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# Measuring Mongolia's Gains from Trade and Increased Integration in the World Economy

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# Measuring Mongolia's Gains from Trade and Increased Integration in the World Economy

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**Abstract**

Following the gains from variety literature (Broda and Weinstein, 2006), we estimated the welfare impact of the dramatic increase in imported varieties growth in Mongolia and found it to be considerably larger than that found in previous studies of other countries. Our results show that from 1988 to 2015, the gains from variety were equal to 22 percent of Mongolia's GDP, or 0.8 percent annually. Also, by calculating Novy measures of trade costs, we find that the tariff-equivalent trade costs between any two partners fell dramatically since the dissolution of and Mongolia`s exit from the Soviet-led CMEA (Council of Mutual Economic Association). Our calculations suggest that the costs between Mongolia and China, now its biggest trading partner, fell from 114% to 63%. This is twice the decline of the post-NAFTA US-Mexico trade costs. Other bilateral trade cost declines (e.g. with Germany) were even greater. As such, this paper documents one of the largest trade liberalizations in modern history.

*JEL Classification Codes*: F14, F15, L13, L

*Keywords:* Gains from trade, Novy Measure, Elasticity of substitution, Welfare effect of trade liberalization, Economic Integration, Mongolia

# 1. Introduction

Mongolia undertook serious economic reforms in 1990 after the collapse of the Soviet Union and suffered a long and dramatic process of transformation into the free-market economy, easing price controls, liberalizing domestic and foreign trade. The centrally planned economy, state-owned industries and banking systems were transferred into the private sectors. The economy is still in transition. However, imports and exports have soared and the nature of imports, exports and trading partners have changed dramatically over the past 20-plus years.

The paper first estimates the comprehensive gains from variety for Mongolian economy during 1988-2015, following the seminal works by Feenstra (1994) and Broda and Weinstein (2006). We also look at the changes in major trade partners and then calculate bilateral trade costs using the method developed by Novy (2013).[1] We find that Mongolia's gains from new variety far surpass other transitional economies. We also find that while bilateral trade costs fell dramatically for most partners. For example, ss Mongolia's number one trading partner changed from Russia to China, the trade costs with China fell from roughly from a 100% tariff equivalent to 60% or so. At the same time, trade costs between Russia and Mongolia were unchanged, however. For some partners who are far more remote, relative to Mongolia, such as Australia and Thailand, the fall in trade costs was dramatic, falling from over 500% to around 200% in the last twenty years. There were also large differences across similar economies. Trade costs between Mongolia and Japan fell by half (200% to 100%) while for Korea and Mongolia there was a much smaller decline. For Europe, there were also significant declines across the board.

[1] This discussion paper is an extension of Battogtvor's PhD dissertation and a working paper by Parsons and Battogtvor (2019).

The gains from variety for Mongolian economy were estimated, using six-digit harmonized system (HS) products data which is the most disaggregated data available for Mongolia. We estimated 1390 elasticities and with the elasticities, we constructed an exact price index to measure the welfare gains from variety growth. This method is consistent with the theory of monopolistic competition and is robust in empirical applications (Feenstra, 1994).

The results show that the welfare gain owing to newly imported varieties from 1988 to 2015 amounts to 22 percent of GDP, or 0.8 percent annually. This is a significant result considering the moderate annual gains from 0.1 percent (Broda and Weinstein, 2006) to 0.4 percent (Chen and Ma, 2012) the most studies show.

We contribute to the growing literature by providing a measure of Mongolia's welfare gain due to import variety from 1988 to 2015. This is the first such study to apply the methodology of Broda and Weinstein (2006) to calculate Mongolian gains from variety, thus we had two *motivations* in mind. First, by measuring Mongolia's gains from import varieties after the liberalization in 1990s, we provided supporting evidence favoring trade liberalization for developing countries. Second, we estimated elasticities exclusive to Mongolia using a highly disaggregated import data and these elasticities may be useful for other studies. Also, using the Novy method, we find that trade costs between Mongolia's partner fell dramatically, often over 100%, far larger than even the largest free trade agreements.

The rest of the paper is organized as follows. Section 2 gives and overview of Mongolia's transition from a barter trade socialist Soviet satellite state to an open economy in the in the earlier 1990s to present. Section 3 first summarizes the prima facie gains from trade as evidenced by rising per capita income and rising real wages. Next, and one of our unique contributions, we calculate the additional welfare gains from increased varieties of goods as Mongolia (a la Feenstra, 1994, 2010 and Broda and Weinstein 2006) opened up and normalized

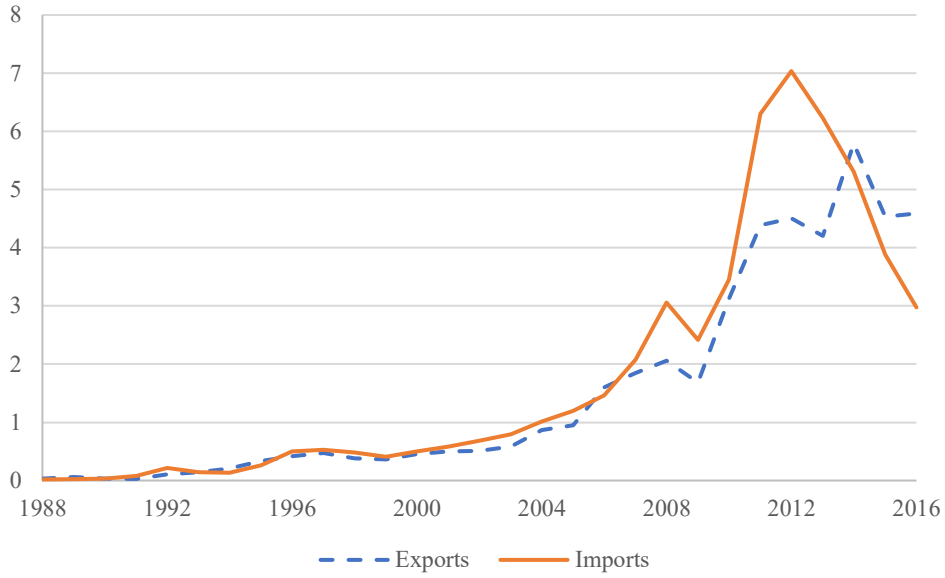
trade relations. Section 4 measures the increase in the degree of bilateral integration with its major trading partners. This is done using original measures of trade costs using the methodology of Novy (2013). Section 5 concludes.

## 2. Mongolia's Transition to an Open Economy

Mongolia is now one of the freer countries in the world. With average tariffs rates below 5% (UN Trains) and essentially no import quotas or tariff-rate quotas (Sharma and Davaakhuu, 2015) it is clearly open to trade now. Despite some non-tariff barriers to trade, not unique to Mongolia, the country has seen its imports and exports skyrocket over the last 20 years. Mongolia joined the WTO in 1997. To appease the existing members and gain accession, it engaged in a number of trade and domestic liberalizations. However, its true first break from near autarky to a more freely trading country occurred earlier, after the Soviet Union collapsed and Mongolia was no longer confined to various, restricted, barter-type trading within the Soviet-led Council of Mutual Economic Assistance (CMEA or COMECON) of which it was a member from 1962 to 1991.

Looking at Figure 1, we can see that trade was almost non-existent since then late 1980s where uniform and reliable data becomes available. Though in absolute levels, it is quite small, we can see a significant increase in trade after leaving CMEA, and then again after accession to the WTO, where trade double from 1996 (pre-accession) to 2004. But the real trade take-off occurs when the mining sector gets moving (helped by enormous inflows of FDI by foreign mining firms) soar. The new export-led rise in incomes in turn spurred consumption in general of and consumption of imports, in particular, in this resource-rich, but land-landlocked and relatively undiversified economy.

