

## A RESPONSE MODEL FOR THE INTERNATIONAL PRICE PROGRAM

Gwyn R. Ferguson and Tamara M. Ciapponi, Bureau of Labor Statistics<sup>1</sup>  
Gwyn R. Ferguson, 2 Massachusetts Ave. NE Suite 3655, Washington, DC 20212

**KEY WORDS:** Establishment Survey, Survey Model, Deterioration, Non-Response

### Introduction

The International Price Program is a longitudinal establishment survey in which monthly price data is collected for goods imported into the United States or exported from the United States. During the survey process, business establishments are selected and reviewed for address verification and prior survey contact. Within selected establishments, general product categories are sampled for initiation. Unique items are then selected within each general category during an initiation process and the selected items are repriced each month until they are phased out of the survey. At each stage in processing, sample losses can and do occur. A model of the types of sample loss at each stage of processing has been developed. This model provides a framework for discussing the scope of the losses at each stage of processing. We believe that this model is general enough to be used for most establishment surveys.

This paper will explain the types of losses which can occur at each stage of sample processing. Some results from recent samples will be shown and explained. We will then discuss how the information learned from this model can be used to identify areas where losses occur and to identify the reasons for this loss. With this knowledge, areas where changes can be made to survey processing to improve response rates and increase the accuracy of the survey in future samples can be identified.

### IPP Response Model

At each stage of the sample processing, the IPP experiences losses. As shown in Figure 1, losses occur during frame preparation, selection of business establishments, selection of product areas within each business establishment, sample refinement, initiation of items for selected business establishment, and repricing of the initiated items. These losses can be losses of an entire business establishment, losses of selected product areas within an establishment, or losses of one or more items within a selected product area for an establishment. We will now detail these losses and explain how we classify the losses at each step.

The frame for the IPP, represented by box 1 on Figure 1, is composed of import or export transaction records. All records for a single business establishment are grouped to form the primary sampling units. The records for each primary sampling unit, or business establishment, are also grouped into general product areas for the second stage of sampling. Import business establishments are lost at this point in processing when no name or address is available for a transaction. The units which are lost are called unidentifiable frame units while the portion of the frame for which address information is available is referred to as identifiable frame units, as shown in boxes 3 and 2 respectively. For exports, we do not obtain the name and address for each transaction in the frame, so all frame transactions are considered to be usable and there are no losses at this stage of processing. However, we do obtain the exporter names and addresses after the sample is selected.

From the sample frame, a sample of business establishments is chosen for each import and each export sample as shown in boxes 4 and 5 of the model. Sample size for this process is due to the makeup of the frame or universe of companies which trade internationally and budget constraints. The universe of companies which trade internationally is skewed and contains a relatively small set of importers and exporters who dominate U.S. trade. The budget constraints restrict the number of units for sampling, initiation, and repricing.

A sample of product areas within each selected business establishment, or secondary sampling units, is selected as shown in boxes 6 and 7 of the model. During this subselection process, the number of items within each secondary sampling unit or entry level item category which will be initiated for each establishment is also determined. The second stage sample size or burden is determined based on the publication needs of the Program and considers the cooperativeness of the respondent. Subselection attempts to create a work load that will not over burden the respondent or the initiation staff but will still ensure that the sample generates enough items for repricing to meet publication needs for the IPP indexes. These considerations limit the sample size and increase the sampling error.

<sup>1</sup> Any opinions expressed in this paper are those of the authors and do not constitute policy of the Bureau of Labor Statistics.

The selected establishments and product categories are then reviewed and refined. During this review and refinement, two types of actions may be taken which can cause sample losses. The first action which can affect sample losses during the refinement occur when an establishment is determined to be a refusal prior to initiation as depicted in box 9. This occurs when it is determined by historical files that the establishment is an adamant refusal. The second action which can affect sample loss rates during the review of names and addresses of selected establishments occurs when a selected establishment is determined to be out of the scope of the survey, such as a foreign government, as seen in box 10.

