Globalization and the Gains from Variety
The Case of a Small Open Economy

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Abstract

In international economics much depends on the definition of a variety. For example, this definition may influence the expected gains from traded variety as calculated by Broda and Weinstein (2006). This paper proposes a more general approach to estimate the gains from variety that does not depend on the definition of a variety. This is achieved by reinterpreting the seminal lambda ratios proposed by Feenstra (1994a). It is shown empirically that during the period of 1990 to 2006 the U.S. gains from imported variety amount to between 0.4% and 4.4% of the GDP depending on the specification used. For a small open economy (SOE) like Switzerland, the gains from variety amount to between 0.3% and 7.7% of the GDP. Thus, depending on the specification used, the gains from imported variety in an SOE can be smaller *or* larger compared a larger economy. This result is then analyzed carefully: First, the import price index bias as derived by Feenstra (1994a) is always lower in an SOE and this is mainly due to the lower growth in imported variety in SOE's. Nonetheless, the gains from variety may be higher in the SOE since the higher import share magnifies the price index bias relative to the large economy. It is furthermore shown that these results may hold quite generally for SOE's. (JEL F12, F14)

1 Introduction

This paper quantifies the gains from variety for Switzerland, a small open economy (SOE), and the U.S. between 1990 and 2006. The approach used is taken from the seminal paper of Feenstra (1994a) which is extended by Broda and Weinstein (2006), henceforth BW2006. By computing an import price index that is corrected for net variety growth, the gains from imported variety are quantified. An SOE, due to the larger import share, may be expected to profit even more from imported varieties than a larger, more domestically oriented country. However, using the methodology of BW2006, the gains from variety amount to 0.4% of the GDP in the U.S. and to only 0.3% in Switzerland for the period between 1990 and 2006. Both values seem pretty low. I claim however, that this small bias is only a lower bound. This is a consequence of the chosen definition of a variety. An upper bound is then proposed and motivated. It is independent of the definition of a variety and it results in gains from variety of up to 4.4% of the GDP in the U.S. and 7.7% in Switzerland. I argue that the actual bias lies between the values mentioned above. A *best practice specification* is then applied which leads to gains from imported variety that lie between 1.2% and 1.6% in the U.S. and between 1.4% and 1.9% in Switzerland. Thus, the gains from variety may be higher in an SOE after all.

It is then analysed where the differences in the gains from imported varieties between an SOE and a large economy come from: They can be attributed to three different sources, namely the import share, variety growth and the magnitude of the elasticities of substitution. A higher import share leads to a magnification of the price index bias by a factor of five in Switzerland relative to the U.S. The bias in the price index of its own is always larger in the U.S. This difference can itself be attributed to the two remaining sources: 60% to 90% of the differences are due to lower variety growth in Switzerland while the rest of the differences stems from the higher elasticities of substitution of Swiss import goods compared to U.S. import goods. Despite the lower bias in the price index, the gains from imported variety may well be higher in Switzerland due to the magnification effect stemming from the higher import share. I furthermore argue that this is a quite general result that may hold for many SOE. This is done by considering various OECD economies.

In the next section, existing theory and empirical evidence about the evaluation of the gains from variety is reviewed. Section 3 derives and discusses the methodology used to determine the gains from imported variety, primarily referring to Feenstra (1994a) and BW2006. Section 4 derives a lower and an upper bound for the bias of the aggregate import price index. Section 5 presents the gains from variety in Switzerland between 1990 and 2006. The contribution of countries and goods to the total gains are calculated as well. Finally, in Section 6 Switzerland is compared to the USA and the differences of the gains from variety are attributed to the different sources. Section 7 concludes.

2 Gains from Variety - Theory and Empirical Evidence

Gains from trade liberalization never top a few percent of the GDP, even when trade barriers are significantly reduced. Feenstra (1992) gives an overview over some results. While this may be surprising, many authors remarked that most models do not incorporate the changes in traded variety upon trade liberalization. In Romer's (1994) numerical example, fixed costs exist for the introduction of a new product into a foreign market and therefore trade barriers will lower the profits of the firms. As a consequence, some goods are not profitable enough to export when trade barriers are high and this may lead to a smaller variety in the importing country. The gains from trade liberalization can then account to up to 20% of the GDP if many goods are prevented from being imported. This seems to be especially true for small open economies, since the fixed costs are more important if only small quantities can be sold in a market and since the imports are relatively important compared to the GDP. Klenow and Rodriguez-Clare (1997) provide evidence for this calibration exercise. In their paper, the gains from trade liberalization using Costa Rican data can account for up to 2% of the GDP. These gains incorporate the gains from variety which raise the overall gains from trade by 50% to 300%, depending on the specification. Hence, although the gains from trade liberalization still seem small, the increase in the number of goods is an important of these gains.

Taking another approach, Hausman (1981), based on Hicks (1940), shows that using microdata, the value of new goods for the consumer can be calculated as the area under the demand function that is added if the price of a good falls from its reservation price to its actual price. Unfortunately, to estimate the reservation prices very detailed data is needed. Consequently, the empirical evidence is restricted to a few single products like breakfast cereals (Hausman 1994) or cell phones (Hausman 1997). Thus, for calculating the gains from imported variety in all product categories this method is not very useful.

Taking one step backwards it can be stated that theoretically, the incorporation of a change in product variety is quite troublesome using an economic model. The traditional demand theory as in Arrow and Debreu (1954) uses a fixed set of goods by construction. Changing the number of goods means, in principle, changing the utility specification with all relationships between all goods. Hotelling (1929) and Lancaster (for example 1966 and 1975) provide some approaches to incorporate new goods. Lancaster presents a whole new theory, which he calls the New Demand Theory. The essence of his approach is that there is a fixed number of characteristics that a good can have. New goods with different levels of these characteristics can then be added easily. The substitutability between the new goods and the existing ones are then defined by the characteristics *ex ante*. A qualitative assessment of welfare effects of new goods for developing countries is available from James and Stewart (1981). Unfortunately, demand systems are difficult to get using this

approach. As a consequence it never had a large impact on the empirics. Nonetheless, conceptually this approach can be useful to bear in mind.

A much larger impact had the theory developed by Spence (1976), Dixit and Stiglitz (1977), and, applied to trade, Krugman (1980). Using monopolistic competition, one good is available in different varieties, each produced by a different firm. Consumers value additional varieties depending on the substitutability between varieties. This substitutability is captured by one parameter, the elasticity of substitution. Thus, instead of having to deal with many characteristics, one parameter incorporates all relationships between varieties. Of course, this greatly simplifies the analysis and explains the empirical success of these models. In these models, trade leads to more varieties available in every country and therefore to gains for the consumers stemming from the love for variety. Based on these monopolistic competition models, Feenstra (1994a) developed 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. The difference between a conventional price index and the import price index taking the variety growth into account can then be used to compute the gains from imported variety.

This is done by BW2006 for the USA using disaggregated trade data for the period of 1972 to 2001. They find that the upward bias uf the conventional import price index is 1.2 percent per year. This leads to a gain from imported variety of 2.6 percent of GDP between 1972 and 2001. Again, this may not seem a lot. Considering the fact that SOE's have import shares that are many times larger than the one of the U.S., one could imagine much larger gains for these economies. This shall be evaluated in this paper.

3   Empirical Strategy and Estimation

This section reviews the methodology used to estimate the gains from imported variety as developed by Feenstra (1994a) and BW2006. The utility model, the exact price index and the stochastic specification are derived in turn.

