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14 Output and Productivity in Canadian Agriculture, 1870–71 to 1926–27

R. M. McInnis

14.1 The Study of Canadian Agricultural Development

Agriculture is widely acknowledged to have played a large and important role in Canadian economic development. Our knowledge of the quantitative dimensions of historical change in Canadian agriculture is, however, remarkably limited. We have census data at decennial intervals on numbers of farms and acres of land, on stocks of animals and production of crops. There are annual data on exports and imports of farm products, and there is a considerable abundance of other raw information of a less comprehensive or less continuously available form. Yet little has been done to assemble that information into an overview of Canadian agriculture over an extended period of history. To date there has been no systematic, quantitative history of Canadian agriculture. This paper is intended as a first step toward that.

Assuredly, there has been historical writing on agriculture in Canada. Much of it has focused on particular regions of the country or on particular sectors of the industry. R. L. Jones (1946) contributed an especially valuable monograph on the history of agriculture in Ontario up to 1880, and several important articles on farming in Quebec in the early years of the nineteenth century. Maurice Seguin's (1970) monograph on Quebec agriculture played an important role in the historiography of that province, and the condition of farming in early nineteenth-century Quebec has played a prominent role in the writings of Fernand

Ouellet (1966, 1980). Andrew Clark's (1959) historical geography of Prince Edward Island quite naturally concentrates heavily on agriculture. The settlement of the wheat-growing region of Western Canada, which occurred mainly since the beginning of the twentieth century, at a time when statistical recording was quite well developed, has been extensively discussed. A series of monographs edited by Mackintosh and Joerg treated a number of aspects of settlement and economic change in the Prairie provinces (Mackintosh 1935; Morton and Martin 1938). Britnell's (1939) volume *The Wheat Economy* was an early attempt at a reasonably systematic treatment in statistical terms of one segment of Canadian agriculture. More recently, attempts to quantify the contribution of prairie settlement to Canadian economic growth have involved the estimation of the growth of production in the "wheat economy" and the increase in rent on prairie farmland (Chambers and Gordon 1966; Bertram 1973; Lewis 1975).

Only Fowke (1946) has attempted a comprehensive survey of agriculture in Canadian economic history. His valuable work offers an interesting interpretation but makes infrequent use of quantitative evidence to support his argument. There has been, then, no synthetic statistical study of Canadian agriculture in the period before the 1920s. There are no studies of aggregate output, carefully measured inputs, and productivity. Canada must be one of the few modern, developed countries that lacks studies of that sort.

The closest thing to an aggregate assessment of Canadian agricultural production is to be found in the work of O. J. Firestone (1958). It should be made clear that Firestone devoted a mere eight pages to a very cursory look at agriculture—clearly intended as only the most superficial sort of glance—and, on the whole, subsequent writers have not paid much attention to Firestone's agricultural data. Firestone estimated gross national product originating in agriculture for decennial census years from 1870, essentially as one step in obtaining overall estimates of gross national product. He was clearly more interested in the broader aggregate and its performance over the decades than in the agricultural sector alone. Nevertheless, his work represents the sum total of synthesized evidence on the quantitative dimensions of Canadian agricultural development.

There are several reasons why we might be less than satisfied with what Firestone has provided. For one thing, estimates for only 6 decennial census years over a span of half a century leave considerable uncertainty about the representativeness of those years. For another, while he does provide a constant dollar as well as a current dollar series, he is not very explicit about how he assembled the price deflator from a few specific wholesale price indexes. Consequently, Firestone's work on agriculture can be described as rather sketchy.

The most problematic thing about Firestone's estimates is that his method probably introduced a serious source of bias. His procedure was to aggregate estimates of production of each commodity made from data in the decennial censuses, and hinging critically on values of each category of production reported in the census of 1901, and then to reduce the aggregate by a fixed coefficient to account for duplication and deductions. That adjustment is to account for farm inputs purchased from other sectors and for crops included in the production aggregate that were used as inputs in the production of livestock and animal products. For this adjustment Firestone used a constant factor of 29.3% of the gross value of agricultural production. That was the average difference between total agricultural output and gross value added in agriculture as reported by the Dominion Bureau of Statistics in its annual *Survey of Production* over the years 1920–39.

The catch to Firestone's adjustment procedure is that it fails to take account of the major structural change that had occurred in Canadian agriculture. The 29.3% factor was derived from evidence covering a period when grain farming in western Canada comprised a large fraction of Canadian agricultural production. Firestone applies that coefficient to a historical period in which western grain farms made up a much smaller part of the total and livestock farming, which used considerably more of its crop production as input on the farm, was the predominant component of Canadian farming. Certainly for 1900 and earlier years, and possibly for 1910 as well, this must have led to an overstatement of gross value added in agriculture. By 1920 or so the adjustment coefficient used by Firestone would be reasonably accurate, so his procedure not only overstates the input of the farm sector in the nineteenth century, it understates the growth that occurred in the early decades of the twentieth century.

It is long since time that a fresh attempt was made to estimate a historical series of aggregate farm output in Canada for the years before 1926 when the official Bureau of Statistics series begins. That I have done in collaboration with M. C. Urquhart. This is part of a larger project organized and directed by Professor Urquhart to produce a new series of historical national income statistics for Canada, with work being carried out by several investigators on the various sectors. The estimates of gross value added in agriculture which are used in this paper are the McInnis-Urquhart estimates with only a few minor modifications. Only an abbreviated description is given here of the sources and methods used in the construction of these estimates, as the full details are intended to be reported elsewhere.[1]

The principal objective of this paper is to explore the pattern of development of Canadian agriculture implied by the new series and,

especially, to examine its implications for changes in productivity. The difficulties of getting suitable measures of factor inputs are highlighted.

14.2   New Estimates of Agricultural Product

It is intended here only to give a brief outline of the procedure used in the estimation of the new Canadian historical agricultural output series. Some further specifics are provided in an appendix where the full annual series is also presented. In constructing the new series our concern was to develop a methodology that would avoid the main shortcomings of Firestone's estimates. That was possible, but at a cost that is perhaps unfortunate, given the considerable regional variation in Canadian agriculture. The series is a national aggregate only. No directly comparable provincial or other regional subaggregates could be provided. Work is underway on another project that uses a different methodology to estimate regional agricultural production estimates.[2] That work will have to be reported elsewhere.

In historical output estimation of the sort reported on here the nature of the available data is the critical matter of concern and, to a considerable degree, concepts and methods have to be tailored to the data. The evidence we have to go on comes primarily from two sources: decennial censuses of agriculture and annual statistics of the foreign trade of Canada. These are supplemented by a variety of other materials, often less than comprehensive and not continuously available. The most important of these are the reports of the *Ontario Bureau of Industries* on its annual surveys of agriculture. For the early twentieth century there are also some annual data reported by the provinces of Alberta, Manitoba, and Saskatchewan. That Ontario contributed about one-half of Canadian agricultural output in the later years of the nineteenth century and that when substantial settlement in the prairie region of the Canadian west occurred in the early twentieth century there were annual data reported by the provincial governments in that region, coupled with the fact that for many products international trade was relatively important in the Canadian case, has meant that it has been feasible to produce a reasonable set of annual estimates of agricultural gross output.

