Methodology for Determining Optimal Import Tariffs

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Abstract

The concept of 'comparative advantage' has always been at the heart of national economic development policy. It refers to the export goods that one country produces better than other countries and the trading of such goods for products that other countries produce best. Mongolia is a small, landlocked country, situated at great distances from the world's major transport channels and seaports. It mainly exports agricultural and mining products to world markets and depends on imported goods for its domestic consumption. Landlocked countries are primarily affected not only by high transportation costs but also by low competitiveness in the global market.

Historically, Mongolia has benefited from the export of its raw agricultural materials, such as cashmere, wool and meat. However, rapid urbanisation, growing population needs and high import prices in recent years, especially during the COVID-19 pandemic, means the country must shift from its static comparative advantage of an economy to a dynamic one. Mongolia must pursue a trade policy aimed at creating value-added end products capable of meeting the demands of its domestic consumption and competing in the international arena based on development potentials and comparative advantages of the country. The objective of this paper is to illustrate how tariff optimisation could potentially be used to protect domestic industry, specifically focussing on the dairy production industry.

1. Background to the Mongolian domestic dairy market

Potential members of the World Trade Organization (WTO) are invited to join other members in a roundtable discussion to negotiate commitments regarding the bound tariff to be imposed on goods imported from member countries upon their accession. This commitment before the members is called the schedules of concessions, and encourages the importing member country to set customs duties at lower rates than its commitment to the bound tariff.

In acceding to the WTO in 1997, Mongolia has committed not to exceed 20 per cent for its customs duties on all imported goods, except for alcohol and tobacco products. The current applied rate is, however, in most cases, a uniform five per cent across all trading sectors.

Since the beginning of its transition to a market economy, Mongolia has pursued strategies to support economic growth through a fairly open trade and investment regime. Trade policy was aimed at adapting promptly to the changing environment, as well as at mitigating difficulties resulting from transition and integration with the world economy. Mongolia liberalised its trade by removing its self-imposed barriers to trade and services, by expanding bilateral trade and economic cooperation and by participating in regional and multilateral trade negotiations.

After three decades of continued economic liberalisation, the economy has undergone some significant changes that have important implications for the sustainability of future growth. The Mongolian economy has successfully reoriented its external sector and trade has become much more embedded in the fundamental strengths of the economy (Namsrai, 2017). Trade turnover has grown nearly 10 times that of its pretransition level. More importantly, the country has achieved this trade expansion by diversifying the destinations of its exports far beyond its former partners. According to World Bank statistics, Mongolia's per capita GDP has increased 7.45 times from 2000 to 2020, 1.53 times in real terms (The World Bank, 2020a).

Mongolia's trade and economy, however, has grown quickly during the last two decades. The country's economic growth has not always been steady and has exhibited a dramatic boom-bust cycle. The economy is concentrated in a few sectors − mining and livestock raw materials and textile products − that account for most of Mongolian exports. In 2020 the percentage share of those products accounted for 93 per cent of the country's total exports (Customs General Administration of Mongolia [CGA], 2000−2021). Because of its narrow economic base, the country remains largely dependent on external factors, including the price and demand of raw materials, especially from the economic situation of its main trading partners.

Diversification could be a useful strategy to manage this unstable economic situation, however, it cannot be achieved quickly − it is a long-term process requiring decades of carefully designed and planned policies. Mongolia is trying to diversify its economy, but in an increasingly globalised world, small countries have few opportunities compared with their much larger and stronger competitors.

Of course, any strategies aimed at diversification of the national economy should be rooted in the industries in which the country has a comparative advantage. In Mongolia, the comparative advantage lies in natural resource-intensive industries, of which there are two major types including livestock-based processing industries such as textiles, leather and dairy, and the mining industry.

