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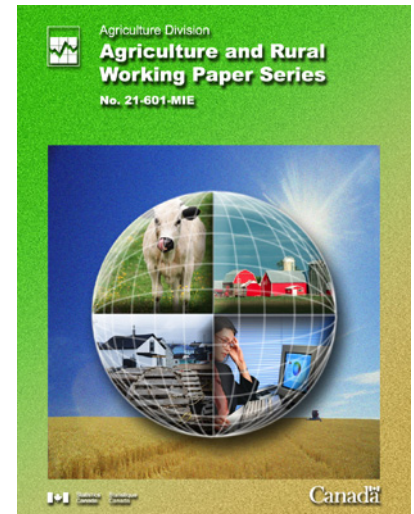
## Research Paper

# The Redesign of the Canadian Farm Product Price Index 2001

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2001

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***Note of appreciation:*** Canada owes the success of its statistical system to a longstanding partnership between Statistics Canada and the citizens, businesses and governments of Canada. Accurate and timely statistical information could not be produced without their continued co-operation and good will.

## Background

The Farm Product Price Index (FPPI) is a monthly series that measures the changes in prices that farmers receive for the agriculture commodities they produce and sell. The price index has separate crop and livestock indexes, a variety of commodity-group indexes such as cereals, oilseeds, specialty crops, cattle and hogs and an overall index - all available monthly and annually for the provinces and for Canada.

The index expresses current farm prices from Statistics Canada's Farm Product Prices Survey as a percentage of prices prevailing in the base period, currently 1997=100. Its primary purpose is to serve the measure of Canadian agricultural commodity price movement and as a means to deflate agricultural commodity prices.

Prices are based on either administrative data sources, or monthly surveys of agricultural producers or commodity purchasers. Commodities are priced at point of first transaction. The fees deducted before a producer is paid are excluded (e.g., storage, transportation and administrative costs), but bonuses and premiums that can be attributed to specific commodities are included. Commodity-specific program payments are not included in the price.

The FPPI is based on a five-year basket that is updated every year. This captures the continual shift in agricultural commodities produced and sold. The annual weight base is derived from the farm cash receipts series. There is a two-year lag in the years used to construct the basket because of the availability of farm cash receipts data and to reduce the

number of revisions made to the index. Therefore, the years used to construct the basket for year  $y$  are  $y-6$  to  $y-2$ .

The seasonal weighting pattern was derived using the monthly marketings from 1994 to 1998. This weighting pattern remains constant and will only be updated periodically, for instance during intercensal revisions or when the time base is revised.

The methodology of the index and the price series used to construct the index have been designed to control error and to reduce the potential effects of these. However, both administrative and survey data are subject to various kinds of error. Survey data are mainly subject to response and data capture errors. In reporting prices each month, farm survey respondents are asked to report the average prices prevailing in their neighborhood, taking into account the various grades of each commodity marketed. Thus, average prices reported by these respondents may differ from month to month due to changes in price, quality or both. The agencies providing administrative data are considered to be the best sources available, and data received from them are judged to be of very good quality.

The FPPI is not adjusted for seasonality, but the seasonal baskets are used since the marketing of virtually all farm products is seasonal. The index reflects the mix of agriculture commodities sold in a given month. The FPPI allows the comparison, in percentage terms, of prices in any given time period to prices in the base period.

## **The main elements of the FPPI redesign**

The Farm Product Price Index (FPPI) was discontinued with the March 1995 estimates when it was still on a 1986 time base. It was revived in April 2001 due to the continuing demand for an index of prices received by farmers.

The time base of the index was changed from 1986 to 1997, since the System of National Accounts (SNA) switched to estimates at 1997 constant prices. In its initial updating the FPPI was calculated up to March 2001, including all of the months from April 1995 forward for which no official estimates have been published.

The indexes were also revised back to 1992, incorporating substantial changes in the way that they are put together. There was no change in methodology for the indexes before 1992. Although the index levels of the 1997=100 series will be different from those of the 1986=100 series they will continue to show the same percent changes for the period ending in December 1991.

### **Key changes in methodology**

The methodology changes made with the revival of the FPPI are the most substantial in its history. There are five main changes:

1) The new index is an annually reweighted chain price index, so the annual weighting pattern is updated every year. The weighting pattern for an index is also called its basket. The old index was a fixed-basket price

index for the most recent period, and its weighting pattern or basket was updated only after ten or more years had elapsed.

2) The new index follows a seasonal-basket concept, where the volume shares of the various commodities are different in each of the twelve months of the calendar year. The old index followed a fixed-basket concept, where those shares were the same for all months of the year. Now there are 12 different weighting patterns used in calculating the months of a calendar year in the FPPI, where before there was only one.

