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Description	

The exact import price and its implications for the USA external imbalance

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Abstract

This paper calculates the Feenstra (1994) "exact price index" for each category of USA imported goods and aggregates them in order to analyze the USA import demand equation for assessing the seriousness of the external imbalance. What distinguishes Feenstra's exact price index is that it incorporates new product varieties. The exact import price index thus calculated suggests that USA conventional import prices are biased upwards. The consequent downward adjustment in import prices causes appreciation in the real exchange rate and lowers the excessive portion of imports (the difference between actual and theoretical amounts of imports obtained from the import demand equation). Since the early 2000s, however, the role that new product varieties play in lowering the excessive portion of imports has declined because the impact of new products on import prices has been outweighed by the impact of the spike in primary commodity prices, which has resulted in a substantial depreciation of the real exchange rate. It is possible that this depreciation combined with relatively large excessive imports has caused the subsequent USA current account deficit to stop expansion in the late 2000s.

I. Introduction

It is widely believed that global imbalances have been a major factor in causing the recent global financial crisis (see, e.g., Obstfeld and Rogoff, 2009). One such imbalance is related to the large current account deficit of the USA, and in particular, increases in imports. Against this background, this paper reexamines the USA import demand equation.

Focuses are put on the price of imports relative to that of domestic goods, from which it is possible to derive theoretical volumes of imports in an import demand equation. The theoretical import volumes can then be compared with actual import volumes to assess the seriousness of the external imbalance. For import prices, this study adopts the Feenstra (1994) "exact price index."

What distinguishes Feenstra's exact price index is that it incorporates new product varieties, while conventional price indexes ignore new products and include only the intertemporal changes in the prices of goods available in two periods.

The purpose of this paper is to aggregate Feenstra's indexes for each category of imported goods at the macro-level and to examine how much the theoretical import volumes derived from the USA import demand equation change as a result of using this aggregate exact price index.[1]

Although Feenstra (1994) also estimated US import demand equations, he did so only for selected goods and did not examine the implications of the exact import price index for the USA economy as a whole.

A study that did aggregate the exact import price index for the USA is that by Broda and Weinstein (2006), but they only covered the period from 1972 to 2001 and not the 2000s which this paper covers. Consequently, they did not detect the change in the impact of imports of new product varieties on the USA trade balance in the 2000s as described hereinbelow. Moreover, the study by Broda and Weinstein (2006) concentrated on how the import of new varieties contributed to national welfare in the USA.

II. The Feenstra (1994) Exact Import Price Index

The Feenstra (1994) exact price incorporates new product varieties into import price indices. In his model, imports are treated as differentiated across countries of supply for each good as in Armington (1969), and imports from countries that have not traded with each other in the past work to raise the utility of importers.

In the case of the constant elasticity of substitution (CES) utility function and the minimum unit cost function derived from the utility function, Sato (1976) and Vartia (1976) have described its price index (P_g) to be

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1 The problems of publicly-available import price data can not be restricted to the way the indexes deal with newly traded products. In this respect, see Nakamura and Steinsson (2009). Consequently, it is not proper to attribute the difference between the public data and the exact price index which this paper reexamines only to the question of whether new product varieties are incorporated or not. This study compares two kinds of prices, exact and conventional price indexes and can affirm the importance of taking new products into account because the only one difference between the two indexes are the introduction of new products.

$$P_g = \prod_{c \in I_g} (\frac{p_{gct}}{p_{gct-1}})^{w_{gct}} \quad (1)$$

where p_{gct} is the price of variety c of good g in period t. I_g is the subset of all varieties of good g. Since in this case varieties are constant over time, $I_g = I_{gt} = I_{gt-1}$.

This is the geometric mean of the individual variety price change, where the weights are ideal log-changes. These weights w_{gct} are computed using cost shares s_{gct} as follows:

$$w_{gct} = \frac{(s_{gct} - s_{gct-1})/(\ln s_{gct} - \ln s_{gct-1})}{\sum_{c \in I_g}((s_{gct} - s_{gct-1})/(\ln s_{gct} - \ln s_{gct-1}))} \quad \text{where} \quad s_{gct} = p_{gct} x_{gct} / \sum_{c \in I_g} p_{gct} x_{gct} \quad (2)$$

where x_{gct} is the quantity of variety c of good g in period t.

