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Abstract

With the seminal work of Feenstra (1994) and its application to the United States by Broda and Weinstein (2006) the gains from variety through trade as suggested by Krugman (1979) have become quantifiable. My paper adds to this literature in different respects: On the theoretical side, the Feenstra ratios are reinterpreted to allow for unobserved growth at the extensive margin. Also, the gains from variety are decomposed regarding countries of origin and industries. On the empirical side, the gains from variety are calculated for the United States and Switzerland, a small open economy. Analyzing the empirical results for these countries as well as data from other OECD economies, it is then argued that size and openness of countries as well as the (unobserved) true growth at the extensive margin are important factors in determining the welfare gains from variety.

JEL classification: F12, F14;

Keywords: Welfare Gains from Trade, Trade in Variety, Small Open Economy;

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1 Introduction

Since the seminal contributions of Krugman (1979, 1980), economists try to quantify the gains from trade within a monopolistic competition framework. Within such a model, gains from variety stem from three sources: Price reductions due to increasing returns to scale, an increased product variety for consumers, and in more recent models, the self-selection of firms upon trade liberalization.[1] I like to motivate my paper by first revisiting some important contributions about the second source of welfare gains - the gains from variety.

The models developed by Spence (1976), by Dixit and Stiglitz (1977), and, applied to trade, by Krugman (1979, 1980) have had a great impact on the theoretical as well as the empirical literature in our field. Within this monopolistic competition setting, consumers value additional varieties depending on the substitutability between varieties, captured by the elasticity of substitution. This dependence on a single parameter and the tractability explains the empirical success of these models.

The first attempt to use this framework to quantify the value of new varieties upon trade liberalization is done by Romer (1994).[2] As a consequence of trade barriers and the fixed costs of introducing a new variety into a foreign market, some goods are not profitable enough to be exported and this leads to a limited variety being offered in the importing country. The gains from trade liberalization can then account for up to 20% of GDP if many goods were previously prevented from being imported. Klenow and Rodríguez-Clare (1997) provide some empirical evidence for this calibration exercise. In their paper, the gains from trade liberalization using Costa Rican data can account for up to 2% of GDP. These gains incorporate the gains from variety which raise the overall gains from trade by 50% to 300%.

The most influential work to date, however, is done by Feenstra (1994). Within a CES framework, he develops a price index for imports that is corrected for new and disappearing varieties. New varieties lower the unit-costs depending on their substitutability with other varieties and their expenditure share. This allows Feenstra (1994) to quantify the upward bias in conventional import price indices that ignore changes in the set of imported varieties. This approach is used by Broda and Weinstein (2006) to estimate the gains from imported variety in the United States between 1972 and 2001. They find that the upward bias of the conventional import price index is 1.2% per year. This leads to a gain from imported variety of 2.6% of GDP over the whole period.

This result of Broda and Weinstein (2006) is the topic of a recent debate. Benassy (1996) emphasizes one peculiarity of the standard Dixit-Stiglitz model: The love of variety is constant and equal to the

[1] In an excellent survey, Feenstra (2006) reviews the empirical evidence for these gains from trade within monopolistic competition models.

[2] Note that many authors have quantifed the value of new varieties using quite different approaches: Examples are Hausman (1997a, 1997b and 1999), based on Hicks (1940). Another example is Petrin (2002) using a random utility specification. However, these approaches require very detailed micro data.

mark-up of firms. Based on this work, Montagna (1999) uses a more general model and shows that the standard Dixit-Stiglitz model incorporates a maximum of love of variety. Furthermore, Hummels and Lugovskyy (2005), based on Lancaster (1979), argue that the less than proportional increase in imported varieties with respect to market size can be explained by the falling marginal benefit of importing additional varieties. In their model, this is due to "crowding" in the variety space. Taking a somewhat different approach, Ardelean (2009) also argues that the standard Krugman (1980) model overstates the love of variety since it assumes that larger countries export more only at the extensive margin, while models in the vein of Armington (1969) assume that countries' exports grow only at the intensive margin. She develops a more general model that nests Krugman and Armington style models and concludes that the love of variety is 44% lower than in Krugman's CES model. These contributions imply that Broda and Weinstein (2006) may overestimate the gains from variety.

On the other hand, in many contributions it is argued that the disaggregated trade date used in Broda and Weinstein (2006) misses out on some variety growth. For example, Schott (2004) shows that trade data is consistent with vertically differentiated varieties within disaggregated product groups. He shows empirically that those varieties differ regarding capital or skill intensity and therefore differ in quality. Similarly, Hummels and Klenow (2005) argue that the unobserved varieties within HS product categories - both horizontally and vertically differentiated - will affect the extensive margin positively. Hallak and Schott (2008) also emphasize the horizontal and vertical differentiation within trade data, set up a model that can account for these unobserved varieties and estimate those differences. Finally, Blonigen and Soderbery (2009), using very detailed market data, show for the automobile market of the United States that the trade data underestimate the growth in variety by as much as 50%.

The detailed firm-level data that has become available recently provides more evidence: In the literature that explores firm-level data, the destination of products, the entry and exit of firms and the number of products per firm are all determinants of the extensive margin. Bernard et al. (2006) argue that much of the change in trade is due to the change within firms. This is also found in Bernard et al. (2009), where multi-product firm level data is analyzed with respect to the intensive and extensive margins and it is found that the extensive margin resulting from entry and exit of firms, but also from new and disappearing products per firm is substantial in the United States. These results are confirmed by Arkolakis and Muendler (2009) for Brazil and Chile. All these contributions imply that Broda and Weinstein (2006) may even underestimate the gains from variety.

It is one main objective of my paper to analyze the effect of this unobserved growth at the extensive margin on the gains from variety.[3] I approach this issue by extending Feenstra (1994). I reinterpret the

[3]Note that detailed firm-level data is still not available for all the imports of a country. Therefore, to quantify the total gains from imported variety as in Broda and Weinstein (2006), one still relies on the disaggregated trade data.

seminal lambda ratios and propose two bounds for the gains from variety: A first case where growth is only possible at the *intensive* margin of an Armington variety - this is the benchmark case originally proposed by Feenstra (1994) - and a second case where all growth in the expenditure of imports happens at the *extensive* margin of the Armington varieties. Since the true magnitude of the extensive margin is unobserved, I will argue that the true gains from variety lie within these bounds.

I then calculate these two bound empirically for Switzerland, a small open economy, and the United States: For the period from 1990 to 2006, these welfare gains lie between 0.3% and 5.0% of GDP in Switzerland. In the United States, the gains account for between 0.5% and 4.7% of GDP. These results imply that the gains from variety estimated in Broda and Weinstein (2006) are a lower bound and may be even higher if some unobserved growth at the extensive margin is taken into account.

As a further theoretical contribution, I provide a decomposition of the gains from variety regarding countries of origin and product categories. This allows me to compare the structure of trade between countries regarding the gains from variety. The empirical results of this decomposition exemplify the different geographical, geopolitical and economic positions of countries: For example, while Switzerland depends heavily on its three large EU neighbours regarding the gains from variety, the gains in the United States are more evenly distributed among its numerous major trading partners in the world.

I will then argue that size and openness of countries are, together with the (unobserved) growth at the extensive margin, important factors in determining the welfare gains from variety in countries: First, considering the fact that many SOEs have import shares that are several times larger than the one of the United States, one could imagine larger gains from variety for these economies. Second, SOEs are often supposed to have disadvantages associated with the import of new varieties: Romer (1994) and many others argue that fixed costs limit the number of goods available in an economy. For SOEs, such fixed costs constitute natural barriers to trade: Since the domestic market is small in these economies, fixed costs are more important relative to larger economies and consequently prevent more goods from being imported.[4]

My empirical results imply that SOEs in the OECD experience a lower growth in imported variety over time. For Switzerland, I show that this lower imported variety growth compared to the United States results in a large welfare loss for consumers. Despite the lower growth in imported varieties, the gains from variety may be higher in Switzerland due to its much higher import share. I argue in this paper that the higher the assumed growth at the extensive margin, the higher are the gains from variety in Switzerland relative to the gains in the United States due to the much higher import share. Thus, the magnitude of the extensive margin seems not only to be important for the total size of the gains

[4]This also is an interesting issue in the light of current theoretical trade literature: A very modern approach to capture variety effects in models is Melitz (2003). In his and other models, heterogeneous firms face fixed costs for exporting and decide whether to enter a foreign market or not.

from variety but also for the relative gains between countries. OECD data is used to show that this may hold quite generally for other small and large OECD economies.

