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PULSES POLICY IN PAKISTAN: AN EMPIRICAL ANALYSIS

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Abstract. Pulses production in Pakistan is decreasing, and domestic demand and imports are increasing. Current domestic polices (a pulses export ban and subsidies on wheat and fertilizer) discourage expansion of pulses production. We develop a partial equilibrium model of the pulses sector and show the impact of: (i) removing the wheat subsidy; (ii) a ten per cent productivity increase in pulses production; and (iii) a tariff on pulse imports. Our results suggest the pulses industry would benefit from phasing out the subsidy on wheat, dropping consideration of a pulse import tariff, and improving productivity with consideration of distributional effects.

Keywords: Pakistan, pulses, policy

JEL Classification: Q18, D04, C61, Q11, Q17

I. INTRODUCTION

Pulses, defined as legumes used for human or animal consumption (PARC 2016), have received significant media attention in Pakistan in recent years. They are a minor crop in terms of production, grown on

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approximately 5 per cent of agricultural land (GOP 2019), around 2.9 million acres. While wheat, rice and other grains are the foundation of food security, pulses have an important role in consumption by providing 'complementary proteins' that are essential amino acids in human diets. The pulses that are dominant in terms of production and consumption in Pakistan are chickpeas (white gram), mung beans (green gram), mash beans (black gram) and lentils (masoor). Chickpeas and lentils are Rabi crops, meaning they are produced during the winter months. In an average year, chickpeas are grown on 84 per cent of pulses area and lentils on 1 per cent. These crops are substitutes in production for wheat, barley, peas and mustard. In contrast, mung and mash beans are Kharif crops, produced during the summer months. They are grown on 13 and 2 per cent of pulses area, respectively, and are substitutes in production for cotton, sugar cane, rice and maize (GOP 2019).

Recent media attention has been given to a number of trends relating to pulses that are currently of concern to the Pakistan Government. Pulse production has declined over the last 60 years to its current value of around 565kt (FAO 2021), without increases in either area planted or yields over this period. This is in contrast to yields in sugarcane and rice, which have doubled since 1960, wheat yields which have tripled and maize yields have increased five-fold over this time period. Pulses yields in Pakistan (0.4t/ha for chickpeas) are currently about half reported yields in India (0.9t/ha), and less than one-third of yields achieved in the United States (1.6t/ha), Myanmar (1.5t/ha) and Australia (1.3t/ha) (FAO 2021). Consumption of pulses in Pakistan has risen since 1970, to around 1.1 million tonnes in 2017. Imports, currently 685kt, have risen dramatically since 1980, to meet the shortfall between consumption and production (FAO 2020).

Concerned about a dramatic increase in exports between 2004 and 2006, the Pakistan Government imposed a 35 per cent export tax on pulses. This resulted in pulse exports all but stopping. The export tax was replaced by an export ban. Unfortunately, this curb on exports has not resulted in low domestic prices for pulses, as prices have increased three-fold since the tax/ban was imposed. The variability in prices has also significantly increased. In order to reduce imports and support production of pulses, the federal government has proposed that the provincial governments consider giving farmers a support price for pulses,

particularly lentils and mash. The country is self-sufficient in wheat, rice, maize, sugar cane, but is not self-sufficient in lentils and mash and this is viewed negatively.

Apart from the export ban on pulses, Pakistan currently does not have other policies that exclusively focus on pulses. The Government provides producer subsidies for fertiliser (US$566 million in 2011-12), and to a lesser extent electricity (US$5 million in 2011-12)[1]. These subsidies benefit all producers, not just pulse producers. However, as pulse crops require less fertiliser than other crops, the subsidies do favour non-pulse producers somewhat.

The Government also administers a wheat price subsidy through a procurement scheme for wheat. The current procurement price is Rs 1,650/40kg, equivalent to US$270/t, which is somewhat higher than the $239/t average for 2020 as reported by AMIS[2]. Furthermore, not all farmers receive the procurement price. Wheat production is currently around 26 million tonnes and the Government normally buys 4-5 million tonnes.