The Feenstra (1994) exact price index (π_g) is the modified version of the price index of equation 1 for the case of different, but overlapping sets of varieties in the two periods:

$$\pi_g = \prod_{c \in I_g} (\frac{p_{gct}}{p_{gct-1}})^{w_{gct}} * (\frac{\lambda_{gt}}{\lambda_{gt-1}})^{1/(\sigma_g - 1)} \quad (3)$$

where σ_g is the elasticity of substitution among varieties of goods g differentiated across countries of supply ($\sigma_g > 1$). $c \in I_g = (I_{gt} \cap I_{gt-1})$, $I_g \neq \Phi$ and λ_{gt} , λ_{gt-1} are given by

$$\lambda_{gt} = \frac{\sum_{c \in I_g} p_{gct} x_{pct}}{\sum_{c \in I_{gt}} p_{gct} x_{gct}} \quad and \quad \lambda_{gt-1} = \frac{\sum_{c \in I_g} p_{gct-1} x_{pct-1}}{\sum_{c \in I_{gt-1}} p_{gct-1} x_{gct-1}} \quad (4)$$

This result states that the exact price index with variety change is equal to the conventional price index (P_g) multiplied by an additional term, $(\lambda_{gt} / \lambda_{gt-1})^{1/(\sigma_g - 1)}$.

In equation 4, λ_{gt} measures 1 minus the share of expenditure in period t on the product varieties that are new. If these new varieties have a substantial share of expenditure, then λ_{gt} will be small and this tends to make the exact price index lower than the conventional price index. In other words, the introduction of new product varieties will lower the exact price index. The term λ_{gt-1} equals 1 minus the share of expenditure in period t-1 on the product varieties that are not available in t. Thus, if there are many disappearing varieties between the two periods, this will tend to make λ_{gt-1} small, and raise the exact price index. When taken together, the increases of varieties play a role in lowering the exact price index.

Having derived the exact price index for each category of good (equation 3), we can now obtain the exact aggregate import price index as follows (Broda and Weinstein, 2006):

$$\prod = \prod_{g \in G} (\pi_g)^{w_{gt}} \quad (5)$$

$\forall g \in G$. G is a set of all imported goods. This is the geometric mean of the price changes in the individual product category, where the weights are ideal log-changes. These weights w_{gt} are computed using cost shares s_{gt} as follows:

$$w_{gt} = \frac{(s_{gt} - s_{gt-1}) / (\ln s_{gt} - \ln s_{gt-1})}{\sum_{c \in G} ((s_{gt} - s_{gt-1}) / (\ln s_{gt} - \ln s_{gt-1}))} \quad \text{where} \quad s_{gt} = p_{gt} x_{gt} / \sum_{g \in G} p_{gt} x_{gt} \qquad (6)$$

where p_{gt} is the price of and x_{gt} is the quantity of good g in period t.

III. Results

(1) Data

USA extremely disaggregated data are from The Center for International Data at UC Davis (http://cid.econ.ucdavis.edu/). In 1989, the US changed its system for collecting disaggregate import and export data. Prior to that year, the data were collected according to the Tariff Schedule of the United States Annotated (TSUSA). Beginning in 1989, however, the data were collected according to the Harmonized System to USA (HTS).

Accordingly, the exact and conventional aggregate import price indexes are calculated and subsequently import demand equations are estimated separately for each of the two kinds of data. The periods analyzed are from 1974 to 1988 for TSUSA and from 1990 to 2006 for HTS.

Table 1 shows the number of traded products and other related basic information.

Looking at the upper half of the table for 1974-1988, we found that the number of varieties (country-good pairs) imported into the US increases about threefold from 36 830 to 92 846. The number of varieties traded only in 1988 not in 1974 amounts to 80 893 out of 92 846. The extent of goods replacement is reduced somewhat, but we can observe the same tendency in the period between 1990 and 2006. The number of varieties imported only in 2006 is 130 821 out of 182 178.