The paper is structured as follows: Section 2 first reviews the methodology used to determine the gains from imported variety, mainly referring to Feenstra (1994) and Broda and Weinstein (2006). In the second part of this section, the extensions of the model are proposed. Section 3 presents the empirical gains from variety in Switzerland and the United States for the period from 1990 to 2006. In Section 4, Switzerland is compared to the United States, and the reasons for the differences in the gains from variety are analyzed. In addition, it is argued that similar results hold for other OECD countries. Section 5 concludes.

2 Modelling, Empirical Strategy, and Estimation

In this section, the methodology used to estimate the gains from imported variety as developed by Feenstra (1994) and Broda and Weinstein (2006) is reviewed first. In the second part of the section some extensions to the standard methodology are proposed.

2.1 Review of the Standard Model

Imported varieties c are grouped into goods g using the following CES utility function:

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

where σ_g is the elasticity of substitution between the varieties of good g. G is the set of goods and C is the set of all potential varieties. d_{gct} is a taste or quality parameter. Utility is separable and homothetic. The unit-cost function for every good g is:

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

where I_{gt} is the set of varieties available at time t and p_{gct} is the unit price of an imported variety. These unit cost functions are the building blocks for the price index.

More specifically, a cost of living index (COLI) is set up. It measures the total cost to the consumer in order to achieve the highest possible utility level given his level of income. With homothetic preferences the cost function for every consumer is independent of the level of income: Diewert (1976) defines an *exact* price index as the fraction of unit costs:

$$P_g^M(\vec{p}_{gt}, \vec{p}_{gt-1}, \vec{x_{gt}}, \vec{x}_{gt-1}, I_g) = \frac{\phi_{gt}^M(I_g, \vec{d_g})}{\phi_{gt-1}^M(I_g, \vec{d_g})}. \tag{3}$$

Note that for the moment a constant set of varieties, I_g, henceforth called the *common set*, is used.[5] Sato (1976) and Vartia (1976) have derived the exact price index for the CES unit-cost function:

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

where

$$\begin{aligned} w_{gct}(I_g) &= \frac{(s_{gct} - s_{gct-1})/(\ln s_{gct} - \ln s_{gct-1})}{\sum_{c \in I_g}((s_{gct} - s_{gct-1})/(\ln s_{gct} - \ln s_{gct-1}))}, \\ s_{gct}(I_g) &= \frac{p_{gct}x_{gct}}{\sum_{c \in I_g} p_{gct}x_{gct}}. \end{aligned}$$

Thus, the price index is the geometric mean of all price changes. The weights depend on the expenditure shares s_{gct}. The exact price index defined above demands that all the varieties are available at all periods. It is due to Feenstra (1994) that the exact price index for a non-constant set of varieties, I_{gt}, is known:

$$\begin{aligned} \pi_g(\vec{p}_{gt}, \vec{p}_{gt-1}, \vec{x}_{gt}, \vec{x}_{gt-1}, I_g) &= \frac{\phi_{gt}^M(I_{gt}, \vec{d_g})}{\phi_{gt-1}^M(I_{gt-1}, \vec{d_g})}, &(5) \\ &= P_g(\vec{p}_{gt}, \vec{p}_{gt-1}, \vec{x}_{gt}, \vec{x}_{gt-1}, I_g) \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{1/(\sigma_g - 1)}, &(6) \end{aligned}$$

where

$$\begin{aligned} \lambda_{gt} &= \frac{\sum_{c \in I_g} p_{gct}x_{gct}}{\sum_{c \in I_{gt}} p_{gct}x_{gct}}, &(7) \\ \lambda_{gt-1} &= \frac{\sum_{c \in I_g} p_{gct-1}x_{gct-1}}{\sum_{c \in I_{gt-1}} p_{gct-1}x_{gct-1}}. &(8) \end{aligned}$$

Hence, the exact or *corrected* price index *with variety change* is a conventional price index times an additional term, henceforth called the *lambda or Feenstra ratio*. Note that the numerators of λ_{gt} and λ_{gt-1} comprise the expenditure on the common varieties; i.e., those varieties that are available at t *and* $t-1$. In the denominator of λ_{gt} the new varieties are included additionally while in the denominator of λ_{gt-1}, the disappearing varieties are included additionally. Thus, the lambda ratio gets smaller if there

[5] It is a remarkable feature that the price index does not depend on taste parameters. The intuition for this result shown by Diewert (1976) is that all the information contained in the taste parameters is captured by the expenditure shares.

are many new varieties, and it gets larger if there are many disappearing varieties. This is determined entirely by the *expenditure* on these new and disappearing varieties. This ratio is then weighted by a term negatively related to the elasticity of substitution. Thus, there is a greater correction in the price index if the elasticity is low. If the elasticity is high however, the lambda ratio converges to one. Now that the exact price indices for the imported goods are known, they are aggregated into the aggregate exact import price index:

$$\Pi^M(\vec{p}_t, \vec{p}_{t-1}, \vec{x}_t, \vec{x}_{t-1}, I) = \prod_{g \in G} \left[P_g(I_g) \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{1/(\sigma_g - 1)} \right]^{w_{gt}}, \tag{9}$$

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

where $CIPI(I)$ is a conventional import price index that does not account for the change in varieties. The ratio of the corrected import price index and the conventional price index expresses the bias from ignoring the change in variety. This ratio is called the *end-point ratio (EPR)* and it is defined as

$$EPR = \frac{\Pi^M}{CIPI(I)} = \frac{CIPI(I)}{CIPI(I)} \prod_g \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{w_{gt}/(\sigma_g - 1)} = \prod_g \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{w_{gt}/(\sigma_g - 1)}. \tag{11}$$

Thus, the EPR is the weighted average of the lambda ratios weighted by a term incorporating the elasticity of substitution. Assuming a simple Krugman (1980) structure, the overall price index of the economy can be written as

$$\Pi = \left(\frac{p_t^D}{p_{t-1}^D} \right)^{w_t^D} (\Pi^M)^{w_t^M}, \tag{12}$$

where w_t^M is the log-change weight of the imports, w_t^D is the weight of the domestic sector and p_t^D is the price of the domestic good. Since this structure admits a separation between the domestic and the import markets, the gains from imported variety result in[6]

$$GFV = \left[\frac{1}{EPR} \right]^{w_t^M} - 1. \tag{13}$$

Hence, the welfare gains can be calculated by weighting the inverse of the weighted aggregate lambda ratios with the fraction of imported goods relative to total economic activity. To calculate the gains, the elasticity of substitution has to be estimated for every product group. The stochastic model is derived by Feenstra (1994) and is omitted here.

[6]This can be derived by using the ratio of the conventional and the corrected price index of the whole economy: $GFV = \frac{\Pi^{con}}{\Pi^{cor}} - 1 = \left(\frac{p_t^D}{p_{t-1}^D} \right)^{w_t^D} / \left(\frac{p_t^D}{p_{t-1}^D} \right)^{w_t^D} \frac{CIPI(I)^{w_t^M}}{(\Pi^M)^{w_t^M}} - 1 = \left[\prod_g \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{-w_{gt}/(\sigma_g - 1)} \right]^{w_t^M} - 1 = \left[\frac{1}{EPR} \right]^{w_t^M} - 1.$

2.2 Extension I: Proposing Two Bounds for the Gains from Variety

As will become clear in the empirical section below, the gains from variety depend heavily on the *definition of a variety* and so do the relative gains between countries: Using disaggregated trade data sets, varieties are always defined as a particular good stemming from distinct countries of origin. This Armington (1969) definition, although widely used, is special and has its weaknesses: One country continually provides one variety of a specific good. There is *no growth at the extensive margin at the level of an Armington variety.* Or as Blonigen and Soderbery (2009) put it, "The Armington assumption "hides" substantial variety change".

