production grew rapidly in the post-2001 period (table 2) and was more stable than its wheat harvests. Growing conditions, which were relatively favorable between 2002 and 2007, contributed strongly to increases in the total amount of wheat available for milling. In 2003, the country's production of wheat and wheat flour finally surpassed the 1985 peaks. The 2003 wheat harvest was estimated to be 3.55 MMT, a level that Afghanistan nearly achieved again in 2005 and approached in 2007. These production peaks were achieved primarily as a consequence of higher yields. Throughout the 2002-07 period, there was no year in which area planted to wheat exceeded the mid-1970s level. Yield, on the other hand, reached a new high in 2007 of 1.52 mt/ha, significantly above the previous 1998 peak (1.30 mt/ha).

Table 2

Wheat and flour, production and consumption growth in Afghanistan

Period average	Wheat production (1,000 MT)	Wheat yield ¹ (MT/HA)	Wheat area (1,000 HA)	Flour production (1,000 MT)	Flour consumption (1,000 MT)
1979-81	2754	1.20	2300	3044	3044
1989-91	1725	1.06	1623	1733	1735
1999-2001	1855	0.95	1945	2335	2496
2009-11	3483	1.50	2325	4150	5693
<i>Growth rates (percent)²</i>					
1980-2010	0.79%	0.75%	0.04%	1.04%	2.11%
1990-2010	3.58%	1.73%	1.81%	4.46%	6.12%
2000-10	6.50%	4.62%	1.80%	5.92%	8.59%

¹Computed by dividing 3 year average of production by its respective 3 year average of area.

²Compound annual growth rates between 3-year averages centered on the years indicated.

Sources: USDA, Production, Supply and Distribution (PS&D) database, accessed June 2011, FAOSTAT database, accessed June 2011, and author's calculations.

The years of favorable wheat harvests were followed by below-average levels of rain and snow during the 2007/08 wet season, which reduced Afghanistan's 2008/09 crop to 2.1 MMT. Millers responded by increasing their imports of wheat, tempering the impacts of inadequate domestic production. Wheat production in 2008 was 37 percent below the prior year, while in contrast, the contraction in flour output was relatively modest at 8.8 percent. Excellent growing conditions allowed the production of wheat and wheat flour to rebound in 2009/10. Yield rose to a new high of 1.65 mt/ha, a 68-percent increase over the previous year and significantly above the previous 2007 peak (1.52 mt/ha). However, erratic domestic wheat supplies remain a challenge for the milling industry—USDA estimates indicate that the 2011/12 harvest was 32 percent below that of 2010/11.

Afghanistan's success at achieving growth in wheat yields reflects long-term efforts at seed development and availability, supported primarily by the United States Agency for International Development (USAID), the Food and Agriculture Organization of the United Nations (FAO), and the International Center for Agricultural Research in the Dry Areas (ICARDA). These yield increases also demonstrate that seed and fertilizer markets have continued to exist and function in Afghanistan, albeit with significant disruptions and under a great deal of adversity (Maletta, 2007; Favre, 2004; Maletta and Favre, 2003).

Wheat Supply Response to Prices

There are no studies that quantify the relationship between wheat yields and wheat prices in Afghanistan, and formal estimates of wheat area elasticities are not available in the literature. Limitations in both the quantity and quality of Afghan data do not allow econometric estimates of supply parameters. According to Persaud (2012), recent trends in Afghanistan's limited available data are consistent with an own-price elasticity of 0.20, i.e., a 1-percent increase in the real price of wheat is associated with a 0.20-percent increase in wheat area in the following year, all else remaining the same. Based on within-sample predictions, Persaud indicated that this elasticity is plausible in that it fits recent historical data reasonably well.

Improved irrigation, rather than higher wheat prices, could be the key factor spurring growth in wheat area as well as in yields. Afghanistan's lack of success at achieving growth in area cultivated to wheat stems from the destruction and continuing disrepair of the country's irrigation systems (Persaud, 2012). In 2009, only 3.2 million hectares, or less than half of the land that could be used for crops, were actually cultivated, mainly because of unpredictable water availability exacerbated by years of military conflict. Since only 3 of Afghanistan's 34 provinces have fully operating irrigation systems in place (Torell and Ward, 2010), cropped area may grow as a consequence of investments aimed at rehabilitating existing irrigation networks (Maletta, 2007). Such additions to crop area, being irrigated land, could be expected to provide relatively high yields. With more assured supplies of water, Afghan farmers would also have stronger incentives to purchase fertilizer and better seeds. Lack of water, on the other hand, could constrain farmers' purchases of fertilizer and improved seed, even with higher farm prices of wheat.

Afghanistan's Links to Pakistan's Wheat Market

Afghanistan's domestic public and commercial milling industry has been slow to rebuild after years of war, in large part because of competition from Government-subsidized wheat flour from Pakistan (Schulte, 2007). The Government of Pakistan has implemented price policies aimed at improving the availability of food for its population (Dorosh and Salam, 2006). The Government intervenes in domestic wheat markets by procuring wheat from farmers at a support price. It also releases wheat to the provinces, which is sold to the flour mills at a Government-determined "issue" or "release" price (USDA, 2009a). The Pakistan Government interventions, which tend to involve sales of wheat to flour mills at below-market rates, generate profits for millers while incurring fiscal costs for the Government because the issue prices do not cover the full cost of wheat procurement (domestic or imported), storage, and handling (USDA, 2009a; Dorosh and Salam, 2006).

The growth of Pakistan's flour mills has been concentrated in provinces neighboring Afghanistan, and Pakistan's domestic policies do not prevent unofficial flows of wheat grain into Afghan markets. However, a large number of Pakistani mills operate only when they are able to purchase subsidized wheat from their Government (Khan, 2007). After Pakistani mills purchase wheat at the Government issue price, they have a choice of exporting their wheat quota or processing it into flour. As discussed, when Afghanistan experiences poor growing conditions, Afghan millers increase their imports of wheat grain, implying that millers are not completely cut off from external sources of wheat.

Despite variations in its official trade policies, Pakistan has for the most part been a reliable supplier of flour to Afghan consumers. For example, Pakistan's export ban from 2003 to early 2007 did not prevent flour movements into Afghanistan. Although Afghanistan's production of wheat fluctuated sharply, domestic prices were fairly stable, suggesting that trade helped to dampen price variability; from December 2003 to December 2007, flour prices in Afghanistan followed those in Pakistan reasonably well. However, 2008 was an exception in that the gap between Afghan and Pakistani wheat prices increased sharply that year (fig. 4). Pakistan had an export ban in place at the time, and yet the country exported a record amount of approximately 2 MMT of wheat, mainly flour, to Afghanistan through unofficial channels (USDA, 2009a; USDA, 2008b).

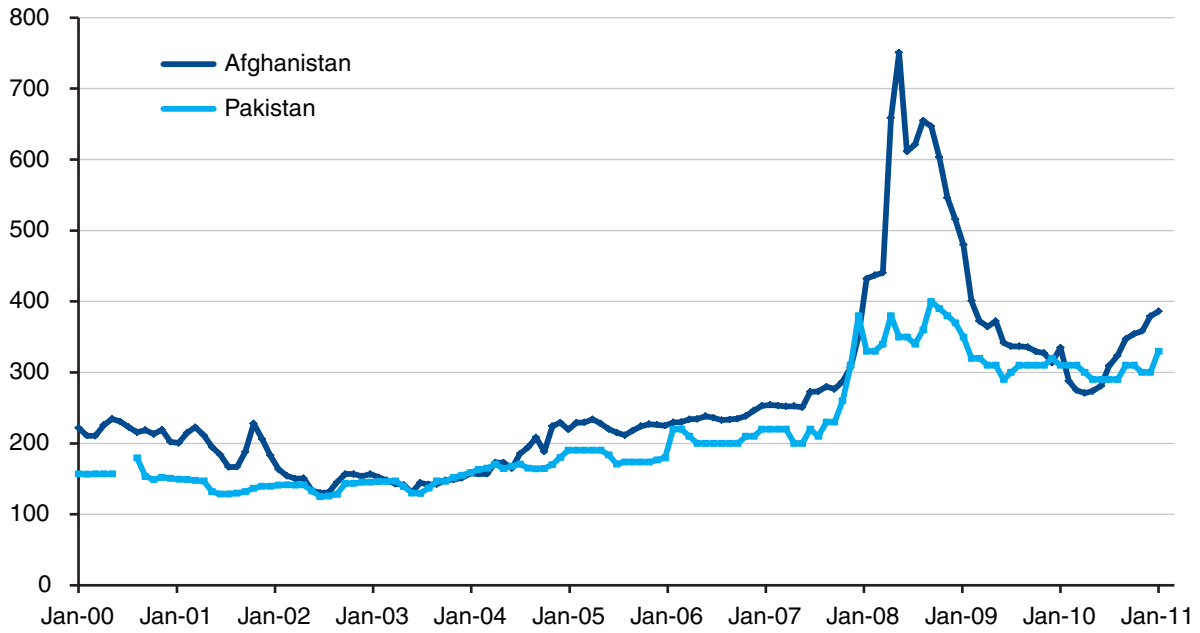
Pakistan's trade restriction may have had some effect on wheat and flour movements into Afghanistan in that exports might have been even greater in the absence of trade restrictions. However, two additional factors contributed to reducing Pakistani exports to Afghanistan: Pakistan itself had to resort to importing wheat later in 2008, due in part to a shortfall in domestic production (USDA, 2009a), and there was increased armed conflict in major transport corridors along the Pakistani border (USDA, 2009b). As supply disruptions eased, Afghan-Pakistani price gaps decreased after May 2008.