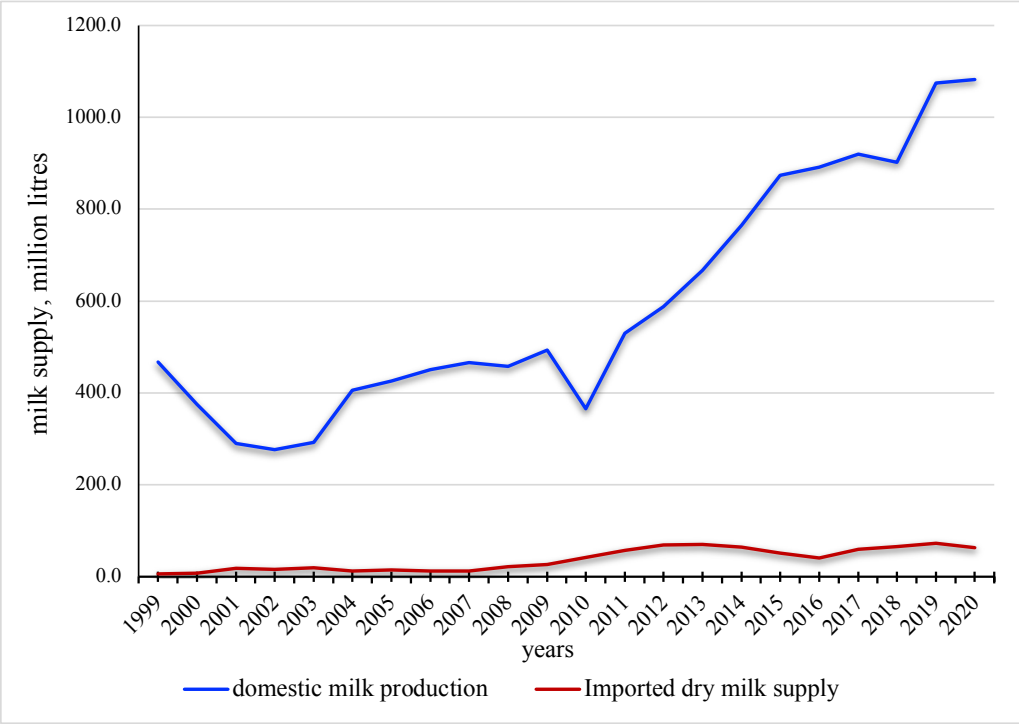
The livelihoods and wellbeing of most nomadic herders in Mongolia still depend largely on livestock in general and on meat and milk in particular. Milk production is the third largest sector of the livestock industry in rural Mongolia, ranking behind meat and cashmere, and has a gross value of US$300−400 million.

Due to increased soil degradation, ongoing climate change, population growth and rapid urbanisation, some countries are now facing a severe scarcity of land for pasture and agriculture, food supply shortages and significant rises in food prices. Persisting global food vulnerability and lack of food supply call for revision of existing policies and regulations on food products, including milk and agricultural products in Mongolia, and their distribution.

Mongolia is one of the few countries of the world that has kept its old nomadic production practices, including milk, for thousands of years. Over centuries, the nomadic herders of Mongolia have developed vast experience and knowledge in dairy production. Traditional milk products remain an important part of the nomadic culture and for the livelihoods of nomadic herders, especially during the long harsh winters. Even so, Mongolia is wasting the export potential of its dairy industry and people in urban areas mostly consume imported milk, especially in winter. Figure 1 illustrates graphically the domestic market supply of the dairy industry.

Milk and dairy products play an essential role in the food consumption of our population. Dry and liquid milk is processed industrially or manually to produce over 150 types of dairy products such as yoghurt, cheese, curd, sour cream, butter and ice cream (Oktyabri, 2012).

Figure 1: Domestic market supply of the Mongolian dairy industry



Source: National Statistical Office of Mongolia (NSO) and CGA (2000−2021).

However, there are huge opportunities to produce and export dairy products. Strong seasonality and low production volumes per herding family, as well as the long distances between milk production areas and markets, lead to high transportation costs, which in turn often becomes the cause of the under-utilisation of the milk produced.

Recent measures, and discussions, to protect domestic production from import competition by imposing high customs duties and providing subsidies, implemented by politicians, economists and scientists, are unrealistic. Because milk is an excellent source of calcium, it is an especially important product for target groups requiring a high calcium intake, such as older adults and the young.