3) In the new index, consistent with its seasonal-basket concept, the annual index number for a given year is a weighted average of the corresponding monthly index numbers. In the old index, consistent with its fixed-basket concept, the annual index number was the mean or simple average of the corresponding monthly index numbers.

4) In the new index, goods for which there are receipts but no marketings have their price movement proxied by a group index (e.g. maple products take their price movement from total crops). In the old index, such goods were simply omitted from the weighting pattern of the FPPI and had no impact on the overall index.

5) In the new index, each annual basket will be based on

marketings for an average of five years; the last annual basket for the old index was based on marketings for an average of four years from 1981 to 1984.

### **The seasonal-basket formula**

The seasonal-basket formula is a variant of what is usually called the Rothwell formula, after Doris Rothwell, an economist with the U.S. Bureau of Labor Statistics, who proposed it in a 1958 paper for the U.S. consumer price index (CPI). However the formula was originally proposed in 1924 by two economists with the U.S. Department of Agriculture, Louis H. Bean and O.C. Stine as an index number for farm prices. Thus the formula adopted was originally designed as an indicator of farm price movements.

The Rothwell formula must be used to calculate indexes of fresh produce in the harmonized indexes of farm product prices of the European Community. Dick Carter, who now works for Statistics Canada, introduced it as the formula for the United Kingdom's agricultural price indexes in 1972, when he worked for the U.K. Ministry of Agriculture, Fisheries and Food. It is also used to calculate series for seasonal commodity groups in the CPIs of several countries, including Japan, France and the United Kingdom.

### **Updating the basket**

The new index's basket is updated every year, whereas the old index's basket was updated every 10 years at most. A basket update no longer implies a change in the base year of the index, as it did in the old index, so it is no longer necessary to

rebase the entire historical series every time a new basket is introduced. However, the most recent years of the new index do not have the nice properties of a fixed-basket index, as they did in the old index.

For example, for the year 1999, one calculates an unlinked series with the year 1998 as base, and a basket based on marketings in 1993-97 for all of the months from January 1998 to December 1999. This is an update from the basket used to calculate 1998, when the basket was based on marketings in 1992-96. With each January updating a year is dropped and a year is added in calculating a new index basket.

The unlinked estimate for 1999 is then multiplied by the chain price index number for 1998 on a 1997 base to get the chain index number for 1999 on a 1997 base. The basket is updated but there is no change in the base year of the index, and no revisions to previous years of the series.

It is tempting to perceive the procedure for updating the basket as little more than a five-year moving average, but it is a little misleading to do so, since from one year to another the farm cash receipts are evaluated at different prices. The receipts for 1992-96 are evaluated at 1997 prices, those for 1993-97 at 1998 prices. Evaluating 1993-97 receipts at 1998 prices means that for each commodity receipts for 1993 are deflated by a price index for 1993, receipts for 1994 are deflated by a price index for 1994, and so forth, where all price indexes used as deflators are on a 1998 base. The unlinked series for 1999 is then a fixed-basket index with a 1998 base and a 1993-97 basket.

It would really only be correct to speak of a five-year moving average of marketings if all baskets were evaluated at the same set of prices, but this is not the case as regards the calculation of the index.

### **Differences in updating of the new index compared to the old index**

The differences are substantial. The last time the old index was updated, it was to a 1981-84 basket, an updating that occurred in December 1986. The movement of the old index was revised backward to 1981 based on the new index basket, and the index was rebased to 1981. There was no linking involved to calculate the index from January 1981 forward, since it was essentially a direct fixed-basket index with a 1981-84 basket and a 1981 base period.

On the other hand, it was necessary to backward link the historical series, prior to 1981, so that it too was available on a 1981 base. Because of this linking process, the indexes for the period 1971-80 no longer had the nice properties of a fixed-basket index that they possessed on a 1971 base. For example, it was no longer necessarily true that an aggregate index would have a value somewhere between that of its smallest and largest component series. But the direct fixed-basket index, from 1981 forward, did have these properties.

The new index, because it is always linked forward, makes the rebasing of the series an operation independent from the annual updating of its basket. Any time the new index has its time base changed (for example, from 1997 to

2001), it will be a simple arithmetic operation, not involving any change in basket. Also, because there is a two-year lag between the last year of the five-year basket and the year that the index is updated to incorporate it, there is never any need to revise the index because of basket updating.

### **Advantages of the new basket update procedures**

The most obvious advantage is operational. There is considerably less work involved in any given basket updating than there was previously, and because they occur every year, they are easier to accommodate in the production schedule. Any decision to move to a new base period can also be easily accommodated because only an arithmetic rebasing of the chain price indexes is required.

