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Are We Underestimating the Gains from Globalization for the United States?

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Over the last three decades, trade has more than tripled the variety of international goods available to U.S. consumers. Although an increased choice of goods clearly enhances consumer well-being, standard national measures of welfare and prices do not assign a value to variety growth. This analysis—the first effort to measure such gains—finds that the value to consumers of global variety growth in the 1972-2001 period was roughly \$260 billion.

The U.S. economy has advanced considerably since Henry Ford quipped that customers could have cars in “any color as long as it is black.” Today’s consumers are able to purchase a wide variety of goods that were not available in the past. Not only can they choose their cars from hundreds of makes and models, but they can also purchase a wealth of technologically sophisticated new products. One development that has significantly broadened consumers’ choice of goods in recent decades is the growth of international trade. As trade with other nations has expanded, U.S. consumers have been able to acquire varieties of goods not available from domestic producers—Japanese cars, for example, and French wine.

In this edition of *Current Issues*, we examine how the availability of new goods and varieties through international trade has affected the welfare of U.S. citizens. While the benefits of free trade have traditionally been associated with declines in the price of existing products, recent trade theory suggests that the introduction of new imported goods constitutes another important gain from trade. Our task in this article is to provide a measure of this gain over the past three decades.

To do so, we first estimate the increase in global varieties from 1972 to 2001. We then estimate how the change in import prices over this period—a standard gauge of consumer welfare—would be affected if this increase in variety were taken into account. Using our results, we determine what consumers would be willing to pay to access the wider range of goods available in 2001 than in 1972.

Significantly, we find that global varieties grew more than threefold over the 1972-2001 period. When we adjust import price growth for the increased variety, we find that import prices in this period fell markedly faster—by about 1.2 percentage points per year—than the conventional, or unadjusted, import price index would suggest.¹ Taking our calculations one step further, we conclude that consumers would be willing to pay \$260 billion, or roughly 3 percent of GDP in 2001, to avail themselves of the expanded range of goods on the market. This sizable sum indicates that U.S. consumers see increased choice in goods as an important benefit of international trade.

Why Do Varieties Matter?

Classical international trade theory postulates that the opening of an economy to trade improves welfare by allowing

consumers to access cheaper imported goods. In the new models of international trade, however, countries benefit from trade not only because the prices of individual goods change, but also because consumers in open economies have access to a wider range of goods than consumers in closed economies. The new models are typically predicated on an assumption that no one country can produce all of the varieties available in the world. If consumers value new varieties and individual countries cannot supply them, then consumers stand to benefit from the increased choice of goods that comes with trade.

In these new trade models, the gains from trade hinge directly on a number of variables. The first is the “elasticity of substitution” among varieties, or how substitutable consumers believe varieties to be. If varieties of a particular good are so alike that consumers will readily substitute one for another—as in the case of gasoline, for example—then having two varieties of that good will have little impact on welfare. However, if the varieties are quite distinct—consider Irish and American beer, or Italian and American cheese—then U.S. consumers will benefit from the opportunity to obtain both varieties.

The gains from trade also depend on differences in quality across varieties. Consumers will place a higher value on access to varieties regarded as superior. Thus, most Americans would presumably prefer the opportunity to buy French red wine to the opportunity to buy Japanese red wine. The final variable affecting the gains from trade is import quantity: All things being equal, consumers will place a higher value on variety growth in product sectors that command a large share of spending—for example, automobiles—than on variety growth in small sectors.

Calculating the Growth of Variety in U.S. Imports since 1972

To track the growth of variety in goods entering the United States over the past three decades, we examine the most disaggregated, or finely detailed, import data available. For the 1972–88 period, we use the seven-digit import classifications of the Tariff Schedule of the United States Annotated (TSUSA) system; for the 1990–2001 period, we use the ten-digit import classifications of the Harmonized Tariff Schedule (HTS), the system that replaced the TSUSA in 1989. These classifications break down U.S. imports into approximately 15,000 goods, each characterized by a level of detail on the order of “red wine in bottles of under one liter.”