Figure 1 *Exports and Imports (Billion Dollars)*

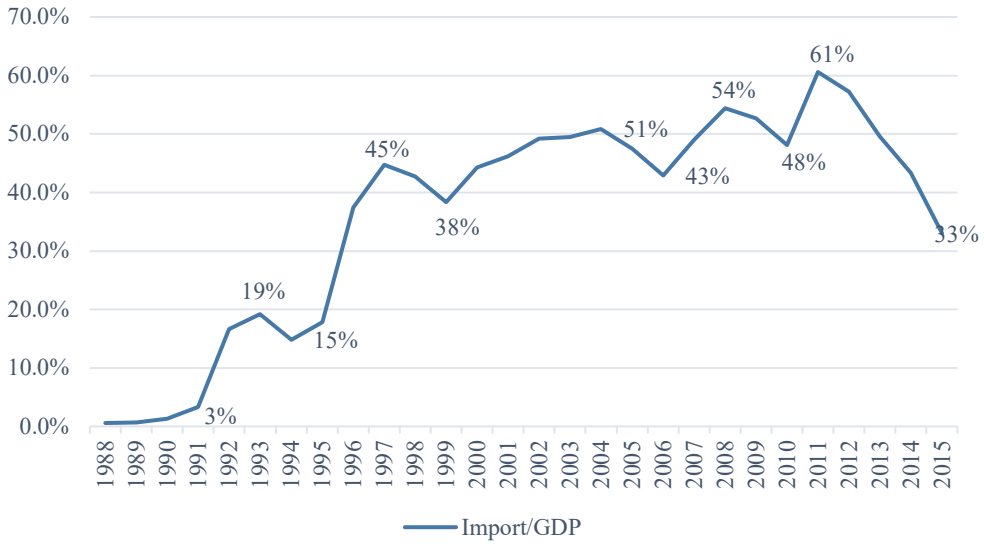



*Source:* Authors' figure based on wits.worldbank.org data.

Figure 2 shows Mongolian imports share of GDP from 1988 and 2016. The share was nearly zero in 1988. It quickly rose after the liberalization in 1990, and reached 45 percent when Mongolia accessed to the World Trade Organization (WTO) in 1997. By 2012, the share was 61 percent of GDP.[2]

[2] However, as a result of the downturn in the economy (in part due to falling resources prices), the ratio of imports to GDP has dropped since 2012.

Figure 2. Imports Share of GDP (%)




*Source:* Authors' calculation based on import data from wits.worldbank.org and GDP data from the World Bank Development Indicators (online).

Naturally, the manufacturing and agriculture sectors shrank, and rural poverty is still a serious problem, but GDP per capita has risen dramatically. Being only $506 in 1997, in 2017, Mongolia's GDP per capita is $3,717 (World Bank data in current US$, non-PPP). The commodity price spikes in and around 2008 have done much to make the value of its exports soar, and dramatically raise the standard of living in this country of just over 3 million people.

Not only did the *volume* of trade increase dramatically, but also the ranking of its major trading partners underwent radically change. In the past, imports were sourced primarily from its old CMEA leader, Russia, with Chinese imports a distant second place. Now in 2016, imports from China are the greatest, though Russian imports follow in a close second these days.

Figure 3. Source of Mongolia's Imports (1996)
*Source: Figures 3-6 by Yoshie Kawabe based on data from UN Comtrade*