Nonetheless, the wheat support subsidy does increase the profitability and reduce the risk of producing wheat compared with other crops, and therefore discourages pulses production. According to the latest notifications to the WTO (WTO 2015a), the market support for wheat amounted to $647 million 2011-12. Current production in Pakistan is valued at around $7,000 million but can vary significantly because of variations in international prices. The subsidy is around ten per cent, which is close to the de minimis level permitted by the WTO.

Government policies, including aid projects, are aimed at increasing productivity. We expect that an exogenous productivity shock would benefit producers and consumers, although the gains would not be equally shared. This is illustrated in figure 1, which shows the impact of a pivotal shift of the supply curve. If domestic prices are determined by world prices, domestic production replaces imports. Production increases from Qs to Qs' and imports are reduced from Qd-Qs to Qd-Qs'. Demand

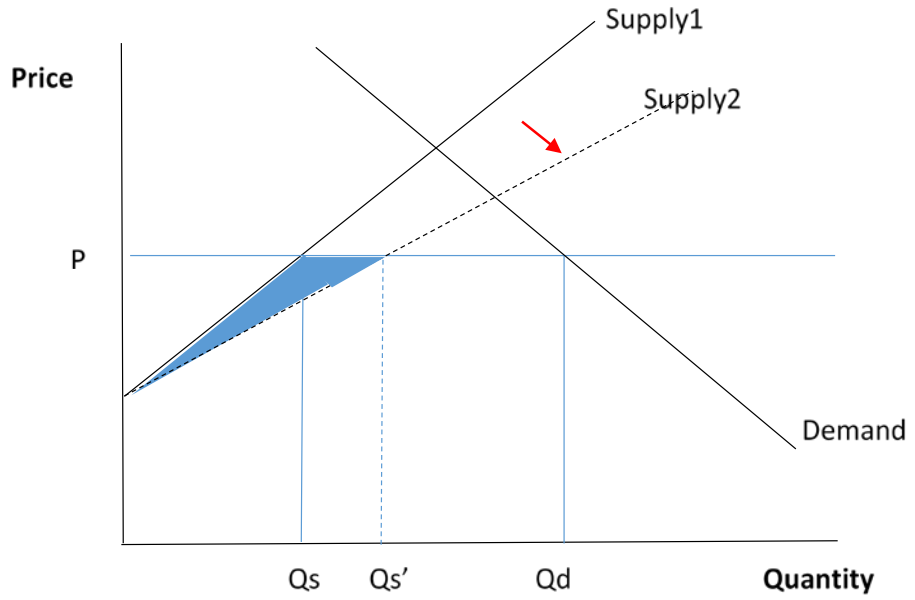
[1] Pakistan last notified domestic support commitments to the WTO in 2015.

[2] US No 2 hard winter wheat, IGC (2021).

is unchanged. Producer surplus increases by the amount of the productivity shift.

FIGURE 1

Effects of a Productivity Improvement with Fixed Price



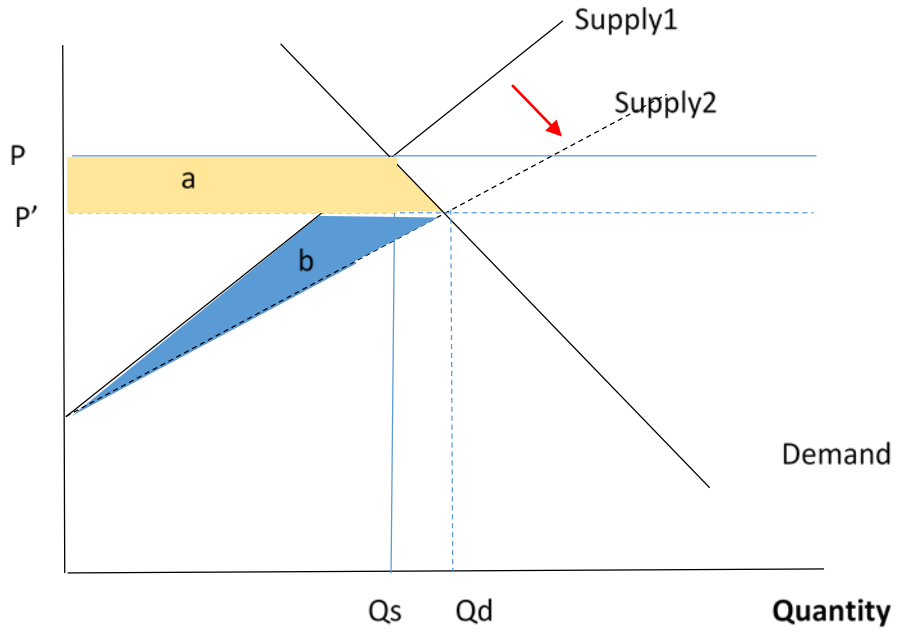
The distribution of gains is different if the additional supply merely depresses domestic prices, as would be the case if all or most production is sold onto the domestic market, as is likely to be the case if an export ban prohibits exports. This may be the case with mung/mash beans, where the share of imports is low. In this situation, the productivity shift leads to a fall in prices received by producers and paid by consumers. Consumer gains are the area *a* in Figure 2. Producer gains are area *b*, but they lose area *a*.