The imposition of high import tariffs poses a significant risk of trade sanctions and restrictions from other member countries if high tariffs are set arbitrarily. On the other hand, high tariffs may cause domestic prices to rise, potentially harming the health of the two target groups mentioned above who are most vulnerable in terms of income.

However, it is important to emphasise that there are opportunities to support domestic production by setting differentiated tariffs on imported goods without violating our commitments to the international community.

Customs tariffs and tax rates are not a subjective issue that can be decided by the will of one person or another but must be set at an optimal level based on specific scientific methods and techniques. In our customs practice, a methodology for setting optimal customs duties is yet to be used, and this article is written to address this theoretical and practical issue, based on a methodology used approximately 10 years ago.

Although it is in theory possible to apply customs tariffs on all types of goods, only imports of price-sensitive goods will be reduced by increasing customs tariffs. Logically, this raises the question of how to calculate the price elasticity of imported goods, and how to use price elasticity to calculate customs tariffs to protect domestic production.

2. Methodology

The concept of the optimal tariff rate was first proposed by Johnson (1951) in his seminal work about trade war. There has subsequently been a phenomenal growth of analytical literature on this subject. Several independent works of economists, including Corden (1966), Johnson (1965), Balassa (1965), Naya and Anderson (1969), Leith (1968) have contributed to the context of empirical work on tariff measurement. Chief among the contributors in this area have been Corden (1969), Ruffin (1969), Tan (1970) and Ramaswami and Srinivasan (1971).

The elasticity of substitution between domestic and foreign goods is commonly called the Armington elasticity. Following Armington (1969), trade models often assume that products are differentiated by their country of origin. In this section, we illustrate methodology to be employed for estimating and updating Armington elasticities.

Let us assume that consumers meet their demands through the purchase of two types of goods, imported and domestic. The quantity of imported goods is denoted by Q_m and the quantity of domestically produced goods is denoted by Q_d.

Assuming that the product has a utility function with a constant elasticity of demand, the utility function is given as follows:

$$U = [\beta Q_d^{\alpha} + (1-\beta) Q_m^{\alpha}]^{-\frac{1}{\alpha}} \quad [1]$$

Here, β represents the share of domestic goods in total consumption, 1-β represents the share of imported goods and α is the parameter for the supply function. If the price elasticity were represented by σ, it would be calculated as follows:

$$\sigma = \frac{1}{\alpha - 1} \quad [2]$$

Assuming that consumers spend their income on only two types of goods – imported and domestically produced – the budget constraints are:

$$I = P_d Q_d + P_m Q_m \quad [3]$$

To maximise the supply, the Lagrangian (Arrow, Hurwiz & Uzawa, 1961) function is applied:

$$L = [\beta Q_d^{\alpha} + (1-\beta) Q_m^{\alpha}]^{-\frac{1}{\alpha}} - \lambda (I - P_d Q_d - P_m Q_m) \quad [4]$$

Using the Lagrange function, the first-order condition is represented to determine the quantity and price for which the supply function reaches its maximum value. The first-order condition of the Lagrangian function by Q_d is:

$$L'_{Q_d} = -{}^{1}/_{\alpha}\, \alpha\beta Q_d [\beta Q_d^{\alpha} + (1-\beta) Q_m^{\alpha}]^{-\frac{1}{\alpha}-1} - \lambda P_d \quad [5]$$

Whereas the first-order condition by is Q_m:

$$L'_{Q_m} = -1/\alpha\, \alpha(1-\beta)Q_m[\beta Q_d^{\alpha} + (1-\beta)Q_m^{\alpha}]^{-\frac{1}{\alpha}-1} - \lambda P_m \quad [6]$$

Also, if we take the first-order condition of the function [4] by λ:

$$I = P_d Q_d + P_m Q_m \quad [7]$$

To find the values of P_d *and* P_m, which are the values for maximising supply, the first-order condition of the Lagrangian function is set to zero. Here, the domestic price to maximise supply is calculated as:

$$P_d = \frac{-1/\alpha\, \alpha\beta Q_d^{\alpha-1}[\beta Q_d^{\alpha} + (1-\beta)Q_m^{\alpha}]^{-\frac{1}{\alpha}-1}}{\lambda} \quad [8]$$