More specifically, if rising expenditures are observed for the imports of a particular Armington variety, this can have two reasons: Either there is growth at the intensive margin (i.e., existing varieties are imported at higher values) or there is growth at the extensive margin (i.e., more *actual*[7] varieties are imported). The Armington definition of a variety only allows for growth at the intensive margin. In this section I will propose the opposite case: I will set up slightly different lambda ratios that can be interpreted as allowing full growth at the extensive margin.[8] It is then argued that the true gains from variety lie between these two polar cases.

This fundamental issue is already adressed by Feenstra (1994).[9] He shows that the lambda ratios as described in the section above do not provide the true correction of the import price index if there is a change in the number of actual varieties. An example can be used to illustrate this point: One variety using this data may be toys from China. In reality however, many actual varieties of toys are imported from China. If this number of actual varieties increases (decreases) over time, this may cause a rise (fall) in the expenditure that is due to more (less) variety. However, this will not be reflected in the lambda ratios: Since toys from China are imported *in 1990 as well as in 2006*, the expenditures on Chinese toys cancel one another out in equations (7) and (8).

Feenstra (1994) argues that Armington varieties that experience a change in *actual* variety should be *excluded from the common set*, that is from the numerators of equations (7) and (8). This means that those varieties should be treated as *new and disappearing* at the same time. This allows the extensive margin of varieties to adjust over time: A change in the expenditure changes the lambda ratio. It means full growth at the extensive margin in the following sense: A rise in the expenditure on a specific

[7]With "actual varieties" the unobserved true number of imported varieties is meant. This is in contrast to the Armington varieties that are observed in disaggregated trade data sets.

[8]With "full growth at the extensive margin", it is meant that increases in expenditure for an Armington variety are always interpreted as growth at the extensive margin and never as growth at the intensive margin.

[9]In his contribution, Feenstra (1994) directly addresses the issue of unobserved quality change in the data. These two issues can be treated identically using Feenstra's approach: Unobserved change in varieties as well as unobserved change at the extensive margin will basically have the same effect on the unobserved taste parameters. Intuitively, a variety which is available in a better quality can be seen as a *new* variety. As a consequence, the methodology laid out below addresses unobserved quality change as well as unobserved growth of varieties.

Armington variety is always interpreted as a corresponding growth in actual variety.[10]

The problem in practice is the identification of these Armington varieties since the actual varieties are unobserved: In principle, this means that a researcher had to decide for each of the tens of thousands varieties whether to include or exclude it from the common set. Quite obviously, this is not possible in an objective way.

This problem is difficult to solve. It is addressed in this paper by using two cases without any discretion for the researcher: One case, where all varieties possible are included into the common set. This is the benchmark case reviewed in Section 2.1 that was proposed by Feenstra (1994), and in this paper it will be called the *lower bound case.* It corresponds to the case with no extensive margin growth at the level of an Armington variety. The second case with no discretion is to exclude all from the common set. This leads to an *upper bound* of the import price index bias and can be interpreted as the case with full growth at the extensive margin. Proposition 1 defines this upper bound case:

Proposition 1 *In the upper bound case, a reinterpretation of the Feenstra ratio is used to correct the import price index. By excluding all varieties from the common set, this allows for full growth at the extensive margin in the sense that all increases in the expenditure of an Armington variety are interpreted as increases at the extensive margin. This leads to the following simplified lambda ratio:*

$$\frac{\lambda_{gt}}{\lambda_{gt-1}} = \frac{\sum_{c\in I_{gt-1}} p_{gct-1}x_{gct-1}}{\sum_{c\in I_{gt}} p_{gct}x_{gct}}. \tag{14}$$

The upper bound case can therefore be seen as the polar case to the original Feenstra ratio which allows for no growth at the extensive margin of an Armington variety.

Comparing this expression to the standard Feenstra ratio, the lambda ratio is simplified. Expenditures on the common set of goods, I_g, have vanished. This is achieved by excluding all varieties from the common set, except the ones whose expenditure does not change over time. As a consequence, the numerators of equations (7) and (8) cancel each other out and equation (14) results.[11] Hence, the proposed upper bound is just a reinterpretation of the Feenstra ratio. Also note that this simplified ratio is now independent of the Armington definition of a variety.[12] All that is needed to calculate the lambda ratio is the total expenditure for a product category.

[10]Feenstra partly uses this approach in his 1994 contribution. To adjust for unobserved quality change, he excludes the varieties from the developing countries and Japan from the common set in one of his specifications.

[11]If there is no variety whose expenditure stays exactly constant over time, an artificial variety with this feature is assumed. This may seem arbitrary at first sight. However, what could be done is to exclude all varieties from the common set except the one with the smallest relative change in expenditure over time. Then, the terms would "almost" cancel each other out and equation (14) is an approximation.

[12]Thus, despite using the same trade data the measure for variety growth is now independent of the Armington definition - a merit which is due to the role of the expenditure shares in the Feenstra ratio.

This interpretation of the lambda ratio contains some good intuition: Equation (14) is the ratio of total expenditures on one good in the final period over total expenditures on this good in the first period. This means that the lambda ratio lowers the price index whenever expenditures rise over time. Again, this is what is meant by full growth at the extensive margin: Rising expenditure on a product category is interpreted as an increase of the variety within this product.[13] This is also the reason for calling it the upper bound: Confronted with (mostly) rising expenditures on imports over time, this definition will yield higher gains from imported variety.

Certainly, the resulting gains from variety will most likely be too high since not every increase in the expenditure reflects a growth in variety.[14] On the other hand, using the benchmark case where *all* varieties are put into the common set, the gains from variety may be too small since increases in the *actual* variety are not considered.[15] As a consequence, I argue that the true gains from variety will lie whithin these two values.[16] Already note here that there are countless in-between cases possible when some varieties are included into and some are excluded from the common set.

2.3 Extension II: Decomposition of the Gains from Variety

The methodology developed by Feenstra (1994) allows for a very simple decomposition of the gains from variety with respect to countries of origin and industries. Especially for cross-country comparisons, it will be interesting to see which trading partners are the most important ones regarding the gains from variety: Depending on the geographical and the political location, results are expected to be quite different between countries. Furthermore, different technology, resource endowments or consumer tastes and the resulting differences in the import structure imply differences in the relative importance of different industries supplying different countries.

To split up the gains from variety with respect to countries of origin, each lambda ratio is weighted by the share a particular country owns on that good. Then, these country-weighted lambda ratios are aggregated over all goods for each country. Proposition 2 summarizes:

Proposition 2 *The gains from variety can be decomposed with respect to countries of origin by calculating the end-point ratio (EPR) for each supplying country. This EPR of imports from country i can*

[13]Note that this is not the whole story: To obtain the import price index bias, the lambda ratio gets weighted by a term incorporating the elasticity of substitution. Thus, if the elasticity is large, the price index will not be corrected by much; a feature that is desirable.

[14]Additionally there is a problem with inflation: If positive inflation is present, then this artificially increases the expenditures and leads to a correction of the import price index that is too large. Note, however, that this is not just a problem of the upper bound proposed here but an issue that is also present in Feenstra (1994).

[15]Furthermore, changes in quality are also neglected.

[16]Technically speaking, the terms *lower* and *upper* bound are not entirely correct: Since there are varieties that exhibit *decreasing* expenditures over time, *excluding* varieties from the common set could also *lower* the bias of the aggregate import price index. Thus, theoretically the upper bound bias can be lower than the lower bound bias. In practice however, when increasing expenditures for imported goods are observed, the upper bound case will yield the higher bias. Thus, as a practical terminology, I think these terms are appropriate.

be written as

$$EPR_i = \prod_g \left[\left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{(w_{gt}/(\sigma_{g-1}))W_{igt}} \right], \tag{15}$$

where W_{igt} is the ideal log-change weight of country i on good g.

Note in that multiplying all these EPR_i's, the EPR from equation (11) results:

$$EPR = \prod_i EPR_i. \tag{16}$$

To find out which industry k[17] contributes the largest share to the gains from variety, the lambda ratios of goods g[18] have to be aggregated.

Proposition 3 *The gains from variety can be decomposed with respect to an industry by aggregating the end-point ratios (EPR) of all goods belonging to a particular industry. For every industry k the EPR can be then calculated as*

$$EPR_k = \prod_g \left[\left(\frac{\lambda_{gkt}}{\lambda_{gkt-1}} \right)^{(w_{gkt}/(\sigma_{gkt}-1))} \right], \tag{17}$$

where g is a good of industry k and w_{gkt} is the ideal log-change weight of this good.