3.1   A Three-Level Utility Model

I start out with a three level utility function. Imported varieties are grouped into goods (1), while these goods are then aggregated into a composite import good (2) which is consumed alongside a composite domestic good (3). The three levels of utility are

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

$$M_t = \left(\sum_{g \in G} M_{gt}^{(\gamma-1)/\gamma} \right)^{\gamma/(\gamma-1)} ; \quad \gamma > 1, \tag{2}$$

$$U_t = \left(D_t^{(\kappa-1)/\kappa} + M_t^{(\kappa-1)\kappa} \right)^{\kappa/(\kappa-1)} ; \quad \kappa > 1, \tag{3}$$

where κ, γ and σ_g are the elasticities of substitution between the goods or varieties of the respective level. G is the set of goods and C is the set of varieties. d_{gct} is a taste or quality parameter. Utility is separable and homothetic. Note that this utility allows for a representative consumer which will be convenient to derive the price index. Next, the unit-cost function for every level of utility is derived.

$$\phi_{gt}^M(I_{gt}, \vec{d_{gt}}) = \left(\sum_{c \in I_t} d_{gct} p_{gct}^{1-\sigma_g} \right)^{1/(1-\sigma_g)}, \tag{4}$$

$$\phi_t^M(G) = \left(\sum_{g \in G} (\phi_{gt}^M)^{1-\gamma} \right)^{1/(1-\gamma)}, \tag{5}$$

$$p_t = \left[(p_t^D)^{1-\kappa} + (\phi_t^M)^{1-\kappa} \right]^{1/(1-\kappa)}. \tag{6}$$

These unit cost functions are the building blocks for the price index. Also, they demonstrate the love-of-variety approach: Suppose a number of varieties exist and all taste parameters are equal to 1. Then, an increase of the number of varieties for given prices implies a decrease of the unit-costs.

3.2 Derivation of an Exact Price Index

A cost of living index (COLI) measures the total cost for the consumer to achieve his highest possible utility level given a level of income. Therefore, a COLI depends on the cost function given a specific income. With homothetic preferences however, the cost function for every consumer is independent of his income. Thus, a price index of good g can be defined as in Konüs (1921)

$$P_g^M(\vec{p_{gt}}, \vec{p_{gt-1}}, \vec{x_{gt}}, \vec{x_{gt-1}}, I_g) = \frac{\phi_{gt}^M(I_g, \vec{d_g})}{\phi_{gt-1}^M(I_g, \vec{d_g})}, \tag{7}$$

where $\phi_{gt}^M(I_g, \vec{d_g})$ are the unit-costs of that good at time t. Note that for the moment a constant set

of varieties, I_g, henceforth called the *common set* is used. It is a remarkable feature that the price index does not depend on the taste parameters as Diewert (1976) shows. The intuition for this result is that all the information contained in the taste parameters is captured by the expenditure shares. Sato (1976) and Vartia (1976) have derived the *exact* price index for the CES unit-cost function. For a price index to be exact it must equal the ratio of the unit-cost functions. This is true for the following price index:

$$\frac{\phi_{gt}^M(I_g, \vec{d_g})}{\phi_{gt-1}^M(I_g, \vec{d_g})} = P_g(\vec{p_{gt}}, \vec{p_{gt-1}}, \vec{x_{gt}}, \vec{x_{gt-1}}, I_g) = \prod_{c \in I_g} \left(\frac{p_{gct}}{p_{gct-1}}\right)^{w_{gct}}, \quad \text{where} \tag{8}$$

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

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

$$\pi_g(\vec{p_{gt}}, \vec{p_{gt-1}}, \vec{x_{gt}}, \vec{x_{gt-1}}, I_g) = \frac{\phi_{gt}^M(I_{gt}, \vec{d_g})}{\phi_{gt-1}^M(I_{gt-1}, \vec{d_g})}, \tag{9}$$

$$= P_g(\vec{p_{gt}}, \vec{p_{gt-1}}, \vec{x_{gt}}, \vec{x_{gt-1}}, I_g) \left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{1/(\sigma_g - 1)}, \quad \text{where} \tag{10}$$

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

Hence, the exact price index *with variety change* is the common price index times an additional term, henceforth called *lambda ratio*. The lambda ratio gets smaller if there are many new varieties and it gets larger if there are many disappearing varieties. It is determined entirely by the *expenditure* for these varieties. This ratio is then weighted by a term negatively related to the elasticity of substitution. Thus, the *upward*

bias of the price index gets higher with lower elasticities and lower lambda ratios. Now that the exact price indices for the imported goods are known, they are aggregated to the aggregate exact import price index:

$$\Pi^M(\vec{p}_t, \vec{p}_{t-1}, \vec{x}_t, \vec{x}_{t-1}, I) = \frac{\phi_t^M(I_t, \vec{d})}{\phi_{t-1}^M(I_{t-1}, \vec{d})}, \tag{11}$$

$$= \prod_{g \in G} \left[P_g(I_g) \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{1/(\sigma_g - 1)} \right]^{w_{gt}}, \tag{12}$$

$$= CIPI(I) \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{w_{gt}/(\sigma_g - 1)}, \tag{13}$$

where, $CIPI(I)$ is a conventional import price index that does not account for the change in varieties. The difference between this index and the index incorporating the new varieties is called the *aggregate import bias*. Finally, the overall price index is

$$\Pi = \left(\frac{p_t^D}{p_{t-1}^D} \right)^{w_t^D} (\Pi^M)^{w_t^M}. \tag{14}$$

3.3 Deriving the Stochastic Model

To determine the exact price indices that account for the change in varieties, an elasticity of substitution, σ_g, is needed for every good. The specification resembles a gravity model. However, Feenstra (1994a) allows for a upward sloping supply curve, a feature not common in these models. First, the demand of a particular variety is derived from the unit-cost function. The specifics are available from Feenstra (1991). Shares instead of quantities are used because this eases the measurement errors due to unit-values:[1]

$$\Delta \ln s_{gct} = \varphi_{gt} - (\sigma_g - 1)\Delta \ln p_{gct} + \epsilon_{gct}, \tag{15}$$

where the difference in the unit-costs is a constant for all varieties c of good g and is summarized by φ_{gt}. The change in unobserved taste parameter, $\Delta \ln d_{gct}$, is assumed to be the stochastic element. Next, defining ω as the inverse supply elasticity, the inverse supply can be written quite generally as

$$\Delta \ln p_{gct} = \psi_{gt} + \frac{\omega_g}{1 + \omega_g} \Delta \ln s_{gct} + \delta_{gct}. \tag{16}$$

By choosing a reference variety and taking differences, the unobservable terms φ_{gt} and ψ_{gt} are eliminated:

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[1]See for example Kemp (1962).

$$\Delta^k \ln s_{gct} = -(\sigma_g - 1)\Delta^k \ln p_{gct} + \epsilon_{gct}^k, \quad \text{and} \tag{17}$$

$$\Delta^k \ln p_{gct} = \frac{\omega_g}{1 + \omega_g}\Delta^k \ln s_{gct} + \delta_{gct}^k, \tag{18}$$

where $\Delta^k \ln s_{gct} = \Delta \ln s_{gct} - \Delta \ln s_{gkt}$ with k as the reference variety. Making the assumption $E(\epsilon_{gct}^k \delta_{gct}^k) = 0$, u_t is defined as $\epsilon_{gct}^k \delta_{gct}^k$:

$$\left(\Delta^k \ln p_{gct}\right)^2 = \theta_{g1}\left(\Delta^k \ln s_{gct}\right)^2 + \theta_{g2}\left(\Delta^k \ln p_{gct}\Delta^k \ln s_{gct}\right) + u_{gct} \quad \text{or} \tag{19}$$

$$Y_{gct} = \theta_{g1}X_{1gct} + \theta_{g2}X_{2gct} + u_{gct}, \tag{20}$$

with the obvious definitions for θ_{g1} and θ_{g2}. Following Feenstra (1994a), the σ's can be calculated from the estimated θ's using the following formula.