Up to this point, the primary sources of loss have been due to sampling frame errors and sample refinement. The establishments and product categories remaining after sample refinement, shown in box 8, become initiation units. The initiation process introduces a different reason for loss, the respondent. Since the IPP survey is a voluntary survey, the cooperation of the respondent is crucial.

Initiation units are sent to the regional offices for initiation. An initiation unit represents a unique address from which initiation data may be obtained. During the initiation process, loss can occur to an entire initiation unit (i.e. primary sampling units), to some of the selected product categories (i.e. secondary sampling units) within an initiation unit, or to some of the items within a product category for an initiation unit.

Field economists contact each selected establishment in an attempt to collect data. During the initiation process the respondent may refuse to participate any further and therefore the entire unit is a refusal, as shown in box 12. Or, the respondent may agree to reprice one or more items but refuse to reprice others as shown in box 15.

Out-of-Scopes also occur at initiation for a variety of reasons such as frequency of trade, never traded, or out-of-business. It is possible that the respondent's trade is out-of-scope for all of the chosen product categories and therefore the entire initiation unit is out-of-scope, as depicted by box 13. However, the respondent's trade may be out-of-scope for some chosen product areas but not for others. This situation is included in box 16 or 18 depending on the nature of the response for the respondent's in-scope items.

Out-of-Scope units result from problems with the sampling frame. For example, an establishment reporting that the selected item was never traded could result from the wrong information having been entered on trade documents. As a result the frame shows a company trading in the wrong product category. Out-

of-business units are also a frame problem. The frame used for sampling is an average of two years old before an establishment is initiated. In the time that has elapsed, some companies cease to trade internationally or go out-of-business. The age of the frame also impacts the number of companies reporting they no longer trade in a product area. Because of the dynamic nature of international trade, importers and exporters often change the product areas in which they trade in response to conditions in the international marketplace. Therefore the secondary sampling units may be out-of-scope.

Once an item is initiated, it enters the repricing phase where respondents are asked to provide updated price information for each item. Reporters are sent repricing forms each month for five years at which time the item is phased out of the survey. During the repricing phase, items can continue to cooperate, become refusals, or become out-of-scope.

From this model, several measures of loss can be computed, actual loss counts or percentages, conditional loss rates, or weighted loss rates. Actual losses can be determined by obtaining counts of the number of primary or secondary sampling units corresponding to each box on the model. Loss rates can be determined by computing the percentage which each box represents of either the entire frame, box 1, or of any of the boxes in the model above the one being considered. For example, the percentage of primary sampling units from the refined sample which cooperated at initiation can be obtained by dividing the number of units in box 11 by the number of units available for initiation in box 8. By summing the weights for the units in each box, you can obtain total weighted loss. As with the counts, dividing the weighted loss by any of the boxes above that one on the model will yield the weighted loss rate for the box in question. Conditional loss or response rates can be computed by considering only specified boxes in the model. For example, to obtain the refusal rate for all in scope establishments available for initiation, you divide the number (or total weight) of primary sampling units in box 12 by the sum of the number (or weight) of the primary sampling units in boxes 11 and 12.

### Results from Recent Samples

Using the response model from Figure 1, we have analyzed the response from several recent import and export samples. A detailed analysis of the response data for each stage of survey processing has been performed and the results are shown below. The data represents the information obtained for import and export samples selected using 1989 and 1990 frame data.

Together, these samples represent all the general product areas included in IPP samples.

Table 1 shows the number of import and export business establishments (PSUs) from the frame. Also displayed is the loss incurred from the lack of name and address information. Table 1 corresponds to boxes 1, 2, and 3 of Figure 1. For exports the names and addresses of the establishments are not obtained for frame data and therefore no loss is incurred at this stage. Table 1 shows that the number of establishments for exports is much greater than the number of establishments for imports. This is because some transaction records at this stage do not have establishment identifiers and each such transaction is treated as a separate PSU. A loss of 7% of the import frame is due to a lack of name or address information.