We define a variety to be a good emanating from a particular country—for example, French red wine. This definition suggests both the power and the limitations of working with

trade data. On the one hand, our definition is specific enough to enable us to examine the interactions of literally hundreds of thousands of good-country pairs. On the other hand, as the example of French red wine indicates, our definition is still very general, collapsing many kinds of French red wine into a single “variety.”²

Looking at the composition of U.S. imports over the 1972–2001 period (Table 1), we see two unmistakable trends. The first is a dramatic increase in the number of measured goods. Between 1972 and 1988, the number of goods imported by the United States almost doubled, rising from 7,731 to 12,822. Similarly, between 1990 and 2001, the number of imported goods rose from 14,572 to 16,390. Closer scrutiny reveals that the increases in these two sample periods did not consist simply of new imports being added to the old (Table 1, rows 3 and 4 and rows 9 and 10). Indeed, it appears that only half to two-thirds of the goods in each of the two samples were imported both at the start and at the end of the period. Moreover, approximately one-third of

Table 1
Variety in U.S. Imports, 1972–2001

	Year	Number of Goods	Median Number of Exporting Countries	Total Number of Varieties (Good-Country Pairs)
	(1)	(2)	(3)	(4)
U.S. Imports, 1972–88				
All 1972 goods	1972	7,731	6	74,667
All 1988 goods	1988	12,822	9	173,937
Goods common to				
1972 and 1988	1972	4,171	6	36,191
1972 and 1988	1988	4,171	10	56,183
Goods in 1972 not in 1988	1972	3,560	7	38,476
Goods in 1988 not in 1972	1988	8,651	8	117,754
U.S. Imports, 1990–2001				
All 1990 goods	1990	14,572	10	182,375
All 2001 goods	2001	16,390	12	259,215
Goods common to				
1990 and 2001	1990	10,636	10	132,417
1990 and 2001	2001	10,636	13	173,776
Goods in 1990 not in 2001	1990	3,936	10	49,958
Goods in 2001 not in 1990	2001	5,754	11	85,439

Sources: NBER Trade Data on CD-ROM; Center for International Data at UC Davis, <<http://data.econ.ucdavis.edu>>.

Note: For the 1972–88 period, goods are defined at the seven-digit level of the TSUSA (Tariff Schedule of the United States Annotated); for the 1990–2001 period, they are defined at the ten-digit level of the HTS (Harmonized Tariff Schedule).

the goods in each sample had disappeared by the end of the sample period. It is possible, of course, that the shifting composition of the imported goods over the sample periods may owe as much to changes in the way the goods are classified as to actual changes in the goods themselves. Nevertheless, the data do suggest that the growth of international trade in recent decades has led to both the creation and the elimination of imports—a fact often overlooked in discussions of globalization.

The second trend that emerges from the import data is a dramatic increase in the number of countries exporting each good to the United States (Table 1, column 3). Over the full 1972-2001 period, the median number of countries supplying each good doubled, rising from six countries at the start of the period to twelve at the end.

Taken together, the data in Table 1 indicate that the number of good-country pairs—that is, the number of varieties (column 4)—rose 133 percent in the first period and 42 percent in the second period, for a total increase of 231 percent. This increase constitutes more than a threefold rise in the number of varieties over the three decades from 1972 to 2001. Roughly half of this increase is attributable to a doubling in the number of goods and half to a doubling in the number of countries supplying each good. While we have not yet explored how consumers value these new varieties, the dramatic growth in the count of new varieties makes a prima facie case that understanding variety growth is important for measuring changes in consumer welfare.

To get a more concrete sense of what is driving the surge in import variety, consider how specific goods have fared. In some cases, variety growth stems primarily from an increase in the number of countries exporting the good. For example, in 1972, the United States imported roasted or ground coffee from twenty-five countries. By 2001, however, the nation was importing roasted coffee from fifty-two countries.³ Similarly, the number of countries supplying beer and wine to the United States rose by about 195 percent and 50 percent, respectively, over the period. The number of countries supplying eyeglasses rose from nine to forty-seven.