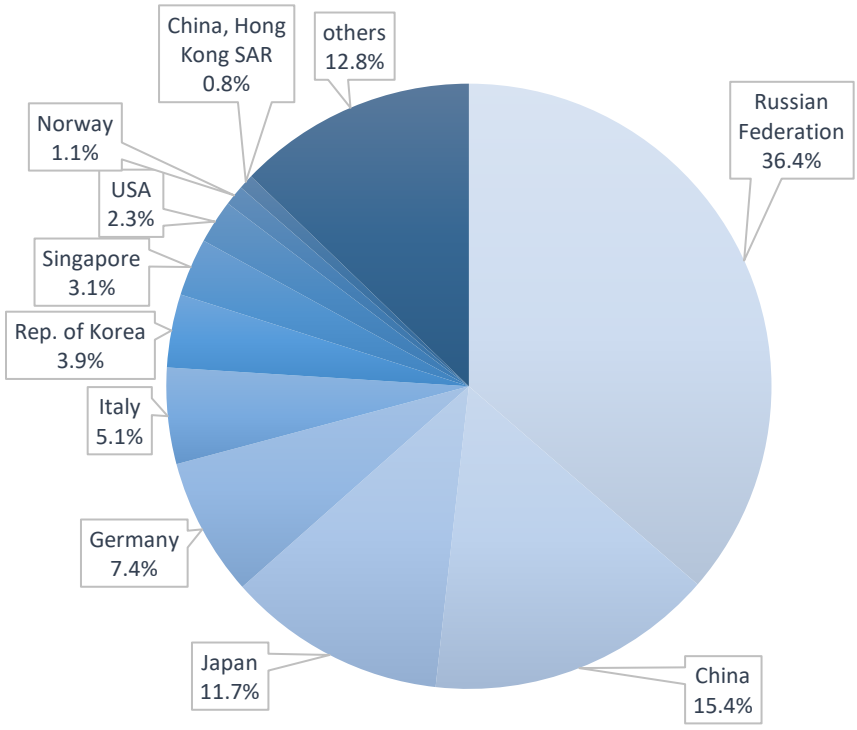



Figure 4. Source of Mongolia's Imports (2016) Source: UN Comtrade

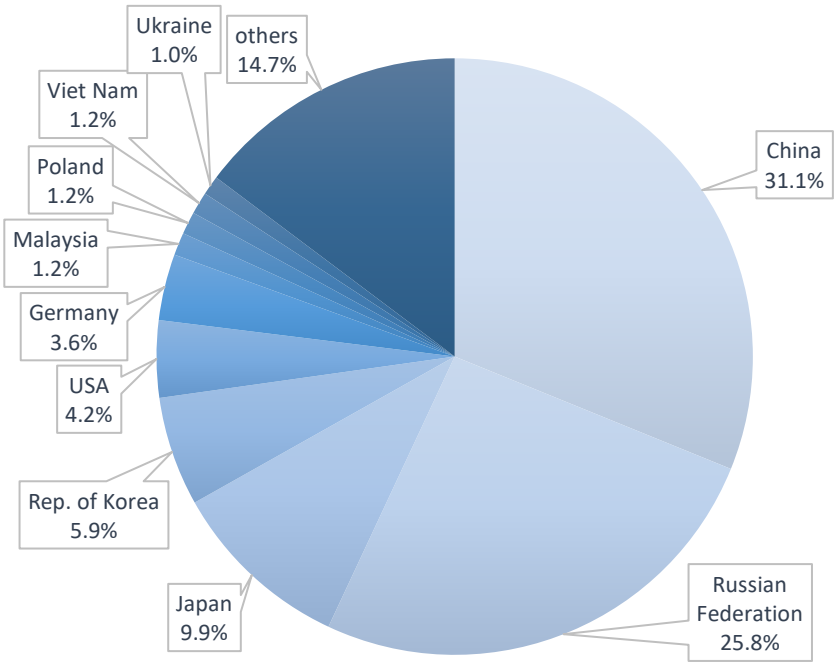


Figure 5. Source of Mongolia's Exports (1996) Source: UN Comtrade

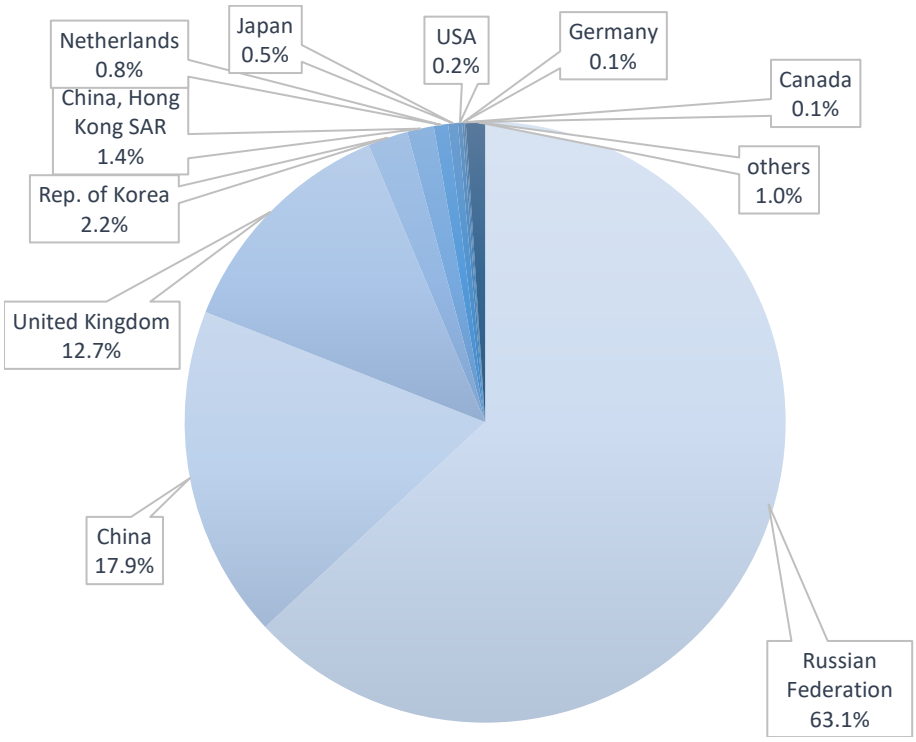
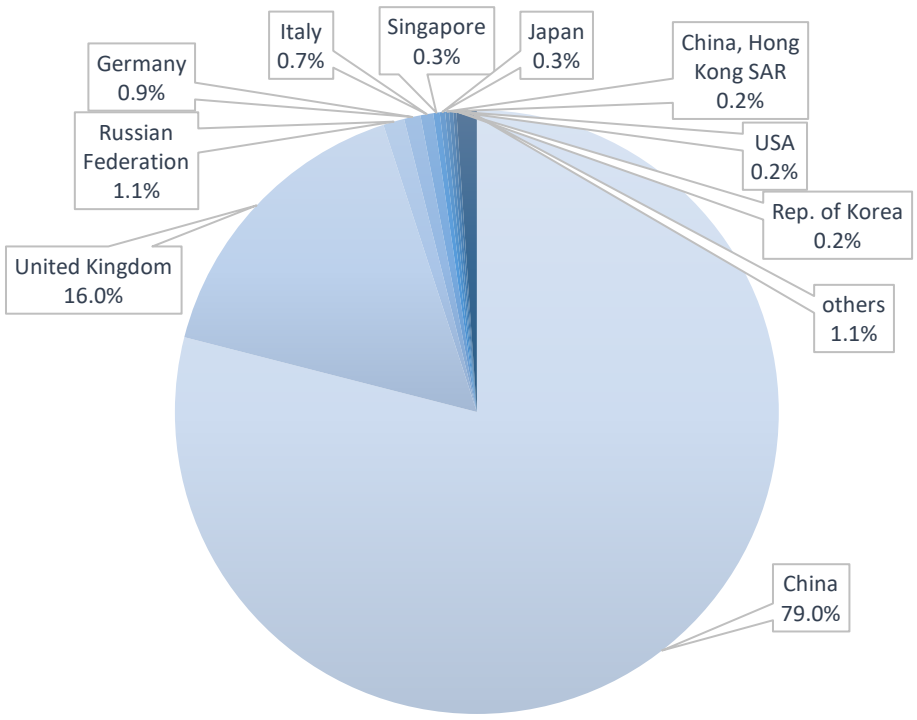



Figure 6. Source of Mongolia's Exports (2016) Source: UN Comtrade



On the export side, the change is even more dramatic. While 63% of Mongolian exports went to Russia in 1996, now, virtually no exports go there. China now accounts for nearly 80% of all Mongolia exports. Trucks laden with copper and coal go in droves to feed the energy and mineral-hungry China. The second largest export destination is, by far, the UK. Over 95% of those exports are gold.

While the gains from trade in moving from a highly restrictive, highly controlled and nearly balanced barter trade to a more 'normal' trading country must have been enormous, as data from the CMEA era is scant, and incomparable, we do not attempt to assess those gains here. Instead, we focus on the huge, continued gains Mongolia has made as it pursues its own, free trade liberalization path since 1996. We assess these gains in two ways: 1) examining the additional gains from trade due in an increase in variety of imports coming into Mongolia over the years; and 2) by measuring how much 'trade costs' have implicitly fallen for Mongolia major trade partners on a bilateral basis in recent years. In other words, with which countries has Mongolia become "closer" in a trade sense, as it continues to grow. These questions would be interesting for any country, but may more of even more interest for this transitional, land-locked, resource-rich country.

## 3. Traditional Gains from Trade and Gains from Increased Variety

It is clear that Mongolia has gained economically since the break up of the Soviet Union and accession into the WTO. As shown in the previous section, imports and exports soared and GDP per capita in nominal terms rose from just over $500 in 1997 to $3,717 in 2017. In PPP-adjusted terms GDP per capita was $12,900 in 2017. This is on par with, say, Peru and lagging a bit behind another former COMECON member, Bulgaria which stood at $20,900 in the same year.

It would be tempting to conduct a Huber (1971)-style gains from trade calculation. Seemingly, Mongolia moved from a near autarkic state to a very open on in a matter of a few years. However, unlike the classic Huber study of Japan which quickly changed from a self-imposed, near autarky country to a situation of nearly complete free trade (tariffs were allowed to be no more than 5%), Mongolia`s experience is not as amenable to such analysis. For one, Mongolia *was* trading with the Soviet Union, but under the opaque barter system of COMECON and which data is scarce and prices and values impossible to map onto some market-based equivalent. Likewise, construction of internal, autarky relative price indices would be difficult, if not impossible to construct because of the Soviet-style planned economy that operated in Mongolia.

Unlike Huber (1971), however, we do have GDP and GDP per capita and wage data, at least shortly after Mongolia transformation, and thus we clearly see that overall welfare rose (though the transition was long and painful). As mentioned in the previous section, GDP per capita rose seven-fold from 1997 to 2017 in twenty years. Growth in real wages tells an even more dramatic story. A real wage index (wages in domestic currency deflated by domestic inflation) rose from 7.175 in 1995 to 124.22 in 2011, a seventeen-fold increase in 16 years.[3]

In this section, we augment the *prima facie* evidence of Mongolia`s great gains from opening up, with additional gains to a massive increase in variety of imports available to the liberalized economy. Here, we implement the methodologies developed by Feenstra (1994) and Broda and Weinstein (2006) to estimate variety adjusted price indices and econometrically estimate the necessary elasticities of substitutions necessary to calculate additional gains from variety. Though these methods have been employed in many other countries (US, Hong Kong, other transitional countries), to our knowledge, ours if the first

[3] Real wage index data from www.ceicdata.com accessed March 11, 2019.

such welfare calculations for Mongolia.[4] Later, in section 4, we employ another recent method, developed by Novy (2013) to measure the reductions in bilateral trade costs between Mongolia and its major trading partners.