$$\text{a) if} \quad \widehat{\theta}_{g2} > 0 \quad \text{then} \quad \widehat{p}_g = \tfrac{1}{2} + \left(\tfrac{1}{4} - \frac{1}{4(\widehat{\theta}_{g2}^2/\widehat{\theta}_{g1})}\right)^{1/2},$$

$$\text{b) if} \quad \widehat{\theta}_{g2} < 0 \quad \text{then} \quad \widehat{p}_g = \tfrac{1}{2} - \left(\tfrac{1}{4} - \frac{1}{4(\widehat{\theta}_{g2}^2/\widehat{\theta}_{g1})}\right)^{1/2},$$

and in either case

$$\widehat{\sigma}_g = 1 + \left(\frac{2\widehat{p}_g - 1}{1 - \widehat{p}_g}\right)\frac{1}{\widehat{\theta}_{g2}}. \tag{21}$$

As for $\widehat{\sigma}_g$, negative values can occur as well as complex numbers.

3.4   Estimation

There is a simultaneity bias present in the stochastic model above. Normally this is attacked by defining additional instruments. However, instruments for the prices and the shares in the above stochastic model cannot be found easily. The panel structure of the data allows for another solution: As Verbeek (2004) and others[2] note, the (unbalanced) panel structure can be used to get unbiased estimators without the use of external instruments. Intuitively, the data is averaged over time and weighted with the number of periods available. This is equivalent to running a WLS on

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[2]For example Hsiao (1985) or Hausman and Griliches (1986)

$$\bar{Y}_{gc} = \theta_1 \bar{X}_{1gc} + \theta_2 \bar{X}_{2gc} + \bar{u}_g, \tag{22}$$

where $\bar{X}_{gc}$ is the mean over time. By defining moment conditions Hansen's GMM can also be applied.

4 Proposing a Lower and an Upper Bound for the Aggregate Import Price Index Bias

Having obtained the estimated elasticities of substitution, the corrected import price indices can be obtained applying equations (8) to (14). This technique allows to estimate the impact of new varieties on an import price index using widely available data. In the background however, there is always the question of *the definition of a variety*. 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 very special and has its weaknesses: One country is always providing one variety of a specific good, there is no growth at the extensive margin for the imports of a good from a particular country. Depending on the definition of the goods or product categories however, there may be more than one variety coming from a particular country within a product category. And even more importantly, this number of the actual varieties coming from a country may *change over time*.

The underlying problem is that all definitions of traded varieties used in international economics today depend on the available data set: If firm-level data were used, the definition of a variety would another one, quite naturally of course. Consequently, empirical results may depend on this definition. There is no common definition of a variety that can be applied using for example firm-level data or the disaggregated trade data used in this paper. In my view, an important task in international economics today is to define a measure of a traded variety that is independent of the data source used. It turns out that the lambda-ratio introduced by Feenstra (1994a) can be interpreted as a first step in this direction.

Feenstra (1994a) shows that a change in the taste parameter d_{gct} can be caused by the fact that a *defined* variety actually consists of more varieties. For example, one variety may be apples from New Zealand. But maybe in reality, more than just one variety of apples is imported from New Zealand. If this number of *actual* varieties increases over time, this may cause a rise in the expenditure that is due to more variety. This is expressed by a rise in the taste parameter in equation (1). If the taste parameter changes over time however, Feenstra (1994a) shows that the bias in the price index is not computed correctly: Using the example from

above, since apples from New Zealand are imported in 1990 as well as in 2006, this variety is included into the common set: As a consequence, the new apples do not contribute to a decrease of the lambda ratio even though they should. This is a consequence of the inflexible definition of a variety under the Armington approach.

In adddition, quality changes are also expressed by a change in the taste parameters. A variety which is available in a better quality can be seen as a *new* variety as well. Thus, changes in the taste parameter due to quality changes should in principle also change the lambda ratios. All these changes are ignored when including a variety into the common set.

Feenstra (1994a) proves that varieties which experience a change in the taste parameters due to a change in quality or *actual* variety should be excluded from the common set. This means that those varieties should be treated as *new and disappearing* at the same time. The problem in practice is the identification of these varieties since the taste parameters are unobserved. Thus, two clear cut cases are proposed here: One where all varieties possible are included into the common set. This is the benchmark case proposed by Feenstra (1994a) and will be called the *lower bound case*. The second case would be to exclude as many varieties as possible. Note that at least one variety is needed so that the lambda ratio is defined as equation (9) shows. This can be avoided by assuming that there exists always one *artifical* variety with *no change* in absolute expenditure. All the other varieties can then be excluded from the common set. This leads to an *upper bound* of the import price bias. Proposition 1 summarizes:

Proposition 1 *The lambda ratio is defined as*

$$\frac{\lambda_{gt}}{\lambda_{gt-1}}, \ where$$

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

To obtain a lower bound of the price index bias, the set I_g contains all varieties that are available in the start and the end period. This is the benchmark case proposed by Feenstra (1994a). To obtain an upper bound, the set I_g contains but one artificial variety with constant expenditure. Then, the lambda ratio simplifies to

$$\frac{\lambda_{gt}}{\lambda_{gt-1}} = \frac{\sum_{c \in I_{gt-1}} p_{gct-1} x_{gct-1}}{\sum_{c \in I_{gt}} p_{gct} x_{gct}}. \tag{23}$$

What is the intuition of this simplified lambda ratio? Note that equation (23) does not depend on any artificial definitions of a variety. All that is needed to compute it are the total expenditures for the good g at time t and time $t-1$. Thus, this measure can be calculated using any data set, independent of how a variety is defined.

Sure enough, this is still a very imperfect measure of variety: Doubling the expenditures for a good results in 50% smaller lambda ratio. And this leads to a very high bias in the import price index. If expenditures for imports are generally rising as it is observed today, this will overestimate the increase in imported variety. Thus, I argue that the bias calculated with this new measure will be an *upper bound of the price index bias*. Consequently, this also results in an upper bound of the gains from variety. On the other hand, using the original definition where *all* varieties are put into the common set, the gains from variety will probably be too small since increases in quality and *actual* varieties are not considered.[3]

5   The Gains From Imported Variety in a Small Open Economy

The application of the methodology described in Sections 3 and 4 can be divided into three parts: First, the elasticities of substitution are estimated. In a second step, the lambda ratios are computed and the corrected import price index is calculated. Then, the gains from imported variety for the whole economy is computed by accounting for the domestic sector. I calculate the gains from variety for an SOE, namely Switzerland, and compare them to the gains in the U.S. To get an overview over the situation of imported varieties within those countries, the variety growth in Switzerland and the U.S. from 1990 to 2006 is examined next.

5.1   Data

The Swiss trade data are available from the Swiss Federal Customs Administration.[4] The data include import values and and imported quantity for all HTS-8 country pairs. This allows the calculation of unit prices. For the U.S., data is available from the Center of International Trade Date at UC Davis.[5] The US data is available at an even more disaggregated level, namely HTS-10. The definition of goods and varieties follows directly from the data: Goods are defined as HTS product categories and varieties are defined as HTS - country pairs as in Armington (1969).