Whereas the import price to maximise supply is:

$$P_m = \frac{-1/\alpha\, \alpha(1-\beta)Q_m^{\alpha-1}[\beta Q_d^{\alpha} + (1-\beta)Q_m^{\alpha}]^{-\frac{1}{\alpha}-1}}{\lambda} \quad [9]$$

From the formula above, the ratio of imported goods to domestic production to maximise supply is calculated as:

$$\frac{Q_d}{Q_m} = \left(\frac{\beta}{1-\beta}\right)^{\frac{1}{\alpha-1}} \left(\frac{P_d}{P_m}\right)^{-\frac{1}{\alpha-1}} \quad [10]$$

If the following substitution of $\sigma = \frac{1}{\alpha - 1}$ [11]

is applied, the ratio will shift to:

$$\frac{Q_d}{Q_m} = \left(\frac{\beta}{1-\beta}\right)^{\sigma} \left(\frac{P_d}{P_m}\right)^{-\sigma} \quad [12]$$

Formula 12 can be logarithmised on both sides:

$$Log_{10}\left({}^{Q_d}/_{Q_m}\right) = \sigma Log_{10}\left({}^{\beta}/_{1-\beta}\right) + \sigma Log_{10}\left({}^{P_m}/_{P_d}\right) \quad [13]$$

Equation 13 determines that the ratio of the quantity of domestically produced and imported goods sold in the domestic market is directly proportional to the ratio of the price at which they are retailed, whereas the previous parameter of the price ratio represents the elasticity of substitution of domestic and imported goods. In other words, it is possible to create a timeline using these ratios, and to calculate the elasticity of substitution.

Assuming:

$$\varepsilon = Log_{10}\left(\frac{\beta}{1-\beta}\right)^{\sigma} \quad [14]$$

$$Y = Log_{10}\left(\frac{Q_d}{Q_m}\right) \quad [15]$$

$$X = Log_{10}\left(\frac{P_m}{P_d}\right) \quad [16]$$

We have:

$$Y = \varepsilon + \sigma X + u_t \quad [17]$$

where u_t represents the difference between the actual and theoretical values of the equation. When the customs duty is altered, the customs value changes from P_m *to* P'_m . However, let us assume that when the customs value is altered, the import volume changes by ΔQ_m, and becomes Q'_m. Then, by finding Q'_m and Q_m from Equation 12, the import volumes after the customs tariffs have been changed can be determined using these ratios:

$$Q'_m = \left(\frac{P'_m}{P_m}\right)^{\sigma} Q_m \quad [18]$$

The price of imported goods is represented by P_m , assuming that the purchase price of the product on the world market is equal to P_w multiplied by the current exchange rate (*ER*) and converted into the national currency, with the value-added tax *v* deducted from the t_0 value added by customs duty. This can be demonstrated as follows:

$$P_m = P_w * ER * (1 + t_0)(1 + v) \quad [19]$$

If the customs duty rate is changed from t_0 to t_1, the import price of P_m becomes P_m':

$$P'_m = P_w * ER * (1 + t_1)(1 + v) \quad [20]$$

If the substitution above is introduced into Equation 18, we achieve the following form:

$$Q'_m = \left(\frac{1 + t_1}{1 + t_0}\right)^{\sigma} Q_m \quad [21]$$

When the customs tariff rate for a particular good is changed from t_0 to t_1, the import volume changes by ΔQ_m units. This can be calculated by Equation 22, where Q_m represents the import volume of the product when the tariff level is present and Q'_m after the tariff rate is altered to t_1:

$$Q'_m = Q_m + \Delta Q_m \quad [22]$$

Hence, if we change the import tariff rate, considering the change in the quantity to be imported, it can be expressed by the following formula:

$$\Delta Q_m = Q_m\left(\left(\frac{1 + t_1}{1 + t_0}\right)^{\sigma} - 1\right) \quad [23]$$

According to the formula above, provided that the elasticity of substitution of domestic and imported goods have been determined, it is possible to predict how the volume of its imports will change based on the percentage of imposed customs tariffs.