Again, the following holds:

$$EPR = \prod_k EPR_k. \tag{18}$$

3 Gains from Variety and the Extensive Margin

In this section, the methodology laid out in Section 2 is applied to Swiss and U.S. data. The lower and the upper bounds of the gains from variety are calculated. The decomposition of the gains is also carried out.

The Swiss trade data are available from the Swiss Federal Customs Administration.[19] The data include import values and imported quantities for all HS-8 country pairs. This allows the calculation of unit prices. For the United States, data is available from the Center of International Trade Data at UC Davis.[20] The U.S. data is available at an even more disaggregated level, namely HS-10. The definition

[17]For example, an industry can be defiend at the HS-2 level. This will be done in the empirical section below.
[18]For example HS-8 product categories, depending on the disaggregation of the data available.
[19]See *www.admin.ezv.ch*.
[20]They are provided by Robert C. Feenstra. Visit *http://cid.econ.ucdavis.edu/*.

of goods and varieties follows directly from the data: Goods are defined as HS product categories and varieties are defined as good - country pairs. I start with some descriptive statistics about imported variety growth in the two countries.

3.1 The Growth in Imported Variety

In the last 20 years the fraction of imports of goods compared to GDP has risen from 30% to 40% in Switzerland. The value of all imports of goods has risen from roughly 80 billion Swiss Francs to over 170 billion, an annual growth rate of over 4%, while GDP has risen by 1.8% per year.[21]

Table 1: Variety of Swiss Imports 1990-2006

	Year	Number of HS goods	Median no. of countries per good	Mean no. of countries per good	Total no. of varieties (goods)	Share of total imports (goods)
		(1)	(2)	(3)	(4)	(5)
All goods (1990)	1990	4,944	10	13.82	68,327	1.00
All goods (2006)	2006	5,124	11	17.85	91,439	1.00
Common (1990)	1990	4,470	11	14.11	63,083	0.86
Common (2006)	2006	4,470	13	18.54	82,868	0.83
1990 not in 2006	1990	474	8	11.06	5,244	0.14
2006 not in 1990	2006	654	7	13.11	8,571	0.17

A good is defined after HS-6. A variety is defined as a good from a particular country. This table is similar to the one in Broda and Weinstein (2006).

Not only have import values risen, but also the imported product variety has. Table 1 displays these remarkable changes between 1990 and 2006 for Switzerland. Column (1) shows that the total number of imported goods has risen from 4,944 to 5,124 within twenty years.[22] 4,470 goods were imported in 1990 as well as in 2006; i.e., these are common goods of both periods. This means that some goods disappeared in the last twenty years, and even more goods were imported for the first time as can be seen in the last two rows of column (1).

Columns (2)-(4) of Table 1 display statistics about the varieties comprised in the goods of column (1). The number of imported varieties has risen from 68,327 in 1990 to 91,439 in 2006. This is an increase of about 34%. Since varieties are defined as goods stemming from different countries, it can be stated that in 1990 one good originated from an average of 13.82 countries, whereas 17 years later the average number of supplying countries has risen to 17.85. Column (5) reveals that a large share of total imports, about 17%, can be attributed to new goods. All the above stresses the changing pattern of Swiss imports in the last 20 years: Imports originate from a larger number and a different set of countries today compared with 17 years ago.

[21] In real terms. The data is taken from the Swiss Federal Statistical Office, *http://www.bfs.admin.ch*

[22] In Tables 1 and 2, HS-6 is chosen as the definition of a good. The reason is that at the sixth digit level, the trade statistics are harmonized and, consequently, imported variety can be compared across countries. At more disaggregated levels, each country can use its own definitions.

Table 2: Variety of U.S. Imports 1990-2006

	Year	Number of HS goods	Median no. of countries per good	Mean no. of countries per good	Total no. of varieties (goods)	Share of total imports (goods)
		(1)	(2)	(3)	(4)	(5)
All goods (1990)	1990	4,987	14	18.46	92,048	1.00
All goods (2006)	2006	5,182	18	25.32	131,191	1.00
Common (1990)	1990	4,518	14	18.79	84,872	0.86
Common (2006)	2006	4,518	18	26.10	117,928	0.84
1990 not in 2006	1990	469	11	15.30	7,176	0.14
2006 not in 1990	2006	664	14	19.97	13,263	0.16

A good is defined after HS-6. A variety is defined as a good from a particular country. This table is similar to the one in Broda and Weinstein (2006).

For the United States the pattern of imported variety is very similar, although even more accentuated as Table 2 shows. As a consequence of the harmonized HS-6 product categories, the number of goods as displayed in column (1) is very similar to Switzerland. However, the U.S. imports these goods from more countries on average: In 1990, the average good is imported from 18.46 countries, whereas in 2006 an average of 25.32 countries supplied the United States. This is between 30% and 40% higher than the average for Switzerland. Column (4) reveals that this leads to many more imported varieties in the United States compared with Switzerland. In 1990, the United States imported 92,048 varieties, 35% more than Switzerland. In 2006, this number rose to 131,191, 43% more than Switzerland. Also, the United States imported 53% more *new* varieties than Switzerland, 13,263 compared to 8,571. This means that the difference in imported variety became even larger between the two countries over the last 17 years, in absolute and relative terms.

3.2 The Gains from Variety in Switzerland and the United States 1990-2006

As a first step for calculating the gains from variety, the elasticity of substitution is estimated for every product group using the methodology presented in Feenstra (1994). Some summary statistics are shown in Table 3. The table shows that the elasticities of substitution are higher for Swiss import goods, which is illustrated by the median of 4.07 compared to 3.28 in the United States.

Table 3: Sigmas for Different Levels of Aggregation

	Switzerland	United States
Elasticities Estimated	7,846	16,322
Mean	11.07	11.84
Standard Error	1.55	1.52
Median	4.07	3.28
Maximum Elasticity	7,685.96	15,263.29
Minimum Elasticity	1.05	1.01

A variety is defined at the HS-8 level for Switzerland and the HS-10 level for the United States

Two main differences between Switzerland and the United States can already be noted here: First, Switzerland imports fewer new varieties compared to the United States. Secondly, the median elasticity of substitution is larger for Swiss imports. This has implications for the aggregate price index.

To compute the corrected aggregate price index as in equation (6), the lambda ratios are calculated.[23] Table 4 shows summary statistics of the lambda ratios under the lower and the upper bound case for Switzerland and the United States. The lambda ratios can be interpreted as a measure of variety growth: The lower the median lambda ratio, the higher the variety growth in the median product category. A lambda ratio of 0.93% can be interpreted as variety growth of about 7.5%. [24]

Table 4: Descriptive Statistics of the Lambda Ratios

	Switzerland	
Statistic	Lower Bound	Upper Bound
Number	2,081	2,081
Mean	1.51	3.20
Median	**0.98**	**0.78**
	United States	
Statistic	Lower Bound	Upper Bound
Nobs	1,365	1,365
Mean	1.53	3.44
Median	**0.93**	**0.35**

Note the differences in the lambda ratios between the two specifications: The medians are lower if more varieties are excluded from the common set. These varieties lower the lambda ratios since the expenditure is increasing for most of them. The lambda ratios are lower in the United States under both specifications. This is a consequence of the higher increase in the new product varieties that were imported at high values by the United States during these 17 years.

Table 5: Bias in the Swiss and U.S. Import Price Indices and GFV

	Switzerland				United States			
	EPR	**Total bias**	Avg. bias	**GFV**	EPR	**Total bias**	Avg. bias	**GFV**
Lower Bound	0.991	**0.88%**	0.05%	**0.27%**	0.952	**4.79%**	0.29%	**0.52%**
Upper Bound	0.853	**14.65%**	0.93%	**4.98%**	0.648	**35.17%**	2.52%	**4.70%**

The total bias is defined as $TB = 1/EPR - 1$. Thus, it is the percentage by which the conventional price index is biased upwards. Average values are always per-annum averages.