In other cases, variety growth stems from both new goods and new sources for each good. Car audio is a prime example: In 1972, twenty-one countries exported car radios of all types to the United States. By 2001, there were nine different classifications for car audio systems and as many as twenty-eight countries exporting each of the nine. Overall, the number of varieties would appear to have risen from 21 to 174. Clearly some portion of this increase—for example, the splitting of the single 1972 classification of car audio into the 2001 classifications of AM radios and AM/FM

radios—does not represent the addition of new goods. However, other 2001 classifications for car audio systems—radios with tape and compact disc players, for example—probably do constitute new goods that have produced a genuine increase in choice.

Countries Exporting to the United States: Changes in the Rankings

The rapid growth of import varieties has been accompanied by changes in the relative importance of various countries as exporters to the United States. In the first column of Table 2, countries are ordered according to the number of goods they

Table 2
Countries Ranked by the Number of Goods Exported to the United States

Country	Ranking in Year			
	1972	1988	1990	2001
Japan	1	1	3	7
United Kingdom	2	4	4	3
Germany	3	3	2	2
Canada	4	2	1	1
France	5	6	5	6
Italy	6	5	6	5
Switzerland	7	11	11	11
Hong Kong	8	9	12	16
Netherlands	9	13	13	14
Taiwan	10	7	7	9
Spain	11	14	15	12
Belgium-Luxembourg	12	15	14	15
Mexico	13	12	10	8
Sweden	14	17	16	19
Denmark	15	22	21	23
Austria	16	18	18	21
India	17	19	23	13
South Korea	18	8	9	10
Brazil	19	16	17	18
Australia	20	20	20	20
Israel	21	21	22	22
Portugal	22	26	28	32
Norway	23	31	31	37
Ireland	24	27	26	28
Finland	25	28	30	31
Colombia	26	33	34	35
Philippines	27	25	25	26
China	28	10	8	4
Argentina	29	29	29	39
Greece	30	38	44	47

Sources: NBER Trade Data on CD-ROM; Center for International Data at UC Davis, <<http://data.econ.ucdavis.edu>>.

Notes: The table reports rankings for the thirty countries that exported the highest number of goods to the United States in 1972. For 1972 and 1988, goods are defined at the seven-digit level of the TSUSA (Tariff Schedule of the United States Annotated); for 1990 and 2001, they are defined at the ten-digit level of the HTS (Harmonized Tariff Schedule).

exported to the United States in 1972, with the largest exporter placed first; the following columns report the rankings of these same countries in 1988, 1990, and 2001. Although the countries exporting the most goods to the United States have tended, throughout the 1972-2001 period, to be large and high-income economies, the position of individual countries within the ranking has changed. Canada moved from fourth to first place, and Mexico moved from thirteenth to eighth place. The sharp rise in the ranking of these two countries may reflect their adoption of a free trade policy: Canada's jump to first place followed a trade liberalization in the 1970s and 1980s; Mexico rose from tenth to eighth place after it liberalized trade in the 1990s.

In the case of other countries, economic growth, perhaps coupled with liberalization, may help explain the change in rank. Fast-growing economies such as China and Korea have advanced rapidly as import sources for the United States. The increase in the number of U.S. imports from China has been especially stunning. In 1972, China exported only 510 goods to the United States; by 2001, that number had risen to 10,199 (Table 3). In other words, while Chinese firms competed in only 0.6 percent of the import markets in existence in 1972, they participated in 62 percent of the markets in 2001. Thus, although Chinese firms account for only 9 percent of all imports to the United States, there

is a Chinese firm selling in almost two-thirds of the U.S. import markets.

The twenty-fold increase in the number of goods exported by China has elevated China from the twenty-eighth position in the 1972 ranking of exporters to the fourth position today. Similarly, India has risen in the rankings—from twenty-third in 1990 to thirteenth in 2001—with the sharp rise in exports that began with the country's liberalization in the last decade. At the other extreme, countries such as Japan and Argentina, whose economies grew slowly at the end of the 1990-2001 sample period, have seen fairly substantial drops in the number of varieties they export.