The quantitative analysis of gains from variety starts with the seminal work of Feenstra (1994). Feenstra (1994) showed how to estimate the elasticity of substitution of individual products. Using these elasticities he offered the formula for an exact price index that can account for entry and exit of varieties. By doing so, Feenstra (1994) demonstrated that new product varieties lead to an increase in consumer utility. However, a comprehensive measure of the gains from import variety puts tremendous demands on data availability, and was not realized until Broda and Weinstein (2006) who applied it systematically to US data. They found that the total gain from the introduction of new varieties in the U.S. was 2.6 percent of GDP between 1972 and 2001.

Following Broda and Weinstein (2006), a body of country studies emerged, using the same methodology.[5] Chen and Ma (2012) found that the welfare gain in the Chinese economy as a result of new import variety amounts to 4.9 percent of GDP, or 0.4 percent annually between 1997 and 2008. Minondo and Requena (2010) investigated the welfare gains due to Spanish imports of new varieties over the period 1988-2006. They found that the total welfare gain is equal to 1.2 percent of GDP in 2006. In a comparative study of Switzerland and the U.S., Mohler (2009) estimated a lower and an upper bound of the gains from variety. He found that during the period from 1990 to 2006, the gains from variety in Switzerland were between 0.3 and 4.98 percent of GDP and that in the U.S. the gains from variety were between 0.5 and

[4] The work here is an extension of Battogtvor's doctoral dissertation. More details can be found in a related earlier working paper Battogtvor and Parsons (2019).

[5] As a reference, only few papers are mentioned here. In addition to its welfare gain estimation, Broda and Weinstein (2006) paper is often cited for the import demand elasticity estimation. Already estimated data of 73 countries excluding Mongolia is available at the following Columbia university webpage: http://www.columbia.edu/~dew35/TradeElasticities/TradeElasticities.html

4.7 percent of GDP. Mohler and Seitz (2010) applied the methodology to the 27 countries of the European Union for the period of 1999 to 2008. Their results show that within the European Union, especially "newer" and smaller member states exhibit high gains from newly imported varieties. For instance, Estonia gained 2.80 percent of GDP (GDP of Estonia), Slovakia 2.37 percent, Latvia 1.65 percent, Bulgaria 1.59 percent, and etc. They also found that interestingly, two of the largest economies in the group, France and Germany, both had negative gains from variety. They argue that the reason for this is that these larger economies were already heavily integrated in the European economy and did therefore not experience the increase in product varieties as did the "new", smaller economies.

We contribute to the growing literature by providing a measure of Mongolia's welfare gain due to import variety from 1988 to 2015. This is the first study that pursues this measure for Mongolia, thus we have two *motivations* in mind as briefly stated in the introduction. First, as a small open economy, Mongolia underwent a drastic liberalization after the dissolution of the Soviet Union. The economy is still now in transition. Thus, measuring Mongolia's gains from import varieties provides supporting evidence favoring trade liberalization for developing countries. It may also provide informative implications to Mongolia's policymakers. Second, we obtain estimates for hundreds of elasticities of substitution using a highly disaggregated import data of Mongolia, which may be useful for other studies. For example, different elasticities may imply different responsiveness of imported products to demand shocks or exchange rate movements suggested by Chen and Ma (2012).

The definition of variety used in this paper is same as the variety defined in Broda and Weinstein (2006), which is an Armington (1969) definition of a product variety. By this definition, a variety is a particular good produced in a particular country. To be more specific, a product in this paper is defined as a six-digit HS good. To give an example, sparkling wine

(with HS-6 product code 220410) was imported from only one country, Germany, in 1989, in contrast to this, in 2015 the same wine was imported from 13 different countries such as France, Spain, Italy, Chile etc. This represents an increase of single variety to 13 different varieties. Therefore, by the Armington (1969) assumption, an HS-6 product supplied by one country is regarded as different from the same product supplied by any other country.

Gains from increased import varieties are not limited to consumers. Access to more imported varieties may enhance productivity growth, leading domestic firms to gain substantially. In fact, with the widely used constant elasticity of substitution (CES) structure, new varieties could be modeled either as consumption goods or as intermediate inputs (Romer, 1994). We follow Broda and Weinstein (2006) and treat all imported goods as intended for final consumption.

**Data and Descriptive Analysis**

To construct the variables needed to estimate the variety gains from trade, we used the United Nations Comtrade - International Trade Statistics database. The import data of Mongolia was for the years 2002, 2008-2012, 2015- 2016 was not available. Therefore, we used the export data of rest of the world to Mongolia from 1988 to 2015, thus covering 28 continuous years. Furthermore, due to the insufficient numbers of varieties, HS-6 products with less than 37 observations are dropped (37 is somewhat arbitrary, but a natural cut-off point in the data). This is due to the problem that many products were not imported to Mongolia constantly throughout the period. Specifically, when Comtrade had import data, but reported the country of origin as 'Unspecified', that data point was dropped. Likewise, if there was 'Value' but no 'Quantity' of imports, that data point was also dropped. In the end, we have 158 thousand observations of 1628 products. Gross domestic product (GDP) data were taken from the World Bank Database.

To study the welfare implication of the drastic increase in imports of Mongolia, we should consider the increase in value of each product (i.e. the intensive margin) and the increase in the number of products and varieties for each product (i.e. the extensive margin).

Table 1 summarizes the count measure of imported varieties of Mongolia between 1988 and 2015 and reveals that behind the rapid growth in import value, the growth in import varieties is similarly dramatic. Column (2) reports the number of HS-6 products for the related years. We can see that the number of these products increased by a factor of seven-fold during the period, from only 226 in 1988 to 1610 in 2015. Moreover, column (5) shows the total number of imported product varieties, which can be calculated as the number of HS-6 products multiplied by the average variety in column (4).

Table 1 *Variety in Mongolian Imports (1988-2015)*

| | *Year (1)* | *Number of HS-6 products (2)* | *Median number of exporting countries (3)* | *Average number of exporting countries (4)* | *Total number of varieties (5)* |
|---|---|---|---|---|---|
| All 1988 goods | 1988 | 226 | 1 | 1.1 | 255 |
| All 2001 goods | 2001 | 1512 | 3 | 3.5 | 5304 |
| All 2015 goods | 2015 | 1610 | 5 | 6.2 | 10052 |
| Common, 1988-2015 | 1988 | 219 | 1 | 1.1 | 247 |
| Common, 1988-2015 | 2015 | 219 | 3 | 8.0 | 1746 |
| 1988 not in 2015 | 1988 | 7 | 1 | 1.1 | 8 |
| 2015 not in 1988 | 2015 | 1391 | 3 | 6.0 | 8306 |

*Source*: Authors' calculations based on the UN Comtrade data.

It can be seen from column (5) that the total number of varieties increased 40 times, from 255 to 10052. This is a remarkable increase that no other country study has ever shown. Columns (3) and (4) show the median and average number of source countries exporting to

Mongolia, i.e. the number of varieties. We can observe that the number of exporting countries increased over time. In 1988 only one variety or source country was available per good, but in 2015 on average six varieties were available. The middle part of the Table 1 reports statistics of the common goods which were available in both the beginning and the end of the period. It is notable that, on average, these common products were imported from only one source country in 1988, however in 2015 the number of source countries rose to eight. The last two rows of the table show that there are 1391 new goods which were not available in 1988, imported from six different countries on average. These dramatic changes in goods and varieties suggest that conventional measures using a fixed basket of goods or varieties could be largely biased. Consequently, these facts demonstrate that the gains from variety are not negligible.