Some matters of definition and specification need first be attended to. The aggregate focused on in this chapter is gross value added in agriculture. That is a measure that is gross of the depreciation of farm capital but net of duplications and of inputs into agriculture from other sectors of the economy. There is potential for confusion of terminology here. Since the procedure that was followed was first to estimate a flow of final products from the agricultural sector and then separately to estimate inputs acquired from other sectors, a name must be given to

the aggregate net production of agricultural goods before the deduction of inputs. I call this the final agricultural product to distinguish it from the even more gross aggregate of agricultural output including farm products used as further inputs on farms, or at least within the farm sector, that was measured by Firestone and in early work of the Dominion Bureau of Statistics.

Agriculture is here defined quite narrowly, in a way that falls short of the total output of farms. There are several reasons for this. Canadian farmers, especially in the nineteenth century, engaged in a range of production that typically went beyond what we would now think of as agriculture. Probably the most important element of this would have been forest products. That went far beyond firewood either for sale or for use on the farm, although that item alone is of considerable importance. By 1870 a few farms might still have been burning wood for potash but, more importantly, logs were often cut for the local sawmill, shingles and staves were made in otherwise slack time during the winter, fenceposts and rails were cut not just for farm use but also for sale, and, especially after about 1890, pulpwood became a really important product in some parts of the country. Farmers also provided both labor and draft animals for transport services and for construction. They processed agricultural products by curing meat and spinning and weaving wool. These and other adjunct products of the farm have not been included in the gross value added in agriculture as estimated here, nor has the rental value of farm dwellings. Moreover, no attempt has been made here to estimate farm capital accumulation in the form of land improvement through clearing, drainage, or fencing. That was not entirely by design. Additions to farm capital in the form of stocks of animals are included, and the original intention was to carry through to a more comprehensive estimate of farm production of new capital. This turned out not yet to be feasible.

Overall, then, what is being considered is a lean estimate of farm net output. In principle there are two ways of dealing with the situation. One is to aim at a comprehensive and widely inclusive estimate of output, reflecting all of the production to which the factors encompassed by the sector under consideration have contributed. Alternatively, one might measure output quite narrowly and restrictively and attempt to make the appropriate adjustment on the input side. It is the latter course that is attempted in the present paper—not always, admittedly, with complete success. Partly it is a matter of fitting the estimates for the agricultural sector into a wider project; more importantly, though, it is a matter of the data that were most readily available and adapting concept to data.[3]

Farm products have been valued at local markets rather than at the farm gate, thus implicitly attributing to agriculture the transport of

output to primary markets. It is production that is being measured, though, rather than sales from farms. Hence, farm output includes production for consumption by the residents of the farm. That only makes sense in an age when one-third to one-half of the population still lived on farms and produced a lot of output for themselves. To overlook that would be a serious distortion, but it has important implications for the interpretation of the composition of agricultural output. Farm family demand must necessarily play a prominent role in the pattern of farm production.

The approach to the estimation of agricultural output that has been adopted here is, broadly speaking, to build up estimates of final agricultural product by estimating separate annual series of output and prices for each of the individual products of the agricultural sector. Such an approach makes the most effective use of such annual data on trade and production as are available. It also facilitates the construction of a constant price series. The main attraction of this approach is that it obviates the need to find some way to reduce aggregate output to a flow of final product to take account of intermediate products.

The direct estimation of final product considerably simplifies the treatment of many field crops—they can be ignored. Some, like turnips and corn for fodder, can just be left aside as wholly utilized within the farm sector for animal feed. In the case of other feed crops such as hay and oats, by far the greater part of the crop was used directly on farms, and it is necessary to estimate only that small fraction of production that contributed to net agricultural output. Often a significant part of that was exported. In this way of handling things the main farm products were dairy and animal products, wheat, potatoes, fruit, and vegetables.

A second prominent aspect of the procedure followed here is that where data on annual production are not directly available, the procedure is to estimate domestic consumption, in some cases just by interpolating between decennial census benchmarks, adjusting for year-to-year changes on the basis of international trade. This involves the not fully substantiated assumption that relatively stable domestic consumption demands took precedence and that exports were catered to out of left-over supply. The validity of this supposition still needs to be firmly established. In the late nineteenth century, Canada was still a predominantly agricultural country, producing a few commodities such as wheat, cheese, and to a lesser extent beef for export as well as domestic markets. An implication of this might well be that household demand took precedence and that exports came essentially out of surplus or "leftover" supply. This has to be recognized as a still insufficiently evaluated characterization of the Canadian agricultural

sector. Tentatively, it may be worth proceeding so long as there is no imposing evidence to the contrary.[4]

The general case, then, is one in which the output of farm product has been estimated as the domestic consumption of that product, adjusted for international trade. In the case of livestock, outputs also include additions to or subtractions from the stock of animals. In cases where production could not be calculated directly, estimates of domestic consumption are made by starting with a benchmark level of per capita consumption. There is some considerable variation from commodity to commodity in the assurance with which these estimates are made. A few examples may provide both a clearer indication of methodology and some sense of the varying success it meets. Consider three of the most important items of farm input: wheat, cheese, and beef.

There are reasonably extensive data relating to wheat production in Canada, although, as is so often the case, coverage shrinks as one goes further back in time and a different procedure has to be followed in each of three time periods. From 1908–9 onward there is a national series based on a reasonably well-organized annual survey of agriculture. From 1881–82 through 1908–9 there were annual data only for two provinces, Ontario and Manitoba, but those were the two that predominated in wheat production. Decennial census benchmark data on national wheat production was for this period interpolated annually on the basis of the Ontario and Manitoba series. Between 1871 and 1881 there are no annual statistics of production. For those years a fixed per capita consumption of 5.5 bushels and a fixed provision for seed were modified by the amount of exports (net of imports) of wheat and flour. The seed provision is treated as an intermediate product and not as part of agricultural net production.

Cheese provides a good example of a commodity for which a heavy orientation toward export simplifies the estimation of annual output. Canadians were evidently never big cheese eaters. The industry developed very largely in response to opportunities in the export market in Great Britain. At a relatively early date exports comprised the greater part of output. That being the case, annual exports adjusted for a modest per capita addition of three pounds to take account of domestic consumption must give a reasonably accurate reflection of production.

The production of cattle for beef was in many years the largest single component of agricultural output. While from time to time exports reached significant levels, the production of cattle in Canada has been predominantly for domestic consumption, and a large part of that was within the localities where the animals were raised. Hence there are only limited market data pertaining to the cattle trade. Different procedures had to be followed for the years before and after 1890–91.

After that date there were annual data on sales and slaughter in Ontario, augmented by some of the western provinces after the beginning of the twentieth century. Annual estimates of the national stock of cattle were made by interpolating between decennial census counts on the basis of annual changes in the stock of animals in Ontario. Then the Ontario ratio of production to stock was applied to the entire national stock. For years before 1891, census benchmark estimates of domestic per capita consumption were made by adjusting the numbers of animals produced to take account of international trade in live animals and the live animal equivalent of processed meats. Annual figures for per capita consumption then were obtained by a straight line interpolation between census years. Annual estimates of net output were then made by converting per capita domestic consumption into a national aggregate by multiplying by population numbers and then adding exports, net of imports. This procedure was followed through the years after 1870–71 when, proportionally speaking, exports made up the greatest part of output.

In all cases the estimates were for the quantity of output of each commodity. Separate price series were prepared for each commodity. These were based for the most part on existing series of wholesale prices, supplemented in the case of some minor products by indexes of annual change in export or import unit values. The major shortcoming with this is that the price series are even more Ontario-centered than are the production series. Overall, the estimating procedure is too much tied to agriculture in Ontario, the province that carried the greatest weight in the national total. There is a real lack of infusion of any sense of the variety of regional experience that is such a prominent part of the Canadian scene. We are especially lacking in information on farming in the Maritime provinces and Quebec. Much additional research needs to be done before anything can be done to improve upon the situation. The assembly of price series for markets in those provinces would be a good starting point.