Assuming from Equation 23 that the tariff rate required to protect domestic production from imports is t_1, this means:

$$t_1 = \left(1 + \frac{\Delta Q_m}{Q_m}\right)^{1/\sigma} (1 + t_0) - 1 \quad [24]$$

The most challenging problem in common practice is that although increasing import tariffs to support the domestic production of certain goods reduces the import of these goods, it causes increased import of components used for their production or other goods produced using these products. On the one hand, a tariff increase of imported inputs would raise the costs for domestic producers and may lower their output. On the other hand, increasing tariffs on imported inputs is likely to result in the increased import of finished products produced using such inputs.

Therefore, when changing import tariffs for certain products, it is important to change the tariffs for other related products accordingly. Thus, effective protection measures need to consider the whole tariff structure on domestic producers in a particular sector. The following formula (Bhagwati & Srinivasan, 1971) of the Effective Rate of Protection (ERP) is used to coordinate changes in tariffs under such circumstances:

$$t_e = \frac{P_{wi}(1 + t_{mi}) - \sum_j P_{wi}(1 + t_j) * a_j}{P_{wi} - \sum_j P_{wi} * a_j} = \frac{t_i - \sum_j a_{ij} * t_{ij}}{1 - \sum_j a_{ij}} \quad [25]$$

where:

P_{wi}: world price of i^{th} final good

t_e: effective tariff rate for imported i^{th} final good

t_{mi}: nominal customs tariff rate on imported i^{th} final good

t_{ij}: customs tariff rate for j^{th} imported material used in the production of the final good i.

a_{ij}: percentage share of j^{th} imported material in the value of final good i.

The ERP is a commonly used measure of the net effect of trade policies on the incentives facing domestic producers. It is used to measure the percentage change in the value added in industry because of the imposition of a tariff structure by the country rather than the existence of free trade. The ERP formula (Equation 25) raises several important general points, as follows:

- the ERP will be greater if the nominal rate of protection on the final good is larger, and if the nominal protection on its inputs and the share of its imported inputs is smaller.
- the higher the value of a_{ij}, the greater the effective protection rate for any given nominal tariff rate on the final product. A tariff on imported inputs to be used in the production process reduces the level of effective protection.
- if the nominal rate of protection is the same both on imported inputs and final product, the ERP will be identical to this common rate for the final good and its inputs. If the nominal tariff on the final good is larger than on its inputs, the ERP will be larger than the nominal protection on the final good.

3. Setting optimal customs tariffs for the import of liquid and dry (powdered) milk products

Customs tariffs are an internationally recognised, traditional tool for regulating foreign trade. By imposing customs tariffs, it is possible to increase the retail prices of low-cost imported goods. This allows countries to protect domestic production from foreign competition. Historically, governments have used customs tariffs for various purposes, such as improving the balance of payments by reducing imports, determining the optimal supply and demand ratio in the domestic market, correctly defining nontariff regulation scope and generating state budget revenues.

Following the eight rounds of the General Agreement on Tariffs and Trade (GATT), countries around the world have significantly reduced customs tariffs from previous levels as part of its trade liberalisation policy (WTO, 2020). Today, customs tariffs are no longer a powerful tool for regulating foreign trade.

Currently, there are very few countries that arbitrarily set their own tariffs. Most countries around the world have joined the WTO and set customs tariffs in accordance with the commitments undertaken within this international community. Currently, 164 countries have joined the WTO (WTO, 2021). According to the latest estimates, WTO members account for 98 per cent of all world trade (WTO, 2021) and 96.6 per cent of total world GDP (The World Bank, 2020b).[1]

The sustainable supply of imported milk and dairy products is essential to the development of the domestic production of dry milk and other milk and dairy products for a country such as Mongolia. This is because of its high volatility in export revenues, recurrent deficiency in payment balances, and high transportation costs while geographically distanced from key international road transport networks. On the other hand, developing domestic production is paramount for addressing major development issues such as providing thousands of rural herders with access to markets, reducing rural unemployment and poverty, and closing the gap between urban and rural development by creating favourable conditions for mobilising local production resources.

The question of whether to source the milk and dairy products domestically or via import depends on the rate of import tariffs. Granted, the direct increase in import tariff rates without the development of milk production is likely to have a negative impact on the supply of this type of product. It may be necessary to apply seasonal tariffs on milk and dairy products, especially during the winter, when domestic milk supply is disrupted.