Since Pakistan is a major player in the Afghan grain market, wheat prices in Pakistan tend to affect those in Afghanistan. Chabot and Dorosh (2007) conducted formal econometric tests to explore issues of (1) market integration between major markets within Afghanistan, and (2) market integration between Pakistani and Afghan markets. The cointegration results from those authors suggest that wheat prices in major markets in Afghanistan and in Lahore, Pakistan, tend to move together in the long run. Changes in Pakistan's Government-fixed release (issue) prices, to the extent that they influence market prices of wheat within the Pakistani market, also shape prices that prevail in Afghanistan. Indeed, from 2000-2010, the real issue price of wheat in Pakistan and the real retail price of flour in Afghanistan are well correlated (correlation coefficient = 0.90), implying that shifts in Pakistan's price policies impact Afghan consumers.

Figure 4

Prices of wheat in Afghanistan and Pakistan

U.S. \$ per metric ton



Notes: Pakistani wheat prices are Peshawar retail prices; Afghan wheat prices are simple averages of prices from Kabul, Jalalabad, Mazar, Faizabad, Hirat, and Kandahar.

Sources: Pakistan's wheat prices are from Government of Pakistan, Monthly Review on Price Indices (various issues). Afghan wheat prices are from the U.N. World Food Programme's Price Analysis in Afghanistan (World Food Programme, 2013).

Afghanistan's Import Policies

Afghanistan's trade policies have played only a limited role in protecting domestic wheat and flour producers. Although import duties are the main source of revenue in Afghanistan, the country has one of the most open trade regimes in the region and is characterized by atypically low revenue mobilization. Tax revenues in Afghanistan, which amount to 3.4 percent of GDP, are far below the average of 14.9 percent for low-income countries (World Bank, 2005). In the case of the wheat and flour sector, Afghanistan's official import policies have been fairly liberal in that the Government has not established countervailing policies to Pakistan's domestic grain market interventions. In 2007, import tariffs on wheat and flour were 3.5 percent (Schulte, 2007). In response to the 2008 price spikes, Afghanistan eliminated its import tariffs on wheat and flour in February of that year (World Bank, 2010). In 2009, Afghan wheat production rebounded, and growing conditions continued favorable in 2010. In an attempt to protect producers from falling prices, the Afghan Government set tariffs on wheat and flour imports at 10 percent (GOA, 2010; FAO, 2010). The following year (2011) brought a combination of poor growing conditions in Afghanistan and rising domestic and international prices. Accordingly, the Afghan Government reduced the tariff on imported wheat flour from 10 percent to 5 percent (USAID, 2011).

The degree to which Government border policies have restricted movements of wheat and flour is uncertain. Private Afghani traders have a track record of successfully procuring imported wheat from regional suppliers. The Afghan border is difficult to control, allowing significant amounts of undocumented trade. Afghanistan's trade network is comprised of multiple routes along which wheat and flour are transported across long and porous borders. Afghan traders have adapted to recurring transport blockages by developing ways to work around or circumvent these obstructions, an ability that would also be useful for evading tariffs. On the other hand, efforts to avoid import duties involve costs. Profit-maximizing traders may find it worthwhile to pay relatively modest tariffs, while high tariffs or trade bans encourage smuggling.

Prospects for Afghanistan's Flour Market

Despite their drawbacks, policies aimed at protecting domestic millers and farmers from foreign competition have been recommended as a means of enhancing livelihoods of Afghan producers (USAID, 2009b; Altai Consulting, 2007; USAID, 2005). The basis for this recommendation is that imports of relatively low-priced commodities, while providing immediate positive impacts on food security, particularly for Afghan consumers, could be a disincentive for Afghan producers. Afghan millers and farmers are at a disadvantage when competing with Pakistan's wheat and flour sector, which benefits from fertilizer subsidies, the use of Government-determined support prices to further encourage wheat production, and, as discussed, Pakistan's release-price policy that encourages the growth of its milling industry (USAID, 2009b; Altai Consulting, 2007; USAID, 2005). The Afghan Government has demonstrated some willingness to protect domestic producers by setting tariffs and by supporting prices through procuring small quantities of wheat from farmers, reportedly to discourage opium production. According to one source, shortly after the record 2009/10 wheat crop was harvested, the Government became concerned that falling wheat prices in the South would lead to more farmers planting poppy the following year.²

Imposing higher tariffs or stepping up enforcement of existing border policies would necessitate investments in improved monitoring and surveillance efforts, as well as in expanding and defending border checkpoints. These efforts would be costly, given Afghanistan's rugged terrain, unstable conditions, and poor security in border areas. Even if the Afghan government were successful at providing significantly higher levels of protection for domestic producers of flour and wheat, the result would be to impose costs on consumers, with the likelihood of relatively small positive impacts on domestic production. Flour is Afghanistan's key staple food, providing more than half of the calories consumed. Policies that lead to higher flour prices are likely to have adverse impacts on low-income consumers. Further, though higher wheat prices might provide some incentive for producers, they would not address the critical constraint to domestic wheat production, i.e., lack of irrigation (Persaud, 2012).

²Personal communication with USDA/FAS staff, September 25, 2010.

Model of Afghanistan’s Wheat and Flour Markets

It is not possible to project the long-term growth of Afghanistan’s flour imports with certainty. Considerable uncertainty surrounds the country’s access to both imported and domestically produced wheat, as well as to the future growth in Afghanistan’s income, population, and food prices. Accordingly, we develop a multiyear partial equilibrium model capable of analyzing a range of different time paths and/or growth rates of key drivers of supply and demand. (For details on the overall model structure, see box: “Characteristics of the Afghanistan Wheat Market Model.”). Data and information are not available for projecting the costs the Afghan Government would incur in enforcing higher tariffs or for effects such as net changes in employment from alternative tariff policies. The analyses developed in this report do, however, highlight likely tradeoffs between Afghan farmers, consumers, and millers if the Afghan Government were to be successful in enforcing various combinations of tariffs on wheat and flour imports. These alternate scenarios could help to inform public sector decisionmakers considering the role of border policies in supporting the Afghan domestic wheat and flour sectors.

Characteristics of the Afghanistan Wheat Market Model

The study’s framework for analyzing various scenarios incorporates behavioral relationships for consumption, area cultivated to wheat, and the quantity of wheat milled. Farm production of wheat in Afghanistan is an identity, computed as the product of area and yield. Wheat area is an increasing function of the expected returns from its cultivation, where the lagged wheat price and lagged yield represent expected returns. Yield growth is driven by a trend term that represents improvements in technology and irrigation. For the purpose of this analysis, the specification of both the area and yield equations in the model assumes normal weather throughout the projection period. Consumption of flour (on a wheat-equivalent basis) is a function of income, population, and the own-price, i.e., the price of flour. Due to lack of data, wheat and flour stocks are assumed to be zero.

The quantity of wheat milled is specified as an increasing function of the milling margin, i.e., the ratio of flour to wheat prices, and a trend term. Consequently, the domestic prices of wheat and flour influence the quantity of flour produced. For example, rising (falling) prices of wheat, the key input or raw material cost for millers, tends to reduce (increase) flour production, other things equal. Similarly,

rising (falling) domestic flour prices encourage (discourage) Afghan flour production, all else equal. The trend term reflects growth in the capacity to mill wheat into flour that results, for example, from improvements in energy supplies needed to run wheat mills. Wheat imports are computed by subtracting domestic wheat production from the quantity of wheat milled. Flour imports (on a wheat-equivalent basis) are computed by subtracting domestic milling from flour consumption. The specification of wheat and flour prices is flexible, depending on the relationship between domestic and import prices. In situations where Afghanistan does import wheat and flour (Scenarios I, II, and IV, discussed later), their domestic prices track Pakistan’s release price, which in turn moves according to the projections of Pakistan’s Government producer price generated by USDA Agricultural Projections to 2022 (USDA, 2013). A different pricing regime is implemented when imports do not occur—the domestic price is that which equates Afghan demand with its domestic production, i.e., an endogenously formed market-clearing autarchy price.

A more complete description of the model, including the model parameters, is given in appendix 1, and the equations are provided in appendix 2.

The projections developed in this report are based in part on expectations for future trends in variables that are exogenous to the model, e.g., Afghan income, population, and wheat yields. In all four scenarios, real GDP grows at an annual rate of 6.0 percent from 2010-2022 (table 3), and Afghanistan’s population grows at annual rate of 2.25 percent. These assumptions are consistent with IMF predictions (2012) that real GDP will grow in the range of 6-7 percent per year for 2009-18, and with Maletta (2006), who uses a figure of 2.3 percent for population growth through 2020. As in Persaud (2012), wheat yield grows at an annual rate of 0.9 percent in all scenarios, reflecting increasing use of fertilizer and improved seed varieties. Stocks of wheat and flour are assumed to be negligible throughout. The trend term in the wheat-milling specification is calibrated in the benchmark/reference scenario so that projected growth in milling is in line with growth in wheat supplies. This trend term is used in all four scenarios.