The net gains depend on the slope of the curves and the nature of the shift. Lindner and Jarrett (1978) showed that the nature of the supply shift matters. Alston *et al.* (2009) demonstrate how the share of benefits accruing to producers may be zero or indeed negative depending on the nature of the shift and the supply and demand elasticities. In figure 2 the shift is shown as divergent, but it could as well be parallel or convergent.

If the supply curve pivots from the bottom, it means the high-cost producers benefit most from the productivity shift. Martin and Alston (1997) suggest that new plant varieties that are herbicide-tolerant, heat-tolerant, or drought-tolerant usually create larger cost reductions in areas with lower productivity. Thus, there are greater gains for high-cost producers. Changes that do not rely on technological breakthroughs, such as no-till, are likely to favour high-cost producers. A parallel shift will occur when the innovation helps both high cost and low-cost producers. Changes in crop rotation, planting dates, higher yielding varieties, improved fertilizers and pesticides are innovations that help all producers and generate parallel shifts.

FIGURE 2

Effects of a Productivity Improvement with Flexible Price



A little introspection would suggest a strictly parallel shift is somewhat unlikely, especially at low prices where the quantity supplied is low. Nonetheless, the nature of the curve, and the effect on low-cost

producers is important in determining the magnitude and distribution of the gains from a productivity shift.

We simulate, for illustrative purposes, a ten per cent productivity increase in the production of chickpeas, lentils and mung/mash beans (a pivotal shift). The nature of the shift has an impact when calculating producer surplus, but not consumer surplus, assuming the supply curve goes through the same equilibrium point in each case.

The Australian Centre for International Agricultural Research, in collaboration with the Pakistani government, is currently funding research into improving productivity and marketing of pulses, as well as evidence-based economic analysis of policies that impact pulses in Pakistan. We consider three scenarios here: (1) removal of the wheat support subsidy, (2) impacts of policies that lead to a pulses productivity improvement; and (3) imposition of an import tariff. While removal of the wheat support subsidy and imposition of an import tax stem from government policies, productivity improvements may stem from Government investment in research, development and extension that increases production efficiency such as mechanization, adoption of higher-yielding varieties, efficient use of inputs, improved infrastructure and adoption of innovations. We present the methodology used in our analysis in Section II, the results in Section III, and we discuss conclusions and policy implications in Section IV.

II. METHODOLOGY

To conduct economic analysis of the welfare impacts of Pakistan's pulses-related policies, we develop a partial equilibrium model of Pakistan's pulses sector. The model is a modified version of GSIM, a modelling framework developed by Francois and Hall (1997). GSIM was developed as a static, deterministic, single commodity, bilateral trade model driven by export supply and bilateral import demand equations. We have modified it to include multiple commodities with cross-elasticities linking the commodities. We have also altered some of the welfare (consumer and producer surplus) equations because we are interested in whether changes in Government support for wheat and other crops will affect production of pulses. The modified version of GSIM

includes seven commodities; three pulses (chickpeas, lentils and mung/mash - trade data for mung and mash are aggregated so we cannot easily disaggregate these crops) and four non-pulses which are substitutes in either production or consumption (cotton, rice, sugarcane and wheat). GSIM is global, including all trade for a given commodity.