**Methodology: the Broda and Weinstein Method**

Following Feenstra (1994, 2010) and Broda and Weinstein (2006), we start by deriving an exact price index for a constant elasticity of substitution (CES) utility function of a single good with a constant number of varieties.[6] This index is then extended by allowing for new and disappearing varieties. Finally, we show how to construct an aggregate import price index and gains from variety formula. Let us start with a simple CES utility function with the following functional form for a single imported good. Assume that varieties of a good $g$ are treated as differentiated across countries of supply, $c$:

$$M_{gt} = \left( \sum_{c \in C} d_{gct} m_{gct}^{1-\sigma_g} \right)^{\frac{1}{(1-\sigma_g)}} \quad ;\sigma_g > 1 \tag{1}$$

[6] For more details, refer to Feenstra (1994, 2010), Broda and Weinstein (2016) and an earlier working paper in Battogtvor and Parsons (2019).

where $C$ denotes the set of all countries and hence of all potentially available varieties. In the equation, $m_{gct}$ is the subutility derived from the consumption of imported variety $c$ of good $g$ in period $t$; $d_{gct}$ is the corresponding taste or quality parameter. The elasticity of substitution among varieties of good $g$ is given by $\sigma_g$ and is assumed to be larger than one.

Let $I_{gt} \subset C$ be the subset of all varieties of good $g$ imported in period $t$. Using standard cost minimization for the subutility function (1) gives us the minimum unit-cost function:

$$\phi_{gt}(I_{gt}, \vec{d}_{gt}) = \left( \sum_{c \in I_{gt}} d_{gct} (p_{gct})^{1-\sigma_g} \right)^{\frac{1}{1-\sigma_g}} \tag{2}$$

where $p_{gct}$ is the price of variety $c$ of good $g$ in period $t$ and $\vec{d}_{gt}$ is the vector of taste or quality parameters for each country.

Suppose the set of varieties $I_g$ in period $t$ and $t-1$ are identical, the taste parameters $\vec{d}_g$ are also constant over time and $\vec{x}_{gt}$ and $\vec{x}_{gt-1}$ are the cost-minimizing consumption bundle vectors for the varieties of good $g$ for given the price vectors. In this case Diewert (1976) defines an exact price index as a ratio of the minimum cost functions:

$$P_g(\vec{p}_{gt}, \vec{p}_{gt-1}, \vec{x}_{gt}, \vec{x}_{gt-1}, I_g) = \frac{\phi_{gt}(I_g, \vec{d}_g)}{\phi_{gt-1}(I_g, \vec{d}_g)} \tag{3}$$

where the price index does not depend on the unknown taste or quality parameters $d_{gc}$. Sato (1976) and Vartia (1976) have derived the exact price index for the case of the CES unit-cost function. It can be written as the geometric mean of the individual variety price changes:

$$P_g(\vec{p}_{gt}, \vec{p}_{gt-1}, \vec{x}_{gt}, \vec{x}_{gt-1}, I_g) = \prod_{c \in I_g} \left( \frac{p_{gct}}{p_{gct-1}} \right)^{w_{gct}} \tag{4}$$

where the weights are calculated using the expenditure shares $s_{gct}$:

$$w_{gct} = \frac{\left(\frac{s_{gct} - s_{gct-1}}{\ln s_{gct} - \ln s_{gct-1}}\right)}{\sum_{c \in I_g}\left(\frac{s_{gct} - s_{gct-1}}{\ln s_{gct} - \ln s_{gct-1}}\right)} \tag{4.1}$$

$$s_{gct} = \frac{p_{gct}x_{gct}}{\sum_{c \in I_g} p_{gct}x_{gct}} \tag{4.2}$$

So far, it was assumed that all varieties of good $g$ were available in both periods to calculate the exact price index. To include new and disappearing varieties into account, Feenstra (1994) showed how to modify this exact price index for the case of different, but overlapping, sets of varieties in the two periods. This contribution of Feenstra is given by the following proposition.

**Proposition:** For every good $g$, if $d_{gct} = d_{gct-1}$ for $c \in I_g = (I_{gt} \cap I_{g-1}), I_g \neq \emptyset$, then the exact price index for good $g$ with change in varieties is given by

$$\pi_g(\vec{p}_{gt}, \vec{p}_{gt-1}, \vec{x}_{gt}, \vec{x}_{gt-1}, I_g) = \frac{\phi_{gt}(I_{gt}, \vec{d}_g)}{\phi_{gt-1}(I_{gt-1}, \vec{d}_g)} \tag{5}$$

$$= P_g(\vec{p}_{gt}, \vec{p}_{gt-1}, \vec{x}_{gt}, \vec{x}_{gt-1}, I_g)\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{1}{\sigma_g - 1}} \tag{6}$$

where

$$\lambda_{gt} = \frac{\sum_{c \in I_g} p_{gct}x_{gct}}{\sum_{c \in I_{gt}} p_{gct}x_{gct}} \quad \text{and} \quad \lambda_{gt-1} = \frac{\sum_{c \in I_g} p_{gct-1}x_{gct-1}}{\sum_{c \in I_{gt-1}} p_{gct-1}x_{gct-1}} \tag{7}$$

Feenstra's theoretical contribution is correcting the conventional price index $P_g(I_g)$ by multiplying it with an additional term which captures the influence of new and disappearing

varieties. This additional term is called the lambda ratio. The numerator of this term, $\lambda_{gt}$, captures the impact of newly available varieties. $\lambda_{gt}$ is the ratio of expenditures on varieties available in both periods (i.e., $c \in I_g = \left(I_{gt} \cap I_{g-1}\right)$) relative to the entire set of varieties available in period $t$ (i.e., $c \in I_{gt}$). Hence, $\lambda_{gt}$ decreases when expenditure share of new varieties increases and therefore, the exact price index decreases relative to the conventional price index. On the other hand, the denominator of the lambda ratio, $\lambda_{gt-1}$, captures the impact of disappearing varieties. $\lambda_{gt-1}$ increases when there are only few disappearing varieties, and therefore the exact price index is relatively low when compared to the conventional price index.

The exact price index also depends on the elasticity of substitution between varieties, $\sigma_g$. If $\sigma_g$ is high, $\frac{1}{\sigma_g - 1}$ is close to zero and the additional term $\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{1}{\sigma_g - 1}}$ is close to unity. Hence the variety change has small influence on the price index. This is intuitive, when $\sigma_g$ is high since new and disappearing products are close substitutes to existing varieties, they only have a minor influence on the price index.

The exact price index with variety change for good $g$ was derived in equation (6). Aggregating it for all imported goods $G$ gives us the aggregate exact import price index:

$$\Pi(\vec{p}_t, \vec{p}_{t-1}, \vec{x}_t, \vec{x}_{t-1}, I) = \frac{\phi_t\left(I_t, \vec{d}\right)}{\phi_{t-1}\left(I_{t-1}, \vec{d}\right)} \tag{8}$$

$$= CIPI(I) \prod_{g \in G} \left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{w_{gt}}{\sigma_g - 1}} \tag{9}$$

where $CIPI(I) = \prod_{g \in G} P_g(I_g)^{w_{gt}}$ and the weights $w_{gt}$ are defined in equation (4.1). Equation (9) shows that the aggregate exact import price index is the product of the aggregate conventional import price index, CIPI(I), and the aggregated lambda ratios which is referred

as an "aggregate bias" of the import price in Broda and Weinstein (2006).