Calculating the Welfare Gains from New Varieties

Although increased product variety is generally believed to bring welfare gains, standard national measures of welfare and prices do not assess how much better off consumers are when a new variety of an existing good or a new good becomes available. Both the U.S. import price index and the consumer price index (CPI) measure the current cost of a particular basket of goods and services relative to the cost of those same goods and services in some base period in the past. Thus, both indexes largely fail to capture the introduction of new varieties and the increase in the standard of living that new varieties bring about.⁴ Indeed, in this regard, the two indexes fall short of being a true cost-of-living index—one that measures the cost of maintaining a certain level of welfare without restrictions on what is in the basket of goods and services examined.⁵

In this section, we report our efforts to recalculate the U.S. import price index for 1972-2001 taking variety growth into account. Our object—both here and in the longer, technical study on which this article is based⁶—is to provide a truer measure of the cost, over this thirty-year period, of maintaining a particular level of satisfaction from the consumption of imports. If new varieties of goods enhance the standard of living, then consumers can spend less to achieve the same level of satisfaction as in the past. By comparing our variety-adjusted estimate of the rate of change in import prices over the sample period with the conventional estimate that does not include variety growth, we obtain a measure of the nation's welfare gains from variety growth.

In the box on page 5, we present an equation for calculating a variety-adjusted price index. Although the equation describes a simple case in which all varieties are uniform in quality and priced identically, it nonetheless captures the most important elements of the more sophisticated calculations performed in our longer study.

Table 3
U.S. Imports from China, 1972-2001

	Year	Number of Goods	Percentage of Total U.S. Imports in Year
1972-88			
All 1972 goods	1972	510	0.1
All 1988 goods	1988	4,673	1.9
Goods common to			
1972 and 1988	1972	215	0.0
1972 and 1988	1988	215	0.2
Goods in 1972 not in 1988	1988	295	0.0
Goods in 1988 not in 1972	1988	4,363	1.7
1989-2001			
All 1989 goods	1989	5,587	2.5
All 2001 goods	2001	10,199	9.0
Goods common to			
1989 and 2001	1989	3,567	1.3
1989 and 2001	2001	3,567	3.9
Goods in 1989 not in 2001	1989	2,002	1.2
Goods in 2001 not in 1989	2001	6,582	5.0

Sources: NBER Trade Data on CD-ROM; Center for International Data at UC Davis, <<http://data.econ.ucdavis.edu>>.

The key variables in our adjusted estimate of the price index are (1) the extent of the growth in varieties for each good over the sample period and (2) the degree of similarity, or elasticity of substitution, among the varieties of each

Box: Empirical Methodology

Our empirical calculation of the import price index begins with some assumptions about how consumers think about varieties. Here, we assume that all consumers evaluate varieties using a constant elasticity of substitution (CES) utility function that places equal weights on imports from every country. If the prices of all varieties of an imported good are identical and there are no differences in quality across varieties (an assumption we relax in the longer version of this article), we can write the price index that takes variety growth into account, P_c^V , as

$$P_c^V = P_c \times \prod_g \left(\frac{n_{gc72}}{n_{gc01}} \right)^{\frac{1}{\sigma_g - 1}},$$

where P_c is the conventional price index (that is, the index with no adjustment for variety growth), n_{gc72} is the number of varieties of good g imported by country c in the year 1972, n_{gc01} is this number for 2001, and $\sigma_g > 1$ is the elasticity of substitution among varieties of a different good. As the equation makes clear, the effect of variety growth on the import price index depends on two factors. First, increasing the number of source countries for a given good will lower the ratio of old to new varieties, n_{gc72}/n_{gc01} , and hence the price index.^a This fall in the price index reflects the assumption that consumers value greater choice. Second, the precise amount by which new varieties affect the price index depends on how substitutable varieties of each good are. If varieties are very similar, then σ_g is large, the exponent in the above equation is small, and increases in the number of varieties will have little effect on the price index. In sum, our methodology assumes that there are two determinants underlying how varieties affect the price index: the magnitude of the increase in varieties and the degree of similarity among varieties.

^aOne drawback of this method of measuring growth in the number of varieties is that it erroneously captures splits or mergers of product classifications as a change in the number of varieties and hence could artificially impact the calculation of the variety-adjusted price index. Fortunately, the methodology we use in our longer technical paper (Broda and Weinstein 2004) is robust to a wide variety of data problems arising from the creation and elimination of product classifications. For example, if goods are randomly split or merged, then the index remains unchanged. Moreover, the methodology is robust to new goods being of higher quality than old goods because superior-quality goods will claim a larger share of total import expenditures at fixed prices.

good. The simplest way to measure variety growth for a particular good is to compare the number of varieties in that product category at the beginning of the sample period with the number of varieties at the end of the period. For instance, we used this method earlier in the article to calculate the extent of variety growth in coffee, beer, and other products. However, a simple count of varieties ignores the fact that we may import a huge quantity of one variety and a small quantity of another. While we make no allowance for differences in quantity in the simple case we present in the box, we adjust for the share of each variety in total import expenditures in our longer paper (Broda and Weinstein 2004).

