

**Distr.
GENERAL**

**CES/SEM.49/3
12 August 2002**

Original: ENGLISH

**STATISTICAL COMMISSION and
ECONOMIC COMMISSION
FOR EUROPE**

**CONFERENCE OF EUROPEAN
STATISTICIANS**

**Joint UNECE/Eurostat/FAO/OECD
Seminar on Agricultural Statistics:
Perspectives for Agricultural
and Rural Indicators and Sustainability
(Paris, 21-22 November 2002)**

**COMMISSION OF THE EUROPEAN
COMMUNITIES (EUROSTAT)**

**FOOD AND AGRICULTURAL
ORGANISATION (FAO)**

**ORGANISATION FOR ECONOMIC
CO-OPERATION AND DEVELOPMENT
(OECD)**

**AGRICULTURAL EMPLOYMENT AND PRODUCTIVITY:
OBSERVATIONS, TRENDS AND MEASUREMENTS METHODS**

Invited paper submitted by Statistics Canada*

I. INTRODUCTION

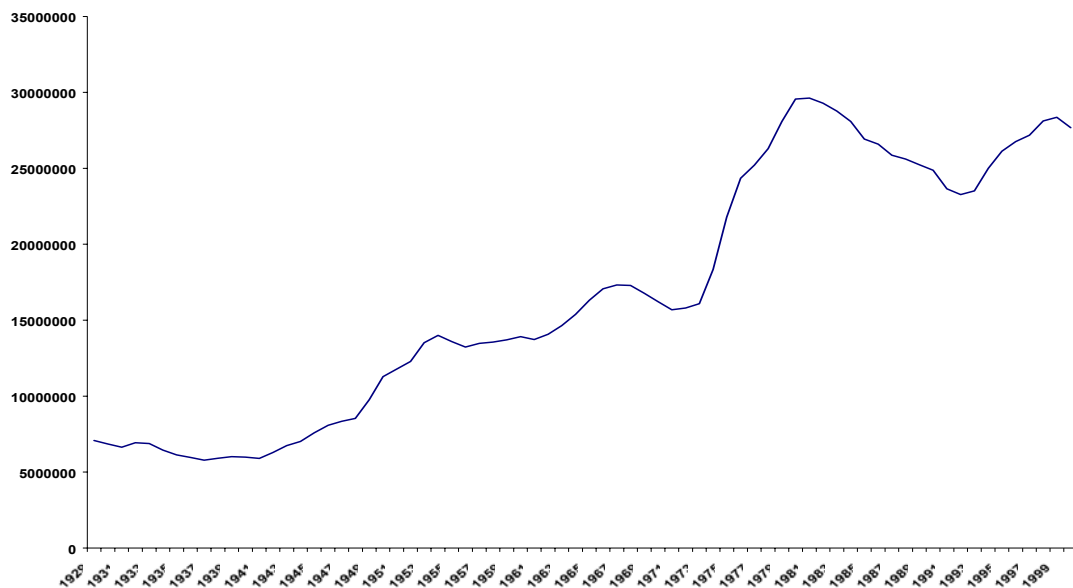
1. This article has two parts. First, it describes changes that have taken place with regard to Canadian agricultural employment and labour productivity in response to, (a) the substitution of capital for labour, reducing the labour needs of agriculture, and (b) the attractive non-farm employment opportunities offered by the other sectors of the Canadian economy. Second we offer some information regarding the measurement methods. The Labour Force Survey, the Survey of Employment, Payrolls and Hours, and Survey of Labour Income Dynamics, provide the data used to measure employment, wages and salaries and to calculate labour productivity in agriculture and in the rest of the economy.

* Prepared by Mr. Geoff Bowlby and Mr. Michael Trant, Statistics Canada.

2. By their very nature economic development and productivity improvements in agriculture result in a shift in labour out of the primary industries such as agriculture and into new opportunities created in the rapidly developing manufacturing and service sectors. This has been the case in Canada where for over the last 75 years labour-saving machinery has been substituted for labour on farms allowing farmers to be able to manage farms of ever-increasing size (Figure 1).