Using equations (4) to (10) and these lambda ratios, the conventional import price index as well as the corrected import price index are computed. Table 5 displays the EPRs for both countries under the two specifications. Over the last 17 years, ignoring the change in the set of imported varieties has led to an upward bias of the import price index by 0.88% in Switzerland, an annual bias of 0.05%. For the

[23] Note that for HS-8 (SITC-5) goods the lambda ratio is not defined if there is no common variety in the first and the last period. Where this requirement fails, the lambda ratio of the SITC-5 (SITC-3) good is used for all the HS-8 (SITC-5) goods within this SITC-5 (SITC-3) category. To obtain an elasticity for these aggregated goods, the geometric mean of the sigmas of the HS-8 (and only the HS-8) goods is used. For example, for Switzerland only 2,081 lambda ratios are defined (not 7,846), a combination of SITC-3, SITC-5 and HS-8 goods. Note however, that *all* 7,846 sigmas are used for the calculation of the index. This is the way Broda and Weinstein (2006) implemented it. It leaves open the question as to *which* lambda ratios should be chosen in the upper bound case where an artificial variety is included in the common set. The most obvious choice is to use these lambda ratios that are defined in the lower bound case. This is very convenient since then the two specifications are comparable as they exhibit exactly the same lambda ratio structure.

[24] This is calculated as 1/0.93-1=0.075.

United States the total bias is 4.79%, 0.29% annually. The corrected import price index in the upper bound case is 14.65% lower than the conventional import price index in Switzerland, an annual bias of 0.93%. For the United States the total bias amounts to 35.17%, 2.52% annually.

The Gains from Variety: Lower and Upper Bound

As laid out in Section 2 by equations (12) and (13), now the bias in the import price index has to be weighted by the import share to obtain the gains from variety relative to GDP. As in Broda and Weinstein (2006) I determine that share simply by taking the fraction of imports relative to GDP. Broda and Weinstein (2006) consequently obtain a share of 10.3% for the period of 1990 to 2001. This share raises to 10.6% when taking the years 2002-2006 into account. In Switzerland, the average import share is 30.7% during this period.

Using these weights and the two different biases of the price index above, the gains from variety can be calculated. Using the lower bound bias, the gains from variety account for 0.27% of GDP in Switzerland as Table 5 displays. Using the upper bound bias the gains from variety account for 4.98% of GDP in Switzerland. For the United States the gains from variety lie between 0.52% and 4.70% of GDP. Thus, the gains from variety found in Broda and Weinstein (2006) seem to be a lower bound.[25] Another proposition can be formulated:

Proposition 4 *The empirical gains from imported variety are substantially higher in Switzerland and the United States if the proposed upper bound is used instead of the benchmark case of Feenstra (1994). This is due to the fact that using the upper bound, increases in expenditure on imports are interpreted as increases in variety.*

These gains from imported variety can now be further analyzed: First, it can be assessed which trading partners contribute the largest part to these gains. Secondly, the gains from imported variety can be attributed to the different supplying industries.

The Contribution of Different Trading Partners

Considering Table 9 for the lower bound case and Table 10 for the upper bound case, Germany contributes by far the largest part to the gains from variety in Switzerland, namely about 35%.[26] Furthermore, approximately 60% of all the gains are due to imports from Switzerland's most important trading

[25] Broda and Weinstein (2006) find a welfare gain of 0.90 for the period of 1990 to 2001. One part of the difference to my results can be explained by the slightly lower elasticities in Broda and Weinstein (2006). Furthermore, estimating the gains for the period of 1990-2001 I find basically the same results as for the longer period. Thus, the period of 2002 to 2006 do not contribute to the gains from variety. I think the results are quite similar in magnitude.

[26] The relative contribution of a single country (or industry) to the gains compared to the total gains from variety can be approximated by $(1 - EPR_i)/(1 - EPR)$, where EPR is the end-point ratio using all imports.

partners Germany, Italy and France. Further important contributors are China, France, the United Kingdom, Austria, and Spain.

In the United States, Canada and Japan are the most important trading partners regarding the gains from imported variety, each with a 15% to 20% share on the total gains under both specifications. Mexico, France, Germany, Taiwan, the United Kingdom, China and Italy are all in the top ten under both specifications.

Switzerland appears to be substantially dependent on its three large neighbouring countries, whereas the gains from variety in the United States are more equally distributed among many major trading partners allover the world. The geographical and the political situation of the two countries is clearly reflected in these statistics: While Switzerland is highly integrated into the EU and located in the heart of Europe, for the United States, its NAFTA partners and Japan are important, while the rest of the World has a more equal share on the gains from variety.

Comparing the lower and the upper bound, there are some noteworthy differences: For example, China contributes 8.2% to the gains from variety in Switzerland in the lower bound case, but only 2.2% in the upper bound case. This is a direct consequence of the upper bound that assumes that rising import values are related to a rising imported variety: While Switzerland imported many additional new varieties from China over the last two decades, the value of the imports from China is still small compared to the imports from large European countries. The same is true for imports originating from countries of the former Czechoslovakia, the former USSR, or from countries like Poland or Hungary. In the United States, the differences beetween the lower and upper bound are not that pronounced.

The Contribution of Different Industries

Tables 11 and 12 in the appendix show the contribution of the 25 most important HS-2 products (industries) to the gains from variety in the lower and in the upper bound case. The ranking of goods in the two tables is quite similar. For the United States, 20 out of 25 products that are ranked in the top 25 in the lower bound case are also ranked in the top 25 in the upper bound case (in bold script). For Switzerland this is the case for 12 of 25 product categories. Also, most of the products shown in the tables are assumingly differentiated, with some exceptions like Aluminum.[27]

In Switzerland, chemicals, various machinery, clocks and watches, vehicles, articles of plastic, various instruments, furniture and some other categories contribute most to the gains from variety. In the United States, the most important industries are vehicles, clothing, machinery, articles of iron or steel, various instruments, chemicals, aircraft, books and other printed matter, etc.

[27] Note, however, that according to the Rauch (1999) classification, most of the sub-categories comprised in the category "Aluminium and Articles thereof" are not classified as homogeneous goods but as reference priced ones.

4 Size and Openness and the Gains from Variety

This section analyzes the differences in the gains from variety between the United States and Switzerland more closely. Specifically, the following questions shall be answered: What factors exactly determine the differences in the gains from variety between countries and what is the relative importance of these factors? And: When and under what circumstances are the gains from variety higher or lower in Switzerland, relative to the United States? Additionally, it is shown that the results that are found for Switzerland and the United States may hold generally for other small and large OECD countries.

4.1 Small vs. Large Country: What's the Difference?

Table 5 implies that the bias in the import price index is smaller in Switzerland under both specifications. Within the model, these differences can be attributed to two sources: There is the expenditure on new and disappearing varieties, and there is the magnitude of the elasticities of substitution. The more new varieties imported at high values, the higher the bias in the import price index. The lower the elasticities of substitution, the more the lambda ratios deviate from one.[28]

To separate these two sources, the import price index bias is estimated under *fixed* elasticities of substitution. Table 6 below displays the results. The EPRs vary considerably with the choice of the fixed elasticities.[29] Note however, that no matter which specification is used or how large the fixed elasticities are, *the bias in the import price index is always larger for the United States.*

Table 6: Bias in the Swiss and U.S. Import Price Indices Under Fixed Elasticities

	Switzerland					United States				
	variable	$\sigma = 2$	$\sigma = 4$	$\sigma = 8$	$\sigma = 15$	variable	$\sigma = 2$	$\sigma = 4$	$\sigma = 8$	$\sigma = 15$
Lower bound	0.9%	3.5%	1.2%	0.5%	0.3%	4.8%	9.3%	3.2%	1.4%	0.7%
Upper bound	14.7%	46.8%	19.0%	8.6%	4.4%	35.2%	71.4%	34.1%	16.4%	8.5%

Table 7 shows the bias in the price index in Switzerland relative to the bias in the United States. In the lower bound case for example, the bias in Switzerland if variable sigmas are used is 81.7% lower than the one in the United States.[30] If fixed sigmas are used, the bias in Switzerland is between 62.5% and 63.5% lower, depending on the size of the fixed sigmas. This means that in the lower bound case, between 76.4% and 77.7% of the difference in the price index bias between Switzerland and the United

[28]Illustration: The lambda ratio is weighted by $1/(\sigma_g - 1)$, resulting in the term $\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{1/(\sigma_g-1)}$. For example, if $\frac{\lambda_{gt}}{\lambda_{gt-1}} = 0.8$, with a low elasticity, $\sigma = 1.5$, the mentioned term becomes $0.8^2 = 0.64$. With a higher elasticity, for example $\sigma_g = 5$, the term gets closer to one, $0.8^{0.25} = 0.95$.