The critical distinctions between the four scenarios are that they incorporate different combinations of Afghan wheat and flour tariffs. As shown in the following sections of this report, efforts to support Afghanistan’s flour-milling sector by increasing border protections, even if enforceable along the country’s rugged borders, lead to higher prices that affect consumers. Similarly, efforts to boost domestic production of wheat for milling through border policies would require a difficult-to-enforce combination of flour and wheat tariffs or other restrictions that would impose costs on consumers. Free trade, entailing unhindered wheat and flour imports, may lead to stronger growth in domestic flour production and consumption, but with small potential losses in farm output.

Scenario I: Reference

We first generate a 12-year projection, or Reference scenario, for Afghanistan’s wheat and flour sectors beginning in 2010 and ending in 2022. The reference scenario is based on existing policies and assumed changes in key exogenous variables, e.g., income and population growth.

In the Reference case (Scenario I), the wheat tariff is 10 percent in the base year (2010) in conformance with the official border policy and is assumed to remain at that level throughout the projection period. The flour tariff is also 10 percent in the base period. However, in the following year (2011), the flour tariff drops to 5 percent, reflecting the Afghan Government’s tariff revision, and is assumed to remain at that level throughout the projection period. This policy shift, while benefiting Afghan consumers, also contributes to a growing gap between domestic production and demand for flour.

Table 3

Major analytical assumptions for Afghan flour and wheat model

Variable	Reference	Scenario II	Scenario III	Scenario IV
Population growth (%)	2.25	2.25	2.25	2.25
Real Gross Domestic Product growth (%)	6.0	6.0	6.0	6.0
Yield growth (%)	0.9	0.9	0.9	0.9
Flour tariff (%), in projection period	5	20	0	0
Wheat tariff (%), in projection period	10	10	20	0
Stock change (MT)	0	0	0	0

Source: USDA, Economic Research Service.

Afghan domestic prices of wheat and flour are shaped by Pakistan's Government-determined release price, and, by assumption, Afghanistan's official border policies.

Given a constant tariff on wheat imports and the absence of an upward trend in Pakistan's release price, Afghanistan's wheat prices exhibit almost no growth in real terms from 2010-2022 (table 4). Domestic flour prices are lower as the tariff on imports of flour decreases from 10 percent to 5 percent.

On a wheat-equivalent basis, per capita consumption of flour grows at an annual rate of 1.4 percent, due to a combination of growth in per capita GDP of 3.7 percent per year and slightly lower flour prices. Total consumption, as distinct from per capita flour consumption, increases at an annual rate of 3.7 percent to 8.8 MMT in 2022. Hence, projected increases in consumption are not as rapid as in the past decade. Nevertheless, this growth in demand still exceeds projected increases in flour output, as indicated below.

A constant tariff on wheat, coupled with a reduced tariff on imports of flour, leads to a smaller gap between the domestic prices of these two commodities, compressing the milling margin. Given the combination of changes in the milling margins and the trend term that reflects an assumed rate of expansion in milling capacity, Afghan flour production is projected to grow at about the same annual rate as domestic wheat output (2.2 percent). Flour production initially drops due to the reduction in the flour tariff, then trends upward to 5.7 MMT by 2022 (fig. 5 and "Milled" in col. 1 of table 4), well below consumption (8.8 MMT) in the terminal year. Indeed, the projections indicate a widening flour deficit—in 2022, domestic flour production meets only 65 percent of demand, whereas in 2010 Afghanistan was approximately 77 percent self-sufficient in its flour requirement. Flour imports initially jump due to the reduction in the flour tariff (fig. 6) and then climb to 3.07 MMT in 2022.

Scenario II: Increased Flour Tariffs

Tariffs on imported flour have been recommended as a means of leveling the playing field with Pakistan and improving the viability of Afghanistan's flour-producing sector (USAID, 2009b; Altai Consulting, 2007; USAID, 2005). As in the Scenario I Reference case, the tariff on wheat imports remains unchanged from its base-year level (10 percent). Unlike in the Reference case, we analyze the impacts of greater protection for millers by doubling the flour tariff to 20 percent.

Flour is the main source of calories for the population of Afghanistan, and consumers do not significantly diversify their diets when the price rises, in this case as a result of the increased import duty on flour. In the terminal year of the projection, the quantity of flour consumed per person (218 kgs) is 2 percent below the 2022 level in the Reference scenario (223 kgs). But since consumers must now pay higher prices, per capita expenditures on flour in Scenario II (119.8 USD, terminal year) are 11.6 percent higher than in the Reference case.

A constant tariff on wheat, coupled with an increased tariff on imported flour, leads to a larger gap between the domestic prices of these two commodities, expanding the milling margin. Millers receive higher prices for their output without paying more for wheat. Improved price incentives encourage faster growth in domestic flour production—in Scenario II, output growth (4.0 percent per year) is almost twice that of the Reference case (2.2 percent).

Table 4

Results of Afghan wheat and flour model

Variable	Scenario I: Reference			Scenario II: 20% flour tariff 10% wheat tariff		Scenario III 20% wheat tariff 0% flour tariff		Scenario IV Free Trade	
	Base	Terminal	Growth Rate	Terminal	Growth Rate	Terminal	Growth Rate	Terminal	Growth Rate
			<i>Percent</i>			<i>Percent</i>		<i>Percent</i>	
Flour tariff (%)	10	5	-5.6	20	5.9	0	--	0	--
Wheat tariff (%)	10	10	0.0	10	0.0	20	5.9	0	--
Release price (\$/mt)	284	288	0.1	288	0.1	288	0.1	288	0.1
Wheat area (1,000 ha)	2,300	2,682	1.3	2,682	1.3	2,707	1.4	2,631	1.1
Wheat yield (mt/ha)	1.6	1.8	0.9	1.8	0.9	1.8	0.9	1.8	0.9
Wheat production (1,000 mt)	3,700	4,804	2.2	4,804	2.2	4,849	2.3	4,712	2.0
Milled (1,000 mt)	4,403	5,724	2.2	7,069	4.0	4,849	0.8	6,172	2.9
Total consumption (1,000 mt)	5,700	8,798	3.7	8,593	3.5	8,867	3.8	8,867	3.8
Per capita flour expenditures	94.1	107.4	1.1	119.8	2.0	103.1	0.8	103.1	0.8
Per capita consumption (kgs/person)	189	223	1.4	218	1.2	225	1.5	225	1.5
Wheat imports (1,000 mt)	703	920	2.3	2,265	10.2	0	--	1,460	6.3
Flour imports (1,000 mt)	1,297	3,074	7.5	1,524	1.4	4,018	9.9	2,694	6.3
Total imports (1,000 mt)	2,000	3,994	5.9	3,789	5.5	4,018	6.0	4,155	6.3
Afghan wheat price (\$/mt)	341	345	0.1	345	0.1	363	0.5	314	-0.7
Afghan flour price (\$/mt)	498	481	-0.3	550	0.8	458	-0.7	458	-0.7
Milling margin (ratio, unitless)	1.5	1.4	-0.4	1.6	0.7	1.3	-1.2	1.5	0.0
Tariff revenue (flour)	59	70	1.5	140	7.5	0	--	0	--
Tariff revenue (wheat)	22	29	2.4	71	10.3	0	--	0	--
Total tariff revenue	81	99	1.8	211	8.3	0	--	0	--
Gdp per capita, real (\$)	517	797	3.7	797	3.7	797	3.7	797	3.7
Population (millions)	30.2	39.4	2.3	39.4	2.3	39.4	2.3	39.4	2.3

mt = metric ton; ha = hectare; kg = kilogram; GDP = Gross Domestic Product;

Milled = domestic production of flour.

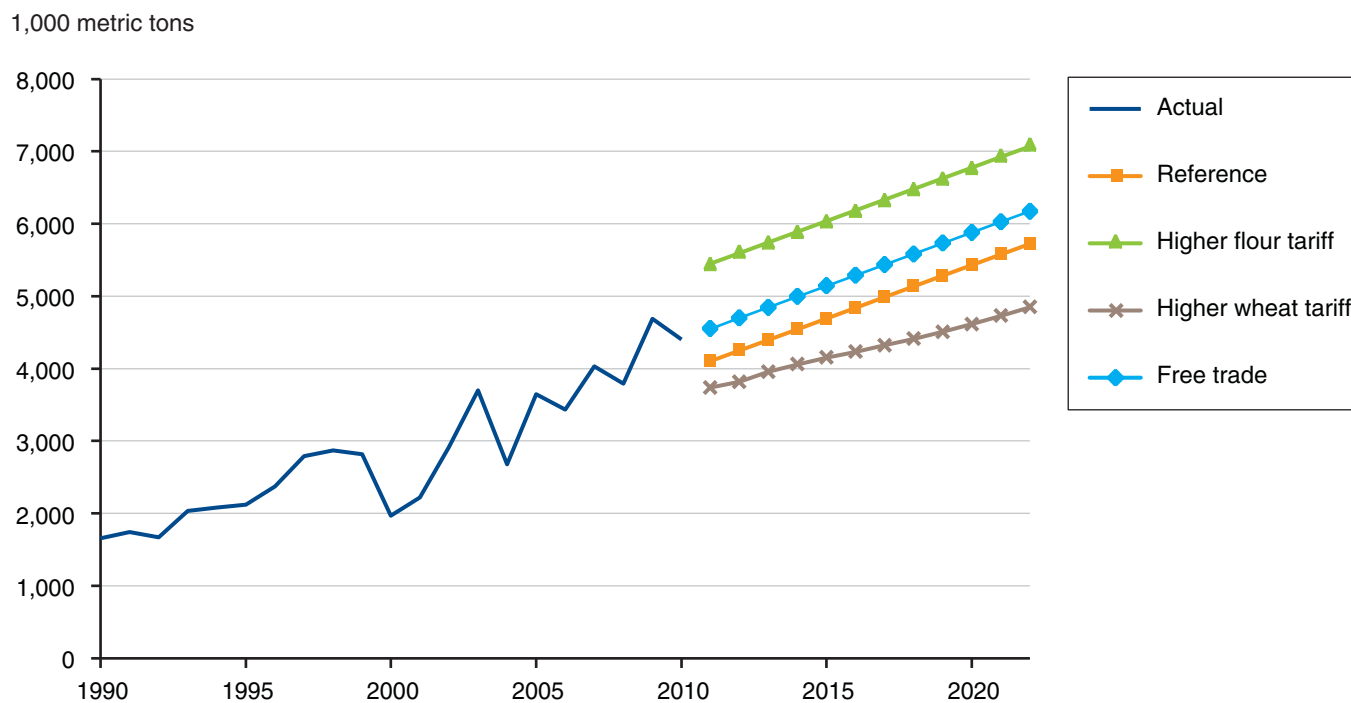
Sources: Area, yield, production, and consumption are from USDA PS&D database. Milled, wheat imports, and flour imports are author's calculations based on IGC database and USDA PS&D database. Population and GDP are from IMF (2012). Prices of wheat and flour are from the U.N. World Food Programme's Price Analysis in Afghanistan (World Food Programme, 2013).