The aggregate import bias, or simply the bias measure, is thus an indicator of an upward bias of the aggregate conventional import price index compared to the aggregate exact import price index. The ratio between aggregate exact price index including variety and the aggregate conventional price is as follows.

$$Bias = \frac{\prod(I)}{CIPI(I)} = \prod_{g \in G} \left( \frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{\frac{w_{gt}}{\sigma_g - 1}} \tag{10}$$

Using a simple Krugman-style (1980) economy, the inverse of the bias can be weighted by the import expenditure share to obtain the gains from variety:

$$GFV = \left( \frac{1}{Bias} \right)^{{w_t}^M} - 1 = \left[ \prod_{g \in G} \left( \frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{-\frac{w_{gt}}{\sigma_g - 1}} \right]^{{w_t}^M} - 1 \tag{11}$$

where ${w_t}^M$ is the import expenditure share in *t*. [7]

**Estimation Strategy**

In order to compute the exact import price index in equation (9), we have to estimate the elasticity of substitution between varieties of each good. (See Battogtvor and Parsons (2019) for detailed of the estimation method developed by Feenstra (1994) and improved by Broda and Weinstein (2006).)

*Why Elasticities are Important?*

An elasticity of substitution is measured as the ratio of proportionate change in the

relative demand for two goods to the proportionate change in their relative prices. In order to obtain estimates, we make several simplifying assumptions. Similarly, in order to value varieties, let us assume that we have only one or at most two elasticities of substitution, an assumption often made when using a utility function. This will implicitly assume the following (Broda and Weinstein, 2006). First, elasticities of substitution among varieties of different goods are the same. However, the same amount of increase in price of a variety of two different goods may be valued differently by consumers. For example, presumably consumers care more about varieties of computers than crude oil. So, all increases in imports do not give the same gains in reality. Second, elasticities of substitution across goods equals that across varieties of a given good. However, presumably we care more about the different varieties of vegetables than about varieties of potatoes. The third, and probably the most problematic issue arises from the assumption that all varieties enter into the utility function with a common elasticity. For example, let's say Saudi Arabian oil prices went up. Then what will happen to our imports of Mexican oil? What will happen to our imports of automobiles? One should rise and the other should fall. The reason is that Mexican oil is almost the perfect substitute of the Saudi Arabian oil and cars are the complements. However, if we assume that the elasticities are equal, then it is very hard to interpret the meaning of the elasticity and there will be no intuition to its magnitude.

In this section, we discuss the results of our estimation of Mongolian welfare gains from an increased import product variety from 1988 to 2015. The estimation has four steps. First, elasticities of substitution $\sigma_g$ for each product are estimated. Second, we use equation (7) to calculate the lambda ratios $\lambda_g$ for each imported product category. Third, with $\sigma_g$ and $\lambda_g$, we obtain an estimate of the exact price index for each product after import variety change. Finally, using equation (9), we apply the log-change ideal weights to the price movements of each good in order to estimate the impact of variety growth on the aggregate import price index.

Then with the knowledge of each year's aggregate import price index, using equation (11), we quantify the variety gains from trade with respect to GDP.

***Our Estimates of Elasticities of Substitution***

We estimated for each HS-6 product and obtained 1390 elasticities of substitution ("sigmas" henceforth). The sigmas are too numerous to report so in Table 2, we present the descriptive statistics of sigmas and Table 3 reports sigmas for the 20 products with the largest import share. Looking at these tables, we get a sense of the degree of substitutability among varieties. If sigma is high, say above 10 or 20, then this suggests that the gains from variety are small. Intuitively, when $\sigma_g$ is high, since new and disappearing products are close substitutes to existing varieties, they will only have a minor influence on the price index and hence the gains from variety.[8] Conversely, if sigma is low, then this suggests that goods are highly differentiated by country, meaning the potential for gains from variety is high.

Table 2 *Estimated Elasticities of Substitution*

| *Statistic* | *HS-6 level* |
|---|---|
| Percentile 90 | 12.1 |
| Percentile 50 (Median) | 3.6 |
| Percentile 10 | 1.8 |
| Mean | 8.4 |
| No of HS products | 1390 |
| Median variety per product | 14 |

*Note:* Authors' calculation. See text for explanation.

[8] If we look at equation (6) and (9), it is clear that if $\sigma_g$ is high, $\frac{1}{\sigma_g - 1}$ is close to zero and the additional term $\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{1}{\sigma g-1}}$ is closer to unity. Hence the variety change has small influence on the price index, when $\sigma_g$ is high.

Table 2 shows that the average elasticity of substitution is 8.4. and median is 3.6.[9] Table 3 shows that the most products with the largest import share, with only one exception, have lower elasticities of substitution, implying a larger gain from variety.

Table 3 *Sigmas for the 20 Products with the Largest Import Share*

| *HS-6 products* | *Sigma* | *Import share (%)* | *Descriptions* |
|---|---|---|---|
| 271000 | 2.39 | 22.95 | Petroleum Oils, Oils Obtained from Bituminous Minerals, Preparations Thereof |
| 870323 | 1.44 | 2.33 | Other Vehicles, Spark-ignition Engine Of a cylinder capacity exceeding 1,500 cc but not exceeding 3,000 cc |
| 842952 | 1.20 | 1.33 | Machinery With a 360 degrees Revolving Superstructure |
| 870410 | 24.63 | 1.33 | Motor vehicles for the transport of goods Dumpers designed for off-highway use |
| 870322 | 7.33 | 1.11 | Other Vehicles, Spark-ignition Engine Of a cylinder capacity exceeding 1,000 cc but not exceeding 1,500 cc |
| 870423 | 2.43 | 1.06 | Motor vehicles for the transport of goods GVW exceeding 20 metric tons |
| 110100 | 2.21 | 1.05 | Wheat Flour, Meslin Flour |
| 730890 | 8.69 | 1.02 | Other Structures and Parts of Structures, of Iron or Steel |
| 252329 | 5.04 | 1.01 | Other Portland Cement |
| 240220 | 2.90 | 0.94 | Cigarettes (Containing Tobacco) |
| 843149 | 3.39 | 0.81 | Parts of Derricks, Cranes, Graders, Levelers, Scrapers or Pile-drivers |
| 180690 | 5.06 | 0.78 | Cocoa Preparations (In Containers, Packings, in Liquid, Powder, Granular Form) |
| 847490 | 2.26 | 0.75 | Parts of Machinery for Sorting, Crushing, Mixing, Molding or Shaping |
| 300490 | 2.07 | 0.73 | Other Medicaments (Put up in Packings for Retail Sale) |
| 721420 | 17.22 | 0.72 | Concrete reinforcing bars and rods, Hot-rolled, Hot-drawn, Hot-extruded |
| 610462 | 5.78 | 0.70 | Women's or Girls' Trousers, Breeches, of Cotton, Knitted or Crocheted |
| 630221 | 3.71 | 0.66 | Bed Linen, Printed, of Cotton |
| 732611 | 4.11 | 0.59 | Grinding Balls and Similar Forged or Stamped Articles for Mills |
| 271320 | 3.26 | 0.58 | Petroleum Bitumen |
| 170490 | 3.12 | 0.55 | Other Sugar Confectionery, Not Containing Cocoa |

*Source:* Authors' calculation.

[9] For comparison, results of Broda and Weinstein (2006) are as follows: the mean is 17.3 in HS9, 7.5 in SITC-5 and median is 3.7 in HS9, 2.8 in SITC-5 in period 1972-1988 in US.

***Change in Varieties***

The second step is to calculate the changes in variety over time (i.e. the lambda ratio). The calculation of lambdas requires the existence of common varieties in the beginning and at the end of the period.[10] This is one of the major obstacles we face when implementing the technique. As a result, there are fewer lambda ratios than product groups or sigmas. Some lambda ratios cannot be defined at the HS-6 level since there is no common variety. We then follow Broda and Weinstein (2006) and define the lambda ratio at the HS-4 level.