Within GSIM, imports of a commodity in any one country are a function of national demand and domestic production. Exports are determined by the global demand for imports. Imports are distinguishable by source and are not perfect substitutes. Bilateral trade flows are influenced by relevant bilateral trade tariffs, and production subsidies and quota. Tariffs and quota are bilateral, and possibly different between countries, so that within GSIM, a change in tariffs or quota leads to a change in relative prices that drive differential changes in imports from various countries. The extent to which changes in relative prices lead to a switch in the source of imports is determined by elasticities of substitution. The model solves numerically to find a market clearing price such that global imports equal global exports using Excel's Solver function. Total welfare is calculated as the sum of producer surplus, consumer surplus and change in government revenue.

We include ten regions within the modified GSIM; Pakistan and its major trading partners, plus a Rest of World region. Data required for the model are bilateral trade flows (in values), bilateral trade taxes, and elasticities of supply, demand and substitution between imports (the so-called Armington elasticities). Bilateral trade data for 2019 was obtained from UN Comtrade via WITS[3]. Production data was obtained from the Agricultural Market Information System (AMIS) and the United States Department of Agriculture Foreign Agricultural Service for Pakistan and the United Nation's Food and Agriculture Organization (FAO) for other countries.

ELASTICITIES

Elasticities for Pakistan were estimated and published in Rani et al. (2020). Own and cross price demand elasticities were obtained by

[3]World Integrated Trade Solutions (WITS) is an online data aggregation and download software package provided by the World Bank.

estimating a Linear Approximate Almost Ideal Demand System (LA-AIDS) model applied to time-series data from 1981 to 2015. A description of the modelling can be found in Rani et al. (2020). The estimated own-price and cross-price demand elasticities are shown in Table 1. We drop the estimates that are not significant, or of incorrect sign or seem unrealistic. All own price elasticities are less than one, as expected. There appears to be almost no relationship between pulses and wheat, although lentils and rice appear to be complements in consumption.

TABLE 1

Demand Elasticities for Pakistan

	Chickpeas	Lentils	Mung/Mash	Cotton	Sugar	Wheat	Rice
Chickpeas	-0.63		0.66			-0.03	
Lentils		-0.34	0.64				-0.32
Mung/Mash	0.47		-0.86				
Cotton				-0.20			
Sugar					-0.13		
Wheat						-0.35	0.13
Rice	-0.59	-0.37	0.01			-0.49	-0.74

Source: Rani *et al.* (2020)

The estimated supply elasticities are shown in Table 2. All own price elasticities are positive and less than one. The pulses tend to have higher elasticities than the traditional crops such as wheat and rice. This reflects the scope farmers have to take these crops in or out of production depending on price expectations. The cross elasticities show that a change in the price of wheat affects the quantity supplied of chickpeas and lentils. However, there is no effect in the other direction. The price of pulses does not affect the supply of wheat. This is because the area planted to pulses is small in comparison with wheat. The main conclusion to be drawn from the supply side estimates is that a fall in the price of wheat should provide a significant boost to the supply of chickpeas. Furthermore, it means that support policies for wheat (tariffs, exports subsidies and input subsidies) discourage the production of pulses.

TABLE 2

Supply Elasticities Matrix for Pakistan

	Chickpeas	Lentils	Mung/Mash	Cotton	Sugar	Wheat	Rice
Chickpeas	0.40	-	-	-	-	-0.58	-
Lentils	-	0.17	-	-	-	-0.16	-
Mung/Mash	-	-	0.38	-	-	-	-
Cotton	-	-	-	0.27	-	-	-
Sugar	-	-	-	-	0.45	-	-
Wheat	-	-	-	-	-	0.14	-
Rice	-	-	-	-	-0.49	-	0.20

Source: Rani *et al.* (2020)

Finally, Armington elasticities show the substitution between domestic and imported goods, and between imports from different sources. Thus, there are two sets of Armington elasticities. By convention, the second set are twice the first. This means consumers may have a preference for domestically produced goods, but once they have decided to consume and imported product the source is not so important. The values used here for the first set of Armingtons are 1.85 for the three pulses, and 2.5, 2.7, 4.45 and 2.6 for cotton, sugar, wheat and rice respectively[4].