Figure 1: The substitution of capital for labour in Canadian agriculture

Value of farm machinery and equipment, constant dollars (thousands of dollars)

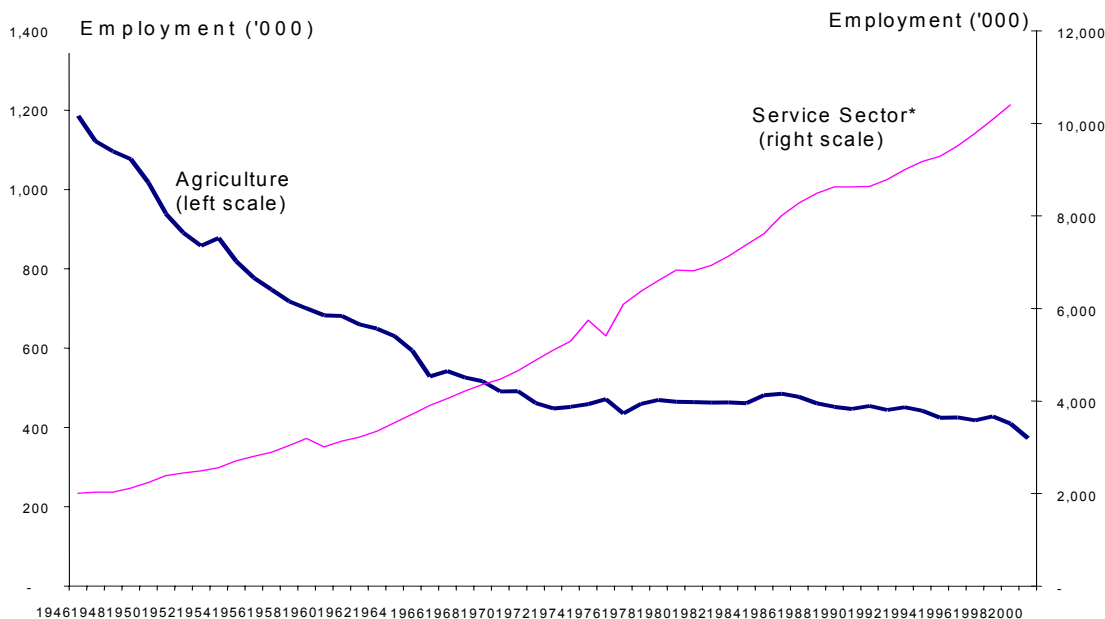


Source: Statistics Canada, Agriculture Division, CANSIM, Table 002-0007.

3. Rising farm productivity, along with added opportunities in the cities, led to a large exodus from the farm beginning shortly after World War II. In 1946, about 1.2 million Canadians worked on a farm as a main-job. By 1976 that number dropped to a little under a half a million. The decline has been more gradual since 1976 in contrast to employment in other parts of the economy, most notably the service sector, where it has continued to rise (Figure 2).

4. Farming is employing fewer Canadians over time. The Canadian labour market was at one time dependent on farming and goods-producing manufacturing industries, but employment and labour market growth is now in the service sector.

Figure 2: Farm employment dropped dramatically after WWII as Canada moved to a services-based economy



Source: Labour Force Survey.

* Excludes public administration

5. Production and productivity of Canadian agriculture is on an upward trend. Gross farm revenues are increasing in each province, despite with periodic setbacks due to weather and price downturns. Development in the rest of the economy is however even more pronounced and as each year passes agriculture contributes a decreasing proportion to total gross domestic product. Farming in 2001, for instance, represents about 1.4% of total Canadian GDP.