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[3]Theoretically, can one speak of a *lower* and an *upper* bound? Generally, the answer is no. 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.

[4]See *www.admin.ezv.ch.*

[5]They are provided by Robert C. Feenstra. Visit *http://cid.econ.ucdavis.edu/.*

5.2 The Growth in Imported Variety

In the last 20 years the fraction of imports of goods compared to the 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 the GDP has risen by only 1.8% per year.[6] This more than proportional rise of imports is commonly attributed to three different sources: The reduction of trade costs, free capital movement and high growth of economies in East Asia or Eastern Europe.

Less attention has been given to the fact that during the same time period not only the import values have risen, but also the imported product variety. Tables 1 displays these remarkable changes between 1990 and 2006 for Switzerland. Column (1) displays that the total number of imported goods has risen from 4'944 to 5'124 within twenty years.[7] 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).

Table 1: Variety of Swiss Imports 1990-2006

	Year	Number of HTS goods	Median no. of countries per good	Mean no. of countries per good	Total no. of varieties (goods)	Share of total imports (goods)	Total no. of varieties	Share of total imports (varieties)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
All goods (1990)	1990	4944	10	13.82	68327	1.00	68327	1.00
All goods (2006)	2006	5124	11	17.85	91439	1.00	91439	1.00
Common (1990)	1990	4470	11	14.11	63083	0.86	49382	0.83
Common (2006)	2006	4470	13	18.54	82868	0.83	49382	0.78
1990 not in 2006	1990	474	8	11.06	5244	0.14	18945	0.17
2006 not in 1990	2006	654	7	13.11	8571	0.17	42057	0.22

A good is defined after HTS-6. A variety is defined as a good from a particular country.

Columns (2)-(4) of Table 1 displays 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, 17%, can be attributed to new goods. Columns (6) and (7) abstract from the goods and considers the varieties imported. In column (6) the total varieties are again displayed in the first two rows. The second two rows show how many *common varieties*[8] were imported in 1990 and 2006. The last two rows display the new

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

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

[8]As opposed to the varieties of *common goods* displayed in column (4).

and disappearing varieties. Thus, 27% of all varieties imported in 1990 have disappeared whereas 49% of all varieties present in 2006 have not been imported in 1990. Column (7) shows that about 22% of the total import value can be attributed to new varieties. All the above stresses the changing pattern of Swiss imports in the last 20 years: Imports originate from more and from different countries today compared 17 years ago. Secondly, there are not only many new varieties, but also many disappearing ones.

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

	Year	Number of HTS goods	Median no. of countries per good	Mean no. of countries per good	Total no. of varieties (goods)	Share of total imports (goods)	Total no. of varieties	Share of total imports (varieties)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
All goods (1990)	1990	4987	14	18.46	92048	1.00	92048	1.00
All goods (2006)	2006	5182	18	25.32	131191	1.00	131191	1.00
Common (1990)	1990	4518	14	18.79	84872	0.86	67163	0.85
Common (2006)	2006	4518	18	26.10	117928	0.84	67163	0.79
1990 not in 2006	1990	469	11	15.30	7176	0.14	24885	0.15
2006 not in 1990	2006	664	14	19.97	13263	0.16	64028	0.21

A good is defined after HTS-6. A variety is defined as a good from a particular country.

For the U.S. the pattern of imported variety is very similar, although even more accentuated: Table 2 shows the statistics for the U.S. As a consequence of the harmonized HTS-6 product categories, the number of goods as displayed in column (1) is very similar in the U.S. 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 U.S. This is between 30% and 40% higher than the average in Switzerland. Column (4) reveals that this leads to many more imported varieties in the U.S. compared to Switzerland. In 1990, the U.S. imported 92'048 varieties, 35% more than Switzerland. In 2006, this number raises to 131'191, 43% more than Switzerland. Also, the U.S. imported 53% more *new* varieties than Switzerland, 13'263 compared to 8'571. This also means that the difference in imported variety even became larger between the two countries in the last 17 years. This is also shown by Table 3. Switzerland experienced a growth in total variety of roughly 34%, the U.S. one of 43%. The number of goods remained relatively stable in both countries, a consequence of the chosen definition of a good.

Table 3: Growth in Varieties: U.S. and Switzerland 1990-2006

	Switzerland	U.S.
Growth in all goods	3.64%	3.91%
Growth in all varieties	**33.83%**	**42.52%**
Growth in varieties of common goods	31.36%	38.95%

5.3 Estimating the Elasticities of Substitution

In this paper the linear WLS approach is used to estimate the elasticities of substitution as in Feenstra (1994a).[9] As in Feenstra (1994a), equation (22) is estimated with a constant to account for simple measurement errors.[10] To use all available data, a variety is defined as HTS-8 for Switzerland and HTS-10 for the U.S.

Table 4 displays the estimated elasticities for different aggregation levels.[11] The table shows that the elasticities of substitution are higher for the Swiss import goods, which is illustrated by both, the mean and the median.[12] Qualitatively, the results are slightly different. As BW2006 point out, it is expected that the elasticities decrease if goods are defined broader since then, the varieties comprised in these goods are more differentiated. The U.S. estimates exhibit this pattern as in BW2006. For the Swiss estimates however, the opposite pattern occurs.

Table 4: Sigmas for Different Aggregation Levels

	Switzerland			U.S.		
	SITC-3	SITC-5	HTS-8	SITC-3	SITC-5	HTS-10
Elasticities estimated	248	2781	7752	239	2485	13395
Mean	5.84	11.54	10.98	5.89	6.25	11.78
Standard Error (Mean)	0.27	4.85	1.57	1.34	0.63	1.44
Median	**4.49**	**4.12**	**4.07**	**2.93**	**3.08**	**3.40**
Maximum elasticity	29.84	13455.85	7685.96	272.83	1012.02	14743.98
Minimum elasticity	1.33	1.07	1.05	1.41	1.02	1.01

Swiss and US data from 1990-2006 is used for all estimates. A variety is defined at the HTS-8 level for Switzerland and the HTS-10 level for The U.S..

Thus, two main differences between Switzerland and the U.S. can already be noted here: First, Switzerland imports less varieties compared to the U.S. Secondly, the mean and the median elasticity of substitution is larger for Swiss imports. This will have implications for the aggregate price index.

5.4 Deriving the Aggregate Price Index

To compute the corrected aggregate price index as in equation (10), the lambda ratios are required.[13]

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[9]As mentioned above, GMM can be used to get the estimates for the sigmas. However, many goods only come with a very limited number of observations. Because GMM may be biased in small samples, in my view it is safer to use the above estimator. The downside is that not all of the sigmas will be estimated to be greater than one: Since only sigmas that are greater than one are compatible with the CES utility function, the goods with sigmas smaller than one or with complex values will be excluded from the calculation of the gains from variety. Using a GMM, one could perform a grod search to find values above one for every estimated sigma as in BW2006. The exclusion of these goods can be interpreted as taking a cautious approach to estimate the gains from variety: Using all goods, the gains would be higher.

[10]Many thanks to Robert C. Feenstra who provided me with the STATA-files used for the estimation. I also thank Hui Huang who has written the STATA version of the code.

[11]That is, different definitions of goods are used. For example, SITC-3 means that there are about 250 goods defined. The definition of a variety stays the same, namely HTS-8 for Switzerland and HTS-10 for the U.S. Note that for deriving the corrected import price index, only the sigmas of the last columns are used.

[12]Note that the means are heavily influenced by some outlier elasticities.