The second key variable—the elasticity of substitution—is a measure of the degree to which consumers value new varieties of a particular good. If U.S. consumers see blueberries from Chile and Argentina as equivalent or “perfectly substitutable,” then they will not value access to the Chilean berries if they already have access to Argentinean blueberries. In other words, the opportunity to buy both products will do nothing to enhance consumers’ standard of living. By contrast, if consumers see Italian and Chinese shirts as essentially different, then they will regard themselves as better off if they are able to purchase shirts from both countries. *How much* better off depends on the degree of substitutability between the two varieties of shirts.

For our recalculation of the import price index, we document the degree of substitutability for varieties of more than 30,000 goods imported by the United States (see Broda and Weinstein [2004]). We find that for the period between 1972 and 1988, the goods sector with the highest substitutability among its varieties was crude petroleum and shale oil. The goods sector in which varieties were the least substitutable was footwear. In general, the degree of substitutability was higher for homogeneous products (petroleum is an apt example) than for highly differentiated products.⁷

The Impact of Increased Import Variety on U.S. Welfare

Our recalculation of the import price index, based on a more sophisticated version of the methodology outlined in the box, suggests that the variety-adjusted index fell 28.0 percent faster than the conventional index between 1972 and 2001, or about 1.2 percentage points per year. The difference in the rate of decline was particularly marked for the earlier sample period: the variety-adjusted price of imports fell 19.7 percent faster than the unadjusted price between 1972 and 1988, or about 1.4 percentage points per year. For the later sample period, the impact of variety growth was much smaller, with the adjusted index falling 8.3 percent faster

than the official index between 1990 and 2001, or about 0.8 percentage point per year. The lower rate of decline in the later period may reflect the fact that many of the gains resulting from the rising importance of East Asian trade may have been realized before 1990.

To calculate the impact of variety growth on consumer welfare, we have to make an additional assumption about how the increased availability of foreign varieties affects domestic production. For this exercise, we follow Krugman's (1980) argument that the number of domestic varieties remains the same as the number of import varieties changes. In reality, some imported varieties replace domestic varieties while others just complement them. However, if domestic varieties are replaced, the resources used in their production may be put to work in the production of a new variety of that product or some other good.

With the assumption that the number of domestic varieties is unchanged, we can proceed to estimate the impact of global variety growth on the well-being of U.S. consumers. We found earlier that the official import price index understates the rate of decline in import prices by 28.0 percent over the three decades from 1972 to 2001. If imports account for about 10 percent of U.S. GDP, then the value to consumers of the increase in global varieties is about 3 percent of GDP⁸ in 2001, or roughly \$260 billion.⁹ This sum represents what consumers would be willing to pay to access the expanded set of varieties available in 2001.

Putting Our Findings in Context

Our estimates should be viewed with some caution. As we noted earlier, we treat the interaction of domestic and imported varieties very simply, relying on the assumption that the number of domestic varieties remains the same when the number of imported varieties increases. In addition, we choose one way of modeling variety—the CES model presented in Dixit and Stiglitz (1977)—while recognizing that other researchers might adopt a different approach.¹⁰

Although our method has certain limitations, our findings are striking indeed. A welfare gain of \$260 billion from global variety growth is three to six times larger than traditional estimates of the gains from eliminating protectionism (see, for example, Feenstra [1992] and Romer [1994]). Our finding that the conventional import price index, by failing to correct for the increase in varieties, understates the decline in import prices by 1.2 percentage points per year also underscores the considerable impact of variety growth.