Table 1: Frame Loss

	Frame	Identifiable	Unidentifiable
PSUs - Imports	282,575	93%	7%
Exports	1,855,561	100%	0%
SSUs - Imports	982,088	96%	4%
Exports	2,448,778	100%	0%

Table 1 also shows the number of secondary sampling units (SSUs) that are lost due to the lack of name and address information. Again exports have many more secondary sampling units than imports. The 7% of import establishments that show no name or address correspond to 4% of the import secondary sampling units. This would indicate that establishments which trade in fewer product categories tend to have missing name and address information.

The next process is to select a sample of establishments. Table 2 shows the percentage of import and export establishments that are selected to participate in the IPP Survey and corresponds to boxes 4 and 5 in Figure 1. Since the number of export establishments in the frame is so large, less than one half of one percent of the primary sampling units are selected.

Table 2: Selected Units

	Identifiable	Selected	Non-selected
PSUs - Imports	262,652	1.75%	98.25%
Exports	1,855,561	0.27%	99.73%
SSUs - Imports	939,958	9.72%	90.28%
Exports	2,448,778	3.36%	96.64%

Table 2 also shows the percentage of secondary sampling units that correspond to the selected and non-selected establishments. Over 90% of import SSUs and 95% of exports are not selected at this stage. The non-selected SSU percentages are lower than the PSU percentages because the selected establishments are

generally larger and trade in more product areas than the non-selected establishments.

The next process, subselection, samples the product categories traded by the selected establishments and determines the number items to be initiated within each product category. Table 3 shows the percentage of secondary sampling units that were selected and not selected from the chosen business establishments. Table 3 corresponds to boxes 6 and 7 of Figure 1. Almost 75% of both import and export secondary sampling units are not selected during subselection.

Table 3: Subselection

Secondary Sampling Units	SSUs for Selected Establishments	Subselected Units	Non-Subselected Units
Imports	91,390	26%	74%
Exports	82,255	27%	72%

The final process before the initiation of the sample is to refine the sampled establishments. During this process some establishments and their corresponding product categories are deemed refusals or out-of-scope of the survey. Establishments are refusals if previous attempts at initiation have resulted in adamant refusals. Establishments are out-of-scope of the survey if they are government agencies, if only a foreign address exists for the establishment, or if no name and address could be obtained for the selected export establishment. Table 4, which refers to boxes 8, 9, and 10 of Figure 1, shows the establishments and secondary sampling units that are lost during sample refinement. Only a very small percentage of units are lost due to refusals. Less than 9% of import establishments corresponding to 12% of SSUs are classified as out-of-scope during sample refinement. Also a very small number of export establishments and SSUs are classified as refinement out-of-scopes. For imports the majority of the out-of-scope units have foreign addresses. For exports, the out-of-scope units are mostly comprised of units with foreign addresses and units with no address.

Table 4: Sample Refinement

	Selected Units	Refusals	OOS
PSUs - Imports	4,600	0.00%	8.50%
Exports	5,003	0.24%	3.40%
SSUs - Imports	23,923	0.00%	12.15%
Exports	22,747	0.43%	2.59%

During sample initiation, an establishment or primary sampling unit is assigned to a response category through a hierarchy of the item dispositions:

**Cooperation:** If at least one item is cooperative, the establishment is classified as cooperative.

**Refusal:** If at least one item is a refusal and no items are cooperative, the establishment is classified as a refusal.

**Out-of-Scope:** If all the items are out-of-scope, the establishment is classified as out-of-scope.

Table 5 shows the percentage of establishments that fall into each response category and the total number of establishments available for initiation for imports and exports. These rates were derived from data for boxes 11, 12, and 13 of Figure 1. From Table 5 we see that 33% of the import establishments do not have any cooperative quotes. Similarly 41% of the export establishments are lost during initiation. While the percentages of loss due to refusals in both imports and exports are almost equal, the percentage of loss due to out-of-scopes is significantly higher for exports due mainly to problems with the export frame data which are detailed later in this section.