Wheat prices do not rise in this scenario because there are no adjustments to the import duty on wheat. As long as Afghanistan continues to import wheat, the domestic price is determined by Pakistan’s release price of wheat, adjusted by the wheat tariff and a margin that reflects the costs of freight and handling.³ In other words, as long as Afghanistan is a wheat importer, adjustments to the flour tariff have no influence on domestic wheat prices—an increase in the flour tariff is not passed through as higher domestic wheat prices for farmers, and protecting the processing industry does not increase prices received by farmers. Domestic wheat production continues to grow at the same annual rate as before (2.2 percent), implying that the milling industry must increasingly source its raw material supplies externally. Wheat imports grow substantially faster than flour imports, and by the terminal year, far exceed flour. This outcome differs from the Reference scenario, in which flour imports predominated.

Scenario III: Increased Wheat Tariffs

Although imports from neighboring countries have stabilized Afghan prices of wheat and flour and contributed to food security, tariffs on imported wheat have been recommended as a means of providing stronger incentives for domestic wheat production (USAID, 2009b). We isolate the impacts of taxing imports of the farm commodity by doubling the wheat tariff to 20 percent, while setting the import duty on flour to zero throughout the simulation period. With lower flour

Figure 5
Projected domestic production of flour under alternative scenarios

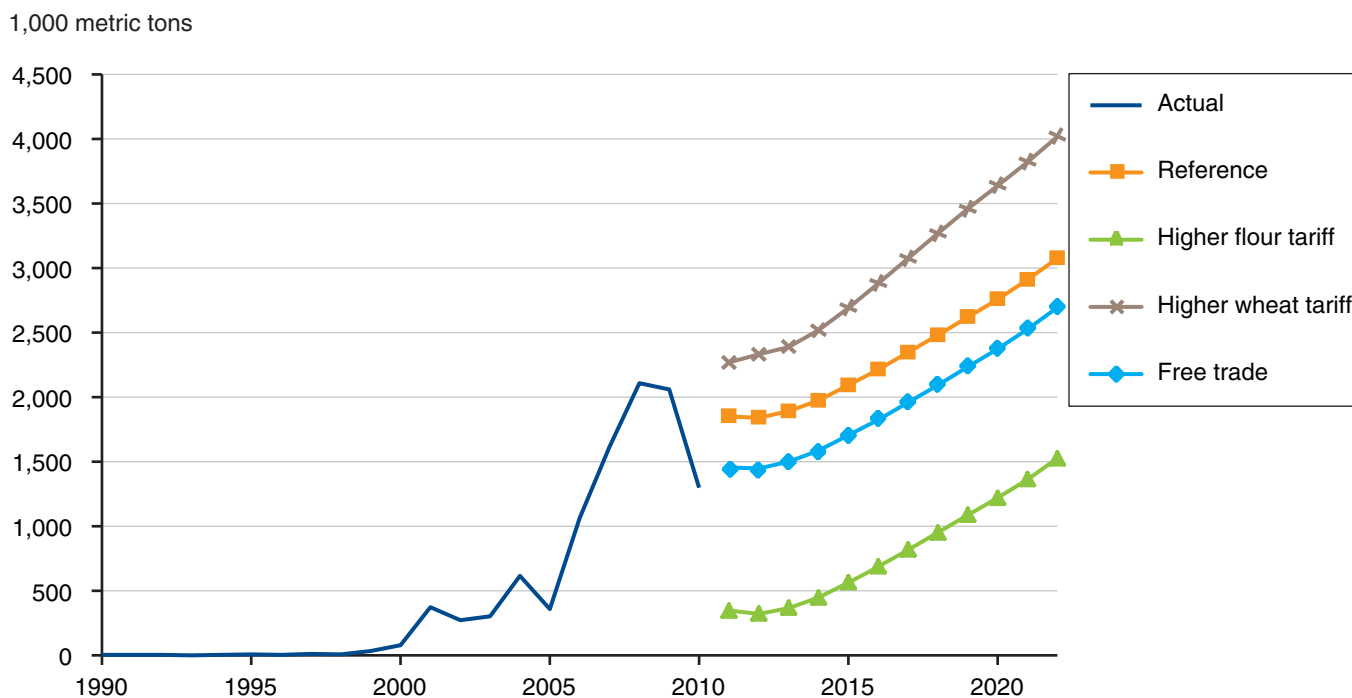


Sources: 1990-2010 data are author’s calculations based on IGC database, USDA PS&D database, and FAOSTAT database. ERS model replicates 2010 data; 2011-22 figures are results of ERS model.

³At the level of imports considered in these analyses, increases in the quantity of imports are assumed to have inconsequential impacts on the unit costs of freight and handling.

Figure 6

Projected flour imports under alternative scenarios



Sources: 1990–2010 data are author’s calculations based on IGC database, USDA PS&D database, and FAOSTAT database. ERS model replicates 2010 data; 2011–22 figures are results of ERS model.

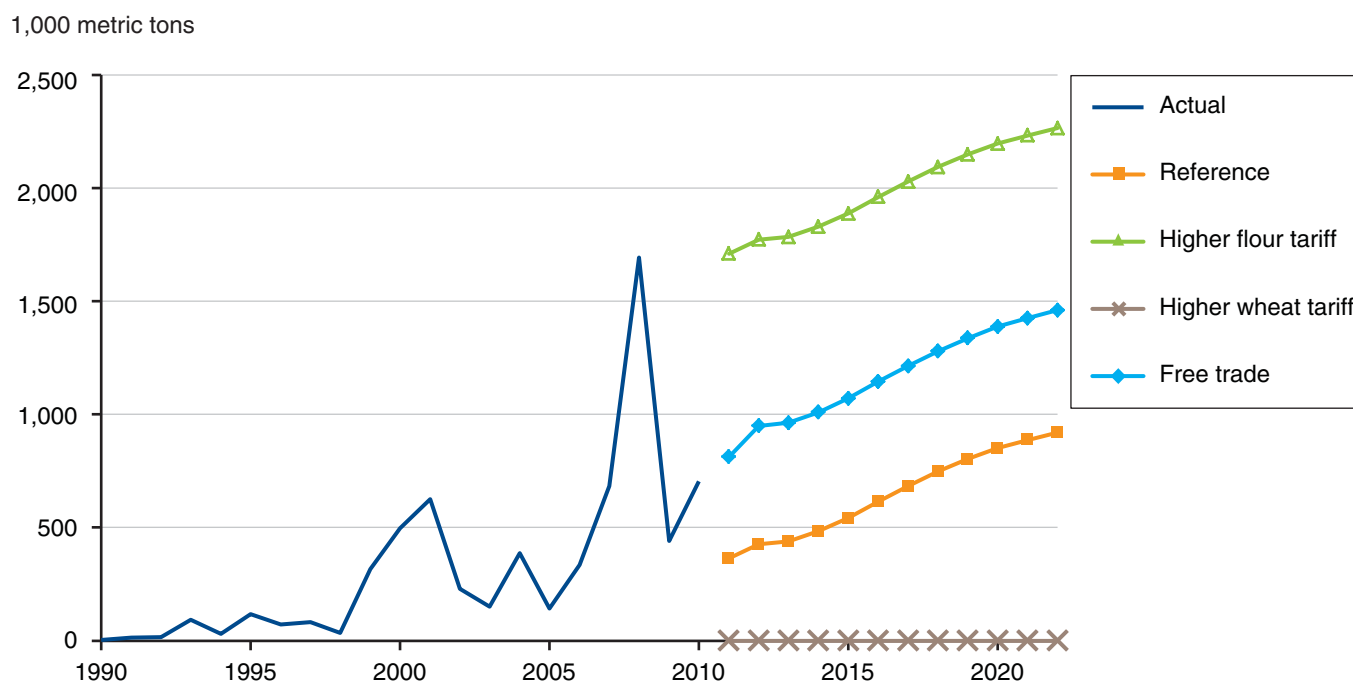
prices and the same income, consumption in Scenario III grows faster than in Scenario I. Unlike the previous scenario, Scenario III eliminates the flour tariff altogether in order to illustrate a key point—wheat tariffs alone do not result in substantially higher Afghan wheat prices. In the absence of a flour tariff, restrictions on wheat imports have little impact on domestic wheat prices. Moreover, imports of wheat grain are already relatively low, so restrictions on these imports have little impact on domestic wheat supplies and prices. In the terminal year, the price of wheat in Afghanistan is 363 USD per MT, only about 5 percent higher than the 2022 price in the Scenario I Reference case. The annual growth in domestic wheat output in Scenario III (2.3 percent) is almost unchanged from Scenario I (2.2 percent).