To understand the magnitude of this understatement, or “bias,” consider how it compares with other estimates of bias in aggregate prices. In 1996, the Advisory Commission to Study the Consumer Price Index found that the CPI at that time overstated the increase in the cost of living by about 1.1 percentage points per year (Boskin et al. 1996). Improvements in the quality of consumer goods—which were not taken into account in the calculation of the CPI—accounted for about 0.6 percentage point of this bias.¹¹ These numbers suggest that the variety-growth bias we find in the import price index is, in fact, quite large: specifically, it is twice as large as the quality-change bias in the overall price index and as large as the total bias from all sources.¹²

Conclusion

This article reports the results from the first attempt to estimate the impact of new varieties on the U.S. import price index.¹³ We find that the index overstates import price inflation by 1.2 percentage points per year for the 1972-2001 period. The real cost of imports was almost 30 percent lower at the end of this period than the conventional price index would suggest. This drop in import prices, we contend, has raised U.S. welfare by \$260 billion, or about 3 percent of 2001 GDP.

The magnitude of this gain from trade suggests that the effects of variety growth on prices and welfare merit further exploration. Additional research is needed on the interaction between imported and domestic varieties. Our own future work on these issues will consider how the growth and elimination of domestic varieties affect consumer prices and welfare.

Notes

1. The conventional index used as a benchmark in our analysis mimics the official U.S. import price index in that it makes no adjustment for the impact of variety growth. Although it is derived from a different formula, it is closely related to the official index in practice.

2. Whether consumers assess goods coming from different countries as different “varieties” is something we will be able to determine by estimating the degree of substitutability between them. For example, high levels of substitutability between Brazilian and Colombian coffees would suggest that consumers do not regard these products as distinct varieties. An alternative definition of a variety that appears in the trade literature is “goods coming from a particular firm.” The problem with this definition, however, is that all goods from a given firm are not the same variety. More practically, it is very difficult to get firm- or plant-level data for a large set of countries that export to the United States.

3. The 2001 classification for roasted coffee contains only caffeinated coffee in packages of under two kilograms. The actual number of suppliers could be higher.

4. In calculating the CPI, the Bureau of Labor Statistics omits the introduction of new goods until they are eventually discovered as part of the gradual rotation of the sample of goods. Even when the no-longer-new good enters the CPI calculation, no adjustment is made for the consumer gains it provides in relation to the earlier goods. For a good summary of CPI biases, see Lebow and Rudd (2003).

5. The import price index and the CPI are both fixed-weight indexes; they assign weights to the prices of individual goods and services that are fixed over time. While the assessment of cost-of-living changes is a recognized measurement goal of the fixed-weight index, it is a theoretical construct that cannot readily be translated into a single, straightforward index formula. Therefore, the fixed-weight index cannot easily track all of the factors that affect the cost of living in today's dynamic economy.

6. This article summarizes the findings of empirical work described in detail in Broda and Weinstein (2004).

7. Broda and Weinstein (2004) show that the estimates obtained are reasonable under a number of criteria.

8. Intuitively, if the price of 10 percent of the goods in the CPI falls by 30 percent, then the CPI falls by 3 percent. This implies a rise in real GDP of 3 percent.

9. About 2 percentage points of the welfare gain accrue to the earlier sample period.

10. We choose the Dixit and Stiglitz model because of its prominence, tractability, and empirical feasibility.

11. While we compare the magnitude of the import index and CPI biases, we cannot add the variety-growth bias to the existing CPI bias. This is mainly to avoid a "double counting" of the effect of imported varieties. Many of the imported goods are intermediate goods that already show up as lower prices in final consumption goods.

12. We note, however, that the average quality-improvement bias in the CPI masks a large variance across different CPI expenditure categories. Both the 1996 Boskin et al. study and a more recent paper by Lebow and Rudd (2003) present estimates of quality bias in many important CPI subindexes—including medical care, personal computers, televisions, toys, and audio equipment—that

are larger than our estimate of variety bias. Overall, the weighted sum of the bias found for these categories, which account for 9.7 percent of the CPI, is 2.25 percentage points per year. Another category, "personal computer services (Internet)," accounts for 0.1 percent of the CPI but has an estimated annual bias of 19.0 percentage points.

13. Although some researchers have studied the price impact of variety growth at the micro level (a single good, or at most a few goods), we know of no other study that considers the effects of variety growth on aggregate prices.

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