However, the more important advantage is conceptual. The FPPI is used as both a short term and a long term indicator of price changes. People interested in making price comparisons from year to year and in following the evolution of price movements over decades both make use of the FPPI. In order to make long term comparisons feasible it is necessary for the index basket to be updated from time to time. An index of farm product prices based on a 1935-9 basket would not be very useful for analyzing farm price movements in the 21<sup>st</sup> century. On the other hand, any change in basket inevitably creates a discontinuity in the monthly or annual movements of the series.

Infrequent basket changes reduce the number of discontinuities in the series,

but make them more important when they occur. Moreover, infrequent basket changes create problems of their own. It may be necessary to proxy a price index for a commodity in a province where it is no longer produced. On the other hand it is not possible to introduce a new product until there is a new basket updating, which may not occur until long after a new commodity has obtained a substantial market share. With annual updating of baskets, new commodities can be added to a basket or disappearing commodities deleted from it in any year.

Generally speaking, a chain price index should be constructed so that the basket used in its initial year is representative of that year, the basket used in its terminal year is representative of that year and the baskets lying between them change smoothly between the initial and terminal baskets, being approximately linear combinations of the two baskets. The chain price index formula used in the FPPI satisfies these criteria. A 1986-90 basket is reasonably representative of 1992 and a 1995-99 basket of 2001, while the use of a five-year basket reference period ensures that the interim baskets change smoothly from the initial to the terminal basket.

It would not be desirable to link in basket changes that were quickly reversed in later updates. This would happen if, for example, one linked monthly, so that every twelfth update one would approximately circle back to the initial basket. It would also happen if there were only a single year determining the weighting pattern. The basket for a given year  $y$  that experienced normal weather conditions following a year in which there was a

severe drought would have more in common with the baskets of earlier years than it would with the basket for the previous year.

### **Revaluing weights at constant prices**

Any index basket must have its expenditures expressed in terms of the constant prices of its base period in the case of a direct index, or of its link period, in the case of a chain index. The Industry Product Price Index (IPPI) basket is based on 1997 expenditures and they are not re-expressed in the prices of any other year. This is because from 1997 forward the IPPI is a direct Laspeyres index and its basket reference year and its base year are one and the same. There is no need to re-express its expenditure weights in terms of prices of another year.

The FPPI is not a direct Laspeyres index, but a chain index, and at the annual level, a chain fixed-basket index. The link year for the 1994-98 basket is 1999, so all expenditures for 1999 are re-expressed at 1999 prices. In general, for any five-year basket running from  $y-5$  its expenditures are re-expressed at prices of year  $y$ .

This ensures a measure of price change for consecutive years that involves only the prices of those years, and does not depend in any way on the prices of the five preceding years.

The FPPI practice is identical with that of the consumer price index. Its most recent basket reference year is 1996, but since the 1996 basket is only linked into the index at December 1998, 1996

expenditures are re-expressed at December 1998 prices.

### **Meaningful comparisons of the baskets**

A direct comparison of the baskets for two different years is an apples with oranges comparison if it is based on the weighting patterns used in the actual FPPI calculation. The 1992-96 basket is evaluated at 1997 prices, while the 1993-97 basket is evaluated at 1998 prices. If a comparison between the two weighting patterns shows a substantial increase in the basket share of a particular commodity for the more recent basket it is unclear if it due to a rise in that commodity's share of the volume of marketings from 1992-96 to 1993-97, or merely due to an increase in its price relative to other commodities from 1997 to 1998.

Any comparison of index baskets should be based on a common set of prices. In a comparison between the new index basket and the previous basket one would generally re-evaluate the basket used for the previous year at the same prices used to evaluate the current year basket. For example, for the 2002 update, a 1996-2000 basket is evaluated at 2001 prices. A comparison with the previous 1995-99 basket at 2000 prices is inappropriate; instead the previous basket should be evaluated at 2001 prices to match the current basket.

An acceptable alternative would be to evaluate both baskets at base year prices (that is, at 1997 prices), especially if three or more baskets were being compared.

### **Baskets are sensitive to the choice of a common set of prices**

Farm prices are volatile. Whatever common set of prices are selected leaves one with an apples and oranges comparison, which one would not have if one compared baskets used in the production cycle directly.

Just because farm prices are so volatile, there would be some merit in basing comparisons for several baskets on a multi-year base period, say 1996-1999 prices rather than 1997 prices.

### **Measuring price movements**

The FPPI contains many commodities that are unavailable in December (e.g. apricots, broccoli, cauliflower). It is not possible to link at December for these series without imputing a December price for them, and it would be better to avoid linking based on imputed prices.