Table 5: Sampling Unit Response

	COOP	REF	OOS	Total
PSUs - Imports	67%	14%	19%	4,205
Exports	59%	15%	26%	4,815
SSUs - Imports	38%	21%	41%	21,017
Exports	29%	20%	51%	22,034

Table 5 also shows the percentage of secondary sampling units for each response disposition category and the total number of secondary sampling units in the refined sample for imports and exports. The cooperative response rate is the number of secondary sampling units in box 14 of the model divided by the total number of like units in box 8. The numerator for the refusal rate is the sum of the number of secondary sampling units in boxes 15 and 17, while the out-of-scope rate is computed based on the secondary sampling units in boxes 16, 18, and 19. While 33% of the import establishments were lost, Table 5 shows that 62% of the selected product areas within all establishments were not initiated due to refusals or out-of-scopes. For exports 41% of the establishments were lost and 71% of the product areas were not initiated. Exports also have more secondary sampling unit loss due to out-of-scopes than imports. The reason for the large out-of-scope rate for exports will be detailed later in the paper.

Table 6 states the explanation for the item refusals for imports and exports. It is clear from Table 6 that "Reporter Burden" is the main reason cited for refusing to participate in the survey. "Reporter Burden" is cited when the reporter states that either the number of items requested is too large or that the amount of time required for the initiation visit or repricing is more than the reporter can afford. "Reporter Burden" is more

prominent for importers than exporters. Situations where the frame leads to a broker who filed the trade documents for the reporter, but the broker does not maintain the pricing information needed for the survey are called "Actual Reporter not Chosen". This situation has a much higher frequency in exporter samples. Other frequently reported reasons for refusing to participate in the IPP survey include the following:

**Non-Mandatory:** The IPP is not a mandatory survey requiring participation by respondents.

**Confidentiality:** This category is used for respondents who are not convinced that the IPP will maintain the confidentiality of their pricing data and refuse to provide us with their price information.

**IPP Has No Value:** This category is used for respondents who do not understand the uses of the IPP indexes or see how they can provide any useful information for the indexes.

Table 6: Refusals

Refusal Reasons	Imports	Exports
Reporter Burden	47%	33%
Non-Mandatory	14%	9%
Confidentiality	6%	6%
IPP Has No Value	6%	8%
Actual Reporter not Chosen	0%	14%
Other Refusals	27%	30%
Total Refusal Items above	4,396	4,301

Out-of-Scopes can be classified into four major categories as shown in Table 7 which tallies the item out-of-scopes for imports and exports. The main reason for out-of-scope items is "Frequency of Trade" which is cited when the reporter states that he does not trade any particular item in the desired product area at least once a year. This category also includes items for which the reporter acknowledges trading in the past but states that the company has ceased trading. These out-of-scopes account for 54% of all import out-of-scopes and 39% of all export out-of-scope items and reflect the volatile nature of trade in the international marketplace. Other frequently reported reasons for out-of-scopes include the following:

**Misclassified:** The respondent states that his or her establishment has never traded in the product area for which data is requested.

**Unpriceable Transaction:** The reporter states that trade occurred but that the prices of the items which were traded are not known. This situation occurs when items are traded as part of a large shipment composed of many items and the only

price is for the entire shipment, with no details for individual item prices.

**Out-of-Business:** The IPP considers an establishment to be out-of-business when it has physically gone out-of-business or has ceased to trade on the international marketplace.

Table 7: Out-of-Scopes

Out-of-Scope Reasons	Imports	Exports
Frequency of Trade	54%	39%
Misclassified	11%	21%
Unpriceable Transaction	16%	20%
Out-of-Business	9%	7%
Other Out-of-Scopes	10%	12%
Total Out-of-Scope items above	8,664	11,279

The establishment response of Table 5 is further broken out in Table 8 which shows the item response within cooperative establishments for imports and exports. Table 8 corresponds to boxes 14-16 of Figure 1. The columns of the table are defined by the response of the items within the cooperative establishments. For example, in Table 8, we see that the import cooperative establishments agreed to cooperate for 59% of the items for which data was requested, refused for 6% of the items, and responded that 35% of the items were out-of-scope. Considering only the cooperative establishments, losses of 41% for imports and 49% for exports occurred at initiation. This means that almost half of the items for cooperative establishments are lost at this stage.