In 2019 imports of pulses into Pakistan amounted to $270 million. The major sources of Pakistan's imports are Canada, Russia and the United States. The major imports were chickpeas ($213 million) and lentils ($56 million).

It is clear from the cross-price elasticity that the price of wheat affects the supply of pulses. To analyse the impact of removal of the wheat procurement price and an increase in pulses productivity, shocks to these variables are introduced to the model *ceteris paribus*, and the impact on production, consumption, domestic prices, imports, exports, consumer surplus, producer surplus, government revenue and net welfare are reported and discussed.

[4] These elasticities are taken from the GTAP database (Aguiar et al. 2019).

SCENARIOS

Three scenarios are presented, as listed in Table 3. These are different ways of encouraging the production of pulses. We treat them as alternative policy measures although they could be implemented together.

TABLE 3

Scenarios

No.	Name	Description
1	Wheat subsidy	Removal of the wheat price subsidy
2	Productivity	10% increase in pulses productivity
3	Tariff	Imposition of 10% tariff on all pulse imports

WHEAT PRICE SUBSIDY

The Pakistan Government subsidises wheat production. The Government procurement price for wheat has climbed steadily over the past ten years. For 2019/20 it was Rs. 1,650/40 kg. At current exchange rates (Rs153/$), this is around $269/tonne. This somewhat above the average international wheat price in 2020 at $239 per tonne (AMIS 2021). Consumers pay more. In January 2021, wheat was selling wholesale in Faisalabad for Rs 5,800/100kg (AMIS 2021), about $360 per tonne, well above the prices farmers receive. The value of the Government procurement policy varies with the international price. Wheat producers also receive domestic support. In 2011-12 this amounted to about ten per cent of the value of production. We simulate the removal of a ten per cent wheat production subsidy to determine the economic impact on the pulses sector.

PULSES PRODUCTIVITY IMPROVEMENT

A problem for pulse producers is low yields. Khan and Answar (2016) report yields of 0.60t/ha for chickpeas and lentils, 0.5t/ha for mung beans and 0.50t/ha for mash beans. They argue that, with optimal management practices, yields could be much higher - 0.9t/ha for chickpeas and lentils, 0.98t/ha for mung beans and 1.0t/ha for mash beans. This compares with wheat, cotton and rice yields of 2.5t/ha,

1.0t/ha and 1.4t/ha, respectively (PAR Agricultural Education 2016). Domestic chickpeas sell for around Rs 4,800 per 40 kgs, whereas wheat brings Rs 1,650. Pulse yields may also vary greatly, especially for rain fed crops. An increase in productivity would make pulses more competitive with wheat, rice and sugar.

TARIFF ON PULSES IMPORTS

Pakistan pulse imports in 2019 amounted to $269 million (UN Comtrade), about one third of consumption. Effectively applied tariffs on pulse imports are three per cent. The major pulse imported to Pakistan is chickpeas, for which the major sources in 2019 were Russia ($56 million) and Canada (US$31 million), although this varies from year to year. There are now no exports of note. In 2005 chickpea exports amounted to $33 million, which included $31 million to India. In 2006 exports of pulses had climbed rapidly to 167 kt, about a third of national production.

The Government imposed an export tax in 2006 and subsequently an export ban to secure domestic production for domestic consumption, thereby hoping to keep prices down for domestic consumers. The export ban is still in place. This analysis does not analyse removal of the export ban, although Vanzetti et al. (2020b) argues that removal of the export ban would encourage increased pulses production in Pakistan by allowing producers to benefit from selling into the higher-priced world market.

This analysis does not consider removal of the fertiliser subsidy (worth $566 million at last count). This policy benefits all users of fertilizer, although it is of relative disadvantage to pulse producers who use less fertilizer than cereals and oilseed producers.