The estimates of final agricultural product are largely net of intermediate production and goods used as input in the farm sector. Exchanges of animals between farms, as for example exchanges between breeders and feeders, have been netted out. Only the export of feed crops or the sale to feed nonfarm draft animals, or the minor use of oats, corn, and barley for human consumption, has been counted as output. To go from final agricultural product to gross value added in agriculture only some relatively minor deductions have to be made. At least these are minor deductions until years in the twentieth century when tractors and fuel begin to become important. Over most of the period under examination the two principal items of purchased input were bran and other mill feeds and blacksmith services. By the 1890s

binder twine had become a significant item. At no time in the period under review was purchased fertilizer an important input in Canadian agriculture. The other purchased items that have to be allowed for are mainly containers—cooperage, sacks, bags, and baskets. The total of these deductions never rose above 10% of final agricultural products before 1914. Some details of estimation are given in connection with table 14.A.2.

The full annual series of final agricultural product is presented in tables 14.A.1 and 14.A.2. The former shows the main commodity groups that make up agricultural product. The latter table provides a deflation of the current dollar estimates to constant 1913 prices. Since final agricultural product was estimated directly as a series of sums of price-quantity products, the constant dollar series was constructed simply by recalculating the entire pq matrix. Any base price set could have been used. Many of the series for the United States are in terms of 1910–14 average prices. The use of 1913 prices alone here results in a series almost identical to that which would have been produced with 1910–14 average prices. The implicit price index that results from this calculation comprises a new price index for Canada, one that will bear some comparison with the long-existing wholesale price indexes of Coates (1910) and Taylor and Mitchell (1931).

There is little that can be done to evaluate the reliability of the agricultural production estimates, such as by comparison with other evidence. Usually all the available evidence is exhausted in making the estimates in the first place. The use of the estimates in analysis and interpretation—what we turn to next—is the main vehicle for assessing the plausibility of the estimates.

One partial check that can be reported in a tentative way entails a comparison of the new estimates of gross value added in agriculture in several census years with the sum of similar estimates by county across the whole country. The regional estimates are not entirely in-dependent—they make use of a lot of the same basic data—but the method of estimation, particularly the method of netting out interme-diate production, is quite different.[5]

The comparison between the new McInnis-Urquhart estimates of gross value added in Canadian agriculture and the national sums of county-level estimates of the same aggregate can be made for five decennial census years from 1881 through 1921. For the first and last of those years the two estimates come out, for what must be purely fortuitous reasons, virtually the same. For the three intervening census dates the sums of county estimates come out 7% or 8% above the McInnis-Urquhart national estimates. This is more in line with what might be expected since the county series probably was light on the estimation of some of the deductions required for purchases of inputs

from other sectors. Overall the comparison is an encouraging one, although it has to be emphasized that it is more a check on method than on general accuracy. If there were major flaws in some important census aggregates they would put both sets of estimates in error. In light of the discussion of the ensuing section, where exceptionally slow growth of agricultural output in the 1881–91 intercensal decade is highlighted as one of the substantive results of the new estimates that calls for explanation, a note of caution should be entered. If the sum of the county estimates could confidently be expected to come out above the national estimate (something that probably cannot be said with sufficient confidence) then there may be an indication that the McInnis-Urquhart figure for 1881 might have some upward bias.

14.3   Canadian Agricultural Output, 1870–71 to 1920–21

The constant (1913) dollar series of gross value added in Canadian agriculture is shown in figure 14.1. Two features are notable. One is
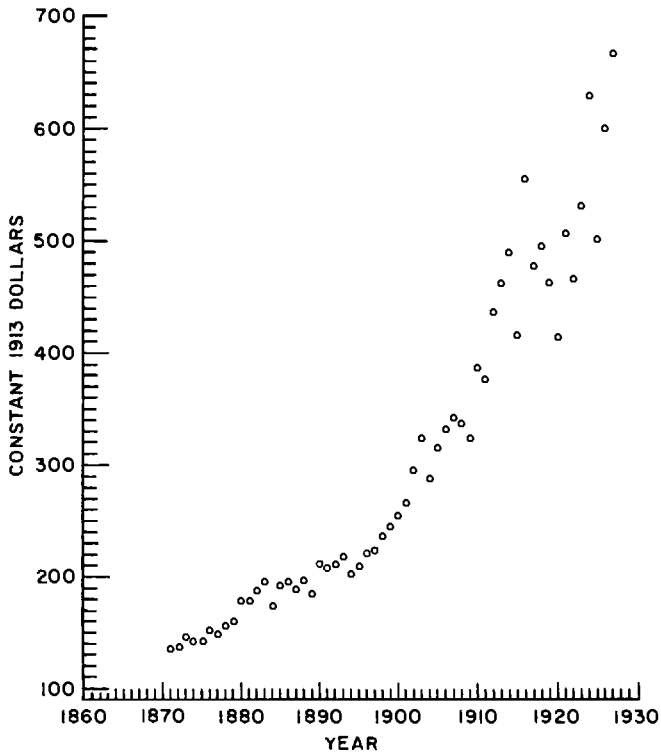

Fig. 14.1   Gross value added, Canadian agriculture, 1870–71 to 1926–27 (constant 1913 dollars).

that there is an evident break in the mid-1890s with output growing more rapidly in the years following. That is quite in accord with the usual account of Canadian agricultural development. The more rapid growth after about 1896 reflects the rapid settlement of the agricultural region the provinces of Alberta and Saskatchewan. An alternative characterization of the growth of agricultural output might be that between 1870–71 and 1882–83 it grew almost as rapidly as in the post-1896 period but that there was an intervening period from 1883 through 1895 when output grew very little. Throughout, however, the growth of agricultural output was associated with an expansion of the area farmed. That is obviously true of the period of western settlement, after 1896. In the years immediately following 1871, though, Canada was extended to include Prince Edward Island, British Columbia, and Manitoba.[6]

The second prominent feature discernible in figure 14.1 is the marked increase of instability associated with the greater weight in the total of the wheat growing region of the Prairie Provinces. Growth of output was fairly steady and year-to-year fluctuations relatively modest until 1909–10. In that year there was an especially large jump in output, associated with a 56% increase in wheat production. Thereafter, the output series fluctuates widely from year to year. That is not something introduced by the way in which the estimates are constructed but a consequence of the increased role of western Canadian wheat, grown under conditions of considerable uncertainty.

The principal interest of this paper is in the long-term development of Canadian agriculture. With that in mind, the following discussion is directed entirely to changes between decennial census dates. Estimates of factor inputs can be made only for census years, and those are the only years for which comparisons can be made with the Firestone estimates. With regard to the latter, it had earlier been pointed out that a shortcoming of the Firestone estimates was that, since they covered only decennial census years, they might offer a distorted picture depending upon the representativeness of those years. We can now examine this a bit more fully with the aid of data in table 14.1. In that table the new McInnis-Urquhart estimates of gross value added in Canadian agriculture are examined for decennial census years in terms of the estimates for census years alone and for 3- and 5-year averages centered on census years. It is still not possible to do much for the initial census year which, for want of estimates for years before 1870–71, is not averaged.