An increased tariff on wheat, coupled with the elimination of the duty on imported flour, leads to a smaller gap between the domestic prices of these two commodities, compressing the milling margin even more than in Scenario I. Millers now receive lower prices for their output while paying more for wheat. Reduced price incentives dampen growth in domestic flour production—in Scenario III, output growth (0.8 percent per year) is substantially less than in the Scenario I Reference case (2.2 percent). Consequently, wheat imports drop to zero in 2011 and remain at that level for the rest of the simulation period (fig. 7). Millers do not rely on imported wheat because the tariff-adjusted import price exceeds the price of wheat available from Afghan producers.

Scenario III is distinctive because the wheat pricing regime in this experiment differs from the price determination mechanism in the other simulations. (See appendix 2, “Semi-Autarchy Wheat Price,” for technical details on the Scenario III pricing regime.) For example, in Scenario II an adjustment to the flour tariff had no impact on the domestic wheat price. But now, in Scenario III, unlike in the

Figure 7

Projected wheat imports under alternative scenarios



Sources: 1990-2010 data are author's calculations based on IGC database, USDA PS&D database, and FAOSTAT database. ERS model replicates 2010 data; 2011-22 figures are results of ERS model.

previous scenarios, wheat imports are driven to zero due to a high wheat tariff combined with a zero flour tariff. We therefore switch to a pricing regime in which the domestic wheat price is derived in part from the import price of flour. As explained below, reinstating the flour tariff, which raises the import price of flour, also increases the domestic wheat price. Wheat tariffs become more effective at raising domestic wheat prices as the flour tariff rises.

Afghan Wheat Prices Now Linked to Flour Tariff

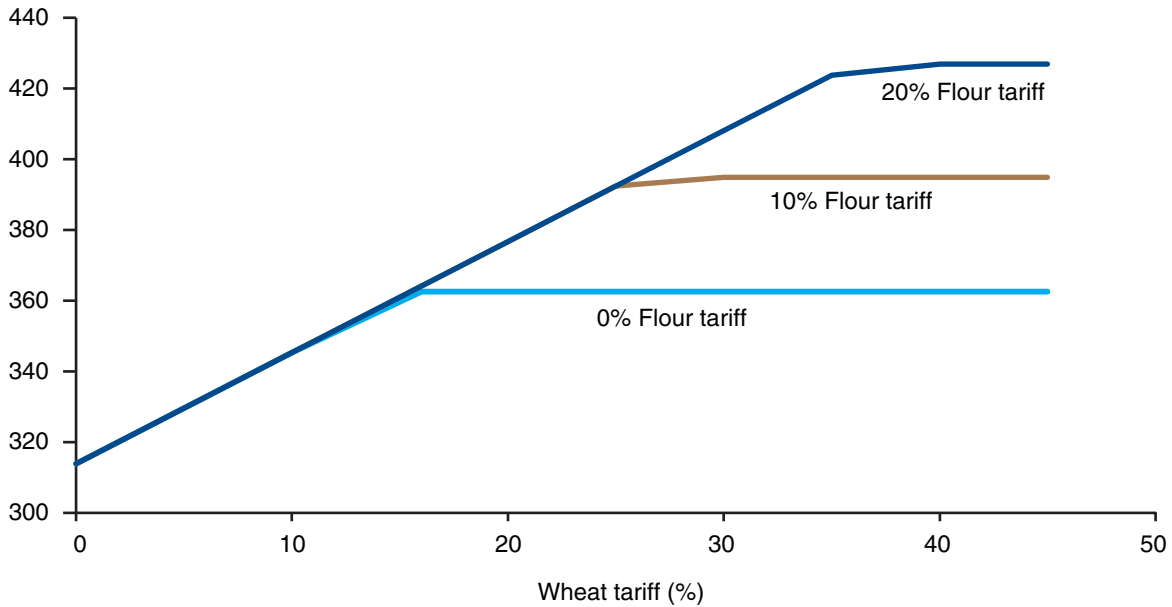
We begin with a flour tariff of zero. When the wheat tariff is 16 percent, wheat imports fall to zero because the import price is too high relative to the semi-autarchy Afghan price that prevails in the absence of wheat imports. Once wheat imports vanish, the domestic price becomes the semi-autarchy price and additional increases in the wheat tariff (beyond 16 percent) have no ability to further raise domestic wheat prices. Figure 8 shows the impact that rising wheat tariffs have on the terminal-year domestic wheat price for various levels of the flour tariff. With a flour tariff of zero, the terminal-year domestic wheat price initially rises with higher wheat tariffs. The wheat price reaches a maximum of 363 USD per MT when the wheat tariff is 16 percent and then has no response to further wheat tariff increases—wheat tariffs, in the absence of a flour tariff, have only a limited ability to transfer benefits to farmers.

Raising the flour tariff above zero can result in higher domestic wheat prices, once wheat imports have been eliminated; that is, higher wheat prices would come at the cost of consumers. The economic logic underlying this result is that higher flour tariffs encourage increased domestic flour production and hence greater demand for the raw material, which raises the domestic wheat price

Figure 8

Domestic wheat price¹ for various combinations of flour and wheat tariffs

Wheat price (U.S. \$ per metric ton)



¹Afghan wheat price in the terminal year (2022) of the projection period.

Source: ERS Model.

(see appendix fig. 2.1). For example, a wheat tariff of 40 percent results in a wheat price of 395 USD per MT when the flour tariff is 10 percent and 427 USD per MT when the flour tariff is 20 percent; flour production expands in response to higher flour tariffs. Millers therefore demand more wheat, and domestic prices continue to rise until the domestic price equals the import price and wheat imports become viable even with the imposition of a high wheat tariff. Increases in the demand—and hence the price—of wheat came about through flour tariffs and higher domestic flour prices that impose costs on Afghan consumers. Thus, efforts to boost farm output through border policies likely require a combination of wheat and flour tariffs that harm consumers.

Scenario IV: Elimination of Wheat and Flour Tariffs

Pakistan’s domestic grain market interventions have been aimed at improving the availability of food for its population. However, expanding wheat and flour production in Pakistan has also helped to meet the demands of Afghanistan’s growing population. Eliminating tariffs on wheat and flour imports would improve Afghanistan’s access to Pakistan’s relatively abundant supplies of these staples. We analyze the impacts of free trade by setting Afghanistan’s import duties on wheat and flour to zero throughout the simulation period, while assuming the continuation of Pakistan’s grain market interventions.

In Scenario IV, per capita consumption increases at a slightly faster pace than in Scenario I. Because the flour tariff was already close to zero in the Reference case, the shift to free trade has a modestly positive impact on consumption.

Eliminating the 10-percent tariff on wheat imports reduces domestic wheat prices and dampens the growth in domestic wheat production. However, the supply response to price changes is limited. Farm output now grows at an annual rate of 2.0 percent, roughly the same as in the Scenario I Reference (2.2 percent).

Since Afghanistan does not impose tariffs on imports of wheat and flour in this scenario, milling margins are exogenously determined by Pakistan's grain market interventions. From the standpoint of the milling sector, free trade generates two opposing effects. Compared with the Reference case, millers now receive lower prices for their output. However, the more significant effect is that flour producers now pay less for wheat. The net result is that the gap between the domestic prices of flour and wheat is now larger than in the Scenario I Reference case. Improved milling margins (price incentives) lead to faster growth in domestic flour production—output growth in Scenario IV at 2.9 percent per year exceeds that of the Reference case (2.2 percent).

In this scenario, the milling industry must increasingly source its raw material supplies externally, and wheat imports now grow almost three times faster than in Scenario I. In contrast, despite (modestly) higher levels of flour consumption, the quantity of flour imports in the terminal year of Scenario IV (2.69 MMT) is below that of the Reference case (3.07 MMT). This occurs because a shift to free trade has stronger positive impacts on flour production than on consumption.⁴

⁴Recall that in the Scenario I Reference case the wheat tariff is twice as high as the flour tariff during the simulation period, implying that free trade would benefit millers more than consumers.

Conclusions

Flour milling is Afghanistan's largest agroindustry, and wheat is the country's major crop and staple food. In the post-2000 period, although flour production increased rapidly, demand grew even faster, spurred by a rapidly expanding population and a strong recovery in economic growth since 2002. Afghanistan now ranks among the world's largest importers of flour, with its imports sourced mainly from Pakistan. Afghanistan's wheat and milling sectors experienced substantial headwinds from the destructive effects of military conflict and instability. Flour producers must cope with undependable and highly variable wheat supplies. The milling sector has been slow to rebuild after years of war, in part because of competition from Pakistan, where the Government provides price support for wheat producers and also supplies mills with low-cost wheat. In addition, unreliable supplies of electricity and limited marketed surpluses of Afghan wheat have discouraged the growth of commercial milling activity. Small-scale mills, which are particularly important in rural areas where underdeveloped infrastructure impedes wheat transport, account for approximately 90 percent of the country's flour production.