(2) Exact import price vs. Conventional import price

The estimation method for price indexes is based on that developed by Feenstra (1994).[2] Fig. 1 depicts exact and conventional aggregate import prices for the periods of 1974-1998 and 1990-2006 respectively. As seen in Fig. 1(a), in the late 1970s, there were the same spikes in two price indexes due to the oil shock. After that, however, the two indexes differ greatly especially in a first half of 1980s which is due to the increasing amount of new goods imports. Meanwhile, the difference between the two indexes is relatively small in 1990-2006 (Fig. 1(b)). The upward bias in the conventional import price index over the period between 1974 and 2006 is 29.2 percent or 1.1 percentage points per year.[3]

As a result, the real exchange rate in the case of the exact price appreciates significantly during the period of 1974-1998 and this is an opposite result to the conventional price (Fig. 2(a)). The real

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[2] See Feenstra (1994) pp.163-165.

[3] For the years 1989 and 1990, year-to-year comparisons of prices are not available due to data constraints. The average per-annum rate of change of the two periods of 1974-1988 and 1990-2006 is therefore applied.

exchange rate here is calculated as the USA GDP deflator divided by the import price index. This trend of appreciation can be said to be consistent with the USA current account deficit, which increased in the 1980s. In 1990-2006, the real exchange rate in the case of exact price shows a moderate upward trend in the 1990s and the conventional aggregate price does not (Fig. 2(b)). Accordingly, the USA current account deficit started to balloon in the late 1990s.

Another important finding to note in Fig. 1(b) is both exact and conventional aggregate import prices show upward trend in 2000s. This indicates that the aggregate import bias defined as the exact aggregate price index divided by the conventional aggregate price index has stagnated, and in the 2000s, the role newly imported goods play in lowering the exact import price is virtually nil.

On the other hand, the conventional aggregate import price soars in the 2000s because of the spikes in primary commodity import prices.[4] This import price increase in the 2000s leads to the real exchange rate depreciation as shown in Fig. 2(b).

(3) Estimation of US import demand equation

As an import demand equation, this paper adopts the specification derived by the structural model in Senhadji (1998). This empirically tractable equation is derived from the assumption that the import decision in each country is made by a perpetually living representative agent who decides how much to consume from the domestic endowment and from imported goods.

The derived aggregate import demand equation is log-linear in the real exchange rate and an activity variable defined as GDP minus exports. Based on the data this paper uses, however, the correlation between the two independent variables is too high, and it seems unavoidable that serious multicollinearity occurs. Accordingly, this paper estimates the two single regressions. One is the regression which includes the volume of imports divided by the activity variable as a dependent variable and the real exchange rate as an independent variable. The other specification consists of the volume of imports as a dependent variable and the real exchange rate as an independent variable.

Import demand equations are estimated for each period of 1974-1988 and 1990-2006. The variable for the volume of imports reflects nominal import values deflated by exact or conventional aggregate import prices, and real exchange rates are, as mentioned earlier, calculated based on the GDP deflator relative to two kinds of import price indexes.[5] All variables are logged. Also, the independent variable, or the real exchange rate, lags the dependent variable by one year in order to avoid endogeneity problems. Consequently the results from two estimations, one of which uses exact prices and the other conventional prices, are compared.

First, unit roots tests are performed for six kinds of variables; the import volumes, the import volume divided by the activity variable and real exchange rates, all of which are prepared separately for exact and conventional aggregate import prices. As a result, all are difference stationary variables. Next, in each of the two estimation periods, Johansen’s cointegration test is performed for pairs of dependent and independent variables for both exact and conventional price indexes and the test found in all cases that variables are cointegrated. Consequently, estimations are performed for the equilibrium relationship between the variables.

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[4] There have been significant price rises in Mineral products (HTS code 5) and Products of the chemical or allied industries (HTS code 6).

[5] In the exact import price index, traded goods are treated as differentiated across countries of supply for each good as in Armington (1969), as mentioned above. Conversely, domestic products are all produced in the USA, and this paper assumes that the domestic price index does not need to take new product varieties into account in this model’s framework. It therefore uses the GDP deflator.