The census year 1881 was reputed to have been a poor crop year, and that shows up in an unusually low figure for wheat output. In 1881 and again in 1901, a rather poor census year was followed by a year of considerably higher yields. Overall, though, it makes little difference whether one focuses on the census years alone or on either 3- or 5-

Table 14.1   Gross Value Added, Canadian Agriculture, Census Years, 1871–
                    1921 (Millions of Constant 1913 Dollars)

Years	Census Year Only	3-Year Average	5-Year Average
1870–71	136	136[a]	136[a]
1880–81	178	181	180
1890–91	208	210	206
1900–1901	266	272	277
1910–11	376	400	397
1920–21	508	463	477

Source: Calculated from table 14.A.2.
[a]Census year only.

year averages centered on those census years. The 5-year averages which are used in subsequent tables correspond closely to the figures for individual census years. The choice makes little difference in the nineteenth century. In the twentieth century the situation is somewhat different. The census year 1911 is itself on the low side, and 1921 is a relatively high year. In both of these cases the 5-year average probably offers a more representative number.

Any way one looks at it, the most rapid growth of agricultural production occurred in the first decade of the twentieth century when, in real terms, the growth was a little over 40%. The rapid growth continued through the following decade when output expanded by 35%. The other outstanding feature is that the decade between 1881 and 1891 was one of slow growth—only 17%. It would be of some considerable interest to track down the source of that slow growth in the 1880s. By contrast, by any way in which the data are organized, the first decade of the twentieth century was a period of remarkably rapid growth.

The composition of agricultural output is shown in table 14.2. There we see, on the whole, the simplicity of Canadian agricultural production. It was overwhelmingly oriented to the production of foodstuffs. Fibers and other agricultural inputs to other sectors never amounted to more than about 12% of agricultural output (1881). Wheat emerges as an outstanding element in final agricultural product only in the early years of the twentieth century. Even in 1910–11 the value of wheat production (net of provision for seed) still made up only 24% of the flow of final agricultural product. In most years the leading component of agricultural output was animals for meat—primarily beef and pork. That component contracted sharply in the 1870s but expanded again in the last decade of the nineteenth century. In the 1870s there was a notable contraction of a well-established Canadian export trade in cattle. Exports to Great Britain grew to substitute to some extent for the

Table 14.2   **Final Agricultural Product and Its Composition, Canada, 1870–71 to 1926–27**

Years	Total Product	Dairy Products	Other Animal Products	Wheat	Other Field Crops	Other Outputs
	Millions of Current Dollars					
1870–71[a]	139	24	60	22	17	16
1878–79 to 1882–83	172	35	57	33	26	21
1888–89 to 1892–93	186	49	65	27	23	22
1898–99 to 1902–03	235	66	88	33	22	26
1908–09 to 1912–13	444	95	154	106	51	37
1918–19 to 1922–23	963	185	290	297	103	85
	Percentage of Total					
1870–71	100.3	17.3	43.2	15.8	12.2	11.5
1878–79 to 1882–83	100.0	20.3	33.1	19.2	15.1	12.2
1888–89 to 1892–93	100.0	26.3	34.9	14.5	12.4	11.8
1898–99 to 1902–03	100.0	28.1	37.4	14.0	9.4	11.1
1908–09 to 1912–13	100.0	21.4	34.7	23.9	11.5	8.3
1918–19 to 1922–23	100.0	19.2	30.1	30.8	10.7	8.8

Source: Table 14.A.1.
[a]Census years only.

loss of the American market, mainly in the last decade of the nineteenth century. Dairy production grew continuously in relative terms throughout the later nineteenth century. Rather interestingly, the most pronounced increase in the share of dairy products came in the otherwise slow-growth decade of the 1880s. It was not solely a matter of retreat in other sectors. In real terms the production of dairy products grew by 40% between 1881 and 1891. All other components of agricultural output were rather stagnant during that decade.

The new series of gross value added in agriculture is compared in table 14.3 with the earlier estimates by Firestone. The comparison is made in both current and constant dollars since the two series differ both in the pattern of real output they portray and in the price trends. In current dollars the relation of the new series to Firestone's estimates is pretty much as was expected. The two estimates compare closely in 1921. The McInnis-Urquhart estimate is 97% of the Firestone estimate. In earlier years, though, the Firestone estimates are considerably higher than the new series. The difference is greatest in 1901 when the McInnis-Urquhart estimate is only 70% of Firestone's figure. Part of the difference is in the implication of price changes. The main differences in the pattern of price change shown by the two series is in the first and the last decades. The new series indicates a more substantial fall in prices between 1871 and 1881 than did Firestone. The implicit

Table 14.3   Comparison of Firestone with McInnis-Urquhart Estimates of
                    Gross Value Added in Canadian Agriculture, Census Years
                    1871–1921

Years[a]	Current $GVA	Firestone Constant $GVA	Implicit Price Index	McInnis-Urquhart		Implicit Price Index
				Current $GVA	Constant $GVA	
1870–71	145	161	90	132	136	97
1880–81	186	214	87	151	178	85
1890–91	217	268	81	173	208	83
1900–1901	282	321	76	197	266	74
1910–11	509	509	100	380	376	101
1920–21	1,073	580	185	1,041	508	205

Sources: Firestone, Firestone 1958, tables 63, 69; *McInnis-Urquart,* table 14.A.2.
[a]Individual census years only.

price indexes for the two series are fairly similar from 1881 through 1911. The new series would indicate, though, that the rise in prices from 1911 to 1921 was greater than Firestone's estimates implied.

The main difference between the two series, however, is in real production rather than its valuation. For 1871 the McInnis-Urquhart estimate of real value added is only 84% of the level estimated by Firestone. The relationship was at about the same level a decade later. Thereafter, Firestone's series indicated greater growth, so that by the turn of the century the new estimate is only 72% of Firestone's. Earlier in the paper I explained why there was a strong presumption that Firestone may have considerably overestimated agricultural output. What may be a bit surprising is that the large differential persists right up to 1911. For that year the new estimate is only 74% of Firestone's figure. The convergence of the two series occurs almost entirely in the 1911–21 decade, although it should be noted that in the real output series the McInnis-Urquhart estimate is still only 88% of the Firestone estimate in 1921.[7] One implication of this is that the new series shows considerably less growth of real output in the first decade of the twentieth century and rather more growth in the second decade.

14.4 A Tentative Look at Inputs and Productivity Growth

It is not possible at this time to give a reasonably conclusive and well-grounded account of input growth and productivity change in Canadian agriculture. Too much remains to be done in explaining what might be squeezed out of the available data for anything like a definitive analysis to be provided. What follows is more in the nature of a preliminary exploration of what the rather meager data that can readily

be assembled do imply. Mainly what they show is that there was a lot of growth in agricultural inputs, primarily because a vast area of new land was brought under cultivation.

Information on inputs into agricultural production comes essentially from the decennial censuses. It is only sensible, then, to concentrate on the change between census dates. Land is the most directly measurable input; moreover, it is the one in which the most dramatic growth is to be seen. Land, then, makes an obvious starting point.

14.4.1   Land

The amount of agricultural land is directly obtainable from the decennial censuses. Table 14.4 summarizes some basic census data on farms and farmland. The number of farms is measured rather restrictively as the number of farm units occupying more than 10 acres. This undoubtedly leaves out of account a few small but genuine farms. The size distribution in the published nineteenth-century censuses provide no break between 10 acres and very small plots of less than an acre. In some years the censuses included large numbers of small plots of an acre or less that were merely rural and suburban residences rather than farms. If these small units are not left out, the count of farms can be quite misleading. The numbers of farms shown in table 14.4 are undercounts by only slight amounts; the numbers of acres are affected hardly at all by this definitional proscription.