[13]Note that for HTS-8 (SITC-5) goods the lamda ratio is not defined if there is no common variety in the start and in the end period. Where this requirement fails, the lambda ratio of the SITC-5 (SITC-3) good is used for all the HTS-8 (SITC-5) goods

Table 5 shows summary statistics of the lambda ratios under three specifications for Switzerland and the U.S.: The lower bound case, the upper bound case that have both been derived just before and a *best practice* case where I identify countries that did not experience great dynamics in their export behaviour to Switzerland. These countries are then included into the common set.[14] Any other country is never included into the common set. Note the differences in the lambda ratios between the three specifications: The medians get lower if more countries are excluded from the common set. These varieties lower the lambda ratios since the expenditure is increasing for most varieties. Comparing Switzerland with the U.S. it is apparent that under every specification, the lambda ratios are lower in the U.S. This is a consequence of the many more new product varieties that were imported at high values by U.S. in the last 17 years.

Table 5: Descriptive Statistics of Lambda Ratios

	Switzerland		
Statistic	Lower Bound	Best Practice	Upper Bound
Nobs	2084	2084	2084
Mean	1.51	3.78	3.17
Percentile 5	0.54	0.26	0.15
Median	0.98	0.91	0.78
Percentile 95	1.42	3.39	4.85
	U.S.		
Statistic	Lower Bound	Best Practice	Upper Bound
Nobs	1479	1479	1479
Mean	1.50	2.07	3.25
Percentile 5	0.00	0.00	0.00
Median	0.94	0.73	0.36
Percentile 95	2.22	3.78	4.07

Using equations (8) to (13) and these lambda ratios, the conventional import price index as well as the corrected import price index can be computed. The ratio of these indices expresses the bias from ignoring the change in variety. This ratio is called the endpoint ratio (EPR) and it is defined as

within this SITC-5 (SITC-3) category. To get an elasticity for these aggregated goods, the geometric mean of the sigmas of the HTS-8 (and only the HTS-8) goods is used. For example for Switzerland there are not 7'752 lambda ratios defined, but only 2'080, a combination of SITC-3, SITC-5 and HTS-8 goods. Note however, that *all* 7'752 sigmas are used for the calculation of the index. This is the way BW2006 implemented it. It leaves open the question *which* lambda ratios should be chosen in the upper bound case where an artificial variety is included into the common set. Using an artificial variety, in principle every lambda ratio could be defined. However, 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.

[14]I choose to exclude those countries from the common set that experienced the highest absolute growth in the *number* of varieties. All the countries that make up for 75% of the raise in variety are excluded. I deliberately ignore the values that these countries export to Switzerland. Thus, also a small not so important country with high variety growth can be excluded from the common set, while a large country that exports high values to Switzerland but in always the same product categories is included into the common set. Note that I consider absolute values. Thus, countries that experience negative growth on variety can also be excluded from the common set. A list of the excluded countries is added to the appendix.

$$EPR = \frac{\Pi^M}{CIPI(I)} = \frac{CIPI(I)}{CIPI(I)} \prod_g \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{w_{gt}/(\sigma_g-1)} = \prod_g \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{w_{gt}/(\sigma_g-1)}. \tag{24}$$

Thus, the endpoint ratio is the weighted average of the lambda ratios weighted by a term incorporating the elasticity of substitution. Table 6 displays the endpoint ratios for both countries under all three specifications. The bias in the lower bound case is small. Within the last 17 years, ignoring the change in the number imported varieties has led to an overestimation of the import price index of 0.87% in Switzerland, an annual bias is 0.05%. For the U.S. the total bias is 4.86%, 0.31% annually. The corrected import price index in the upper bound case however, is 14.67% lower than the conventional import price index in Switzerland, an annual bias of 0.99%. For the U.S. the total bias amounts to 34.79%, 2.64% annually. The best practice case lies between the upper and the lower bound cases, 3.85% in Switzerland and 14.23% in the U.S.

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

	Switzerland				U.S.			
	EPR	Total bias	Avg. ratio	Avg. bias	EPR	Total bias	Avg. ratio	Avg. bias
Lower Bound	0.991	0.87%	0.999	0.05%	0.951	4.86%	0.997	0.31%
Best Practice	0.961	3.85%	0.998	0.25%	0.858	14.23%	0.990	0.96%
Upper Bound	0.853	14.67%	0.990	0.99%	0.652	34.79%	0.974	2.64%

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

5.5 The Gains from Variety in Switzerland and the U.S. 1990-2006

To quantify the welfare gains, assumptions about the structure of the domestic economy have to be made. Since the data does not allow it to model any complex interactions between imported goods and the domestic economy, the same structure as in Krugman (1980) is assumed. That is, using equation (14), the conventional and corrected price indices for the whole economy can be calculated. Taking the ratio of these indices results in the welfare gains. Since the two indices only differ by a multiplicative term, the gains from variety can be written as

$$GFV = \left(\frac{1}{EPR} \right)^{w_t^M} - 1, \tag{25}$$

where w_t^M is the log-change weight of the imports. Thus, 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. The problem here is that the imported goods also incorporate middle products and investment goods. It will hence be difficult to choose an appropriate measure for total economic activity.

For a large economy like the U.S this may not be very important. BW2006 just use the share of domestic consumption on the GDP. They consequently get a share of the imports of around 10% for the period of 1990 to 2001. Doing the same for an SOE has more severe consequences: Imports as a fraction of the total GDP amount to 36% on average between 1990 and 2006 in Switzerland using a log-change weight. However, using only consumption instead of GDP, the share of imports amounts to 47%. Of course, this is a consequence of many investment goods and middle products imported, used in the production process and then partially exported to other countries. These imported and exported goods may not play such an important role in the U.S., but for Switzerland they matter a lot. Because neither of the two shares can be justified convincingly, I assume that a sensible weight lies between 36% and 47% for Switerland and between 8% and 10% for the U.S.

Using these weights and the three different biases of the price index above, the gains from variety can be calculated. Using the lower bound bias and the smaller weight, the gains from variety account for 0.32% of the GDP in Switzerland as Table 7 displays. Using the upper bound bias and the higher weights, the highest gains from variety account to 7.74% of the GDP in Switzerland. For the U.S. the gains from variety lie between 0.40% and 4.37% of the GDP depending on the specification. The best practice case always lies between these extreme values. Hence, depending on the specification used, the gains from variety can be higher or lower in the small open economy compared to the U.S.

Table 7: Gains from Imported Variety, Switzerland and U.S., 1990-2006

		Switzerland				U.S.	
		Weights				Weights	
		36%	47%			8%	10%
	0.991	**0.32%**	0.41%		0.951	**0.40%**	0.50%
EPR	0.961	1.42%	1.86%	EPR	0.858	1.24%	1.55%
	0.853	5.88%	**7.74%**		0.652	3.48%	**4.37%**

The gains from imported variety can be further analysed: 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 imported product categories.