II. CHANGES IN CANADIAN AGRICULTURAL EMPLOYMENT

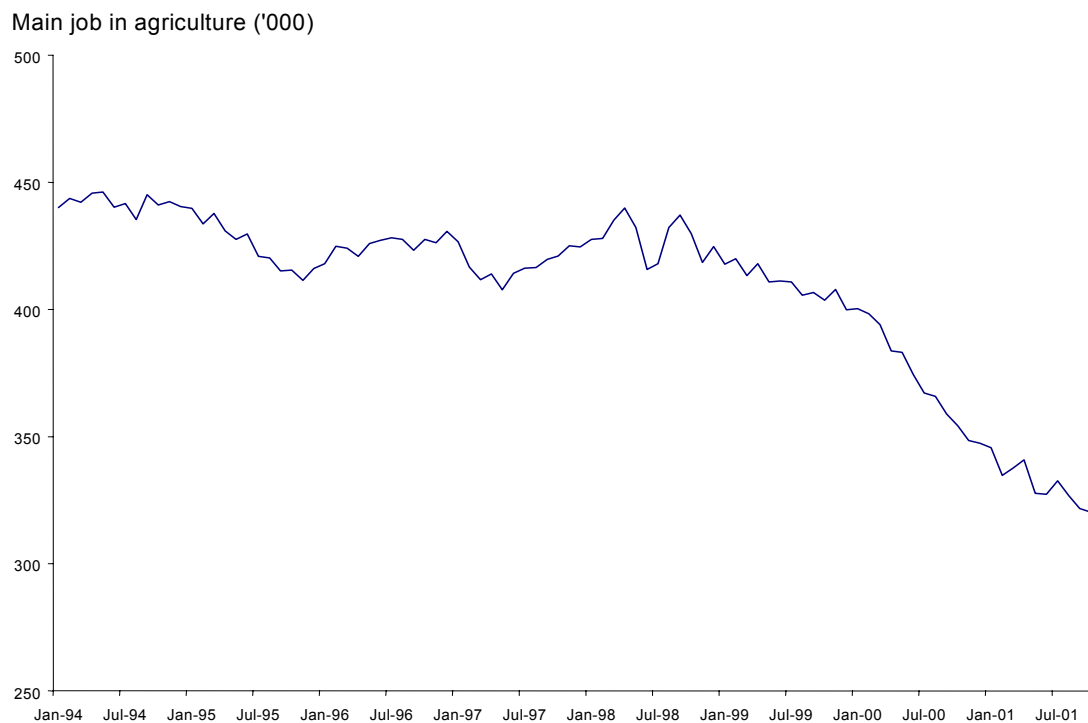
6. The analysis of Canadian agricultural employment data is based on an article by Geoff Bowlby, published in Perspectives on Labour and Income, Statistics Canada (catalogue 75-001-XIE), February 2002. The main data source is the monthly Labour Force Survey (LFS).

7. The LFS is designed to count the number of people who are employed, unemployed, or not in the labour force and provides some of the best Canadian information on agricultural employment. The survey asks questions on the industry and occupation of the respondent's main-job, measured in terms of the amount of hours worked per week. As a consequence, a farm worker is an individual who works on a farm as a main-job. A farm operator who runs a farm or

works on a farm as a second job is not included. Such individuals would be assigned to the industry of their main-job.

8. The year 1999 marked the beginning of a more pronounced downward trend when farm employment as a main-job dropped 6% from 1998 (Figure 3). In 2000 the rate of decline accelerated, causing a further 13% drop. This was followed by another decline in 2001, so that by the beginning of 2002 farm employment was 313,000, 26% below where it had been only three years earlier - the largest drop in about 35 years.

Figure 3: Farm employment dropped sharply from 1999 to 2001



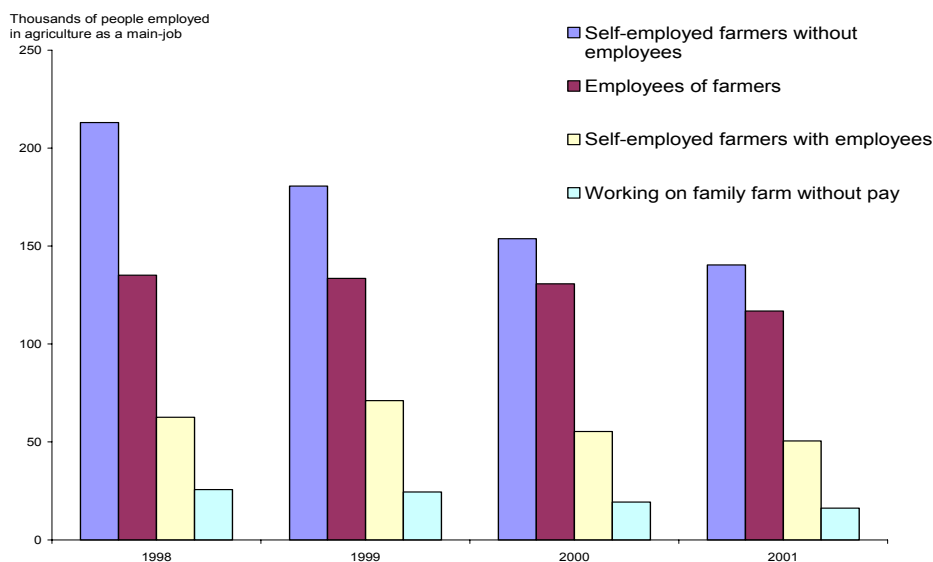
Source: Labour Force survey, seasonally adjusted.