One reason the CPI links at December is to ensure that the December-to-January movement is a measure of pure price change, that is, if all prices show the same rate of change from December to January, the total index will show the identical rate of change. A special case of this would be if all prices in January were the same as those in December; then the total index should show zero change. Linking at December ensures that December and January prices are both measured in terms of the new basket, whereas linking at the year would distort the comparison because of the shift from the old to the new basket. (Whether this objective is actually



achieved, given the important number of seasonally disappearing commodities in the CPI, is a moot point.)

However, in the FPPI the December to January comparison is distorted by the shift from one monthly basket to the next in any case, so this reason for linking at December does not exist. And if one were to link at the year, one would preserve the year-to-year movement as a measure of pure price change or to link at the year, and preserve the year-to-year movement as a measure of pure price change. As was just mentioned many agricultural commodities have no marketings in December, so the year-to-year measure is much more representative of agricultural production in general than the December-to-December movement. The obvious choice for the FPPI is to link at the year. The CPI is not linked at December everywhere, Sweden being one country that links at the year.

### **The annually-chained index and the role of the monthly basket**

It is not necessary to have monthly data for the earlier year to correctly calculate the chain index. This is done for analytical purposes. In a monthly-basket index the 12-month ratios of the index numbers (e.g. January over January, February over February, etc.) should be measures of pure price change, that is, if there is no change in any of the prices from one month to the next, the index change should be nil. While there is a change in the index basket from one month to the next, there is no change in the index basket between the same calendar months of consecutive years.

Unfortunately, this is not the case in the FPPI because it is an annually-chained index, so the basket does change between the same calendar months of consecutive years. We calculate the chain links as 24-month spans so that have a measure of pure price change for 12-month changes (i.e. what the change would be if the 12-month change were not distorted by basket shifts).

It means that every year is essentially calculated twice: The year 1999 will be calculated initially based on a 1994-1998 basket, and these estimates will become part of the FPPI. It will be calculated again based on a 1995-1999 basket, and these estimates will only be used to analyze price movements between 1999 and 2000.

There would be some merit in calculating each unlinked span for an extra year, so that if the basket went from year  $y-5$  to  $y-1$  it would be calculated over the years from  $y-1$  to  $y$ , even though it would only be used as the basket for year  $y$ . This would mean that each year-over-year change would be comparable with a previous year-over-year change based on the same basket. Also, the pure price change component of each 12-month change would be comparable to a 12-month change for the previous year based on the identical basket. Then one could decompose the 12-month change in the index between a pure-price-change component (i.e. what the change would be if the index kept its original basket) and a component for the interaction between price change and basket change.

This was not implemented because it is already a fair amount of extra work to calculate all unlinked series over a 24-

month span, and it would have no influence on the quality of the index itself, only the quality of the analysis. Nevertheless, this is something that might be implemented in the future.

Extending the spans backwards or forwards beyond 36 months to cover 48 or 60 months one would come into increasing problems of non-comparability due to changes in the number of commodities or the industry classification. Also, if one creates unlinked series for an annually-linked chain series over too long a span, it raises the question why one is calculating such a series at all. One might just as well chain every five or ten years as used to be done with the FPPI.

### **The analysis of component contributions to a pure price measure of 12-month change**

The pure price change measure of 2-month change, as with any measure of pure price change, can be broken down into additive component of change, and that is another benefit of calculating the data over a 24-month span. Because of the chain linking, it is not generally possible to calculate component contributions to 12-month change for the overall index, in the sense of a set of component contributions whose sum is the 12-month percent change of the aggregate index.

### **The FPPI compared to Statistics Canada's other chain indexes**

It is instructive to compare the FPPI to the monthly or quarterly chain price indexes published by Prices Division for

building construction: the apartment building construction price indexes, the new housing price index (NHPI), and the non-residential building construction price indexes.

The New Housing Price Index (NHPI), for example, has its basket updated every year to reflect building completions for the last three years at base year constant prices, and these are used to weight component price indexes with the same base year for the thirteen months from December to December only, linking being at December rather than at the year. Since linking is at December, the December-to-December movement is a measure of pure price change, but the same is not true for any calendar month. There is no way to know how much of the 12-month change in the NHPI is due to pure price change because of the short span of the calculation. Consequently, analysts are forced either to ignore the 12-month changes in the index, or to treat them as if they were measures of pure price change, even though this is not so.

Likewise, the year-to-year movement of the NHPI does not represent a measure of pure price change, unlike the year-to-year movement of the FPPI. And there is no way of knowing how the change from one basket to another distorts this year-to-year movement, as one would know if each consecutive unlinked NHPI series were calculated over a 24-month span, like the FPPI.

### **Applicability of the seasonal-basket approach to the Farm Input Price Index**

The Farm Input Price Index (FIPI) is now an annual price index so for now at least a seasonal-basket price index is a moot point. The source of weights for the FIPI when it was a quarterly index was Farm Operating Expenses and Depreciation Charges for 1992. This was an annual survey and so did not provide the weighting information required to calculate a seasonal-basket index.