If high, nonseasonal tariffs must be levied, these tariffs will need to be raised once domestic dry milk factories and plants are constructed. Otherwise, high milk tariffs could have adverse effects on the livelihoods of the most vulnerable.

To determine the optimal level of milk import tariffs, the substitution elasticity of domestic and imported milk was estimated using Equation 16. For model parameter estimation, we have used 1999−2019 foreign trade customs statistics and national statistical data. According to regression analysis results, the estimated substitution elasticity of substitution between domestic and imported milk is 1.049 (Table 1).

Table 1: The regression model coefficients for estimating the long-run Armington elasticity for milk.

	$Y = \mathrm{Log}_{10}\left(\frac{Q_d}{Q_m}\right)$
$X = \mathrm{Log}_{10}\left(\frac{P_m}{P_d}\right)$	1.049
	*0.404
$\varepsilon = \mathrm{Log}_{10}\left(\frac{\beta}{1-\beta}\right)^{\sigma}$	0.800
	*0.191
Number of observations	**21**

*These values are the standard errors of the corresponding coefficient estimates.

From the Table 1, we could rewrite Equation 12 as follows:

$$Y = 0.80 + 1.049 * X + u_t \quad [26]$$

A tariff increase imposed on imported milk increases its price in the domestic market, and thereby may lead to a decrease in demand for imported milk. The decrease in import demand reduces competition in the domestic market; the reduced competition then allows prices to rise. A rise in milk price in the domestic market affects supply and promotes domestic production. The sales of domestic producers should increase, all else being equal.

The above calculation of long-run Armington elasticity for milk indicates that a 1.0 per cent increase in the price of imported milk would cause a 1.049 per cent decrease in the quantity of imported milk. Conversely, a 1.0 per cent decrease in the price of imported milk could increase demand for imported milk by 1.049 per cent.

In other words, any tariff measures for the protection of the domestic dairy industry will be effective, and a 1.0 per cent increase in the customs tariff rate for milk would lead to a 1.049 per cent decrease in the imported milk supply. Thus, it is possible to protect domestic production from import competition by imposing a high customs tariff on imported powdered milk.

Using the above estimation of elasticity of substitution between domestic and imported milk, we determined using Equation 24 that the optimal tariff rate for the complete protection of the domestic import-substituting milk industry is 122.7 per cent.

Considering Mongolia's 20.0 per cent bound rate for milk products under the WTO agreement, there is probably little room to increase the present tariff rate for milk powder. The country could raise its current rate to 20.0 per cent from the current 15.0 per cent. This 5.0 per cent increase in the current tariff would reduce milk powder import by 4.57 per cent.

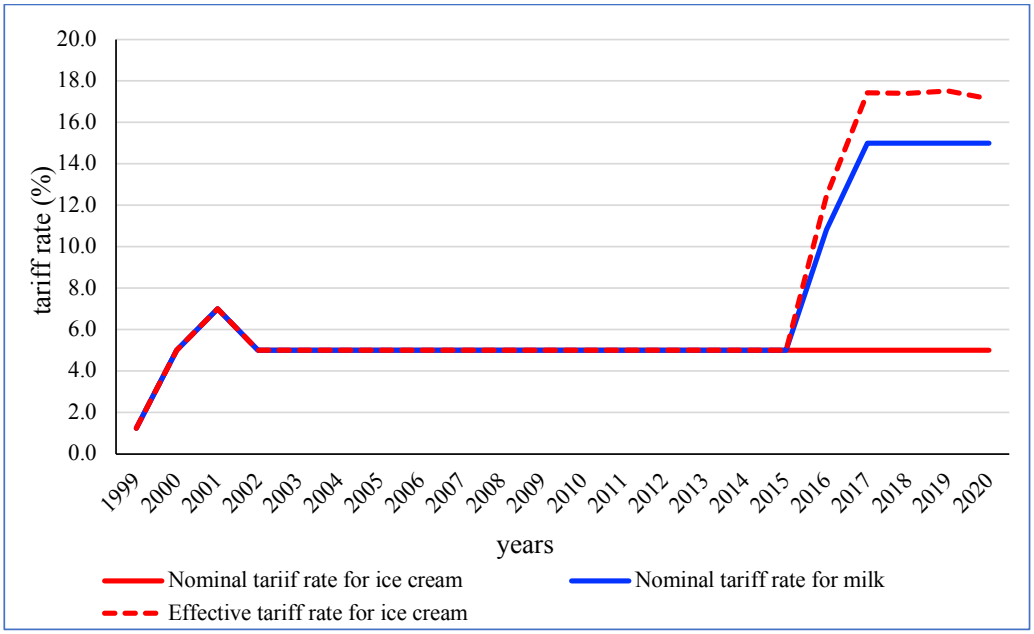
In addition, in the case of customs tariff changes for powdered milk, tariffs on other dairy products,