5.5.1 Which Countries Contribute Most to the Gains from Variety?

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. Thus, the contribution to the gains from variety resulting from the imports of a particular country i can be written as

$$EPR_i = \prod_g \left[\left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{(w_{gt}/(\sigma_g-1))W_{igt}} \right], \tag{26}$$

where W_{igt} is the ideal log-change weight of country i on this specific good g. The contribution of a single country relative to the whole gains from variety is then defined as $(1 - EPR_i)/(1 - EPR)$, where EPR is the endpoint ratio of the aggregated indices. Note that multiplying all the biases, the endpoint ratio from equation (24) results:

$$EPR = \prod_i \left\{ \prod_g \left[\left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{(w_{gt}/(\sigma_g-1))W_{igt}} \right] \right\}. \tag{27}$$

Considering Table 10 for the lower bound case and Table 11 for the upper bound case, it is striking that under both specifications Germany contributes by far the largest part to the gains from variety in Switzerland, namely around 40%. 60% to 70% of all the gains are due to imports from Switzerland's most important trading partners Germany, Italy and France. Austria, the United Kingdom, Japan, Spain, the Netherlands and the U.S. also appear on the first few ranks under both specifications. For the U.S., Canada is the most important trading partner regarding gains from imported variety with a 20% share on the total gains. Japan, Mexico, China, Germany, France, Italy, the U.K., Taiwan and South Korea are all in the top ten under both specifications. It is striking that Switzerland seems really dependent on its three large neighbouring countries whereas for the U.S. the gains from variety are a bit more equally distributed among many major trade partners.

5.5.2 Which Goods Contribute Most to the Gains from Variety?

To find out which SITC-3 goods contributed the largest share to the gains from variety, the lambda ratios of the HTS-8 or the SITC-5 goods have to be aggregated. For every SITC-3 good g this is done by calculating

$$EPR_g = \prod_k \left[\left(\frac{\lambda_{gkt}}{\lambda_{gkt-1}} \right)^{(w_{gkt}/(\sigma_{gkt}-1))} \right], \tag{28}$$

where k is either a HTS-8 or a SITC-5 good depending on the structure of the lambda ratios. Again, $(1 - EPR_g)/(1 - EPR)$ delivers the contribution of good g relative to the total gains from variety. Tables 12 and 13 again show the results for the lower and the upper bound case. The ranking of goods in the two tables is quite different. Also, assumingly differentiated as well as homogeneous goods are ein the top ranks. However, some goods appear in the top ranks under both specifications. For Switzerland, these are Watches and Clocks, Furniture, Manufactures of Base Metal, Paper and Paperboard, Articles of Plastic as well as

Motor Vehicles. For the U.S., Motor Vehicles, Parts of Motor Vehicles, Aluminium, Electrical Apparatus, Alcaholic Beverages, Electrical Machinery, Articles of Apparel, Printed Matter as well as Rotating Electric Plant. All of these goods seem fairly differentiated which makes sense. The only real exception is Aluminium.

6 What Determines the Differences in the Gains from Variety Between a Small and a Large Economy?

These gains from variety can be analyzed a bit more closely. There are three possible sources for the differences between a large and a small economy regarding the gains from imported variety: First, there is the difference in the import share that is very pronounced comparing Switzerland with the U.S. As Table 7 shows, the import share in Switzerland is about 5 times higher than in the U.S. Thus, whatever the bias of the price index is, it gets *magnified* by a factor of 5 relative to the U.S. Secondly, there is the bias in the import price index. This bias can itself 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 are imported at high values, the higher the bias in the import price index. The lower the elasticities of substitution, the higher the magnification of the lambda ratio. Thus, if the lambda ratio is smaller than one, it gets even smaller with a low elasticity of substitution and thus the bias is magnified. (9).[15]

To separate these two sources, I estimate the import price bias under fixed elasticities of substitution. Table 8 below displays the results. The endpoint ratios vary considerably with the choice of the fixed elasticities of substitution. 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 U.S.*

Table 8: Bias in the Swiss and US Import Price Indices Under Fixed Elasticities

	Switzerland				U.S.				
	variable	$\sigma = 2$	$\sigma = 4$	$\sigma = 8$	$\sigma = 15$	variable	$\sigma = 2$	$\sigma = 4$	$\sigma = 8$	$\sigma = 15$
Lower bound	0.87%	3.50%	1.18%	0.51%	0.25%	4.86%	9.39%	3.23%	1.40%	0.70%
Best practice	3.85%	10.73%	3.71%	1.61%	0.81%	14.23%	28.94%	10.76%	4.76%	2.41%
Upper bound	14.67%	46.82%	18.98%	8.63%	4.41%	34.79%	71.62%	34.28%	16.47%	8.60%

Table 9 shows the bias in the price index in Switzerland relative to the bias in the U.S. In the lower bound case for example, the bias in Switzerland if variable sigmas are used is 82.0% lower than the one in the U.S. If fixed sigmas are used, the bias in Switzerland is between 62.7% and 63.8% lower, depending on the

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[15]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, $0.8^{0.25} = 0.95$.

the size of the fixed sigma. Thus, for the lower bound case, about 77% of the difference in the price index bias between Switzerland and the U.S. are due to lower imported variety in Switzerland as is displayed in the last 4 columns of Table 9. The rest, about 23% of the difference is due to the higher elasticities of Swiss import goods. For the upper bound case, about 60% to 80% of the difference in the bias of the price index stems from the differences in variety growth, the rest is due to higher elasticities of substitution. Thus, depending on the specification, between 50% to 85% of the difference in the aggregate import price index bias between Switzerland and the U.S. is due to the fact that Switzerland imported less new varieties between 1990 and 2001. The rest which is always smaller than 50% is due to the higher elasticities of substitution of Swiss import goods.

Table 9: Share of the Difference in the Bias Explained by the Lower Imported Variety in Switzerland

| | | 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	-82.0%	-62.7%	-63.5%	-63.7%	-63.8%	**76.5%**	**77.5%**	**77.7%**	**77.8%**
Best practice	-72.9%	-62.9%	-65.5%	-66.2%	-66.5%	**86.3%**	**89.8%**	**90.8%**	**91.2%**
Upper bound	-57.8%	-34.6%	-44.6%	-47.6%	-48.7%	**59.9%**	**77.2%**	**82.3%**	**84.3%**

6.1 How General are these Results?

The results above imply that the bias in the import price index is always smaller in the small open economy. How general is this result? After all, the only small open economy considered here is Switzerland. Nonetheless I argue that these result may also hold for other small open economies: Using descriptive statistics, one can find a clear relationship between the growth in imported varieties and the size of a country measured by its GDP when using data of OECD countries.[16] Larger countries experienced a larger increase in the growth of variety between 1991 and 2000 as is displayed by Figure 1a. This will generally lead to a higer bias in the import price index in larger economies.

What remains to check is whether smaller countries exhibit higher elasticities of substitution in general. Broda et al. (2006) estimate sigmas for 73 countries. Figure 1b 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 elastcities that lie between 3 and 4. Hence the differences in the price index bias resulting from differences in the median elasticities will generally be small. Furthermore, Table 9 showed that the differences in the grwth of imported varieties is more important. As a conclusion, SOE will tend to have a lower bias in the import price index.

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[16]Only fully developed and industrialized countries are used: Hungary, Poland, the Czech Republic, Slovakia and Turkey are excluded from the sample: Furthermore, the U.S. and Japan are excluded since with these two 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 also holds when these two countries are included.