This being said, many of the expenses associated with farming (fertilizer use, seeding) are highly seasonal, and this would argue for a seasonal-basket approach to the FIPI if the quarterly FIPI were ever restored and redesigned in the manner of the FPPI.

At the same time, many of the expenses associated with farming (mortgage and non-mortgage interest, farm rent) are decidedly non-seasonal, so a top-to-bottom seasonal-basket approach such as has been implemented in the FPPI redesign would never be appropriate for the FIPI.

### **Calculating the monthly weighting patterns for each product**

For each product, for each province, the average of marketings for the five years, 1994-98 was calculated for each month of the year. Then the 12 monthly shares for the province-product pair are calculated. To obtain the monthly revenue weight for a given province-pair, the annual revenue weight for a particular year is multiplied by the relevant monthly share. The sum of

these monthly weights equals the annual weight.

### **Seasonal commodities such as fresh strawberries or fresh corn**

The treatment of seasonal commodities is one of the major strengths of the new approach. Using the old annual-basket approach, seasonal commodities, for example, sweet corn and strawberries had the same basket share in every month of the year. One had to impute prices for such commodities in months when there were no marketings. Using a monthly-basket approach, if there were no marketings for a commodity in a given calendar month in 1994-98, then it simply falls out of the index basket. There is no need to impute a fictive price for it.

When prices are first established for seasonal fresh fruits and vegetables, they are based on farm income forecast work carried out by Agriculture and Agri-Food Canada (AAFC), the provinces and Statistics Canada (STC). At the end of the season a survey is conducted to obtain the amount of the commodity harvested and the dollar value received for the crop. Based on these data, an average price for the season is established. Farmers sell their product at whatever the market offers, however, it would be prohibitively costly to collect monthly prices for the wide range of commodities to which prices must be assigned. One price for the season is established and farm cash receipts data are calculated from that price using an established marketing pattern for each of the commodities.

If there were no marketings for a seasonal commodity in a given month in 1994-98, but there were some thereafter there would be a shift in the overall seasonal pattern of production of an agricultural commodity that is substantial enough to make the season last an additional month, something which doesn't happen very often. But even if it did happen, the monthly weighting patterns for fresh vegetables would be updated when we move to an updated seasonal profile of marketings.

Until then, we would simply ignore any prices for fresh corn in November and they would have no impact on our index. In the existing weighting pattern, even the month of October has only a 5% share of marketings of fresh corn for the province of Ontario, and November has nothing. So any marketings of corn in November would likely account for much less than 5% of the corn total. Assuming a marketings share of 0%, as is done now, is much closer to reality than assuming a share of  $8\frac{1}{3}\%$  (one twelfth), as was done under the old fixed-basket approach.

If there were marketings for fresh corn in November 2001 but not for any other year in the decade such marketings might be reflected in an updated seasonal weighting pattern if the year 2001 were part of it. Obviously if one only has November marketings of fresh corn about once every 10 years there would be little cause to extend the in-season months for fresh corn to include November, and one would probably be well advised to edit out such expenditures from the seasonal weighting pattern.

What happens if we have the opposite problem and due to an early frost there are no marketings of corn in October? This kind of scenario is more likely to occur than the one we just discussed. In this case, there would be no market price for corn but it would still have a basket share in the October index, so an imputed price would have to be assigned to it.

In such situations, the imputed price would be the weighted average price for the months through September. Although one could argue for other solutions, such an imputation is simple, does not depend on price information external to the stratum or the commodity in question and gives the same annual price as one would obtain if one simply ignored October in calculating the annual price. Also, as noted above, at present only one annual price is calculated for seasonally disappearing commodities anyway, so it is logical to impute this price in a month where there are no marketings.

Only one annual price is calculated for seasonally disappearing commodities so this is the price that would be assigned. If sufficient resources ever became available to have monthly pricing for some of these commodities, then another imputation procedure would have to be considered.

In the official Consumer Price Index, imputation for seasonally disappearing commodities is based on the price movement of continuously priced items in the same group as the target series. This amounts to a poor man's version of seasonal weighting. If the FPPI had monthly pricing for seasonally disappearing items, it could seek to

impute prices for out-of-season months more in line with the economic notion of shadow or scarcity prices.

All farm commodities without exception have seasonal marketing patterns and on this basis it makes sense to calculate the whole index as a seasonal-basket index. The European Union (EU) approach, which requires that fresh fruit and fresh vegetables have fixed-basket shares within the overall index has the drawback of not being consistent in aggregation. If one reformulates such an index in terms of greenhouse products and field products for example, and aggregates to a total, one will not get the same result as using the primary commodity classification. This problem does not exist for the FPPI aggregation; one gets the same overall index however one chooses to reorganize groups and subgroups of commodities because they are all generated from the same underlying seasonal weighting patterns.