[29]These elasticities are not without problems: As hinted at in the introduction, in the standard CES model, these elasticities stand for the substitution between goods (market power), the love of variety and the price elasticity of demand. Thus, many things are captured by this parameter, possibly many effects that have nothing to do with love of variety. However, if I compare countries, I find that the relative bias in the price index is quite stable. Naturally, in the upper bound case the relative bias changes quite a bit under different elasticities (Table (7)).

[30]This is calculated as $\frac{0.9\%-4.8\%}{4.8\%} = -81.7\%$.

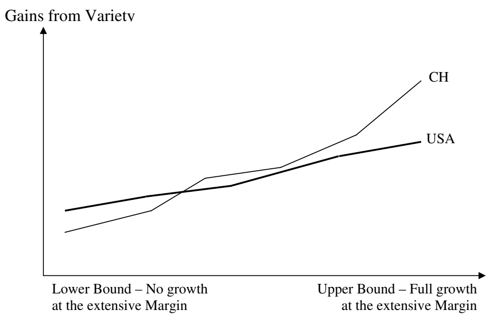
States is explained by lower imported variety growth in Switzerland as is displayed in the last four columns of Table 7. Using the upper bound, this is the case for between 58.9% and 81.0% of the difference. The rest of the difference, which is always much smaller than 50%, is due to the higher elasticities of substitution of Swiss import goods.

Table 7: Share of the Difference in the Bias Explained by Lower Variety Growth

		Relative differences in the bias				% explained by lower imp. variety			
	variable	$\sigma = 2$	$\sigma = 4$	$\sigma = 8$	$\sigma = 15$	$\sigma = 2$	$\sigma = 4$	$\sigma = 8$	$\sigma = 15$
Lower bound	-81.7%	-62.5%	-63.2%	-63.4%	-63.5%	**76.4%**	**77.4%**	**77.6%**	**77.7%**
Upper bound	-58.3%	-34.4%	-44.3%	-47.3%	-48.4%	**58.9%**	**75.9%**	**81.0%**	**82.9%**

Why is this result interesting or important? It says that the U.S. consumers profit more from the imported variety mainly because their choice of preferred goods increased by much more, and not because imported products are generally more differentiated. This is an interesting result in the light of other trade literature: It says that the lower number of imported varieties in Switzerland, which *may* be a consequence of natural (or other) barriers to trade, matters from a welfare perspective. Stated differently, the gains from variety in Switzerland would be much higher were it to profit from a rate of imported variety growth similar to that of the United States: For example using the lower bound, gains from variety would almost double in Switzerland.[31]

Figure 1: Gains from Variety for Different Extent of Extensive Margin Growth



The second point worth analyzing is presented in Table 5: It is striking that depending on the definition of the lambda ratios the gains from variety can be larger or smaller in Switzerland compared to the United States. Note that between the two polar cases there are thousands of possibilities of defining the lambda ratios differently by excluding some varieties from the common set and retaining others in the common set. Figure 1 shows how this may look qualitatively.[32] One observation is, that since the true growth at the extensive margin is not known, it is not clear whether Switzerland or the

[31] Consider the case of $\sigma = 4$ and the lower bound: With the same variety growth as the United States, Switzerland would experience a bias in the price index of $\frac{1.2\%}{1-63.2\%*77.4\%} = 2.3\%$. Thus, the import price index bias would almost double and so would the gains from imported variety.

[32] This figure is "drawn by hand" for expositional purposes. Note that thousands of different paths between the two bounds are possible depending on the order in which the varieties are excluded from the common set. Also, the paths could intersect more than once.

United States enjoy higher variety gains from imports relative to their GDP.

More importantly however, the figure implies that the more action is allowed at the extensive margin, the higher are the gains from variety in Switzerland relative to the United States. This is no coincidence: Considering equation (13), the term in parantheses gets bigger, if more and more varieties are excluded from the common set. And the bigger this term, the larger is the effect of a higher import share w_t^M. In other words, if more growth at the extensive margin is assumed, the higher import share in Switzerland (or any SOE) will more likely dominate the lower growth in variety. As a consequence, the gains from variety in Switzerland can surpass those in the United States. The subsequent proposition summarizes:

Proposition 5 *The comparison of Switzerland and the United States yields the following empirical results:*

(a) In the United States, the import price index is biased upwards more severely which is mainly due to the higher growth in imported variety. This implies that the lower variety growth observed in Switzerland quantitatively matters to consumers from a welfare perspective.

(b) The higher the assumed growth at the extensive margin of imports, the higher are the gains from variety in Switzerland relative to those in the United States. The reason is that the larger the extensive margin, the larger is the effect of the higher import share.

4.2 How General are these Results?

The results of Proposition 5 hold for Switzerland and the United States for the considered period. But how general are these results? Using OECD data, Figures 2a to 2c display relationships of the central variables.[33] Not surprisingly, larger OECD countries generally exhibit a lower import share. Furthermore, one can find a clear positive relationship between the growth in imported varieties and the size of a country measured by its GDP. [34]

What remains to be checked is whether smaller countries exhibit higher elasticities of substitution in general. Broda et al. (2006) estimate sigmas for 73 countries. Figure 2c shows the median sigmas and the total GDP for the OECD countries. It does not seem to be the case that larger countries generally have lower median elasticities. Note that most countries are estimated to have median elasticities that lie between 3 and 4. Therefore, the differences in the price index bias between countries resulting from

[33] Only "fully developed" and industrialized countries are used: the Czech Republic, Hungary, Mexico, Poland, Slovakia and Turkey are excluded from the sample. Furthermore, the United States and Japan are excluded in the figures since with these two extreme outliers in the sample, there seems to be a negative relationship between the GDP and the median elasticity. The positive relationship between GDP and the growth in varieties, and GDP and import share also holds when these two countries are included.

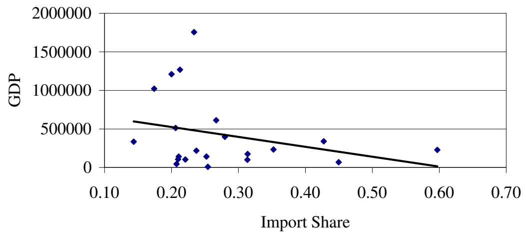
[34] This relationship is not new and is found in other contributions as for example in Hummels and Lugovskyy (2005).

differences in the median elasticities will be relatively small. Table 8 displays some regression results to support the "eyeballing" of this section. Proposition 6 summarizes.

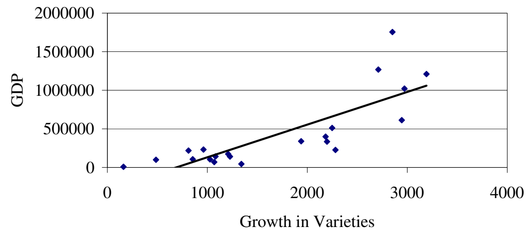
Proposition 6 *The results summarized in Proposition 5 seem to be generally valid for other small and large OECD economies. Part (a) is supported by the observation that the imported variety growth is smaller in smaller OECD economies while there are no substantial and systematic differences in the magnitude of the elasticities of substitution. Part (b) is supported by the observation that import shares are larger in smaller OECD economies. As a consequence, the gains from variety will be relatively higher in SOE if more growth at the extensive margin is assumed.*

Figure 2: Imported Variety and OECD Countries

(a) GDP - Import Shares 1991-2000



(b) GDP - Growth in Varieties 1991-2000



(c) GDP - Median Elasticity 1994-2003

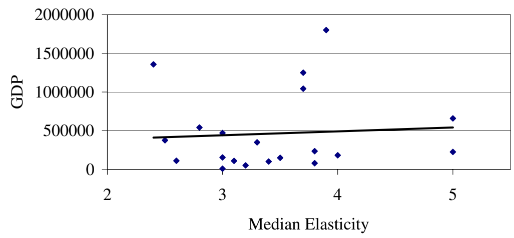


Table 8: Regression Results OECD Countries

	OECD without USA, Japan			OECD with USA, Japan		
Depvar: GDP	Imp. Share	Var. Growth	Med. Elast.	Imp. Share	Var. Growth	Med. Elast.
	1a	1b	1c	2a	2b	2c
Coefficient	-0.065**	1.528***	0.990	-0.030***	0.427***	-1.243***
Stand. Err.	0.029	0.308	2.800	0.009	0.077	0.270
R-Squared	0.084	0.647	0.005	0.231	0.503	0.119

Significance levels: (**) means significant at the 5% level, (***) means significant at the 1% level. Only fully developed OECD countries are included: The Czech Republic, Hungary, Mexico, Poland, Slovakia and Turkey are excluded from the sample. Note that this table just shows correlation between those variables; no causality is implied.