Figure 1: Imported Variety and OECD Countries

(a) GDP - Growth in Varieties 1991-2000   (b) GDP - Median Elasticity 1994-2003
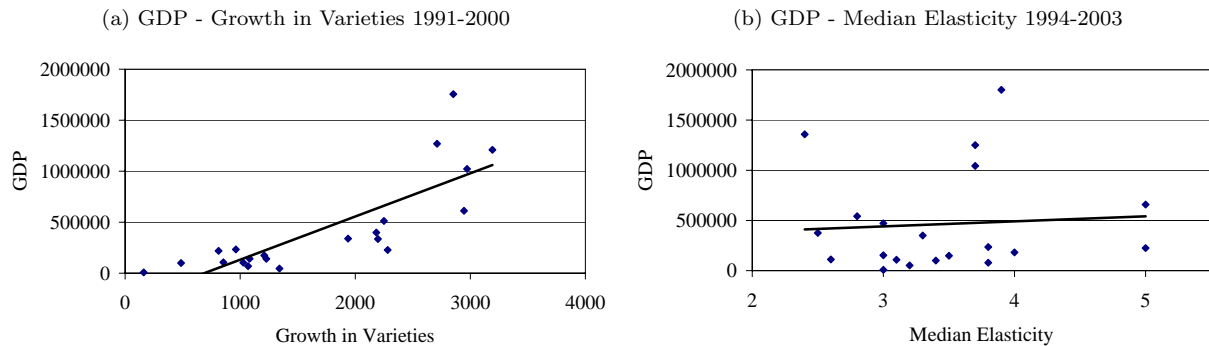
7   Conclusions

In this paper, a lower and an upper bound for the bias in the aggregate import price index of Feenstra's (1994a) seminal paper is proposed. This can be interpreted as a step towards a more general definition of traded variety. Using these bounds, the gains from imported variety can get very large. This is shown at the example of Switzerland and the U.S. Between 1990 and 2006, the increase in imported variety can lead to a welfare gain of up to 7.7% of the GDP in Switzerland and up to 4.4% in the U.S. Using a best specification, the consumers would still be willing to pay between 1.4% and 1.9% of the GDP for the new varieties in Switzerland. The gains in the U.S. are slightly lower, amounting to between 1.2% and 1.6%.

These gains from variety can then be attributed to countries of origin and product categories: 60% to 70% of the gains from variety in Switzerland are due to imports stemming from Switzerland's direct neighbours, Germany, Italy and France. In the U.S. the gains are more equally distributed among many major trading partners. Looking at product categories, classical differentiated goods for example Motor Vehicles contribute large shares to the gains from variety in both countries.

Furthermore, the differences between an SOE and a larger economy regarding the gains from varieties are analysed. The import price index bias is always lower in the SOE. This difference can be attributed to two sources: 60% to 90% of the difference are due to the lower growth in imported variety. The rest is due to the higher elasticities of substitution of Swiss import goods compared to US import goods. However, the much higher import share can overcompensate the lower bias and may lead to higher welfare gains from imported variety in an SOE. These results may be quite general since SOE tend to have a lower imported variety growth and, by definition, a higher share of imports.

Surely, more work on this has to be done to understand the gains from imported variety and also the

differences in these gains between SOE and larger economies. First, more countries have to be examined closely. Another possible area for further research may be the selection of the varieties that are included into the common set of the lambda ratios. Although the best practice approach used in this paper is easy to handle, there may be more convincing methods to select these varieties. This is very related to the question of the definiton of a variety. Finally, the modelling of the relationship of the domestic sector and the imports is not convincing, particularly because the imports include middle products and investment goods as well. One possibility would be to consider only imported *consumption* goods. A more demanding approach would be to model a production process that uses middle products and investment goods that are imported, converts them to consumption goods that are then consumed domestically or abroad.

Appendix

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

Switzerland			U.S.		
Country	Rank	Contr.	Country	Rank	Contr.
Germany	1	37.20%	Canada	1	20.11%
Italy	2	11.55%	Japan	2	13.02%
France	3	11.08%	Mexico	3	10.31%
Austria	4	6.07%	China	4	9.15%
United Kingdom	5	4.83%	Germany	5	7.62%
Netherlands	6	3.70%	France	6	5.23%
Japan	7	2.98%	United Kingdom	7	4.37%
Hong Kong	8	2.94%	Italy	8	3.97%
Belgium & Luxemburg	9	2.72%	Taiwan	9	3.62%
U.S.	10	2.70%	Korea (South)	10	2.14%
Ireland	11	2.38%	Brazil	11	2.11%
Sweden	12	2.13%	Hong Kong	12	1.91%
Saudi Arabia	13	1.56%	Ireland	13	1.77%
Finland	14	1.35%	Sweden	14	1.62%
Spain	15	1.14%	Netherlands	15	1.30%
China	16	1.14%	India	16	1.08%
Denmark	17	1.03%	Spain	17	0.93%
Thailand	18	0.86%	Indonesia	18	0.85%
Taiwan	19	0.61%	Belgium & Luxemburg	19	0.73%
Former Czechoslovakia	20	0.49%	Chile	20	0.69%

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

Table 11: Contribution of Individual Countries to the Gains from Variety, Upper Bound Case

Switzerland			U.S.		
Country	Rank	Contr.	Country	Rank	Contr.
Germany	1	46.14%	Canada	1	23.77%
Italy	2	13.38%	Japan	2	14.27%
France	3	11.68%	China	3	11.52%
Austria	4	5.42%	Mexico	4	11.32%
U.S.	5	4.54%	Germany	5	8.87%
United Kingdom	6	4.39%	United Kingdom	6	4.90%
Netherlands	7	3.82%	Taiwan	7	4.66%
Belgium & Luxemburg	8	3.31%	France	8	4.05%
Japan	9	1.77%	Italy	9	3.93%
Spain	10	1.74%	Korea (South)	10	2.91%
Sweden	11	1.68%	Chile	11	2.02%
Denmark	12	1.10%	Brazil	12	2.00%
China	13	0.99%	Hong Kong	13	1.49%
Hong Kong	14	0.88%	South Africa	14	1.35%
Ireland	15	0.87%	Netherlands	15	1.34%
Finland	16	0.57%	Belgium & Luxemburg	16	1.30%
Former USSR	17	0.54%	Israel	17	1.21%
Thailand	18	0.52%	Sweden	18	1.19%
Taiwan	19	0.41%	India	19	1.17%
Canada	20	0.35%	Thailand	20	1.10%

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

Table 12: Contribution of SITC-3 goods to the Gains from Variety, Switzerland

			Lower bound case
SITC-3	Rank	Contr.	Description
641	1	11.89%	PAPER & PAPERBOARD
514	2	7.82%	NITROGEN-FUNCTION COMPOUNDS
885	3	7.49%	WATCHES & CLOCKS
898	4	7.18%	MUSICAL INSTRUMENTS
515	5	4.80%	ORGANO-INORGANIC COMPOUNDS, HETEROCYCLIC COMPOUNDS, ETC.
524	6	3.52%	OTHER INORGANIC CHEMICALS
971	7	3.45%	GOLD, NON-MONETARY
821	8	3.30%	FURNITURE & PARTS THEREOF
778	9	3.16%	ELECTRICAL MACHINERY & APPARATUS, N.E.S.
773	10	2.85%	EQUIPMENT FOR DISTRIBUTING ELECTRICITY, N.E.S.
775	11	2.76%	HOUSEHOLD-TYPE ELECTRICAL & NON-ELECTRICAL EQUIPMENT
728	12	2.58%	OTHER MACHINERY & EQUIPMENT FOR PARTICULAR INDUSTRIES
716	13	2.29%	ROTATING ELECTRIC PLANT & PARTS THEREOF, N.E.S.
899	14	2.19%	MISCELLANEOUS MANUFACTURED ARTICLES, N.E.S.
699	15	2.06%	MANUFACTURES OF BASE METAL, N.E.S.
554	16	1.97%	SOAP, CLEANSING & POLISHING PREPARATIONS
735	17	1.96%	ACCESSORIES FOR USE WITH THE MACHINES OF GROUPS 731 & 733
574	18	1.94%	POLYACETALS, OTHER POLYETHERS & EPOXIDE RESINS, ETC.
665	19	1.82%	GLASSWARE
891	20	1.79%	ARMS & AMMUNITION
893	21	1.76%	ARTICLES, N.E.S., OF PLASTICS
749	22	1.51%	NON-ELECTRIC PARTS & ACCESSORIES OF MACHINERY, N.E.S.
851	23	1.47%	FOOTWEAR
781	24	1.47%	MOTOR CARS & OTHER MOTOR VEHICLES
657	25	1.44%	SPECIAL YARNS, SPECIAL TEXTILE FABRICS & RELATED PRODUCTS