Even if one were to adopt a more restrictive definition of seasonal commodities it is difficult to justify limiting it to fresh fruit and vegetables as the EU does. What about Christmas trees, for example, which are far more seasonal in their marketings than virtually any item of fresh produce?

It should be remembered that in defining their standard for harmonization the EU was constrained by the fact that its standard must be implemented by a country like Luxemburg with both limited resources for calculating farm product price indexes and limited interest, given its modest agricultural bases, in doing so. Also, virtually none of the countries in the EU, with the possible exception of Finland and

Sweden, would have such an extreme seasonal profile of production as Canada. In many European countries field production can generate two or more crops a year, something that Canadian farmers can only dream about.

### **Price imputations for seasonally disappearing commodities**

It is sometimes necessary to make price imputations for seasonally disappearing commodities if one's monthly weighting pattern is based on a typical seasonal profile rather than the monthly marketings of the year in question. The Dutch economist Bert Balk suggested that the monthly weights for a given year be based on the given year pattern of marketings and the Balk formula actually was implemented by the Netherlands Central Bureau of Statistics for their agricultural output price indexes, the Dutch counterpart of our own FPPI.

Using the Balk formula, there is never any need for seasonal imputation, and there are never any monthly prices that go ignored in the index. If marketings for corn exceptionally occur in December then because the weighting is based on current marketings its December prices are incorporated in the December measure. If on the other hand there are no marketings in October, then corn drops out of the index in that month for that year, but not for other months where there are marketings. There is no need to impute an October price for corn if there are no marketings of it.

From an operational viewpoint, a Balk index is both more difficult to calculate than the Rothwell index (as mentioned

above, the FPPI is based on the Rothwell formula) and more subject to revision. It would hardly be consistent to adopt a basket reference period that does not even incorporate the given year but use a seasonal-basket formula based on the given year seasonal pattern.

From a conceptual viewpoint, the greater comparability of the Balk index is obtained at a certain price in comparability. (Yuri Dikhanov has noted that the idea of achieving both comparability and representativeness in a price index is not unlike the Heisenberg Uncertainty Principle in nuclear physics on determining location and speed of an elementary particle: it is impossible to determine both simultaneously.) The 12-month changes of the unlinked spans of the FPPI are measures of pure price change; those of the Balk index are distorted by basket shifts.

That being said, it would be of considerable interest to recalculate the FPPI according to the Balk formula and see how different it is from the existing index.

### **Weighting the annual indexes with the monthly index numbers**

The monthly shares of marketings of many farm products are highly unequal, with most of the marketings occurring in only two or three months of the year, and in the same two or three months of the year, year after year. One cannot have much confidence in an annual index based on equal weighting of the monthlies if the different months have such unequal contributions to annual output. This is the more so since product

prices are highly and negatively correlated with marketings, being much lower in the months with the largest shares of marketings than in other months of the year. For some products, like field-grown strawberries, there are no marketings at all except in a couple months of the year.

### **The annual unit prices of commodities**

The annual unit price for a commodity is calculated as the total annual revenue divided by the total annual price. This amounts to a weighted average of monthly prices, weighting by same year quantities. By contrast, the annual prices in the FPPI are weighted averages of monthly quantities weighting by average monthly quantities. However, this kind of a weighted average would be much closer to an annual unit price than a simple average of monthly prices. This is another difference between the Rothwell formula used in the FPPI and the Balk formula. The annual prices in the Balk formula are unit prices.

The fundamental issue is one of representativeness. One would not want to give an equal weight to September and January in an annual price for fresh corn anymore than one would want to give equal weight to Ontario and Newfoundland in an index for fresh corn. One wants the average annual price to be properly representative of the relative importance of marketings in the different months of the year.

### **Understanding the monthly changes**

Because the index basket changes from one month to the next, the FPPI does not

provide a measure of pure price change for monthly movements. Even if there is no change in prices from one month to the next there can still be a change in the index due to the change in the basket.

However it is possible to decompose the monthly change in the FPPI, as with the change in a Paasche price index, into a pure price change component and a residual component, for all months except January.

The December-to-January change is distorted not only by the switch from one monthly basket to another but from one annual basket to another. However, the December-to-January change of the unlinked series can be decomposed in the same way as the changes for the other months of the year.

The pure price change component measures what the change in the FPPI would be if there were no change in the monthly basket. The October-to-November measure then would be based on the October basket. Because the October basket is used in both months of the year, the calculation of the pure price change component entails the calculation of imputed prices for some commodities that go out of season in November, fresh corn for example.