Table 4 shows the summary statistics for the lambda ratios. The median lambda ratio is 0.96, which implies that the typical imported product category in Mongolia experienced a positive variety growth of about 4 percent.[11] Using the lambda ratios as a measure of variety growth is more sophisticated than just counting new and disappearing varieties. Due to the large number of new varieties with small market shares, just counting the new varieties can be misleading. Thus, this underscores the importance of carefully measuring variety growth when making price and welfare calculations. The measure also accounts for the importance of different varieties to the consumer budget decision by using expenditure shares as weights. The lower the lambdas, the greater the number of varieties, and thus the more we spend on new varieties.

Table 4 *Descriptive Statistics of Lambda Ratios*

| *Statistic* | *HS-6 level* |
|---|---|
| Percentile 5 | 0.14 |
| Percentile 50 (Median) | 0.96 |
| Percentile 95 | 4.78 |

[10] The reason why we need common varieties is that we cannot value the creation and destruction of a variety without knowing something about how this affects the consumption of other varieties (Broda and Weinstein, 2006).

[11] Calculated as 1/0.96=1.042 or 4.2%.

*Note:* Due to the existence of outliers reaching high absolute values, the median is preferable to the mean.

### *Welfare Gains from Variety*

Using the estimated elasticities of substitution and the lambda ratios, we next calculate the variety change effects on price. Following equation (9) and aggregating the lambda ratios yields estimates of the impact of variety growth on the aggregate exact import price index. Table 5 reports the results.

In column (4) of Table 5, the ratio of the aggregate exact price index including variety and the aggregate conventional price index is reported as the *bias* measure as in equation (10). It is worth explaining the intuition behind this bias. If this fraction is lower than one, it means that the changing set of imported varieties has *lowered* the import price index. In that case, the consumers benefit from lower unit costs of imports. Thus, these lower costs are the source of the welfare gains. On the other hand, if the bias is larger than one, this means that the import price index is *increased* by the changing variety set. Thus, the disappearing varieties are more valuable to the consumers than the new varieties and it results in welfare loss. Column (4) shows that in most years, the bias is lower than one, meaning the variety change resulted in lower import price index. On average, the bias measure is 0.978 which means that ignoring new and disappearing product varieties in the conventional price index had led to an upward bias of 2.25 percent.[12] This is the same thing as saying that import price inflation is overstated by 2.25 percent per year.

Finally, we are now able to calculate the welfare effect of the fall in the Mongolian exact import price.

[12] Calculated as $(\frac{1}{bias} - 1) \times 100$. For more details, refer to an earlier working paper (Battogtvor and Parsons, 2019).

Column (5) of Table 5 presents the gains from variety for every year from 1988 until 2015. The results show that on a yearly basis, the welfare gains due to the increase in imported product varieties in Mongolia, accounted for an average of 0.8 percent of GDP. This means that a representative Mongolian consumer would be willing to give up 0.8 percent of her income to access the new import varieties every year. The welfare gains for the whole sample period from 1988 to 2015 is approximately 22 percent of the GDP and it is a remarkable result considering the moderate gains the most studies show.

Considering the relatively high results of the welfare gain, we consider the following two reasons among many, to be important. First, as presented in section 3, the Mongolian import share of GDP is extremely high. In Table 5, Column (3) shows the import shares from 1988 to 2015. The import share rose significantly after 1996 and the average was 36 percent during the period. This is rather high compared to other studies. For instance, Broda and Weinstein (2006) found the ideal import share of the U.S.to be 6.7 percent for 1972-1988 and 10.3 percent for 1990-2001, respectively and Chen and Ma (2012) found the log-change ideal weight of China's import in GDP to be 11.5 percent during 1997-2008. Since we used the share of imports in GDP as a weight ${w_t}^M$ in equation (11), and the Mongolian import share of GDP is relatively high, the variety gain is consequently high. Second and the main reason is that not only the growth in number of varieties was drastic, but also the growth in number of products was significant. Column (1) and (2) of Table 5 present the average number of varieties and number of HS-6 products, respectively. We can see that during the period, the number of varieties rose 6 times, from one to six, and on the other hand, the number of products rose 7 times, from 226 to 1610. This means that the numerator of the lambda ratios, $\lambda_{gt}$, which captures the impact of newly available varieties is low. Since $\lambda_{gt}$ is the ratio of expenditures on varieties available in both periods (i.e., $c \in I_g = \left(I_{gt} \cap I_{g-1}\right)$) relative to the entire set of

varieties available in period $t$ (i.e., $c \in I_{gt}$), evolving of the new variety decreases $\lambda_{gt}$. Hence, the exact price index is relatively low and the welfare gain is relatively high.

Table 5 *Import Price Bias and the Gains from Variety*

| *Year* | *Average number of varieties* | *Number of HS-6 products* | *Import Share* | *Bias* | *Gains from Variety (%)* |
|---|---|---|---|---|---|
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* |
| 1988 | 1.1 | 226 | 0.01 | 1.000 | 0.00% |
| 1989 | 1.2 | 275 | 0.01 | 0.992 | 0.01% |
| 1990 | 1.3 | 342 | 0.01 | 0.993 | 0.01% |
| 1991 | 1.2 | 485 | 0.03 | 1.017 | -0.06% |
| 1992 | 1.4 | 783 | 0.17 | 0.911 | 1.56% |
| 1993 | 1.6 | 791 | 0.19 | 0.888 | 2.32% |
| 1994 | 2.1 | 1114 | 0.15 | 1.041 | -0.60% |
| 1995 | 2.5 | 1216 | 0.18 | 0.903 | 1.84% |
| 1996 | 2.9 | 1408 | 0.37 | 0.811 | 8.14% |
| 1997 | 2.9 | 1382 | 0.45 | 0.998 | 0.07% |
| 1998 | 3.0 | 1398 | 0.43 | 1.011 | -0.46% |
| 1999 | 2.8 | 1410 | 0.38 | 0.973 | 1.06% |
| 2000 | 3.3 | 1521 | 0.44 | 0.978 | 1.01% |
| 2001 | 3.5 | 1512 | 0.46 | 0.942 | 2.79% |
| 2002 | 3.5 | 1542 | 0.49 | 0.959 | 2.10% |
| 2003 | 4.1 | 1579 | 0.50 | 0.966 | 1.75% |
| 2004 | 4.3 | 1592 | 0.51 | 0.991 | 0.45% |
| 2005 | 4.4 | 1573 | 0.47 | 1.009 | -0.40% |
| 2006 | 4.6 | 1601 | 0.43 | 1.036 | -1.53% |
| 2007 | 4.9 | 1587 | 0.49 | 0.957 | 2.17% |
| 2008 | 5.1 | 1599 | 0.54 | 0.983 | 0.95% |
| 2009 | 4.9 | 1601 | 0.53 | 0.993 | 0.36% |
| 2010 | 5.7 | 1608 | 0.48 | 0.993 | 0.32% |
| 2011 | 6.6 | 1611 | 0.61 | 0.981 | 1.18% |
| 2012 | 7.1 | 1613 | 0.57 | 1.049 | -2.68% |
| 2013 | 7.7 | 1614 | 0.50 | 0.937 | 3.27% |
| 2014 | 7.4 | 1616 | 0.43 | 1.027 | -1.15% |
| 2015 | 6.2 | 1610 | 0.33 | 1.058 | -1.84% |
| *Total (1988-2015)* | | | | | 22.63% |
| *Average per-annum* | *3.8* | *1293* | *0.36* | ***0.978*** | ***0.81%*** |

*Note:* Authors' calculation based on six-digit disaggregated data from UN Comtrade. See text for detailed explanation.