Table 8: Item Response within Establishments

Cooperative Establishments	Percent of Products			Total
	COOP	REF	OOS	
Imports	59%	6%	35%	15,285
Exports	51%	6%	43%	15,956

Once the initiation phase is completed for each establishment, the cooperative items for the establishment enter the repricing phase of the survey. During repricing, the respondent is asked to provide updated price information for each initiated item on a monthly basis. Items are lost during repricing for three reasons, refusals, out-of-scopes, or temporary refusals, as shown in boxes 21, 22, and 23 of Figure 1. Items are classified as refusals when the reporter explicitly refuses to participate in the survey. Items are out-of-scope when the respondent ceases to trade the items internationally. Items are classified as temporary refusals when the reporter does not respond with a usable price for a given period but has not refused to respond permanently.

Table 9 illustrates the loss incurred during the repricing process. The first repricing ("First Rep")

rows indicate the percentage of items that became refusals or out-of-scopes prior to actual participation in the survey. Also displayed is the percentage of items that were temporary refusals because the reporter did not return a usable price during the first attempt at repricing. Table 9 shows that 2% of both import and export items were out-of-scope before ever entering the repricing phase. The out-of-scope losses again show the changing state of trade in the international market.

Table 9: Repricing

Imports	Refusals	OOS	Temp. Ref.	Total Loss
First Rep	0%	2%	6%	9%
One Year	2%	12%	31%	45%
Never	3%	18%	6%	26%
Exports	Refusals	OOS	Temp. Ref.	Total Loss
First Rep	0%	2%	7%	9%
One Year	1%	7%	28%	36%
Never	1%	7%	7%	15%

The "One Year" rows show the percentage of loss incurred between initiation and a period one year after most items for the sample were initiated. Table 9 shows that a majority of the loss at one year is due to temporary refusals.

The "Never" rows show the percentage of items which have never returned a usable price. These items were cooperations at initiation yet their respondents have never provided a price for use in index estimation. Table 9 shows that 26% of import items and 15% of exports items have never participated in the survey. This shows that approximately half of the IPP repricing loss is long term loss for which no repricing data has ever been obtained.

### Future Improvements and Conclusions

The results of the analysis of the IPP samples have shown several possible areas for further research. The International Price Program should consider research to improve the sample frame to decrease the frame losses as well as out-of-scope losses during the initiation and repricing phases of the sample. Some consideration should also be given to researching alternative methodologies for decreasing the temporary repricing losses. The model has also shown that there is a significant refusal loss during the initiation process, especially due to respondent burden considerations. Research should be undertaken to find methods for reducing this loss, either through sample allocation, respondent burden allocation, or alternative initiation or repricing procedures. Improvements in any of these areas should significantly decrease the sample loss for future IPP samples.

The response model which has been developed can be used to learn much information about the results from, and yield generated by, each sample selected by the International Price Program. Based on the information in the model, conditional response rates as well as weighted response rates for each stage in survey processing can also be derived. This model will be useful for future samples as it provides a framework for analyzing the results of each sample and comparing the results of one sample to those of other samples. The model is general enough that other multi-stage establishment surveys should be able to use it with only minor adaptation. Response could then be compared between different establishment surveys. This model has also provided the ability to point out areas where further research can be performed to improve the survey.

**Bibliography**

CARPENTER, J. F. (1978), "Error Analysis in the International Prices Program", presented at the ASQC Technical Conference in Chicago, Illinois in May, 1978.

DERR, R. E. and CIAPPONI, T. M. (1992 - 1993), "Sample Response Summary", various internal reports, Price Statistical Methods Division, Bureau of Labor Statistics.

HESS, K. K. and CHRZASTEK, B. C. (1985), "IPP Response Model", internal report, Price Statistical Methods Division, Bureau of Labor Statistics.

HIDIROGLOU, M. A., DREW, J. M., and GRAY, G. B. (1992), "Dealing with Nonresponse to Sample Surveys at Statistics Canada", Proceedings of the U.S. Bureau of the Census 1992 Annual Research Conference., pp. 207 - 224.

**Figure 1 -- International Price Program Response Model**