The previous and given month baskets are not on an equal footing when it comes to analysis of contributions to percent changes, because percent changes themselves are not symmetrical. Instead, they are backward looking constructs; their base is always the previous period value. The *simple* change in index numbers between October and November can be indifferently decomposed into a pure

price change and a residual component based on the October or the November basket. However the *relative* change in index numbers between October and November requires that both components be divided by the October index number, and only a pure price change component based on the October basket would still be uninfluenced by basket change when scaled in this way.

The monthly price movements of the FPPI don't mean very much, especially for the most seasonal commodity groups like fruits and vegetables, but neither do the monthly movements for a fixed-basket price index. What precisely would the June-to-July movement for a fixed-basket price index for fresh vegetables signify for example? If the price of corn were imputed using the last in-season price then the June-to-July movement for fresh corn would actually reflect the October-to-July movement. If this movement were substantial enough the measured June-to-July movement for fresh vegetables might actually exceed the June-to-July movements of any of the vegetable items for which prices existed in both June and July. Thus the fixed-basket price index would contradict one of the basic characteristics of an indicator of pure price change, that the aggregate measure be bounded by its highest and lowest components.

It is only when one reconstructs monthly price movements using the monthly baskets that are building blocks of seasonal-basket price indexes that any meaningful analysis is possible.

## Monthly measures of pure price change

Professor Erwin Diewert suggests that where there are large shifts in the index basket for one month to the next, an indicator based on both baskets would be more appropriate. Professor Diewert suggested a Fisher-type indicator, but it would seem that an Edgeworth-Marshall-type indicator would be more appropriate to the needs of the FPPI.

With an Edgeworth-Marshall type indicator one would calculate an average of the October and November baskets and then calculate the October-November movement based on these average basket shares. Once these measures were calculated for the individual provinces they could be aggregated to obtain national estimates.

A Fisher-type indicator would require that one calculate two indicators of pure price change: one based on an October basket, the other based on a November basket, and then take their geometric mean. Because Fisher-type indexes are not consistent in aggregation, one could not calculate Fisher-type measures at the provincial level and then aggregate them to get national estimates. Instead one would have to calculate October-based and November-based estimates right to the national level, then take their geometric mean, which is more complicated.

Also, unlike Edgeworth-Marshall type indicators, one cannot calculate component contributions to aggregate price change that sum exactly to the percentage change of the aggregate (although in most cases, the differences would be trivial).

Perhaps most significant, a Fisher-type indicator is a symmetric average of the indexes based on the October and November baskets. An Edgeworth-Marshall-type indicator is an asymmetric average of the same indexes, weighted by each month's share of combined October-November volumes. If almost all marketings were in October, the Edgeworth-Marshall-type estimate would be closer to an October-based estimate than a November-based estimate, as one would reasonably expect.

The differences between the two types of crosses can be substantial. In May 2001, Alberta potatoes showed a 1.8% decrease based on an April basket and a 3.8% increase based on a May basket. Given that over three quarters of marketings over April-May were in April, the Fisher-type estimate, a 0.9% increase, was unrealistic. The Edgeworth-Marshall estimate, showing a decline of -0.4%, was much more reasonable.

If one were only to calculate one analytical measure of monthly price change it should probably be the Edgeworth-Marshall type indicator. The Laspeyres-type indicator based on the previous-month basket is however quite interesting since it permits a decomposition of the monthly change of the official series into pure price change and residual components, but strictly as a measure of monthly price change, the Edgeworth-Marshall indicator would be more representative and in this sense the superior indicator.

The Laspeyres-type indicator would only have to impute prices for a seasonally



disappearing commodity in the first month following its in-season; the Edgeworth-Marshall-type indicator would also have to impute prices for the first month preceding its in-season. For example, in Ontario, fresh corn is in-season from July to October. While a Laspeyres-type indicator would only have to impute prices for fresh corn in November, an Edgeworth-Marshall-type indicator would also have to impute prices for fresh corn in June as well. (No imputation at all would be required for the simple calculation of the FPPI estimates.) In a fixed-basket price index, it would of course, be necessary to impute prices for fresh corn for the entire eight-month period that it is out-of-season.

### **Comparing the FPPI in Canada with the U.S. Prices Received by Farmers Index**

A major inspiration was the reconstruction of the U.S. Prices Received by Farmers Index. It had a number of features that were emulated in the FPPI redesign:

- A seasonal weighting pattern for the 12 months of the year for all commodities,
- An update of the index basket every year based on marketings for the last five years prior to the previous year,
- A considerably increase in the commodity coverage of the index.

Officials in the United States Department of Agriculture (USDA) were most helpful in responding to enquiries about their index, which was of great benefit to the FPPI redesign.