## 4. Trends in bilateral trade costs over time (Novy method)

In this section, we present calculations of relative trade costs between Mongolia and its major trading partner over the period 1988-2017. As we have seen in Section 2, Mongolia's exports and imports have skyrocketed. Also, its traditional trading relationship with Russia has declined dramatically (particularly in exports to Russia), while trade with China has soared. Rather than thee crude measures of increased and changing integration in the world economy, we present results of the so-called Novy (2013) measure. The basic idea behind the model-based measure is that, if any two countries are truly more open to trade with each other, we should see the trade between the two countries grow more than the trade within each country. That is to say, there are various frictions to any trade, whether it between within or across borders. Natural tariffs only apply to international trade, but other transportations cost exist within and outside of natural border. What really matters, is the degree in which consumers of a country are choosing to import rather than buy domestically. In a truly borderless world, consumers say, in Canada, would be just as likely to buy shoes made in the US or France as in Canada.

The method of constructive the measure of bilateral costs is quite straightforward and given by the formula below.

$$\tau_{ij} = \left(\frac{(x_{ii}x_{jj})}{(x_{ij}x_{ji})}\right)^{1/(2\sigma-2)} - 1$$

Tau is the "trade cost" measure we will calculate from 1988 to 2017, each year, for each country pair (e.g. Mongolia-China, Mongolia-Japan, etc.). However, as this measure requires trade in both directions of the country pair, but there is not always trade recorded in both

directions for each year, there are missing values for many observations, especially in the earlier years. Sigma are taken from our estimated elasticities of substitution.

The various "x"s are trade values in nominal terms. As such, Xij represents, for example, Japanese exports to China. In turn, Xji is China's exports to Japan. All data are in dollars.

Ideally, for intra-national trade, we would use Gross Output minus Exports obtained from Input-Output tables. This data is now readily available for OECD and many other countries. Unfortunately, older Input-Output data is not readily available for Mongolia for older years and plagued with problems. In lieu of I/O data we use the simpler method used in Wei (1996) which is simply GDP less exports as a crude proxy for intra-national trade. While we calculated the taus for 115 trade partners of Mongolia, Table 6 shows the results the Novy measure for Mongolia's for a select sample of trade partner over the three decades. Also, for reasons of space, not all years are reported in Table 6, but are available upon request.

As we can see, there is a clear, general decline in trade costs across the board, with a few exceptions. Germany, for example, saw its bilateral trade costs fall from 271% (tariff-equivalent) in 1988 to 164% in 2017. China, now Mongolia's largest destination for exports by far, and who shares a border with Mongolia, saw its costs fall from 114% in 1994 to 63% in 2017. Compare this the findings of Novy (2013) in which he found that the trade costs between US and Mexico fell from 50% to 30% in the years following (North American Free Trade Agreement (NAFTA). This suggests the falls in trade costs between China and Mongolia were larger, and at the same time tells us that the border is "thicker" than that between the US and Mexico.

Table 6 *Tau Values for a Sample of Mongolia's Trading Partners*

| | **1988** | **1990** | **1994** | **1998** | **1999** | **2000** | **2005** | **2006** | **2008** | **2012** | **2017** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia | n/a | 6.53 | 05.16 | 3.39 | 4.44 | 3.38 | 2.40 | 2.11 | 2.22 | 1.83 | 2.50 |
| Austria | n/a | n/a | 3.15 | 3.03 | 2.99 | 2.79 | 2.25 | 2.02 | 1.57 | 1.34 | 1.91 |
| China | n/a | n/a | 1.14 | 0.95 | 0.95 | 0.68 | 0.65 | 0.52 | 0.44 | 0.34 | 0.63 |
| France | n/a | n/a | 2.57 | 2.18 | 2.45 | 1.62 | 1.85 | 1.69 | 1.65 | 1.54 | 2.05 |
| Germany | 2.71 | 2.48 | 1.93 | 1.57 | 1.75 | 1.44 | 1.39 | 1.36 | 1.18 | 1.17 | 1.64 |
| India | 4.25 | 3.62 | n/a | 2.75 | 2.61 | 2.44 | 3.00 | 2.07 | 1.31 | 1.36 | 2.4 |
| Japan | 2.42 | 2.18 | 1.65 | 1.36 | 1.63 | 1.51 | 1.62 | 1.45 | 1.07 | 1.13 | 1.32 |
| Korea | n/a | n/a | 1.69 | 1.35 | 0.663 | 1.26 | 1.34 | 1.22 | 0.82 | 0.73 | 1.32 |
| Netherlands | n/a | n/a | 2.32 | 2.16 | 2.26 | 1.54 | 2.30 | 2.36 | 1.59 | 1.25 | 2.06 |
| Russian Fed | n/a | n/a | n/a | 0.83 | 0.80 | 0.60 | 0.86 | 0.78 | 0.63 | 0.65 | 0.95 |
| Thailand | n/a | 4.91 | 2.79 | 2.10 | 3.65 | 1.821 | 2.13 | 2.13 | 1.63 | 1.75 | n/a |
| UK | n/a | n/a | 2.32 | 1.97 | 1.98 | 1.58 | 1.89 | 1.75 | 1.66 | 1.59 | 1.9 |
| US | n/a | n/a | 2.12 | 1.70 | 1.79 | 1.31 | 1.48 | 1.49 | 1.39 | 1.12 | 2.12 |

Source: Authors' own calculations.
n.b. Other partners' data and many years have been omitted to fit on the page. Data for other countries and years is available upon request.

## 5. Conclusion

Mongolia underwent radical changes both through its market liberalization (internally and externally) and by abandoning its 30-year old system of trade networks based on the old Soviet-Bloc trading regime (CMEA) to embrace a relatively open trading stance with the entire world. The massive expansion of trade resulted in dramatic increases in both the volume and variety of imports from the entire world. These new imports are being financed, in most part, by Mongolia comparative advantage in resources, the bulk of which are being exported to neighboring China.

While this important transformation has similarities in Eastern Europe (Bulgaria, Poland, etc.), Mongolia`s trade patterns and experience has some distinct characteristics. Two

most notable differences would be its heavy reliance on natural resource exports, but also its geographical position in East Asia and great distance from the EU and the US. Also, while the welfare gains from increased variety from former Socialist states have been measured, such estimates for Mongolia have, thus far, been notably absent. Lastly, it has been 30 years on since Mongolia first shifted its trade focus away from Russia and towards China yet the literature on Mongolia trade transformation and experience seems to end in the 2000s.

As such this paper provided a much more detailed account of Mongolia's experience. First, the nature of Mongolia radical change in trade partners is documented. Next, welfare gains provided by new econometric estimates over 30 years tells us that, indeed, the new access to goods outside the Soviet-bloc has contributed to gains much greater than other transitional economies (much of which are neighbors with wealthy Western Europe) have seen. According to our estimates, Mongolia experienced an addition 22% gain in welfare due to the massive increase in imported varieties. Lastly, we use the Novy method to demonstrate which countries Mongolia is becoming 'closer' to. Naturally, the "border" between Mongolia and China became much more 'narrow', falling from a tariff equivalent of 114% in 1994 to 63% in 2017. But we also see that the tariff-equivalents for some of Mongolia's other major partners have fallen by more than 100%. Yet, despite this, with most partners, the trade costs are still over 200%. It will be interesting to see how much more the trade costs of this resource-rich, landlocked nation, decline in the next twenty years or so.

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