III. RESULTS

WHEAT PRICE SUBSIDY

We simulate the removal of a ten per cent production subsidy to determine the economic impact on the pulses sector, and results are reported in Table 4. We estimate that the removal of the subsidy would lead to a three per cent fall in wheat prices and small fall ($30 million) in

production[5]. This releases land that can be used elsewhere. Production of pulses increases by almost $1. Production of chickpeas and lentils increases by 1.4 and 0.4 per cent, respectively. This is because chickpeas and lentils are substitutes in production for wheat, as indicated by the cross-elasticities. There is less impact on mung/mash beans as they are grown at different times of the year than wheat. Producers and consumers of pulses gain but wheat producers and consumers are worse off because of the removal of the subsidy. The Government benefits from the removal of the subsidy. There is a positive welfare effect (producer plus consumer surplus and Government revenue) of $19 million per year.

TABLE 4

Estimated Impacts of Removing Wheat Production Subsidy

Variable	Chickpeas	Lentils	Mung/Mash beans	Wheat
	%	%	%	%
Producer prices	-1.0	-0.3	0.0	-3.1
	$m	$m	$m	$m
Production	0.9	0.0	0.0	-30.3
Consumption	0.3	0.0	0.0	-11.3
Imports	-0.6	0.0	0.0	0.0
Producer surplus (pivotal)	-0.7	0.0	0.0	-213.2
Consumer surplus	0.8	0.0	0.0	-458.1
Govt. revenue	0.0	0.0	0.0	690.2
Welfare	0.0	0.0	0.0	19.0

Source: GSIM simulations

Government funds previously allocated to the subsidy could be used to make payments to producers or consumers directly, according to need, rather than the scale of production, eliminating the distortionary impacts on prices and relative profitability of crop production.

The Government policy on wheat appears to have had the effect of stabilizing prices, which is generally considered a desirable characteristic, as it helps farmers plan their plantings. However, it does

[5]The supply elasticity for wheat is 0.14.

mean producers and consumers are not responding to world prices. In the past, this has led to a surplus which has accumulated as stocks which must be exported at some point, at prices below the purchase price. Storage is also expensive. The Government spent $112 million on providing storage for wheat in 2011-12 (WTO 2015b). This cost does not include interest and the inevitable spoilage.

The wheat subsidy policy is also poorly targeted. Some of it assists consumers rather than producers (producers are the intended beneficiary of the policy), and the producers that benefit the most are likely to be the large and wealthier producers rather than the poorest farmers. Furthermore, it discriminates in favour of wheat producers at the expense of rice and pulse produces who do not receive such support. It may also be diminishing producer incentives to produce pulses of high quality for local and export markets. It has contributed to the decline in pulse production.

PULSES PRODUCTIVITY IMPROVEMENT

The estimated impacts of an exogenous ten per cent productivity increase in pulses production are shown in Table 5. The increase in production leads to a fall in prices. This means the value of production does not increase as much as the quantity. Imports are replaced, as a result of increased domestic production. Consumers benefit at the expense of producers. There is a net benefit to society, because of the lower costs of production. This is area b in Figure 2[6].

This result is driven by the low elasticities of demand for chickpeas (-0.63), lentils (-0.34), and mung/mash beans (-0.86). With an inelastic demand response, the effect of increased production is to drive down prices. Consumers benefit from lower prices, but there is little increase in consumption. In theory at least, foreign consumers would also benefit from lower prices, but in this instance, Pakistan has banned exports of pulses.

[6]In this example, we assume a pivotal shift. A parallel shift would generate greater gains, almost double.

TABLE 5

Estimated Impacts of 10 Percent Pivotal Productivity Increase in Pulses

Variable	Chickpeas	Lentils	Mung/mash beans
	%	%	%
Producer price	-6	-5	-12
	$m	$m	$m
Production	5.2	0.3	0.1
Consumption	1.7	0.0	0.1
Imports	-3.5	-0.3	-0.1
Producer surplus (pivotal)	-1.8	-0.1	-0.1
Consumer surplus	4.3	0.2	0.3
Welfare	2.6	0.1	0.2

Source: GSIM simulations.