Table 2 reports estimation results. For both of the periods the adjusted coefficients of determination increase significantly when exact price indexes are used as indicated at the left of the table.

Fig. 3 shows the squares of residuals obtained from import demand equations where the residuals equal the log difference of actual import volumes from theoretical volumes of imports.[6] In most every year, the squares of residuals are larger in the case of the conventional price index than in the case of the exact price index. It could be said that the exact price index overall changes the evaluation of the USA external imbalance.

However, the two kinds of squares of residuals jumped up in the period in the mid-2000s. The extent of new product varieties has diminished and the contribution of such new product varieties in correcting excessive imports has diminished in effectiveness. This is because the spikes in primary commodity import prices overcome the new product effects. It is possible that the relatively large excessive imports in the mid-2000s have caused the subsequent USA current account deficit to stop expansion from the late 2000s onwards.

IV. Conclusion

This paper calculates the Feenstra (1994) "exact price index" for each category of USA imported goods and aggregates them in order to reexamine the USA import demand equation. The calculated exact import price index suggests that USA conventional import prices are biased upwards.

Next, the import demand equation of the USA is estimated by using this exact aggregate price index, and it is found that the adjusted coefficient of determination increases significantly. This is because the downward adjustment in import prices causes the real exchange rate to appreciate. The exact price index overall changes the evaluation of the seriousness of the USA external imbalance.

Since the early 2000s, however, the role that new product varieties play in lowering the excessive portion of imports has declined because the impact of new products on import prices has been outweighed by the impact of the spike in primary commodity prices, which has resulted in a substantial depreciation of the real exchange rate. This depreciation seems to be consistent with the USA current account deficit, which appeared to stop expansion in the late 2000s.

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[6] The estimation for the Fig. 6 is made with import volumes divided by the activity variable as a dependent variable.

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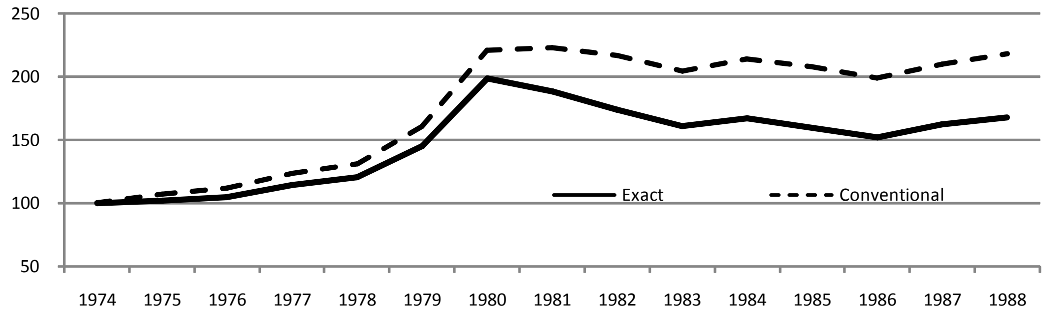
Table 1. Variety in US imports

(a) 1974-1988

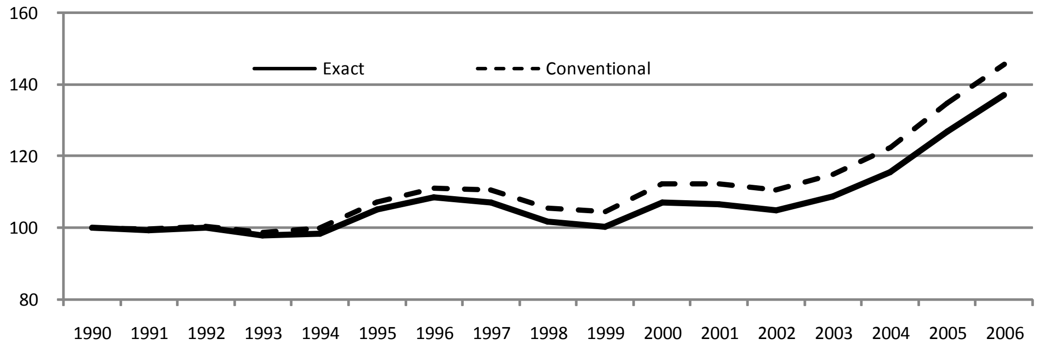
	Number of TSUSA category	Average number of exporting countries	Total number of varieties (country-good pairs)
All 1974 goods	5 634	6.53	36 830
All 1988 goods	10 212	9.09	92 846
Common in 1974	2 948	5.79	17 094
Common in 1988	2 948	8.67	25 566
1974 not in 1988	2 686	7.34	24 877
1988 not in 1974	7 264	9.26	80 893