For the most part it is improved land that should really interest us. It is not the case that unimproved land did not enter into production at all, but mostly it entered into the production of goods such as firewood, pulpwood, and timber that are not included in the measure of agricultural output adopted here. Animals, especially cattle, were grazed on unimproved land. That should introduce only a minor distortion. There was a range cattle industry of some prominence in the years

Table 14.4   **Agricultural Land in Canada, Census Dates, 1871–1921**

Years	Number of Farms (Thousands)	Acres Occupied (Millions)	Acres Improved (Millions)	Improved Acres per Farm	Gross Value Added per Improved Acre
1871	328	36	17	52	7.49
1881	389	45	22	57	7.95
1891	429	59[a]	28[a]	65	7.19
1901	453	63	30	66	8.82
1911	616	110	49	80	7.76
1921	667	141	71	106	6.42

Source: Decennial *Censuses of Canada.*
[a]Adjusted to take account of the original tabulation of much of Quebec farm land in *arpents* rather than acres.

after 1891, but it was a small element in the overall picture. Even there, much of the land on which cattle grazed would not have been counted as "occupied."[8]

Agricultural settlement in the Canadian west was under way by the 1890s, but the most dramatic changes came after 1901. This shows up in table 14.4 with the much greater increases in land area after 1901. As a general expository device in this exploration of the evidence, the entire half-century will frequently be looked at as two subperiods: 1871–1901 and 1901–21. The first represents the period before western settlement had much effect. Improved acreage increased by 76% in the first 30-year subperiod. More than half of that occurred in the older-settled eastern provinces where the area of improved land used in agricultural production had increased by almost 40%. Acres occupied in the eastern provinces expanded by almost as much, so the last 3 decades of the nineteenth century have to be seen as a period in which considerable expansion was occurring in the older-settled areas. Canadian agricultural development in this period was not just a story of western settlement.

The picture would look even more striking if the time period were broken in 1891. From 1871 to 1891 improved acreage in eastern Canada increased by 59%. Western (mainly Manitoba) acreage made up only 5% of the stock of improved land in 1891, and 85% of the increase in improved acreage to that date had come in the eastern provinces. Growth accelerated in the west while, between 1891 and 1901, there was actually a 10% reduction in improved acreage in the east.[9] Figures spanning the last three decades of the century mask this more pronounced expansion and then retreat.

The considerable increase in acreage of improved land, mainly in eastern Canada, up to 1901 underscores the importance of the lack of a measure of capital formation in the form of land improvement in the estimates of gross value added. Unimproved land, labor, and capital in the form of implements, draft animals, and stocks of feed crops were being used to produce improved land, and this was going on at a fairly rapid pace. In principle one could account for this on the output side or, if it is too difficult to measure the value of farm improvement, by segregating agricultural inputs that go into the product "farm improvement."[10] So far I have not been able to estimate a satisfactory series of capital accumulation in the form of land improvement; hence we shall have to endeavor to make an adjustment in one way or another on the input side.

The great increase in acreage in western Canada after 1901 is problematic in another way. Western land was farmed much less intensively. Hence we find that improved land was growing quite a bit more rapidly than was output. Gross value added per acre of improved land declined

considerably between 1901 and 1921. These were less productive acres, though. The physical yield of western land was lower and, in the extensive dry farming areas, more acres of improved land were required for every acre actually under crop. The situation, however, is quite complex. The inherent difference between eastern and western land is probably not enough to account for the change that occurred. A very large increase in available land—cheaply available in the form of free homesteads—brought about a shift to a more land-intensive form of agriculture.

Over the entire 50-year period between 1871 and 1921 the average annual rate of change in acreage of improved land (2.84%) was greater than the rate of growth of output (2.56%). What that may mean for productivity depends upon the weight assigned in the aggregate production function to the input of land. In the last three decades of the nineteenth century, output was growing considerably faster than land; in the first two decades of the twentieth century, though, improved acreage was increasing at an average annual rate of 4.35% while output was growing at only 2.77%.

14.4.2 Labor

The measurement of labor input into Canadian agriculture is a more complex matter. Here too there are decennial census data, but they have been much less critically examined by previous investigators, and the potential margin of variation is greater than in the case of land. Earlier work has taken entirely at face value the tabulations by Statistics Canada of agricultural workers at decennial census dates from 1881 through 1921. Those data are used by Firestone along with a very crude estimate of the number of agricultural workers in 1871. Closer examination reveals too many problems with these data for them to be accepted so unquestioningly.

First off there is the problem of female workers. Except for a small number of female farm operators, mostly widows, separately identified first in the census of 1881, there are no female workers attributed to the agricultural sector. This may not be an entirely unreasonably characterization of nineteenth-century Canadian agriculture. Women in Canada typically did not do field work. If they contributed it was only in peak periods of labor demand. On the whole, then, it seems appropriate not to attempt any measure of female agricultural workers.[11]

Much more problematical are male unpaid family workers, or "farmers' sons," as they were called in the Canadian censuses. Practice varied in the way that "farmers' sons" were classified in addition to some considerable uncertainty as to just who was counted. The census of 1891 does about the most explicit job of identifying agricultural workers. That was the first year in which it seems that farm operators

themselves were clearly identified. In that year there was a reasonable alignment of persons identified as farmers with the number of genuine farms—units of 10 acres or more. Understandably the former were a bit less numerous than the latter, since there were always a few farms operated by persons whose primary occupation was something other than farmer. In 1891, though, the number of persons counted as "farmers" was 98% of the number of farm units of more than 10 acres. "Farmers sons" were generously enumerated. They amounted to 58% of the number of farmers. This is probably an overestimate of unpaid family workers in agriculture. Although it includes no female workers, the 1891 account adds up to a virtually complete tally of farmers sons aged 13 and above, whether or not they were attending school. In that same census agricultural laborers are separately identified. To get a complete count of agricultural labor one needs only to add in a small number of "servants" attributable to the farm sector. The total number of male "servants" is small and, unlike female servants, not predominantly urban. Almost one-third of male servants were under 15 years of age. The category appears to have been used largely to refer to unpaid workers other than family members in households. A plausible guess would put two-thirds of male servants in farm households. In any case the number is small.

The agricultural workforce may have been generously enumerated in 1891, but at least it is relatively well defined. That year has been taken as a pivotal one around which the estimates for the other census years were worked out. Table 14.5 presents estimates of the agricultural workforce, roughly divided by status. As previously indicated, the total for 1891 is essentially the same as given in various census publications and utilized by other writers such as Firestone. To be consistent with that number, the counts for other years have to be adjusted. There are two main problems. One is that the treatment of "farmer's sons" varies; the other is that the category "laborer" often includes more than just agricultural laborers.

Table 14.5   Canadian Agricultural Workforce by Status, Census Dates, 1871–1921 (Thousands of Workers)

Year	Farmers	Family Workers	Paid Labor	Total
1871	324	122	133	579
1881	386	151	130	667
1891	414	241	89	744
1901	445	236	86	768
1911	678	132	148	958
1921	658	212	171	1,041

Source: As explained in text.