Afghanistan's official import policies have been liberal, and flour supplies from neighboring countries have played a key role in stabilizing Afghan prices and meeting the needs of consumers. Despite these food security benefits, policies aimed at protecting domestic millers and farmers from foreign competition have been recommended as a means of enhancing the livelihood of Afghan producers. The Afghan Government has demonstrated some willingness to protect domestic producers by setting tariffs (although at relatively low levels) and by procuring small quantities of wheat from farmers to stock a strategic grain reserve. Government efforts to support domestic wheat prices were also motivated by concerns that low wheat prices could increase incentives for opium cultivation.

Empirical data and other information are not available for projecting the costs the Afghan Government would incur in enforcing higher tariffs or for projecting net changes in employment from alternative tariff policies. The analyses developed in this report highlight the potential tradeoffs that are likely to occur between Afghan farmers, consumers, and millers should the Afghan Government be successful at enforcing various combinations of tariffs on wheat and flour imports. The results indicate that increased protection for millers, accomplished by raising flour tariffs without altering the wheat tariff, delivers no economic gains to farmers and only benefits millers by imposing costs on consumers. By increasing the flour tariff, Afghanistan reduces its dependence on flour imports and growth in domestic flour production accelerates, while imports of wheat expand. However, domestic consumers must pay a higher (tariff-adjusted) flour price, and farmers receive no benefit as the farm price of wheat remains unchanged.

If, on the other hand, the wheat tariff is increased in order to increase benefits to wheat producers, the results indicate that higher (tariff-adjusted) prices alone are not likely to lead to significant output gains, primarily because water shortages are a constraint on wheat yields. Also, Afghanistan's imports of wheat grain—unlike those of wheat flour—are already low, implying that barriers to wheat imports have limited potential to affect domestic prices. To the extent that higher wheat prices are achieved through wheat tariffs, the milling sector pays more for its critical raw material, leading to slower growth in domestic flour production. Efforts to boost production of wheat through border policies would require a combination of flour and wheat tariffs that protect both miller and farmers while imposing costs on consumers.

Finally, model-based simulation results suggest that by completely eliminating its tariffs on wheat and flour imports, Afghanistan could benefit more fully from Pakistan's relatively abundant supplies of wheat and flour. This scenario leads to stronger growth in domestic flour production and consumption, with relatively small losses in farm output, compared with the other scenarios analyzed.

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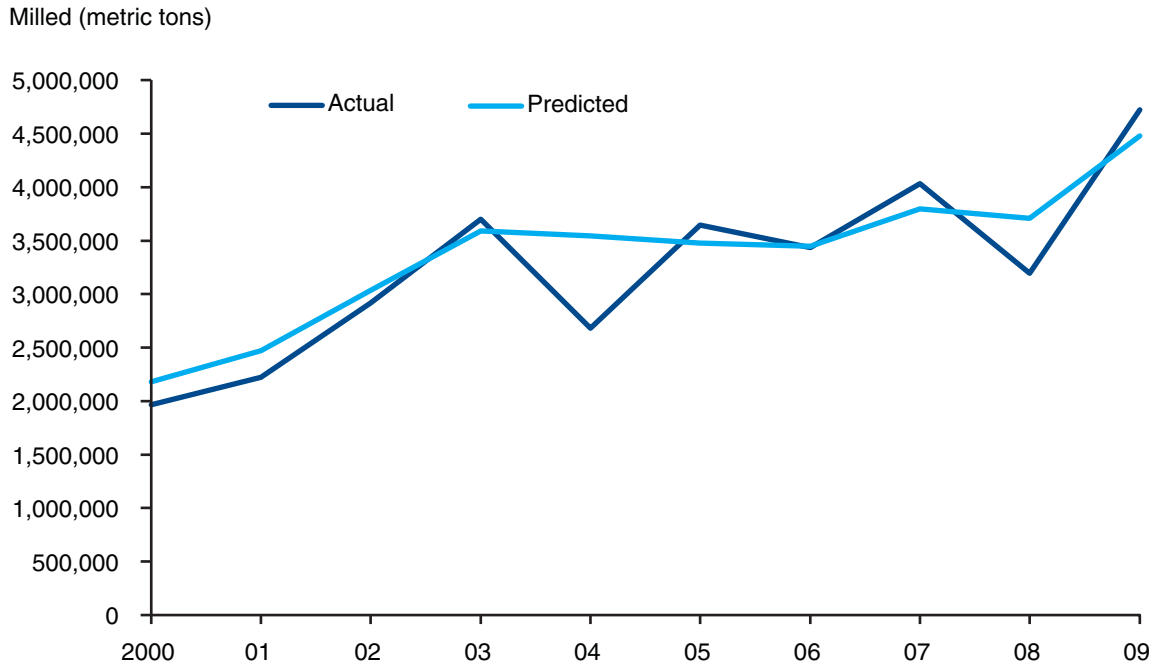
Appendix 1: Elasticities and Parameters

Formal estimates of supply and demand elasticities for wheat in Afghanistan are not available in the literature. Limitations in both the quantity and quality of Afghan data, as discussed in Persaud (2010), pose a significant if not insurmountable challenge for econometrically estimating demand and supply parameters.

The specification and parameters for wheat area and per capita flour demand shown in appendix table 2 are based on Persaud (2012).

The model specification for flour production posits that the quantity of wheat milled depends on the ratio of flour to wheat prices and a trend term that reflects the growth of Afghanistan’s milling sector. An increase in the price of wheat, the key input (raw material) cost for millers, would reduce incentives for the production of flour, all else equal. On the other hand, if millers receive higher prices for the flour that they produce and sell, they would have an incentive to process more wheat into flour, all else equal. In other words, an increase in the milling margin (the flour-to-wheat price ratio) leads to an increase in milling activity. Although the within-sample model predictions for this period do not exhibit the sharp year-to-year variations that characterize the actual data after 2003 (appendix fig. 1.1), the model does capture the overall trend in the quantity of wheat milled.

Appendix figure 1.1
Actual and model predictions of the quantity of wheat milled



Sources: Actual data are computed from USDA PS&D database, FAOSTAT database, and IGC database; predicted values are author’s calculations.

Appendix 2: Model Equations, Parameters, and Price Determination⁵

- (1) $WHPrice = \text{MINIMUM}\{WHPrice_I, WHPrice_A, WHPrice_{AA}\}$
- (2) $FLPrice = \text{MINIMUM}\{FLPrice_I, FLPrice_A, FLPrice_{AA}\}$
- (3) $FLDemandPerCap = \mathbf{FL^2 * GDPPerCap} + \mathbf{FL^3 * FLPrice} + \mathbf{constant_{FLD}}$
- (4) $FLDemand = [\mathbf{FL^2 * GDPPerCap} + \mathbf{FL^3 * FLPrice} + \mathbf{constant_{FLD}}] * POP * 1000$
- (5) $WHArea_t = \mathbf{WH^1 * WHPrice_{t-1}} + \mathbf{WH^2 * WHYield_{t-1}} + \mathbf{WH^3 * Trend} + \mathbf{constant_{WA}}$
- (6) $WHYield_t = WHYield_{t-1} * \mathbf{Trend}$
- (7) $WHProduction = WHArea * WHYield$
- (9) $WHMilled = \mathbf{M^1 * (FLPrice / WHPrice)} + \mathbf{M^2 * Trend} + \mathbf{constant_{WHM}}$
- (10) $WHImport = WHMilled - WHProd$
- (11) $FLImport = FLDemand - WHMilled$
- (12) $WHImport + FLImport = FLDemand - WHProd$

Price Determination

The model structure is capable of determining domestic prices of wheat and flour for four separate cases: (1) imports of flour and wheat are both greater than zero; (2) Afghanistan imports neither wheat nor flour, i.e., strict autarchy; (3) flour imports are zero and wheat imports are greater than zero; and (4) flour imports occur, but not wheat imports.

Imports of Both Flour and Wheat: In situations where imports of flour and wheat are both greater than zero, the domestic price of wheat is determined as Pakistan's release price of wheat adjusted by a margin (WHMargin) that reflects freight and handling costs:

$$(13) \mathbf{WHPrice_I} = \text{PakRelPrice} * (1 + \mathbf{WHMargin}) * (1 + \mathbf{WHTariff})$$

The domestic price of flour is determined as Pakistan's release price of wheat adjusted by a margin (FLMargin) that reflects the sum total of freight, handling, and processing:

$$(14) \mathbf{FLPrice_I} = \text{PakRelPrice} * (1 + \mathbf{FLMargin}) * (1 + \mathbf{FLTariff})$$

Strict Autarchy Flour Price: In situations where there are no imports of flour or wheat, we compute the strict autarchy price of flour by setting $WHImport = FLImport = 0$ in equation (12), implying that flour consumption (on a wheat-equivalent basis) equals wheat production:

$$(15) \mathbf{FLDemand} = \mathbf{WHProd}$$

⁵Variables in boldface are exogenous; all quantity variables are on a wheat-equivalent basis.