(b) 1990-2006

	Number of HTS category	Average number of exporting countries	Total number of varieties (country-good pairs)
All 1990 goods	11 410	9.21	105 103
All 2006 goods	14 791	12.31	182 178
Common in 1990	7 702	9.22	71 019
Common in 2006	7 702	13.26	102 184
1990 not in 2006	3 708	9.19	53 746
2006 not in 1990	7 089	11.28	130 821

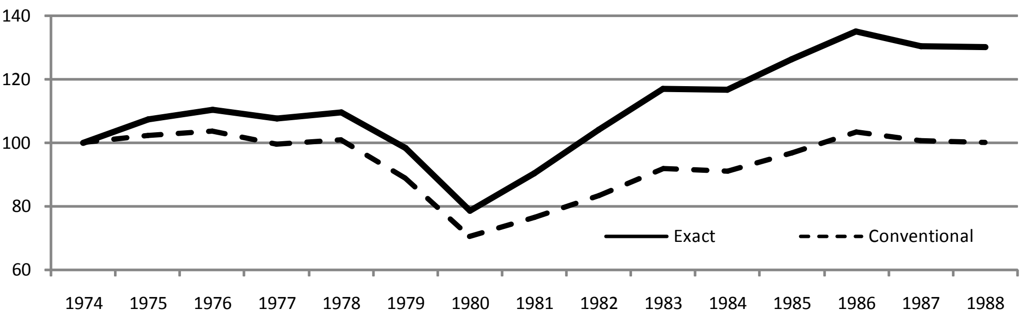


(a) 1974-1988 (1974=100)

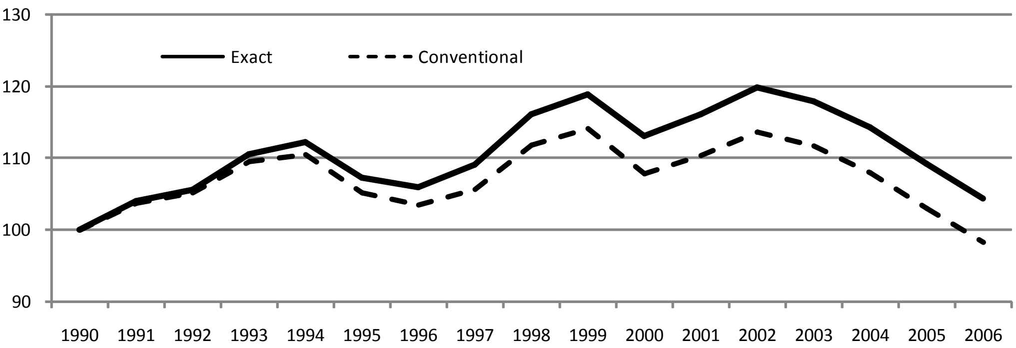


(b) 1990-2006 (1990=100)

Fig. 1. Exact and conventional aggregate import price index



(a) 1974-1988 (1974=100)



(b) 1990-2006 (1990=100)

Fig. 2. Real exchange rate calculated by exact and conventional aggregate import price index

Note : An index rise means appreciation and an index fall means depreciation of real exchange rates

Table 2. Estimation Results of import demand equations

Model 1: Dependent variable is an import volume divided by an activity variable

(a) Exact price index is used for the real exchange rate

	constant		real exchange rate		$\overline{R}^2$
1974-1988	-5.967 (-6.56)	***	1.006 (5.23)	***	0.653
1990-2006	-19.084 (-9.06)	***	2.547 (5.70)	***	0.677