For the two censuses prior to 1891 it is possible to examine the manuscript enumerations in order to establish just how occupational categories got assigned. For both 1871 and 1881 the number of "farmers" returned was much above the number of farms, whereas in 1891, when the occupational classification of the census was much clearer, the count of "farmers" was slightly less than that of farm units of 10 acres or more. That is a plausible result since some farms would have been operated by persons with different primary occupations such as millers, merchants, loggers, or carters, or in some cases a farmer operated farms in two different enumeration areas. In 1881 the number of "farmers" was 30% greater than the count of farms, and in 1871 it was 45%. The resolution for 1871 is straightforward. All male workers in farm households who did not indicate some other specific occupation were counted as farmers. Thus "farmers" includes farmers' sons 13 years of age or over, whether or not attending school. To get a full tally of agricultural workers one needs only to add some share of those enumerated as "laborers." No distinction was made in the census between agricultural and nonagricultural laborers. Indeed there was at the time no real distinction, since these persons would have been day laborers who divided their work between agricultural and nonagricultural pursuits. The best we could do would be to divided them roughly between rural and urban, where the latter includes all cities, towns, and villages. That appears essentially to have been the distinction made in the census of 1891. There the count of agricultural laborers appears to have encompassed all laborers with rural residences. If the estimates are made consistently, it may at least be possible to make adjustments to agricultural labor when undertaking analyses of production relationships.

The situation in 1881 differed again. Then, the category "farmers' sons" was made explicit in the census for the first time, but it referred only to farmers' sons from 13 through 20 years of age. Sons who were 21 or over were classified as farmers. In table 14.5 the number of farmers is estimated for 1881, as for 1871, by applying the ratio of farmers to farms that held in 1891. The remaining "farmers" were added to the category "farmers' sons." The number of farm "laborers" was estimated for 1871 and 1881 as 72% and 68% of all laborers for those two years, respectively. The fractions were derived from local tabulations of adult male population in rural and urban areas. The procedure is undoubtedly generous in that it is more a count of the labor pool available to agriculture than of actual farm labor input. Both farmers' sons and rural laborers are fully assigned to the farm sector when they would undoubtedly have been considerably less than full-time workers. Even with the adjustments that were made, however, the category "farmers' sons" grew too much between 1881 and 1891. Partly it is a matter of reassigning people for the category "laborer"

to that of "farmers' sons" but there remains a considerable suspicion that the latter category may be upwardly biased. If that is not the case, then it must be downwardly biased in earlier years, especially in 1871. Considerably more research needs to be done before the measurement and categorization of labor can be satisfactorily resolved.

The census years after 1891 are not entirely without problems either. The treatment of laborers seems to have been more consistent, but there were continuing problems with family workers as the census definition became increasingly restrictive. In 1901 scarcely any farmers' sons under 16 years of age were enumerated as gainfully employed. The number in table 14.5 is based on an upward adjustment derived from the age structure of young males. A similar adjustment was made for 1911, although by then the number of farmers' sons in the workforce had dropped considerably. Partly this decrease was real. The shift of farming to the western provinces provided opportunities that accelerated the upgrading on the occupational scale of farmers' sons to independent farmers. At the same time, in eastern Canada rapidly growing opportunities for nonagricultural employment drew young men off the farm at earlier ages. Nevertheless, there remains a nagging suspicion that census enumeration had become more restrictive and that the number of family workers in agriculture in 1911 had a downward bias. The 1921 figures are those given in the census, without adjustment. The large increase in farmers' sons between 1911 and 1921 may be an indication that the category was even more seriously understated in 1911 than has been presumed here. One should not be too hasty in reaching that conclusion, though. The aging of farm families in the Western provinces meant that more farmers had sons of working age.

The labor estimates of table 14.5 can be used in conjunction with the estimates of real gross valued added to examine changes in labor productivity in Canadian agriculture. Keep in mind that the labor estimates are upwardly biased, although less so for years in the twentieth century. The estimates of gross value added per worker shown in table 14.6 point to an average annual rate of increase over the entire half-century of 1.36%. That is well above the 0.9% indicated for the United States from an amalgamation of estimates by Towne and Rasmussen (1960) and Kendrick (1961). Because these two slightly different series have to be put together for the United States, the calculation of productivity growth may be just an approximation. There is little question, though, that the Canadian rate is well above that of the United States. This result is due mainly to the pattern for the first two decades of the twentieth century, when productivity growth in United States agriculture flattened out almost completely. Between 1900 and 1920, Kendrick's figures for output per worker in agriculture rise by an average

Table 14.6   **Gross Value Added per Agricultural Worker, 1871 to 1919–23**

Years	GVA[a] per Worker (Constant 1913 Dollars)	% Change over Preceding Decade	U.S. Gross Product per Worker (Constant 1910–14 Dollars)	Canada as % of U.S.
1871	235	—	334[b]	70
1879–83	270	14.9	407[b]	66
1889–93	277	2.6	424[b]	65
1899–1903	361	30.3	490[b]	74
1909–13	414	14.7	505[c]	82
1919–23	458	10.6	524[c]	87

[a]From tables 14.1 and 14.5.
[b]From Towne and Rasmussen (1960) adjusted to match concepts as closely as possible.
[c]From Kendrick (1961).

of only 0.33% per year. That is in considerable contrast to the 1.28% growth rate indicated by the Towne and Rasmussen (1960) series for the last three decades of the nineteenth century. In Canada the growth of output per worker in agriculture was not so much different between the two periods. In the first 20 years of the twentieth century the growth rate of labor productivity averaged 1.20%, almost as high as the 1.46% of the last 30 years of the nineteenth century. Productive growth in the latter period was highly variable across the three decades, being especially low in the decade 1881–91 and quite rapid in the succeeding one. A concern that this pattern may result from variations in the measurement of labor input has already been raised. It is interesting to note, however, that the evidence for the United States points to a very similar pattern.[12]

Agricultural gross value added per worker in Canada was about 70% of the level of the United States in 1870. By 1880 it had slipped to only 66%. These relationships are not at all implausible even though the Canadian figures are derived from especially generous measures of labor input. The agricultural comparison looks roughly the same as the longstanding relationship between per capita incomes of the two countries. United States agricultural output per worker was still relatively low in 1870 as that country worked its way through post–Civil War reconstruction. Canada began to catch up again on the United States in the last decade of the nineteenth century and pulled up sharply in the early twentieth century. Further investigation of the substance of Canadian agricultural development will probably reinforce the plausibility of this pattern as the waning years of the century are shown to be a period of decided agricultural improvement. The full evidence on that has yet to be assembled. In the meantime, a striking finding of

this paper is that, despite one decade of slow productivity growth, the overall rise in agricultural output per worker was more rapid in the late nineteenth than in the early twentieth century. The first two decades of the twentieth century undoubtedly were a time of rapid expansion of agriculture, but they were primarily a time of growth of inputs. Intensive growth was less impressive. The rate of growth of output per worker slackened, and the expanding farm sector could not have been such a dramatic contributor to national per capital income growth.

With the rapid settlement of the Canadian west, a large addition was made to the agricultural workforce (35% in 20 years) and the amount of improved land was more than doubled. The increase in output was less spectacular, and gross output per worker increased by only 28% over the 1901–21 period—an annual rate of only 1.20%. To some extent the figures used here may understate the gain because they fail to take into account all of the capital accumulation in agriculture. The main point, though, may be a reminder that western settlement entailed substantial resource costs. It also meant that land and capital were being abandoned in eastern Canadian agriculture. Transferring labor from eastern Canada, leaving behind still usable physical assets, to work with low-yielding land in the west, may have had fairly limited benefits in the form of direct increases in per worker or per capita income. The net benefits of western settlement would have been even smaller if the attraction of the west tended to constrain supplies of capital to agriculture in eastern Canada.