Plans to introduce a seasonal weighting pattern for the FPPI when its basket was next updated had already been made when the index was discontinued in 1995. Nevertheless, the USDA's switch to a seasonal-basket approach was a great encouragement to everyone who worked on the FPPI redesign. It confirmed that a seasonal-basket approach from top to bottom was viable, and it provided an additional incentive (compatibility with the USDA index) for adopting a seasonal-basket approach for the FPPI.

The FPPI is a chain index with a new annual basket linked into the index every year, and where the link is at the year and not at the month. The USDA index is more like a Paasche price index, with a new annual basket slipped into the index every year, without any linking. This means that the annual price change is not a measure of pure price change, as it is in the FPPI.

For each year, the USDA calculates a five-year average of farm cash receipts at current prices, so that the weighting pattern reflects the price structure of all five years. By contrast, the STC index calculates a five-year average of farm cash receipts at link year prices, as described above. Therefore the weighting pattern of the STC index reflects the pattern of marketings of the five different years but the price structure only of the base year, while the weighting pattern of the USDA index reflects the pattern of marketings of the five different years, and also the price structure of the five different years. For example, for the year 2000, the STC basket would be based on 1994-1998 farm cash receipts at 1999 prices, which is appropriate to calculating the price

change between 1999 and 2000. The USDA weighting pattern would be based on 1994-1998 farm cash receipts at current prices, so the weights reflect 1994-1998 prices. Given that their index formula is more like that of a Paasche price index than anything else, it would make more sense for the USDA to re-express the farm cash receipts at 1990-1992 prices, since the USDA index is at 1990-92=100. But it would be better still if they calculated their index as an annually reweighted chain index, and duplicated the FPPI calculation of annual baskets.

Annual FPPIs are calculated as weighted averages of monthly FPPIs, consistent with the monthly-basket concept of the index. The USDA calculates annual indexes as the means of the monthly indexes, which is inconsistent with its monthly-basket approach to calculating the monthly series, and does not ensure that each month is fairly represented in the annual index<sup>1</sup>.

The STC index includes commodities for which there are farm cash receipts but no marketings in the index basket, allowing them to influence the relative importance of the category to which they belong (crop or livestock). The USDA index simply excludes such commodities from the index. The index for prices received by farmers has a three-year base period (1990-2); the base period of the FPPI is a single year (1997).

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1. As noted by Milton et al. (1995), p.7, federal regulations relating to the calculation of parity prices require the USDA to calculate its annual indexes as a simple average of monthly indexes. These regulations are anachronistic for the seasonal-basket monthly price index that the indexes of prices received by farmers has become.

Except for the use of a multi-year base period, all of these differences are improvements on the USDA methodology, and provide a more meaningful indicator of farm price movements.

The USDA methodology notes that “a 3-year ... base period was selected since it provides ... base period prices for comparison purposes that are overall closer to historical price trends than a 1-year period provides.”<sup>2</sup> The volatility of farm prices is such that a multi-year base period is to be preferred to any single-year base period.

A 1997 base period was chosen for the FPPI because of the rebasing of SNA expenditure estimates to 1997 constant prices, and the rebasing of most of Statistics Canada’s price indexes to 1997=100. It was considered more important to have the FPPI series comparable with other published price indexes than to have a base period that better met its special needs.

This difference between the American and the Canadian index is revelatory of a difference in philosophy between the statistical programs of the two countries. In the United States there are many agencies associated with their statistical program, and there is greater emphasis on delivering products that are useful to their client groups. In Canada there is a centralized statistical agency, Statistics Canada, and there is a greater emphasis on compatibility of all economic statistics with the SNA.

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2. See Milton et al, 1995, p.1.

## Base period impacts on the estimated price movements

At the annual level, the FPPI is a chain fixed-basket price index, but not a chain Laspeyres price index. If it were a true chain Laspeyres index the choice of base period would impact on the movement of the series, since a single-year base period would also imply a single-year basket.

If the FPPI had a multi-year base period, one might get a better idea of the general trend in prices of different commodities over the recent period by eyeballing the most recent annual estimates. A single-year base period is not as well suited to this, since the most recent annual estimate for a particular commodity may be higher than the FPPI average simply

because its 1997 price was unusually low, and it would not show an unusually high level if the comparison was based on, say, a 1996-1998 base period.

This is, all things considered, a minor disadvantage when contrasted with the advantages of compatibility with other price and volume measures for Statistics Canada. Perhaps in the future the SNA will return to multi-year set of constant prices (from 1926-47, the estimates of gross national product were calculated at 1935-9 constant prices) and then there will no longer be a need to choose a somewhat inappropriate base period in the interest of consistency with the SNA.

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