9. Farm size has increased but not to an extent that would explain the entire drop in farm employment.

10. One of the more interesting characteristics of the drop in farm employment is the fact that employment in agriculture has declined the most among self-employed farmers with no employees (Figure 4). This group is more likely to have smaller farms and probably more easily run as a second job. This is important because some of the decline in main-job farm employment

between 1999 and the end of 2001 appears to be the result of more farms being run as second-jobs as farmers increased their hours of non-farm employment.

Figure 4: Employment on farms with no employees falling fastest



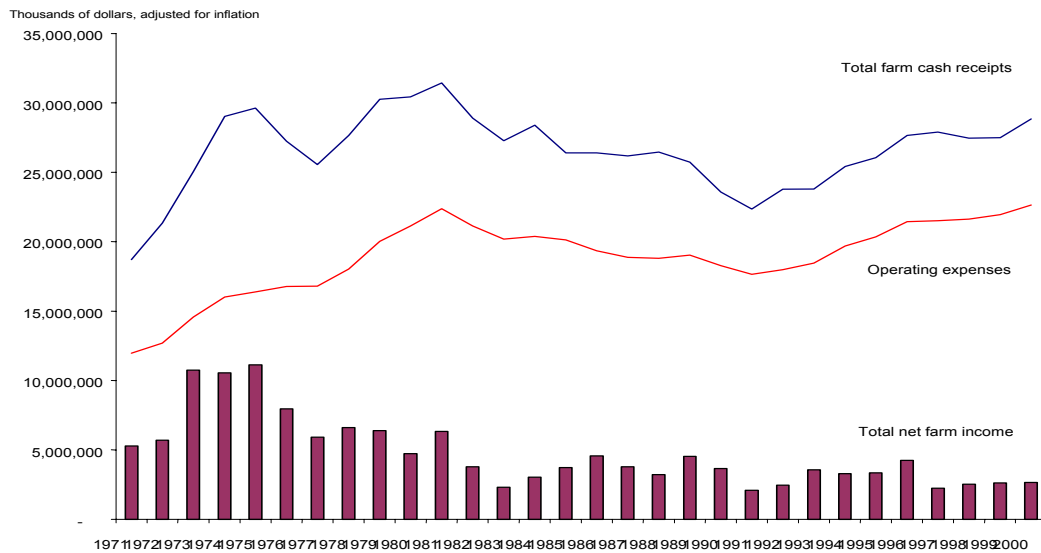
Source: Labour Force Survey.

11. This likely move to more second-job farming has coincided with fewer spouses and children working on the farm as their main-job. So while fewer households have at least one member employed on the farm as their main-job, the number of farming couples mainly employed in agriculture has also fallen sharply.

12. Farm profits have remained unchanged, and at historically low levels for a number of years, perhaps encouraging some into other work (Figure 4). Farm expenses have matched the rise in farm receipts and in terms of constant dollars, farmers have seen net incomes stabilizing somewhere between 4 and 5 billion dollars over the past 20 years.

13. Falling farm employment however, has not resulted in the large-scale abandonment of farmland and seeded area has shown a steady increase over time (Table 1). The number of hectares planted to major crops such as wheat, barley, canola, corn, pulses and hay has been steadily increasing to the current level of about 33.4 million hectares in 2001 and 33.7 million in 2002.

Figure 5: Lack of farm profit growth may be pushing some people off the farm



Source: Statistics Canada, CANSIM tables 002-0001 receipts, 002-0005 expenses, 0020009 net income.