14.4.3 Capital

The least satisfactory estimates provided in this paper are the following figures on capital. They are very tentative and should be treated with caution and viewed as little more than broad indications of likely magnitudes. Data for estimating the capital stock are very scanty. There are decennial census data on buildings and machinery from 1901 forward and on stocks of livestock for all census years. Some Ontario data on buildings and machinery go back to 1881. For nineteenth-century census years it is necessary to assume that the changes from decade to decade in buildings and machinery per farm followed the same time pattern as in Ontario.

Stocks of livestock made up between 55% and 65% of farm capital, as estimated here. That is about commensurate with Tostlebe's figures for the United States.[13] It is fortunate that the stock of livestock is such a large component of farm capital since that is the one element of the total that can be estimated with a reasonable degree of confidence. Numbers of each type of animal at each census date were valued at a fixed set of 1913 prices.

Buildings and machinery are measured much more dubiously. The starting point is 1901 and subsequent census measures of the values of

buildings and machinery, projected backward to earlier years on the basis of a variety of indicators. Machinery and equipment is a relatively small element of the total. Only the value of nonresidential farm buildings should be included in the farm capital estimates made here, since no inputed rent on farm dwellings is included in the measure of agricultural output. The problem is that we have only the sketchiest idea of the relative importance of residential and nonresidential farm buildings. Mainly from evidence on farm investment requirements, or "farm-making costs," we get an indication that residences comprised at least 60% of the value of farm buildings. That proportion has been used here throughout, although there are indications that it may be on the low side of Prairie farming where grain was the principal product.

The broad composition of farm capital and the constant 1913 dollar values of it at each census date are shown in table 14.7. These must be taken as only the roughest sort of indicators. The pattern of growth over time is rather smoother than for other inputs but that may be partly contrived as a consequence of the way the figures were estimated. One of the most difficult issues concerns the estimation of constant dollar values of the stock of capital at a time when prices are changing drastically. That situation is met acutely in 1921 when prices had risen greatly. The value of buildings and machinery reported in the census of 1921 must have entailed a considerable lag in the valuation of assets. Deflating by any conventional price index of currently produced goods would lead to a considerable understatement of the value of capital. The figures shown in table 14.7 are as much guesswork as anything. They can do little more than provide a starting point for analysis.

Capital input in Canadian agriculture seems to have been increasing quite rapidly, just as were other inputs. The average annual rate of increase, 1871–1921, was 2.95%. There was a lower rate in the 1871–1901 period, but in the first two decades of the twentieth century the annual rate of capital increase rose to 3.89%. That again is greater than the rate of growth of output.

Table 14.7   **Estimated Stocks of Farm Capital, Canada, Census Years 1871–1921 (Millions of Constant 1913 Dollars)**

Year	Machinery and Equipment	Nonresidential Buildings	Livestock	Total
1871	46	90	284	420
1881	54	120	354	528
1891	67	166	453	686
1901	93	214	535	842
1911	273	326	770	1369
1921	443	368	993	1804

14.4.4 Total Factor Productivity

In the foregoing sections of the paper the rates of growth of both outut and inputs have been examined. It would be attractive to bring these together to compare the weighted sum of factor input growth with output growth in order to infer how much advance in total factor productivity there may have been.

We might take advantage of the fact that, from the many aggregate production function models of economic growth we can derive a straightforward expression of the growth of output as a weighted sum of the growth of factor inputs, where the weights are factor shares in national income. This approach has become fairly standard in applied work on economic growth and productivity advance. The catch is that for Canada in this period we have no studies of the factoral disposition of national income. Hence we have no reliable way of weighting the component series of inputs.

One way of proceeding that may be instructive is to compare the rate of growth of output with weighted combinations of input growth in Canada assuming that the factor shares used as weights are the same as in the United States. The other assumptions made are standard— an agricultural production function that is linear homogeneous of the conventional Cobb-Douglas sort; land, labor, and capital recognized as the primary inputs into production with no direct account taken of purchased inputs. The latter were indeed minor through most of the period. Artificial fertilizers were little used in Canadian agriculture, and only after World War I did fuel purchases emerge as a significant item of farming costs. In Gallman's (1972) study of productivity change in United States agriculture in the nineteenth study a relatively high value is given to the share of labor in agricultural production.[14] Kendrick (1961, table B–1), focusing on the period at the very end of the nineteenth and beginning of the twentieth century, puts the share of labor quite a bit lower. Kendrick, however, combines land and capital inputs into a single series, whereas I have retained separate indexes of the growth of capital and land inputs. If the same rate of return were earned on farm capital as on improved land, we might then crudely divide Kendrick's "capital" share into shares of reproducible capital and improved land on the basis of the ratios of values of the stocks of those two components in 1901 and 1911 (averaging 0.39).

Whether or not the choice of factor weights makes much difference to the results depends upon the questions of interest. The two sets of estimates of output, input, and total factor productivity growth rates, are summarized in table 14.8. They might be thought of as representing two bounds to the most likely representation of the actual situation. Over the entire half-century under examination, the findings are the

Table 14.8   **Output, Input, and Productivity Growth, Canadian Agriculture, 1871–1921 (Average Annual % Growth)**

Years	Output Growth Rate	Accounted for by Input Growth	Total Factor Productivity Increase
	High (Gallman) Labor Share		
1871–1921	2.56	1.69	0.87
1871–1901	2.40	1.06	1.34
1901–21	2.77	2.33	0.44
	Low (Kendrick) Labor Share		
1871–1921	2.56	1.79	0.77
1871–1901	2.40	1.32	1.08
1901–21	2.77	2.68	0.09

same. The growth of agricultural output was primarily the result of conventional factor inputs, and the increase in total factor productivity was relatively modest: 0.87% per annum on average with the higher factor share of labor, 0.77% with the lower. Those rates of productivity advance in agriculture are very similar to the results obtained by Gallman for the United States over the second half of the nineteenth century. For the 1868–1919 period, an average rate of total factor productivity increase of 0.42% can be computed from Kendrick's estimates. That would seem to indicate that Canada continued to enjoy appreciable, if not really rapid, productivity advance in agriculture after the rate of productivity growth in United States agriculture had begun to taper off. It is less than clear whether one should expect much similarity between the experiences of Canadian and United States agriculture. It is too easy to think of the two countries as similar, forgetting that there are important differences. Corn, for example, played a much less prominent role in Canadian agriculture, and Canada has nothing comparable to the cotton sector of the United States agricultural economy.