			Upper bound case
SITC-3	Rank	Contr.	Description
542	1	21.41%	MEDICAMENTS (INCLUDING VETERINARY MEDICAMENTS)
821	2	3.80%	FURNITURE & PARTS THEREOF
893	3	3.33%	ARTICLES, N.E.S., OF PLASTICS
684	4	2.94%	ALUMINIUM
892	5	2.76%	PRINTED MATTER
885	6	2.61%	WATCHES & CLOCKS
541	7	2.09%	MEDICINAL & PHARMACEUTICAL PRODUCTS
699	8	1.97%	MANUFACTURES OF BASE METAL, N.E.S.
691	9	1.88%	STRUCTURES OF IRON, STEEL OR ALUMINIUM, N.E.S.
582	10	1.83%	PLATES, SHEETS, FILM, FOIL & STRIP, OF PLASTICS
772	11	1.72%	APPARATUS FOR SWITCHING OR PROTECTING ELECT. CIRCUITS, ETC.
872	12	1.51%	INSTRUMENTS FOR MEDICAL, SURGICAL, DENTAL PURPOSES
784	13	1.49%	PARTS & ACCESSORIES OF THE MOTOR VEHICLES OF 722, 781, 782 & 783
681	14	1.49%	SILVER, PLATINUM & OTHER METALS OF THE PLATINUM GROUP
781	15	1.43%	MOTOR CARS & OTHER MOTOR VEHICLES
642	16	1.40%	PAPER & PAPERBOARD, CUT TO SIZE OR SHAPE
764	17	1.33%	TELECOMMUNICATIONS EQUIPMENT
874	18	1.28%	MEASURING, CHECKING, ANALYSING & CONTROLLING INSTRUMENTS
845	19	1.25%	ARTICLES OF APPAREL, OF TEXTILE FABRICS, N.E.S.
695	20	1.23%	TOOLS FOR USE IN THE H& OR IN MACHINES
515	21	1.22%	ORGANO-INORGANIC COMPOUNDS, HETEROCYCLIC COMPOUNDS, ETC.
773	22	1.15%	EQUIPMENT FOR DISTRIBUTING ELECTRICITY, N.E.S.
894	23	1.13%	BABY CARRIAGES, TOYS, GAMES & SPORTING GOODS
641	24	1.12%	PAPER & PAPERBOARD
748	25	1.12%	TRANSMISSION SHAFTS & CRANKS; ETC.

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

Table 13: Contribution of SITC-3 goods to the Gains from Variety, U.S.

			Lower bound case
SITC-3	Rank	Contr.	Description
784	1	26.46%	PARTS & ACCESSORIES OF THE MOTOR VEHICLES OF 722, 781, 782 & 783
841	2	3.94%	MEN'S OR BOYS' CLOTHING
842	3	3.92%	WOMEN'S OR GIRLS' CLOTHING
743	4	3.91%	PUMPS, AIR OR OTHER GAS COMPRESSORS & FANS
684	5	3.80%	ALUMINIUM
699	6	3.47%	MANUFACTURES OF BASE METAL, N.E.S.
542	7	3.46%	MEDICAMENTS (INCLUDING VETERINARY MEDICAMENTS)
898	8	3.20%	MUSICAL INSTRUMENTS
541	9	3.15%	MEDICINAL & PHARMACEUTICAL PRODUCTS
747	10	3.07%	TAPS, COCKS, VALVES & SIMILAR APPLIANCES
792	11	3.04%	AIRCRAFT & ASSOCIATED EQUIPMENT; SPACECRAFT
641	12	2.89%	PAPER & PAPERBOARD
695	13	2.84%	TOOLS FOR USE IN THE HAND OR IN MACHINES
772	14	2.83%	APPARATUS FOR SWITCHING OR PROTECTING ELECT. CIRCUITS, ETC.
515	15	2.70%	ORGANO-INORGANIC COMPOUNDS, HETEROCYCLIC COMPOUNDS, ETC.
892	16	2.49%	PRINTED MATTER
112	17	2.40%	ALCOHOLIC BEVERAGES
778	18	2.38%	ELECTRICAL MACHINERY & APPARATUS, N.E.S.
682	19	2.34%	COPPER
874	20	2.21%	MEASURING, CHECKING, ANALYSING & CONTROLLING INSTRUMENTS
893	21	2.09%	ARTICLES, N.E.S., OF PLASTICS
716	22	1.87%	ROTATING ELECTRIC PLANT & PARTS THEREOF, N.E.S.
848	23	1.81%	ARTICLES OF APPAREL
781	24	1.74%	MOTOR CARS & OTHER MOTOR VEHICLES
845	25	1.64%	ARTICLES OF APPAREL, OF TEXTILE FABRICS
			Upper bound case
SITC-3	Rank	Contr.	Description
784	1	6.20%	PARTS & ACCESSORIES OF THE MOTOR VEHICLES OF 722, 781, 782 & 783
781	2	5.94%	MOTOR CARS & OTHER MOTOR VEHICLES
682	3	5.70%	COPPER
747	4	4.32%	TAPS, COCKS, VALVES & SIMILAR APPLIANCES
813	5	3.95%	LIGHTING FIXTURES & FITTINGS, N.E.S.
821	6	3.56%	FURNITURE & PARTS THEREOF
684	7	3.21%	ALUMINIUM
681	8	3.08%	SILVER, PLATINUM & OTHER METALS OF THE PLATINUM GROUP
778	9	2.55%	ELECTRICAL MACHINERY & APPARATUS, N.E.S.
742	10	2.10%	PUMPS FOR LIQUIDS
713	11	2.08%	INTERNAL COMBUSTION PISTON ENGINES & PARTS THEREOF, N.E.S.
333	12	2.03%	PETROLEUM OILS & OILS OBTAINED FROM BITUMINOUS MINERALS
112	13	2.01%	ALCOHOLIC BEVERAGES
716	14	1.98%	ROTATING ELECTRIC PLANT & PARTS THEREOF, N.E.S.
892	15	1.91%	PRINTED MATTER
525	16	1.87%	RADIOACTIVE & ASSOCIATED MATERIALS
775	17	1.86%	HOUSEHOLD-TYPE ELECTRICAL & NON-ELECTRICAL EQUIPMENT
773	18	1.63%	EQUIPMENT FOR DISTRIBUTING ELECTRICITY, N.E.S.
845	19	1.59%	ARTICLES OF APPAREL, OF TEXTILE FABRICS
522	20	1.57%	INORGANIC CHEMICAL ELEMENTS, OXIDES & HALOGEN SALTS
874	21	1.56%	MEASURING, CHECKING, ANALYSING & CONTROLLING INSTRUMENTS
772	22	1.51%	APPARATUS FOR SWITCHING OR PROTECTING ELECT. CIRCUITS, ETC.
667	23	1.49%	PEARLS & PRECIOUS OR SEMIPRECIOUS STONES
642	24	1.46%	PAPER & PAPERBOARD, CUT TO SIZE OR SHAPE
748	25	1.36%	TRANSMISSION SHAFTS & CRANKS, ETC.

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

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