Increasing productivity, particularly at no cost as in this example, is obviously beneficial, but the net gains are swamped by distributional effects, in this case a transfer to consumers. Consumers benefit from lower prices, and perhaps greater variety and nutrition. However, if the aim of the project is to help poor producers, merely increasing productivity may not help. Indeed, producers may well be worse off from a productivity shift, especially if the export ban remains in place.

In particular, it is not clear whether the poorer farmers will be the ones who will be early adopters of the new techniques which will lead to a productivity increase. Nothing has been assumed here about how any productivity increase will come about. It may be small or high-cost farms that benefit the most, but it is more likely that it is large or low costs farms that are able to implement the productivity enhancing techniques. In that case a parallel rather than a pivotal shift would be more appropriate, and the producer surplus would be greater than that reported here.

IMPORT TARIFF

To move towards self-sufficiency, one approach would be to impose a tax (tariff) on imports, Scenario 3. An import tariff is an alternative to an export ban. Such a policy would be WTO consistent because the bound rate on pulses, at 100 per cent, is well above any likely applied

rate. Pakistan does not have preferential trade agreements with some suppliers such as Australia and Canada (lentils), although India (chickpeas) is a partner in the South Asian Free Trade Agreement (SAFTA).

The imposition of a 10 per cent tariff on pulse imports would reduce chickpea imports by $19 million, from $272 million (Table 6). The tariff would benefit pulse producers ($8.5 million) and Government revenue ($24.9 million) at the expense of consumers (-$33.4 million).

For chickpeas, base period production of $450 million is well short of demand, $652 million, requiring imports of $202 million. Given the own price demand and supply elasticities of chickpeas (-0.632 and 0.4) and the cross-elasticities, domestic production of chickpeas ($3 million) would only partially offset the fall in imports (-$19 million). Consumption would fall by $16 million. The Government would collect tariff revenue of $19 million. The loss in consumer surplus of $27 million offsets the gain in producer surplus, $8 million, and the increase in tariff revenue. The net result is a negligible gain.

Our results show a ten per cent tariff leading an increase in production of lentils of 2.7 per cent. There is a modest fall in consumption and imports. There are similar results for Mung/mash, with an increase in production of 3.3 per cent. It is difficult to see Pakistan becoming self-sufficient in lentils, where imports are ten times domestic production.

TABLE 6

Estimated Impacts of 10 Percent Pivotal Productivity Increase in Pulses

Variable	Chickpeas	Lentils	Mung/mash beans
	%	%	%
Producer prices	11	16	9
	$m	$m	$m
Production	3.0	0.1	0.1
Consumption	-15.8	-1.4	-0.1
Imports	-18.8	-1.5	-0.2
Producer surplus	7.8	0.6	0.2
Consumer surplus	-27.1	-6.0	-0.3
Govt revenue	19.4	5.4	0.1
Welfare	0.1	-0.1	0.0

Source: Authors' calculations.

To the extent that domestic and foreign products are imperfect substitutes, a much higher tariff would be needed to choke off imports. At face value, a tariff policy achieves a number of outcomes that are desirable to the Pakistan Government; imports decrease, domestic production increases, and government revenue increases. The net effect is a small welfare loss. However, the main effects are distributional, the transfers from consumers to producers and Government. Also, imports are not undesirable. It is better for a country to produce what it does best and import the rest (Kishtainy et al. 2012). Food security is achieved efficiently through looking to diversify imports, rather than minimize them.

IV. POLICY IMPLICATIONS AND CONCLUSIONS

In this paper, we present a partial equilibrium analysis of the trade and welfare impacts of Pakistan's domestic and trade policies that relate to pulses. We consider three scenarios: (1) removal of the current wheat price subsidy; (2) policies that generate a productivity increase in pulses; and (3) a tariff on pulse imports.

In the case of removal of the wheat production subsidy, we expect that removing it would cause consumer prices of wheat to increase and producer prices to fall, leading to a small decrease in wheat production. Welfare for producers and especially consumers is expected to fall but the saving in government revenue would outweigh these losses for a small net welfare benefit. The effect of removal of this policy on the pulse sector is likely to be an increase in chickpea and lentil production because these are substitutes in production.