Table 1: Production is increasing as farm numbers and employment decline

	Crops (ha.)	Cattle	Pigs	Poultry	Eggs (dozen)	Milk (kilolitres)
			- 000's -			
1994	32,435	13,924	10,888	695,662	474,459	7,036
1995	32,515	14,730	11,522	695,143	478,591	7,197
1996	32,458	15,051	11,490	720,845	484,914	7,172
1997	32,761	14,910	11,740	750,257	494,269	7,421
1998	32,434	14,706	12,355	798,507	498,847	7,521
1999	33,033	14,447	12,281	839,994	523,161	7,590
2000	33,514	14,416	12,240	877,280	549,711	7,499
2001	33,390	14,635	12,226	926,843	570,028	7,561
2002	33,762					
Change 2001/1999	357	188	-55	86,849	46,867	-29
%	(1)	(1)	(-.5)	(10)	(9)	(-.4)

Source: Statistics Canada, CANSIM tables 001-0010 (crops); 003-0032 (cattle); 003-0011 (milk); 003-0032 (pigs); 003-0017 (poultry) and 003-0017 (eggs).

14. Between 1999 and 2001, 1% more hectares of land were seeded to the major crops. The consequence was a general increase in total crop production reflecting the increase in the amount of land seeded and the planting of new higher yielding crop varieties. Chicken, egg, and cattle production also increased in recent years. Not all farm production has increased. Milk production and pig numbers have decreased slightly, although these declines are nowhere near the drop in farm employment.

15. Age may also be playing a part in the decision to leave farming as a main-job activity. The average age of Canadians, with main-job agriculture, are older than those in the other labour force occupations. Consequently, a large proportion are always approaching retirement age, and the younger people who could take their place are no longer as numerous as was once the case.

III. CHANGES IN CANADIAN AGRICULTURAL PRODUCTIVITY

16. Improvements in agricultural labour productivity have been quite remarkable, increasing more than 5-fold between 1961 and 2000. This is not a complete surprise since there were some 614,700 individuals reporting main-job farm employment in 1961 in comparison to the approximately 367,400 in 2000. During that same time farm production saw some dramatic increases in terms of animals raised and crops grown. Agriculture was one of the few Canadian industrial sectors that experienced employment reductions, and at the same time recording increased product production both in terms of volumes produced and sales. This is not a phenomenon particular to Canada, as the statistical record in most developed countries appears to be quite similar. However, as a result, the 5-fold productivity increase in Canadian agriculture has out-performed the 3-fold productivity gains in the goods producing sector and surpassed the gains in the service sector, which were somewhat less than a 2-fold increase, over the same 1961 to 2000 time period (Figure 6).

17. Another way to view productivity is to measure labour costs per unit produced such as is shown in Figure 7. Again agriculture clearly appears to have led all industrial sectors in terms of productivity gains. In 1961 agriculture was labour intensive in comparison to the good producing and service sectors of the Canadian economy, sectors which at that time required half the labour of agriculture, to produce a unit of value added production. By the year 2000 that relationship had changed. Labour costs had increased for all sectors as had production. Agriculture was the only sector however where production increased while employment declined. The result was only a 2-fold increase in labour costs per unit of real GDP produced in agriculture in comparison to a 4-fold increase in the goods producing sector and close to a 6-fold increase in the service sector.

Figure 6: Labour productivity increases in agriculture exceed those of the goods-producing and service sectors of the Canadian economy