(b) Conventional price index is used for the real exchange rate

	constant		real exchange rate		$\overline{R}^2$
1974-1988	-4.178 (-4.24)	***	0.612 (2.82)	**	0.332
1990-2006	-17.582 (-5.00)	***	2.235 (2.97)	**	0.344

Model 2: Dependent variable is an import volume

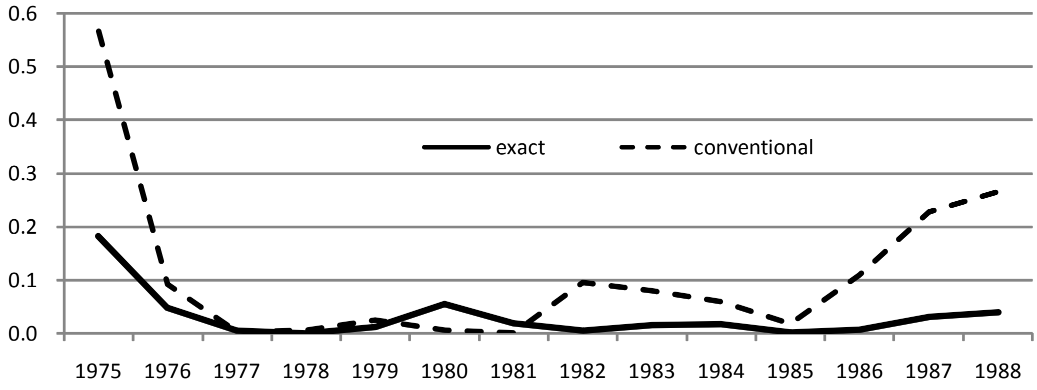
(c) Exact price index is used for the real exchange rate

	constant		real exchange rate		$\overline{R}^2$
1974-1988	-0.006 (-0.00)		1.578 (4.04)	***	0.522
1990-2006	-21.544 (-4.51)	***	5.037 (4.97)	***	0.613

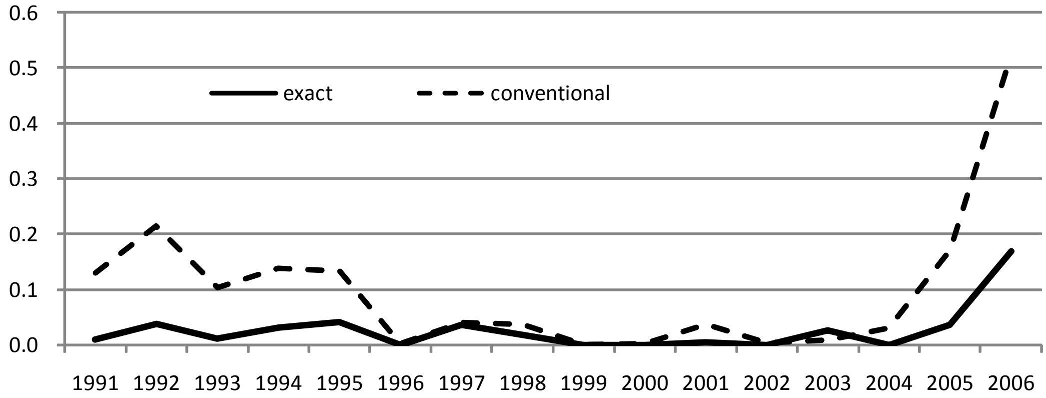
(d) Conventional price index is used for the real exchange rate

	constant		real exchange rate		$\overline{R}^2$
1974-1988	4.332 (1.82)	*	0.642 (1.23)		0.030
1990-2006	-18.132 (-2.17)	**	4.335 (2.43)	**	0.246

Note: *, ** and *** indicate significance at 10, 5, 1% levels respectively. The *t* -values are shown in parentheses.



(a) 1975-1988



(b) 1991-2006

Fig. 3. Squares of residuals obtained from import demand equations

Note: A Squared residual for each year is divided by the sum of squared residuals for the comparison of different equations