5 Concluding Remarks

In this paper, a lower and an upper bound for the bias in the aggregate import price index of Feenstra's (1994) seminal contribution is proposed. The upper bound case assumes more growth at the extensive margin than observed in conventional trade data sets. This assumption is supported by the empirical literature, for example, analyzing firm-level data. Using these bounds the gains from variety are estimated for Switzerland and the United States for the period from 1990 to 2006. In Switzerland, the gains amount to between 0.3% and 5.0% of GDP, while in the United States these gains lie between 0.5% and 4.7%. Consequently, I argue that the gains from variety as found by Broda and Weinstein (2006) are a lower bound.

These gains from variety can then be decomposed with regard to the contributions of countries of origin and industries: Roughly 60% of the gains from variety in Switzerland are due to imports stemming from Switzerland's direct neighbours, Germany, Italy and France. In the United States the gains are more equally distributed among more major trading partners. Looking at product categories, classical differentiated goods like Motor Vehicles contribute large shares to the gains from variety in both countries.

I am further interested in the relationship between the (unobserved) growth at the extensive margin and the size and openness of countries: First, the import price index is always lower in Switzerland, the small open economy. The difference is mostly due to the lower growth in imported variety compared to the United States. This result implies that the lower growth in imported variety in Switzerland matters to Swiss consumers from a welfare perspective.

Secondly, the much higher import share in Switzerland can overcompensate for this lower variety growth and lead to higher welfare gains from imported variety as a percentage of GDP in Switzerland: It is shown that the higher the assumed growth at the extensive margin, the higher the gains from variety in Switzerland relative to those in the United States.

It is furthermore argued that these relationships hold for other OECD countries: Small OECD countries that exhibit a higher import share, tend to have much lower growth in imported varieties over time using conventional trade data sets. This implies a generally lower import price index bias in those countries. Depending on the unobserved extensive margin however, their welfare gains from imported variety, relative to the gains in large OECD countries, are likely to vary due to their much higher import share.

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Appendix

Table 9: Contribution of Individual Countries to the Gains from Variety, Lower Bound Case

Switzerland			United States		
Country	Rank	Contr.	Country	Rank	Contr.
Germany	1	34.0%	Japan	1	18.2%
Italy	2	11.9%	Canada	2	14.3%
China	3	8.2%	Mexico	3	10.7%
France	4	7.5%	France	4	7.7%
United Kingdom	5	7.0%	Germany	5	6.8%
Ireland	6	6.2%	Taiwan	6	5.9%
Austria	7	4.3%	United Kingdom	7	5.2%
Former Czechoslovakia	8	3.0%	China	8	5.0%
Former USSR	9	3.0%	Italy	9	4.3%
Spain	10	2.2%	Hong Kong	10	3.0%
Japan	11	2.0%	Korea (South)	11	2.1%
USA	12	2.0%	Brazil	12	1.9%
Poland	13	1.9%	Netherlands	13	1.8%
Netherlands	14	1.7%	Sweden	14	1.3%
Sweden	15	1.6%	Ireland	15	1.2%
Denmark	16	1.2%	Singapore	16	1.1%
Hungary	17	0.9%	Spain	17	0.8%
Canada	18	0.8%	India	18	0.7%
Former Yugoslavia	19	0.6%	Israel	19	0.6%
Turkey	20	0.6%	Indonesia	20	0.6%

Contr. is the contribution of a country relative to the total gains from variety, expressed in percent. The contribution can also be negative.

Table 10: Contribution of Individual Countries to the Gains from Variety, Upper Bound Case

Switzerland			United States		
Country	Rank	Contr.	Country	Rank	Contr.
Germany	1	36.7%	Canada	1	22.8%
Italy	2	14.6%	Japan	2	18.0%
France	3	9.7%	Mexico	3	9.5%
Spain	4	5.8%	Germany	4	8.2%
USA	5	5.4%	Taiwan	5	8.0%
United Kingdom	6	5.0%	China	6	6.1%
Austria	7	4.8%	United Kingdom	7	5.4%
Belgium & Luxemburg	8	3.8%	France	8	5.1%
Netherlands	9	3.1%	Italy	9	4.1%
China	10	2.2%	Korea (South)	10	3.5%
Ireland	11	1.7%	Hong Kong	11	2.5%
Japan	12	1.3%	Belgium & Luxemburg	12	1.9%
Canada	13	1.2%	Brazil	13	1.9%
Hong Kong	14	0.9%	Netherlands	14	1.7%
Finland	15	0.8%	Israel	15	1.3%
Sweden	16	0.8%	Thailand	16	1.3%
Lybia	17	0.8%	Malaysia	17	1.2%
Former Czechoslovakia	18	0.8%	Sweden	18	1.2%
Denmark	19	0.8%	Singapore	19	1.1%
Former USSR	20	0.7%	Chile	20	1.1%

Contr. is the contribution of a country relative to the total gains from variety, expressed in percent. The contribution can also be negative.

Table 11: Contribution of HS-2 Industries to the Gains from Variety, Switzerland

Lower bound case			
HS-2	Rank	Contr.	Description (short)
29	**1**	**16.6%**	**ORGANIC CHEMICALS**
84	**2**	**14.8%**	**NUCLEAR REACTORS, BOILERS, MACHINERY, ETC.; PARTS THEREOF**
91	**3**	**8.1%**	**CLOCKS AND WATCHES AND PARTS THEREOF**
28	4	7.8%	INORGANIC CHEMICALS, ETC.
85	**5**	**7.2%**	**ELECTRICAL MACHINERY, SOUND AND TV RECORDERS, ETC.**
87	**6**	**7.1%**	**VEHICLES OTHER THAN RAILWAY OR TRAMWAY, PARTS THEREOF**
39	**7**	**6.6%**	**PLASTICS AND ARTICLES THEREOF**
92	8	6.4%	MUSICAL INSTRUMENTS, AND PARTS THEREOF
93	9	4.4%	ARMS AND AMMUNITION, AND PARTS THEREOF
90	**10**	**4.0%**	**OPTICAL, PHOTOGRAPHIC, MEDICAL AND OTHER INSTRUMENTS**
88	11	3.9%	AIRCRAFT, SPACECRAFT, AND PARTS THEREOF
94	**12**	**3.7%**	**FURNITURE; BEDDING, MATTRESSES, ETC.**
22	13	2.7%	BEVERAGES, SPIRITS AND VINEGAR
74	**14**	**2.6%**	**COPPER AND ARTICLES THEREOF**
64	15	2.3%	FOOTWEAR, GAITERS AND THE LIKE; PARTS OF SUCH ARTICLES
70	16	2.3%	GLASS AND GLASSWARE
62	17	2.2%	ARTICLES OF APPAREL ACC., NOT KNITTED OR CROCHETED
59	18	2.1%	IMPREGNATED, COATED, COVERED OR LAMINATED TEXTILE FABRICS
68	**19**	**2.1%**	**ARTICLES OF STONE, PLASTER, CEMENT, ASBESTOS, ETC.**
73	**20**	**2.0%**	**ARTICLES OF IRON OR STEEL**
34	21	1.8%	SOAP, WASHING PREPARATIONS, LUBRICATING PREPARATIONS, CANDLES, ETC.
63	22	1.6%	OTHER MADE-UP TEXTILE ARTICLES; SETS; RAGS
44	**23**	**1.4%**	**WOOD AND ARTICLES OF WOOD; WOOD CHARCOAL**
96	24	1.4%	MISCELLANEOUS MANUFACTURED ARTICLES
4	25	1.2%	DAIRY PRODUCE; BIRDS' EGGS; NATURAL HONEY;ETC.