such as ice cream, yoghurt and cheese, should be changed in line with the revised customs rates.

If such measures are not taken, the importation of the dairy products above will likely increase in place of powdered milk. The effective import tariff for these products can be calculated using Equation 23.

In practice it is important to control the ERP for finished goods in harmony with the tariff change in its imported inputs. Figure 2 displays the tariff rates for ice cream made from imported milk powder.

Figure 2. Graphical illustration of nominal and effective tariff rate for ice cream in Mongolia



Source: Authors' calculation based on "Foreign trade commodity statistics" of the CGA of Mongolia (1999−2020).

Milk powder is an essential ingredient of ice cream. After conversion to liquid milk, it accounts for roughly one-half of the ice cream content. Depending on the market price fluctuations of milk powder and ice cream, the percentage share of milk powder in the value of ice cream changes over time. For this calculation, we have used foreign trade statistics from the International Trade Centre (ITC) (ITC, 2020) and the Customs General Administration of Mongolia between 1999 and 2020 (CGA Mongolia, 2000−2021) and data related to a nominal import tariff rate of milk powder and ice cream for the corresponding years.

From Equation 25, the current ERP for ice cream is $t_e = 0.044$ or 4.40 per cent when the nominal tariff rate for milk powder is $t_{ij} = 0.155$, and the nominal tariff rate for ice cream is $t_{mi} = 0.05$, as for 2020. This means the ERP for ice cream is at a level a little lower than the current 5.0 per cent tariff rate on ice cream.

The above calculation shows that an increase in the tariff rate on milk powder decreases the net effect of the tariff in its final product, ice cream.

Let us say that milk is the only ingredient used in the production of ice cream, and the customs tariff rate for imported ice cream is set higher than 4.4 per cent. In this case, it would be more profitable for producers to use domestically produced milk than to use imported milk powder. However, if the customs tariff rate for ice cream is lower than 4.4 per cent, it will be more profitable to use imported milk powder to produce ice cream.

Therefore, we need to consider such interdependence of products when setting customs tariffs, determining options for importing goods and opportunities to develop domestic production. Consequently, it is crucial to calculate and apply optimal customs tariff rates based on a solid foundation of accurate research.

4. Conclusion

In today's world of global competition, customs tariffs play an important role in protecting and developing domestic production. In the past, customs tariffs played a vital role in the accretion of the government budget in developing countries, but as tariffs decline, this role is likely to subside. On the contrary, its role in protecting national production and ensuring its security has become more significant.

Countries with small economies have limited opportunities to develop all production sectors simultaneously, resulting from the economic potential of the whole country. However, there is a need to protect and develop infant industries through trade policy instruments. Setting optimal customs tariffs is critical for this to occur.

Mongolia has not yet used clear scientific methodology for setting its customs tariffs. Here, we present the methodological issues of determining the optimal rate of customs tariffs, and a method for calculating the optimal tariff.

Our empirical study using the Mongolian dairy industry example shows that an increase in customs tariff rates could be an effective way to protect the domestic industry. Tariffs could protect the domestic milk industry and increase production costs for certain import-substituting final products made from imported milk powder. Hence, calculation of the 'net effect' of tariffs on the domestic value added is crucial.

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Notes

1 Authors' calculation based on the World Bank and International Trade Centre (ITC) data base 2020.

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