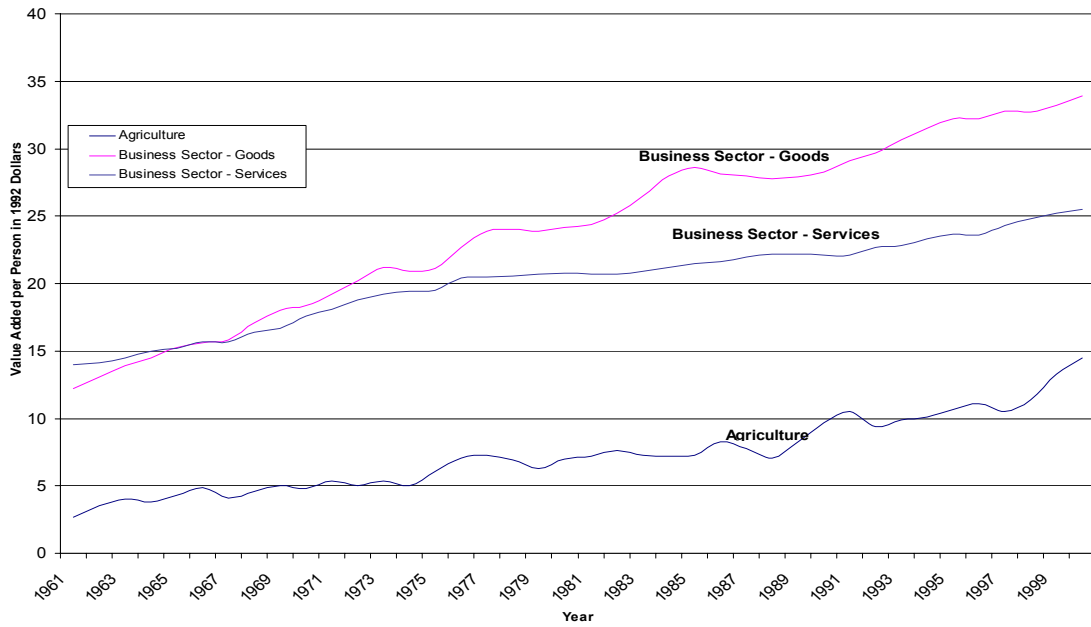
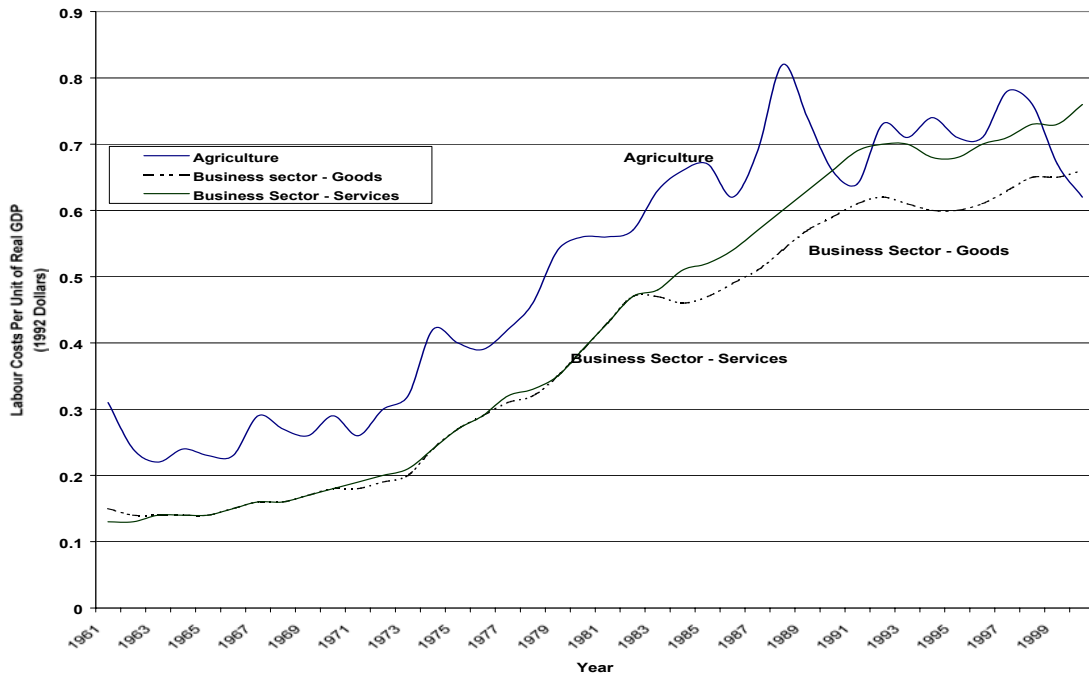


Figure 7. Unit labour costs in agriculture are among the lowest in the Canadian economy



Source: Statistics Canada, Labour Productivity and Related Variables, CANSIM, tables 383-005 and 383-0003.

18. There are some mitigating arguments to temper what appear to be substantive labour productivity gains in agriculture. The most significant is the measurement of labour in agriculture. An agricultural worker is an individual who works on a farm as a main-job. A main-job being defined as the job where there are the most hours worked per week. A farm operator who runs a farm or works on a farm as a second job is not included. Such individuals would be assigned to the industry of their main-job. At almost any point in time a large proportion of those working in agriculture also have employment in another industrial sector. The 1996 Census of Agriculture reported that 46% of all Canadian farmers worked some days of off-farm work at some point in the previous year. The comparable figure in 1941, some 60 years ago, was 36% (Bollman, 1979). Farmers were initially to be found in the forest, fishing, mining and petroleum industries but they are now participating in all sectors with the proportion of farmers with non-farm work representing a substantive proportion of all farmers at any one time (Hathaway and Perkins, 1968). In certain years the amount of hours devoted to non-farm work may exceed the hours spent farming as a consequence of low returns in agriculture or particularly attractive non-farm job opportunities.