Appendix table 1

Variable list

Variable	Description	Unit	Base value
WHPrice	Afghan wheat price, real	US \$ / ton	341.4
WHPrice _{t-1}	Afghan wheat price, lagged one year	US \$ / ton	318
FLPrice	Afghan flour price, real	US \$ / ton	498.2
PakRelPrice	Pakistani release price of wheat, real	US \$ / ton	284.5
WHMargin	Wheat marketing margin	percent	9.1
FLMargin	Flour marketing margin	percent	59.2
Mmargin	Milling Margin	percent	1.5
FLDemandPerCap	Per capita consumption of flour	kg / capita	189
GDPPerCap	Gross domestic product per capita, real	US \$ / capita	517
FLDemand	Total flour consumption	1,000 tons	5,700
POP	Population	millions	30
Trend	Linear trend term	--	11
WHArea	Wheat area harvested	1,000 ha.	2,300
WHYield	Wheat yield	tons / ha.	1.61
WHYield _{t-1}	Wheat yield, lagged one year	tons / ha.	1.7
WHProduction	Wheat production	1,000 tons	3,700
WHTariff	Tariff on wheat imports	percent	10
FLTariff	Tariff on flour imports	percent	10
WHMilled	Wheat milled in Afghanistan	1,000 tons	4,403
FLImport	Flour imports	1,000 tons	1,297
WHImport	Wheat imports	1,000 tons	703

Notes: WHMilled = domestic flour production. Base year for deflator set to 2010. Wheat imports (WHImport), flour imports (FLImport), and flour production (WHMilled) are computed from USDA PS&D database and IGC database. Flour consumption (FLDemand), flour imports (FLImport), and flour production are on a wheat-equivalent basis.

Sources: Area, yield, and production are from USDA PS&D database. Afghan prices of wheat and flour are from the U.N. World Food Programme's Price Analysis in Afghanistan (World Food Programme, 2011). GDP deflators, population, and GDP are from IMF (2011). Pakistani release price of wheat is from Agricultural Prices Commission, Government of Pakistan.

Substituting equation (4) into (15) we have,

$$(16) (FL^2GDPPerCap + FL^3FLPrice_{AA} + constant_{FLD}) * Pop * 1000 = WHProd.$$

$$(17) FL^2GDPPerCap + FL^3FLPrice_{AA} + constant_{FLD} = WHProd / (Pop * 1000).$$

$$(18) FL^3FLPrice_{AA} = WHProd / (Pop * 1000) - FL^2GDPPerCap - constant_{FLD}$$

Solving the above for the price of flour yields:

$$(19) FLPrice_{AA} = [(WHProd / (Pop * 1000)) - FL^2GDPPerCap - constant_{FLD}] / FL^3$$

Appendix table 2

Parameters and elasticities for Afghanistan wheat model

Equation & coefficient	Elasticity	Parameter
Per capita flour demand equation:		
FLPrice (FL ³)	-0.2	-0.07582
GDPerCap (FL ²)	0.32	0.11816
Constant _{FLD}	--	175.478
Wheat area harvested equation:		
WHPrice _{t-1} (WH ¹)	0.20307	--
WHYield _{t-1} (WH ²)	0.41714	--
TREND (WH ³)	--	0.01
Constant _{WA}	--	9.30490
Quantity of wheat milled equation:		
FLPrice / WHPrice (M ¹)	--	6758759.243 ^a
TREND (M ²)	--	147396.3228
Constant _{WHM}	--	-7059547.803

Source: Author.

^aCoefficient of quantity milled with respect to price ratio does not equal coefficient of quantity milled with respect to an individual price, e.g., FLPrice.

Strict Autarchy Price of Wheat: In situations where there are no imports of wheat or flour, we compute the strict autarchy price of wheat by first setting WHImport=0 in equation (10), implying the quantity of wheat milled equals domestic production of wheat:

$$(20) \text{WHMill} = \text{WHProd}$$

Substituting equation (9) into the above we have,

$$(21) M^1 * (\text{FLPrice}_{AA} / \text{WHPrice}_{AA}) + M^2 * \text{Trend} + \text{constant}_{WHM} = \text{WHProd}.$$

Solving the above for the price of wheat yields:

$$(22) M^1 * (\text{FLPrice}_{AA} / \text{WHPrice}_{AA}) = -M^2 * \text{Trend} - \text{constant}_{WHM} + \text{WHProd}.$$

$$(23) \text{WHPrice}_{AA} / M^1 * \text{FLPrice}_{AA} = 1 / [-M^2 * \text{Trend} - \text{constant}_{WHM} + \text{WHProd}]$$

$$(24) \text{WHPrice}_{AA} = M^1 * \text{FLPrice}_{AA} / [-M^2 * \text{Trend} - \text{constant}_{WHM} + \text{WHProd}]$$

As shown above, the strict autarchy price of wheat is a function of the strict autarchy price of flour. Note that M¹ is positive because it reflects the impact of the flour milling margin on the quantity of wheat milled. Thus, increases in the autarchy price of flour (due to rising GDP, for instance) are passed through as rising wheat prices. The trend term in (24) reflects growth in the capacity to mill

wheat into flour as a result, for instance of improvements in energy supplies needed to run wheat mills and/or growth in physical mill capacity. An increase in the capacity to mill wheat into flour, captured by Trend in (24), will make the denominator smaller and hence the wheat price larger, thus benefiting Afghan farmers, all else equal. On the other hand, destruction of the milling sector (due to warfare, for instance) reduces wheat prices and harms farmers, all other things equal.

Substituting (19) into (24), we obtain:

$$(25) \text{WHPrice}_{AA} = M^1 * [((\text{WHProd}/(\text{Pop} * 1000)) - \text{FL}^2 \text{GDPPerCap} - \text{constant}_{\text{FLD}}) / \text{FL}^3] / [-M^2 * \text{Trend} - \text{constant}_{\text{WHM}} + \text{WHProd}]$$

Semi-Autarchy Flour Price: There may be instances where Afghanistan imports wheat but not flour. This outcome may be a result of (a) relative prices, when the cost of importing wheat is low enough that it is not worthwhile to import the processed commodity (b) milling expansion leading to flour self-sufficiency, implying that Afghanistan replaces imported flour with imported wheat. Note that in this case, the import price of wheat influences the domestic price of flour. Accordingly, the Afghan flour price computed here is referred to as semi-autarchy rather than strict autarchy. To compute the semi-autarchy price of flour, we first set FLImport=0 in equation (11), implying that the quantity of wheat milled equals flour consumption:

$$(25) \text{FLDemand} = \text{WHMill}.$$

Substituting equations (4) and (9) into the above, we have,

$$(26) (\text{FL}^2 \text{GDPPerCap} + \text{FL}^3 \text{FLPrice}_A + \text{constant}_{\text{FLD}}) * \text{Pop} * 1000 = M^1 * (\text{FLPrice}_A / \text{WHPriceI}) + M^2 * \text{Trend} + \text{constant}_{\text{WHM}}$$

$$(27) \text{FLPrice}_A (\text{FL}^3 * \text{Pop} * 1000 - M^1 / \text{WHPriceI}) + (\text{FL}^2 \text{GDPPerCap} + \text{constant}_{\text{FLD}}) * \text{Pop} * 1000 = M^2 * \text{Trend} + \text{constant}_{\text{WHM}}$$

$$(28) \text{FLPrice}_A (\text{FL}^3 * \text{Pop} * 1000 - M^1 / \text{WHPriceI}) = M^2 * \text{Trend} + \text{constant}_{\text{WHM}} - (\text{FL}^2 \text{GDPPerCap} + \text{constant}_{\text{FLD}}) * \text{Pop} * 1000$$

$$(29) \text{FLPrice}_A = [M^2 * \text{Trend} + \text{constant}_{\text{WHM}} - (\text{FL}^2 \text{GDPPerCap} + \text{constant}_{\text{FLD}}) * \text{Pop} * 1000] / (\text{FL}^3 * \text{Pop} * 1000 - M^1 / \text{WHPriceI})$$

Semi-autarchy Wheat Price: There may be instances where Afghanistan imports flour but not wheat, e.g., when the cost of importing flour is so low that it is not worthwhile to import and process wheat. Shocks that adversely affect Afghanistan's wheat milling sector may also lead to the replacement of imported wheat with imported flour. The Afghan wheat price computed here is referred to as semi-autarchy rather than strict autarchy, since the import price of flour influences the domestic price of wheat. With imports of wheat set to zero in equation (10), the quantity of wheat domestically produced equals the quantity milled:

$$(30) \text{WHMill} = \text{WHProd}$$

Substituting equation (9) into the above we have,

$$(31) M^1*(FLPriceI/WHPrice_A) + M^2*Trend + constant_{WHM} = WHProd.$$

Solving the above for the price of wheat yields:

$$(32) M^1*(FLPriceI/WHPrice_A) = - M^2*Trend - constant_{WHM} + WHProd.$$

$$(33) WHPrice_A / M^1*FLPriceI = 1 / [- M^2*Trend - constant_{WHM} + WHProd.]$$

$$(34) WHPrice_A = M^1*FLPriceI / [- M^2*Trend - constant_{WHM} + WHProd.]$$

Switching to a higher flour tariff can result in higher semi-autarchy domestic wheat prices, once wheat imports have been eliminated; that is, higher wheat prices would come at the cost of consumers. The economic logic underlying this result is that flour prices and milling margins expand when the flour tariff rises, leading to an outward shift in the derived demand for the raw material and hence to an increase in the domestic wheat price above its initial autarchy level.