Upper bound case			
HS-2	Rank	Contr.	Description (short)
30	1	31.8%	PHARMACEUTICAL PRODUCTS
84	**2**	**10.3%**	**NUCLEAR REACTORS, BOILERS, MACHINERY, ETC.; PARTS THEREOF**
39	**3**	**6.6%**	**PLASTICS AND ARTICLES THEREOF**
85	**4**	**6.4%**	**ELECTRICAL MACHINERY, SOUND AND TV RECORDERS, ETC.**
76	5	4.2%	ALUMINIUM AND ARTICLES THEREOF
71	6	3.9%	NATURAL OR CULTURED PEARLS, PRECIOUS OR SEMI-PRECIOUS STONES, ETC.
73	**7**	**3.8%**	**ARTICLES OF IRON OR STEEL**
90	**8**	**3.8%**	**OPTICAL, PHOTOGRAPHIC, MEDICAL AND OTHER INSTRUMENTS**
94	**9**	**3.6%**	**FURNITURE; BEDDING, MATTRESSES, ETC.**
87	**10**	**3.1%**	**VEHICLES OTHER THAN RAILWAY OR TRAMWAY, PARTS THEREOF**
29	**11**	**2.2%**	**ORGANIC CHEMICALS**
49	12	2.2%	PRINTED BOOKS, NEWSPAPERS, PICTURES, ETC.
72	13	2.0%	IRON AND STEEL
83	14	1.9%	MISCELLANEOUS ARTICLES OF BASE METAL
91	**15**	**1.7%**	**CLOCKS AND WATCHES AND PARTS THEREOF**
74	**16**	**1.7%**	**COPPER AND ARTICLES THEREOF**
27	17	1.5%	MINERAL FUELS, MINERAL OILS, ETC.
48	18	1.2%	PAPER AND PAPERBOARD;, ETC.
33	19	1.1%	ESSENTIAL OILS; PERFUMERY, COSMETIC PREPARATIONS
32	20	1.0%	TANNING OR DYEING EXTRACTS; PAINTS; ETC.
38	21	1.0%	MISCELLANEOUS CHEMICAL PRODUCTS
40	22	1.0%	RUBBER AND ARTICLES THEREOF
68	**23**	**0.9%**	**ARTICLES OF STONE, PLASTER, CEMENT, ASBESTOS, ETC.**
95	24	0.9%	TOYS, GAMES AND SPORTS REQUISITES
44	**25**	**0.9%**	**WOOD AND ARTICLES OF WOOD; WOOD CHARCOAL**

Contr. is the contribution of an industry relative to the total gains from variety, expressed in percent. The contribution can also be negative.

Table 12: Contribution of HS-2 Industries to the Gains from Variety, United States

			Lower bound case
HS-2	Rank	Contr.	Description (short)
87	**1**	**24.1%**	**VEHICLES OTHER THAN RAILWAY OR TRAMWAY, PARTS THEREOF**
62	**2**	**8.2%**	**ARTICLES OF APPAREL ACC., NOT KNITTED OR CROCHETED**
85	**3**	**7.6%**	**ELECTRICAL MACHINERY, SOUND AND TV RECORDERS, ETC.**
73	**4**	**6.8%**	**ARTICLES OF IRON OR STEEL**
90	**5**	**5.6%**	**OPTICAL, PHOTOGRAPHIC, MEDICAL AND OTHER INSTRUMENTS**
30	6	5.0%	PHARMACEUTICAL PRODUCTS
29	**7**	**4.6%**	**ORGANIC CHEMICALS**
84	**8**	**4.5%**	**NUCLEAR REACTORS, BOILERS, MACHINERY, ETC.; PARTS THEREOF**
88	**9**	**3.7%**	**AIRCRAFT, SPACECRAFT, AND PARTS THEREOF**
61	**10**	**3.2%**	**ARTICLES OF APPAREL ACC., KNITTED OR CROCHETED**
49	**11**	**2.8%**	**PRINTED BOOKS, NEWSPAPERS, PICTURES, ETC.**
42	**12**	**2.8%**	**ARTICLES OF LEATHER; SADDLERY; HANDBAGS; ETC.**
82	**13**	**2.7%**	**TOOLS, IMPLEMENTS, CUTLERY, SPOONS AND FORKS, ETC.**
48	**14**	**2.7%**	**PAPER AND PAPERBOARD;, ETC.**
22	**15**	**2.3%**	**BEVERAGES, SPIRITS AND VINEGAR**
69	16	2.0%	CERAMIC PRODUCTS
74	**17**	**2.0%**	**COPPER AND ARTICLES THEREOF**
44	18	2.0%	WOOD AND ARTICLES OF WOOD; WOOD CHARCOAL
64	19	1.6%	FOOTWEAR, GAITERS AND THE LIKE; PARTS OF SUCH ARTICLES
39	**20**	**1.5%**	**PLASTICS AND ARTICLES THEREOF**
76	**21**	**1.4%**	**ALUMINIUM AND ARTICLES THEREOF**
63	**22**	**1.3%**	**OTHER MADE-UP TEXTILE ARTICLES; SETS; RAGS**
38	23	1.0%	MISCELLANEOUS CHEMICAL PRODUCTS
28	**24**	**1.0%**	**INORGANIC CHEMICALS, ETC.**
72	**25**	**0.8%**	**IRON AND STEEL**

			Upper bound case
HS-2	Rank	Contr.	Description (short)
85	**1**	**16.0%**	**ELECTRICAL MACHINERY, SOUND AND TV RECORDERS, ETC.**
84	**2**	**14.3%**	**NUCLEAR REACTORS, BOILERS, MACHINERY, ETC.; PARTS THEREOF**
87	**3**	**13.1%**	**VEHICLES OTHER THAN RAILWAY OR TRAMWAY, PARTS THEREOF**
94	4	7.9%	FURNITURE; BEDDING, MATTRESSES, ETC.
71	5	4.9%	NATURAL OR CULTURED PEARLS, PRECIOUS OR SEMI-PRECIOUS STONES, ETC.
39	**6**	**4.3%**	**PLASTICS AND ARTICLES THEREOF**
74	**7**	**4.3%**	**COPPER AND ARTICLES THEREOF**
29	**8**	**4.0%**	**ORGANIC CHEMICALS**
90	**9**	**3.7%**	**OPTICAL, PHOTOGRAPHIC, MEDICAL AND OTHER INSTRUMENTS**
28	**10**	**3.1%**	**INORGANIC CHEMICALS, ETC.**
61	**11**	**3.0%**	**ARTICLES OF APPAREL ACC., KNITTED OR CROCHETED**
27	12	2.6%	MINERAL FUELS, MINERAL OILS, ETC.
73	**13**	**2.4%**	**ARTICLES OF IRON OR STEEL**
62	**14**	**2.3%**	**ARTICLES OF APPAREL ACC., NOT KNITTED OR CROCHETED**
82	**15**	**2.3%**	**TOOLS, IMPLEMENTS, CUTLERY, SPOONS AND FORKS, ETC.**
76	**16**	**2.3%**	**ALUMINIUM AND ARTICLES THEREOF**
49	**17**	**2.1%**	**PRINTED BOOKS, NEWSPAPERS, PICTURES, ETC.**
22	**18**	**1.8%**	**BEVERAGES, SPIRITS AND VINEGAR**
48	**19**	**1.6%**	**PAPER AND PAPERBOARD;, ETC.**
88	**20**	**1.5%**	**AIRCRAFT, SPACECRAFT, AND PARTS THEREOF**
83	21	1.5%	MISCELLANEOUS ARTICLES OF BASE METAL
96	22	1.3%	MISCELLANEOUS MANUFACTURED ARTICLES
42	**23**	**1.3%**	**ARTICLES OF LEATHER; SADDLERY; HANDBAGS; ETC.**
63	**24**	**1.3%**	**OTHER MADE-UP TEXTILE ARTICLES; SETS; RAGS**
72	**25**	**1.3%**	**IRON AND STEEL**

Contr. is the contribution of an industry relative to the total gains from variety, expressed in percent. The contribution can also be negative.