19. In Figure 3 it is clear that there is substantial volatility in the agricultural labour force as measured by main-job farming, though the long-term trend is fewer jobs over time. The sharp decline in main-job farming that began in 1999 provides much of the explanation as to why labour costs per unit of real GDP in agriculture are lower for agriculture than the other sectors of the economy. What is not clear is whether this is temporary, and the consequence of attractive but short-term non-farm employment opportunities and a specific measurement method, or a significant change in agricultural labour requirements.

20. Agricultural employment in Canada is in decline for a host of reasons most of them interrelated. The factors driving falling farm employment are complex. The decision to enter or leave farming is complicated by a number of "push" or "pull" factors. Technological advances allowing for increasing amounts of capital to be substituted for agricultural labour, better non-farm employment opportunities resulting in more farming being conducted as a second job, and more off-farm work for farm spouses are all contributing factors. The last two may be particularly significant since the timing of the drop in main-job farm employment in Canada in the years 1999 to 2001, coincides with a period of significant increase in off-farm job opportunities.

IV. MEASUREMENT METHODS

21. **Labour Force Survey:** The Statistics Canada Labour Force Survey (LFS), the source of much of the data on employment in agriculture in the first part of this paper, is the primary source of Canadian employment statistics. The LFS provides monthly estimates of employment and unemployment, which are released 13 days after the completion of data collection.

22. LFS data are used to estimate the unemployment rate as well as other standard labour market indicators such as the employment rate and the participation rate. The LFS also provides employment estimates by industry, occupation, public and private sector, hours worked and cross-classifiable by a variety of demographic characteristics. Estimates are produced for Canada, the provinces, and a large number of sub-provincial regions. For employees, wage rates, union status, job permanency and workplace size are also produced.

23. The current LFS questionnaire was introduced in 1997. At that time, significant changes were made to the questionnaire in order to address existing data gaps, improve data quality and make better use of the power of Computer Assisted Interviewing (CAI) systems.

24. The LFS uses a probability sample that is based on a stratified multi-stage design. Each province is divided into large geographic stratum. The first stage of sampling consists of selecting smaller geographic areas, called clusters, from within each stratum. The second stage of sampling consists of selecting dwellings from within each selected cluster.

25. The LFS uses a rotating panel sample design so that selected dwellings remain in the LFS sample for six consecutive months. Each month about 1/6th of the LFS sampled dwellings are in their first month of the survey, 1/6th are in their final month of the survey. One feature of the LFS sample design is that each of the six rotation groups can be used as a representative sample by itself.

26. As of 2002, the monthly LFS sample size consists of approximately 53,000 households, resulting in the collection of labour market information for approximately 100,000 individuals. The LFS sample is allocated to provinces and regions within provinces to meet the need for reliable estimates at various geographic levels. These include national, provincial, census metropolitan areas (large cities), and rural areas.

27. **Survey of Employment Earnings and Hours:** The Canadian Survey of Employment Earnings and Hours (SEPH) is produced from the combination of the Business Payroll Survey and information on the actual payroll deductions from the Canada Customs and Revenue Agency.

28. The survey of Employment, Payrolls and Hours is Canada's only source of detailed industry information on the total number of paid employees, payrolls, hours by province and territory. It is a principal source for Labour Income estimates.

29. The statistics compiled by SEPH are based on a census of the administrative records on payroll deductions for all in-scope establishments with employees that can be found on the Business Register. The total payroll employment estimates and the monthly payrolls are derived from the administrative data.