Appendix figure 2.1 illustrates an alternate scenario in which an increase in the flour tariff leads to higher domestic wheat prices and production, benefiting Afghan farmers. As shown in the upper panel, Afghan millers receive a tariff-adjusted border price of $P_f(1+tf)$, and the quantity of flour production is at F_p . Given a domestic flour price of $P_f(1+tf)$, demand for flour exceeds Afghan production, and imports are $F_c - F_p$. In this scenario, the wheat tariff has been set at a level that prevents imports. Thus, the tariff-adjusted border price $P_wB(1+tw)$ exceeds the autarchy price P_wA . In this case, the prevailing domestic price is actually the autarchy price, P_wA , implying that wheat production equals consumption ($W_p = W_c$) and imports are zero.

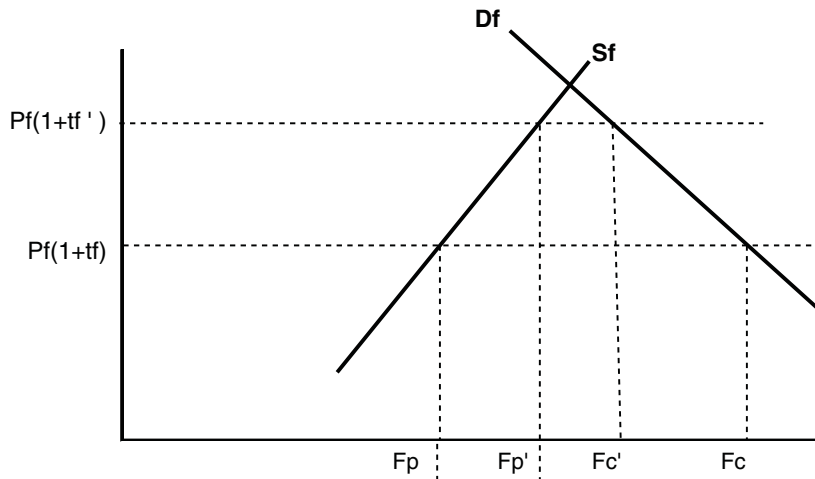
Now consider a sharp increase in the flour tariff, from $P_f(1+tf)$ to $P_f(1+tf')$ (upper panel). Consequently, flour imports are curtailed as the gap between domestic production and consumption of flour contracts to $F_c' - F_p'$. With increased domestic production of flour, the derived demand for wheat shifts outward substantially from D_w to D_w' (lower panel). The new (higher) autarchy price of wheat, P_wA' , is not operative because it exceeds the tariff-adjusted border price of $P_wB(1+tw)$ —the latter is now the prevailing domestic price. Afghan wheat farmers are now faced with stronger price incentives since the currently prevailing domestic price exceeds the original autarchy price, i.e., $P_wB(1+tw) > P_wA$. Afghan wheat farmers benefit from the increased flour tariff and domestic wheat output expands. Nevertheless, Afghan production falls short of demand, and the country shifts to being an importer of wheat, where imports are given as $W_c' - W_p'$.

Sensitivity Analyses

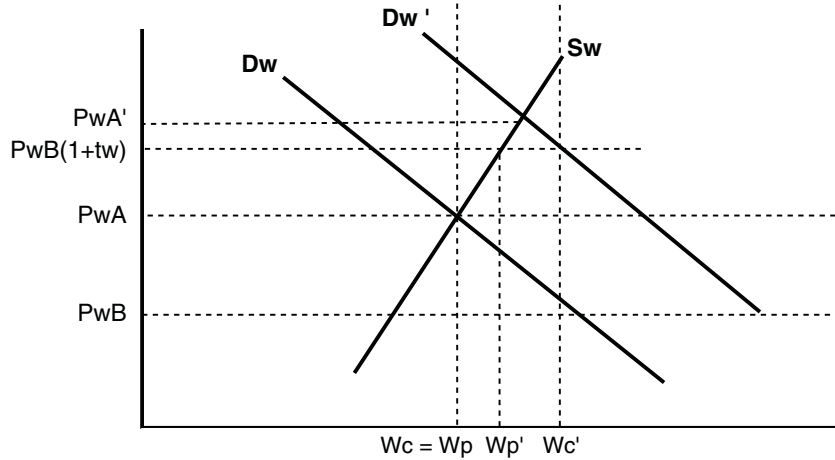
We gauge the sensitivity of the projections by changing the magnitude of key behavioral parameters. The largest impacts on the model results stem from (a) changes to the value of M^1 , which captures the impact of the milling margin on the quantity of wheat milled and (b) changes to FL^2 , the income elasticity of demand for flour. For example if M^1 is increased by 10 percent, wheat imports in the terminal year of the Reference scenario decrease to 899.2 thousand MT, which is 4.75 percent lower than the figure reported in table 4. The impacts on the other variables are relatively small—the quantity of wheat milled changes by less than 1 percent (-0.78 percent) and flour imports rise by 1.3 percent. As expected, combined wheat and flour imports are unchanged, as are domestic wheat production and flour consumption. In Scenario II, the impact of increasing M^1 by 10 percent is most

A Combination of flour and wheat tariffs benefits farmers

Flour



Wheat



Source: Author.

pronounced for flour and wheat imports, which decrease (rise) by 4.7 percent (3.9 percent). The quantity of wheat milled rises relatively little (1.3 percent), and combined wheat and flour imports are unchanged, as are domestic wheat production and flour consumption. In Scenarios III and IV, the impacts are small, with no variable changing by more than 1.3 percent. In all scenarios, when the income elasticity FL^2 in the flour demand equation is increased by 10 percent, the largest impact is on flour imports. Flour imports rise by 3.78 percent, 6.89 percent, 2.96 percent, and 4.25 percent in Scenarios I, II, III, and IV, respectively.

Appendix 3: Data Sources and Uncertainties

There is considerable uncertainty surrounding estimates of population, production, consumption, and trade flows for Afghanistan. Total population estimates are approximations, since large segments of the population flow in and out of the country, including the seasonal movement of nomadic tribes into Pakistan and the large return of refugees in 2002-04, both of which were difficult to count accurately.

The Food and Agriculture Organization (FAO) and the World Food Programme (WFP) develop crop production estimates for Afghanistan, working under adverse conditions of war, rural insecurity, and poor transport infrastructure, while also coping with tight budget and time constraints. Government data at the provincial level are limited, and this further increases the difficulties of quantifying crop production for Afghanistan as a whole (Chabot and Dorosh, 2007). From 2000 forward, Afghan wheat production estimates from FAO are strongly correlated with USDA Production, Supply and Distribution (PSD) data. This report uses PSD data, since this source provides data through 2008 as well as estimates for 2009.

Estimates of trade flows are uncertain—reliable independent customs data on Afghanistan’s wheat imports are not available (Chabot and Dorosh, 2007), and there is a great deal of unofficial cross-border trade. USDA PSD online database may provide the best estimates of (combined) wheat and flour imports. Based on Foreign Agricultural Service (FAS) Global Agriculture Information Network (GAIN) reports as well as conversations with FAS Agricultural Specialists from Islamabad, market sources are utilized to account for official and unofficial trade in the USDA PSD import numbers for wheat and flour. Although trade figures are uncertain, various sources such as FAS GAIN reports, United States Agency for International Development (USAID), the United Nations World Food Programme, and the World Trade Atlas agree that Pakistan is the dominant supplier of wheat (primarily in the form of flour) to Afghanistan. Kazakhstan ranks a distant second in most years, but revised trade data indicate a significant increase in 2008/09 Kazakh wheat and flour exports to Afghanistan that moderated the drop in Afghan consumption.

Afghanistan’s production of flour (on a wheat-equivalent basis) is computed as the sum of domestic wheat production and wheat imports, assuming that all imported wheat is milled. Although USDA PSD likely provides the most reliable trade quantities, it has the disadvantage of aggregating wheat and flour into a single import figure. In contrast, FAOSTAT reports wheat and flour imports as separate commodities. To arrive at an internally consistent estimate of wheat imports, we first compute the ratio of wheat versus flour imports, relying on FAOSTAT data up to 2008/09. This ratio is then used to decompose the USDA PSD trade data into separate figures for wheat and flour imports. For years after 2008/09, we compute the ratio of wheat versus flour imports, relying on data from International Grains Council (IGC). This ratio is used to decompose the USDA PSD trade data into separate figures for wheat and flour imports. Flour consumption can then be computed as sum of domestic flour production and flour imports.

This report uses price data collected by the World Food Programme (WFP) in the six major cities of Afghanistan: Kabul (the capital), Kandahar in the Southwest, Hirat in the West, Mazar-e-Sharif in the Northern province of Balkh, Fayzabad in Badakhshan province at the Northeast, and Jalalabad in the Eastern province of Nangarhar. WFP price data are useful for evaluating the affordability of food for low-income segments of the population. By design, the data series represents the lowest priced food varieties available in urban bazaars. Consequently, the average retail prices in these

cities are likely to be higher than the WFP price series. Nevertheless, the data collection method is straightforward and consistent: WFP data collectors identify the minimum price after recording a sample of prices in different stalls of each bazaar (Maletta, 2004). No data exist on producer prices in Afghanistan.