Current support for wheat is about ten per cent of the value of production, close to the maximum permitted by the WTO, of which Pakistan is a member. The mechanism for distributing this subsidy is unwieldy. The Government pays a large amount, Rs. 1400/40kg, to procure a variable share of the crop. This has the effect of raising average prices. However, the support is not accurately targeted to those farmers most in need. Most of it goes to large producers. A better approach would be to provide the $650 million in direct payments to low-income farmers, or better still, to low-income rural inhabitants. Assuming that small farmers in Pakistan are the poorer farmers (we make this assumption due to the absence of data on income levels of farmers in Pakistan), and 5.7 million farms are small (less than five hectares)[7], each of these could be provided with income support of over $100 per year, enough to lift many over the poverty line. Wheat producers should receive and respond to world prices.

The economic impacts of a productivity shift depend on the nature of the supply shift. We simulate a shift of the supply curve at no cost to producers, as would be expected through management improvements such as changes in crop rotation, changes in planting dates, higher yielding varieties, and more efficient or improved fertilizers and pesticides use. This is expected to lead to an increase in production and consumption, but also a decrease in domestic prices. As a result, the value of production and consumption is expected to fall, and consumers benefit, potentially at the expense of producers, resulting in a net welfare gain.

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[7] According to the Census of Agriculture 2000, there were 6.6 million farms in Pakistan of which 5.7million (or 86%) are less than the 5 hectares in size.

We show that the nature of the shift makes a big difference in the gains to producers. Careful attention needs to be given to these distributional effects. If the policy is aimed at helping small farmers, where the crop is sold onto the domestic market and demand is inelastic, producers may be worse off and the benefits of the policy go mainly to consumers. Government should instead focus on shifting out the demand curve. One approach to this would be to remove the export ban. Producers could then benefit by selling into the high-priced world market.

Apart from a market support price for wheat, costing an estimated $650 million, the Government provides a fertilizer subsidy of $566 million, available to producers of all crops. We don't model removing the subsidy, but we expect its removal would favour pulse producers over other crop producers as they use relatively less fertilizers, even with the fertilizer savings pulses provide to cereals and oilseeds by way of nitrogen fixation. Sugar is a heavy user of fertilizer, and removal of the support policies for sugar would reduce competition for fertilizer, making more available for more nutritional crops.

One policy for pulses is a Government procurement policy for pulses, similar to wheat. This is based on the observation production has stagnated and imports are increasing. Though not reported in the results section of this paper, our modelling suggests that a pulses procurement policy of 10 per cent (similar to that of wheat) would increase pulses prices, production and consumption, and decrease imports. It would benefit producers much more than consumers for a net welfare loss of practically nothing. We estimate it would cost the government approximately US$7 million, with $5 million going to producers. The solution implemented for wheat, while effective, is inefficient and inequitable, and should be phased out and replaced. Rather than creating similar inefficiencies and inequities for the pulse sector by introducing a procurement scheme, we recommend the sector be integrated with world markets through removal of the export ban. This would have a stabilizing effect and would raise producer prices (Vanzetti et al. 2020b). In 2016, world prices of chickpeas were at record levels, about $1000 per ton, but producers could not benefit from these prices.

Pulse production has stagnated over recent years as producers have switched to wheat, rice and sugar. These crops provide greater and more certain returns. We recommend phasing out the wheat price subsidy and fertilizer subsidies on all crops, and drop consideration of a pulse price subsidy. With removal of the export ban (as recommended by Vanzetti et al. (2020b)), we expect that farmers would be encouraged to grow more pulses. Investing in research is likely to have benefits to Pakistan's economy, although it may well be to the benefit of consumers and detriment of producers. The money that the Government would save from phase-out of the wheat and fertilizer subsidies could be spent on social protection programs targeted more appropriately if thought necessary.

There is nothing specific about pulses which make it a preferable crop to grow instead of rice or wheat. Even with these recommended policy changes, it may be that Pakistan producers continue to grow these crops with greater profitability than pulses. In that case, Pakistan's best strategy may be to focus on wheat and rice production and continue to import pulses from a diverse range of countries.

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