30. The Business Payrolls Survey (BPS) is conducted monthly to collect data to estimate SEPH variables not available on administrative records. The BPS uses a stratified simple random sample of 11,000 establishments out of a population of 900,000 establishments in Statistics Canada's Business Register. A one-twelfth rotation of the sample is done every month.
31. The estimates derived from the administrative source are then combined with the results of the BPS to produce estimates for the full range of SEPH variables.
32. **Survey of Labour and Income Dynamics:** The introduction of the Survey of Labour and Income Dynamics in the early 1990's added a new dimension to existing survey data on labour market activity and income, the changes experienced by individuals through time. At the heart of the survey's objectives is the need for a good understanding of the economic well-being of Canadians. More specifically, what economic shifts do individuals and families live through, and how do they vary with changes in their paid work, family make-up, receipt of government transfers or other factors? The survey's longitudinal dimension makes it possible to see such concurrent and often related events. Starting in 1993, SLID follows the same respondents for six years. The second "panel" was introduced in 1996, overlapping the first one for a three-year period, and the third panel in 1999. Other panels will be introduced every three years. Each panel has about 15,000 households, including about 30,000 adults.
33. A preliminary interview takes place at the beginning of each panel to collect background information. Each of the six years has a split-interview format, with labour topics covered in January and income topics in May. In both cases, questions refer to the previous calendar year. The income interview occurs in the month of May, following the deadline for filing tax returns, when respondents are most familiar with their records.
34. With recurring surveys, it makes a difference whether one interviews a new sample of people each time, as most surveys do, or the same people several times in a row, as in a longitudinal survey. The advantage of cross-sectional samples is that they are generally more representative of the population, and they reveal the levels and trends of income or labour for the whole population or sub-groups.
35. In SLID, the focus extends from static measures to the whole range of transitions, durations, and repeat occurrences of people's financial and work situations. This would include for example, the fluctuations in people's labour, income or family characteristics as a consequence of a new job or being laid-off or families being split apart or joined together.
36. **Labour Productivity Measures:** Productivity is a measure of the productive capability or efficiency of an economy. It can be determined in terms of a level – how much output is produced per unit of input, for example output per worker – or in terms of a growth rate, the increase in output per worker. Statistics Canada focuses on the growth rate in productivity

because of its usefulness in understanding the extent to which improvements in productivity contribute to economic growth.

37. Labour productivity growth is the most widely used measure of productivity. This productivity measure captures the increase in the quantity of goods and services produced per unit of labour – usually hours worked. It measures the increase in the productive capacity of the economy relative to employment. Labour productivity growth is intuitively meaningful since it measures the growth in how much workers are able to produce. It is also of empirical interest since gains in real wage rates closely track gains in labour productivity (Baldwin, J.R., Harchchaoui, T., Hosein, J., and Maynard, J.P., 2001).

38. Measurement of efficiency gains due to productivity growth are derived by subtracting the contribution of the additional quantities of inputs used between two time periods from the change in the quantity produced. The result, a measure of productivity growth, is the residual portion of growth that cannot be accounted for by the additional quantities of inputs that have been used to produce the increase in outputs observed.

39. Productivity growth captures the economy's progress in improving its capability of producing output as more inputs are devoted to production. Being able to get more from less tells us something about the rate of technological change. In the long-term, this productivity measure, because of the way that it is calculated, represents the improvement in the efficiency with which a business, industry, or country produces goods and services. In this sense, increased productivity is a key element in improving our economic well-being because, without it, the rate of increase in output would be the same as the increase in the factors of production used.

References

Baldwin, J.R., Harchchaoui, T., Hosein, J., and Maynard, J.P. (2001) "Productivity: Concepts and Trends", Productivity Growth in Canada, Statistics Canada, (catalogue 15-204-XIE).

Bollman, R.D. (1979) Off Farm Work by Farmers, Statistics Canada, (catalogue 99-756E).

Bowlby, Geoff, (2002) "Farmers Leaving the Field" Perspectives on Labour and Income, Vol. 3, No. 2, Statistics Canada, (catalogue 75-001-XIE).

Hatheway, D.E. and Perkins, B. (1968) "Farm Labour Mobility", American Journal of Agricultural Economics, No. 50, pp. 342-352.

Statistics Canada, (2002) Employment Earnings and Hours, Vol. 80, No. 2, (catalogue 72-002-XIB).

Statistics Canada, (2002) Guide to the Labour Force Survey, (catalogue 71-543-GIE).

Statistics Canada, (1998) Labour and Income Dynamics, Survey Overview, (catalogue 75F-0011-XPB).