The choice of factor weights makes a greater difference to the account one would give of early twentieth-century experience. If one looks at the 1901–21 subperiod, the growth of agricultural output is even more a matter of factor input growth. The rate of productivity advance dropped markedly. Using the higher (0.70) share for labor, the average annual rate of advance of total factor productivity is only 0.44% compared with a vigorous 1.34% over the last three decades of the nineteenth century. With the lower (0.57) share of labor, there is virtually no productivity growth at all (0.09%). Labor's share need only be as low as 0.55 to eliminate productivity growth altogether. Without more firmly based evidence on factor shares, there is no resolution of the issue. That the first two decades of the twentieth century might

have been a period when there was virtually no productivity growth in Canadian agriculture is far from implausible. In the United States over the same period, there appears to have been an actual decline in total factor productivity. Whether or not productivity growth in Canada had actually fallen to zero, it was almost certainly at quite a low rate. This was at a time when Canadian agriculture was undergoing a very rapid expansion and per capita income in Canada was increasing rapidly. The agricultural expansion is often supposed to have been at the heart of that per capita income growth. What the very low rates of productivity growth in agriculture suggest is that the farm sector as a whole cannot have made much of a direct contribution to Canadian per capita income growth in the first two decades of the twentieth century. Of course, per capita or per worker income growth need not in any relatively short period depend upon growth in total factor productivity. Output per worker can increase because the workforce gets more land and capital to cooperate with. That is in fact what was going on at the time. We have already seen in table 14.6, however, that gross value added per agricultural worker did not increase very rapidly between 1901 and 1921. We are left, then, with some serious questions about the direct contribution the agricultural sector could have made to Canadian per capita income growth in the period of the "Wheat Boom," the most glorified period of Canadian economic development. By contrast, the last three decades of the nineteenth century was a period of considerably greater productivity growth in agriculture. Even the lower of the two estimates puts total factor productivity advance at an average annual rate of more than 1%. In that period the agricultural sector would have made a proportionately much greater direct contribution to national per capita income growth. One implication of the productivity estimates made in this paper would be to redirect thinking about the nature and sources of economic growth in Canada.

Clearly, the quantitative record falls short of permitting a firm accounting of input, output, and productivity growth in Canadian agriculture. The weakest series—that for capital input—enters into the productivity calculation with only a small weight. There remain uncertainties about both the land and labor input series. Both might turn out to be quite sensitive to variations in the flow of factor services from generously measured stocks. A quality adjustment to the land input might reduce its rate of increase, although that point could be argued both ways. Land values cannot be used readily to indicate land quality so long as substantial amounts of land were available as free homesteads. The picture that seems to be visible behind the haze of data uncertainties is one of Canada opting for agricultural development in the form of large increases in factor inputs but with a relatively low rate of productivity growth.[15] The national picture may be concealing

important contrasts in regional patterns. To clarify the situation it will be important to expedite the development of regional output and input series. The calculations made in this paper, however, suggest a degree of caution in regarding the extension of agriculture into the Canadian west as a major contribution to per capita income growth in Canada.[16]

Appendix

Table 14.A.1   Composition of Final Agricultural Product Canada, 1870–71 to 1926–27 (Millions of Current Dollars)

Years	Total Product	Dairy Products	Other Animal Products	Wheat	Other Field Crops	Other Outputs
1870–71	139	24	60	22	17	16
1871–72	145	26	57	24	18	20
1872–73	144	24	59	26	16	19
74	145	29	58	25	17	16
75	154	39	53	20	22	20
76	147	33	53	24	21	16
77	141	33	50	26	15	17
78	147	36	48	24	18	21
79	136	30	41	26	21	18
80	162	30	50	37	24	21
1880–81	161	38	54	32	22	15
82	195	35	61	38	37	24
83	206	42	78	33	28	25
84	185	40	68	26	26	25
85	173	40	71	21	21	20
86	176	34	72	24	25	21
87	158	38	52	26	23	19
88	172	42	53	23	30	24
89	173	42	64	26	25	16
1889–90	181	42	66	25	24	24
91	189	48	65	27	22	27
92	193	54	63	34	22	20
93	193	57	66	25	21	24
94	170	60	44	21	21	24
95	177	55	62	19	19	22
96	170	50	58	30	15	17
97	162	51	54	23	16	18
98	193	54	60	36	18	25
99	197	58	70	26	18	25
1899–1900	214	64	75	31	19	25
1900–1901	217	68	82	28	18	21
02	255	67	96	37	27	28
03	295	74	116	45	29	31
04	279	74	96	39	32	38

Table 14.A.1   (continued)

Years	Total Product	Dairy Products	Other Animal Products	Wheat	Other Field Crops	Other Inputs
1900–05	291	71	115	49	26	30
06	319	86	112	56	28	37
07	329	87	125	54	29	34
08	368	92	122	70	42	42
09	353	98	110	77	35	33
1909–10	426	96	142	120	33	35
11	427	97	163	85	43	39
12	497	85	169	125	76	42
1912–13	515	101	187	121	70	36
14	565	95	217	137	73	43
15	539	98	220	128	56	37
16	753	115	213	299	80	46
17	850	134	256	281	128	51
18	1,014	148	308	377	122	59
19	995	176	361	275	108	75
20	1,034	200	328	291	131	84
1920–21	1,155	216	336	383	121	99
22	789	174	211	228	82	94
23	844	160	212	309	75	73
24	880	171	237	309	86	77
25	889	175	229	292	124	69
26	1,111	188	281	413	138	91
1926–27	1,035	187	273	387	117	71

Sources and procedures:
Dairy products
Cheese: Estimated as net exports plus a fixed allowance for domestic consumption of 3 pounds per capita. Prior to 1907 the exports are for the same fiscal year as the agricultural year identified in the aggregate output estimates. With the shift in the fiscal year in 1907 the estimates are changed to include the exports of the contemporaneous and the following fiscal years.
Butter: Census benchmark estimates of butter production are reconciled with export and import data for those years to obtain per capita estimates of "domestic disappearance" for those years. Annual levels of per capita consumption are then calculated by linear interpolation between census years and multiplied by population numbers to obtain an aggregate. Net exports are added to the national consumption estimates to get the quantity of national production. The total is valued at the wholesale price of butter less one cent per pound.
Fluid milk: Estimated by linear interpolation between census benchmark estimates of per capita consumption. The latter are fairly crude estimates derived from a reconciliation of estimates of butter and cheese production with plausbile levels of milk production per cow. Milk is valued at the farm price of butter converted into whole milk at a conventional rate of 23 pounds of milk to a pound of butter.
Other animal products
Cattle: Animal production is the sale or slaughter of cattle for consumption or export, adjusted for the change in farm inventories. Slaughter cattle are valued at higher prices than those being added to inventories. The stock of cattle is estimated for years from 1882 to 1921 by interpolating between decennial census benchmarks on the basis of annual provincial government reports for Alberta, Manitoba, and Ontario. Between 1871 and 1881 there are no annual reports for any province, and a smooth interpretation is

Table 14.A.1   (continued)

used. Production of cattle for export or slaughter is then estimated from the annual stock by the use of a ratio of production to stock derived from the annual reports for Ontario. Prior to 1891 there are no Ontario production reports, and annual production is based on interpolations between 1871, 1881, and 1891 census-based estimates of per capita consumption adjusted for net exports. One fortunate aspect of this procedure is that the 1871–81 decade is the period of the greatest relative importance of cattle exports; in some years they exceeded 25% of output.

Hogs: The estimating procedure is essentially the same as used for cattle.

Sheep and lambs: For 1871–91 the annual production is estimated as domestic consumption from figures for per capita consumption linearly interpolated between census benchmarks, adjusted annually for net exports.

For 1891–1921 the procedure is an elaboration of the foregoing. Annual estimates of "domestic disappearance" are first made in the same way as for the earlier period for both Canada as a whole and for Ontario. The ratio of sales and slaughter reported annually by the Ontario Bureau of Industries to the estimate for that province by smooth interpolation is then used to adjust the national, smoothly interpolated estimate.

For 1920–21 to 1926–27 the estimate is taken directly from the *Handbook of Agricultural Statistics* (Dominion Bureau of Statistics, various years).

Wool: For census years the quantities of wool produced on farms as reported in the censuses were valued at a farm price of wool projected backward from the 1920s on the time pattern of import unit values of raw wool.

Horses: Net agricultural production includes (1) exports of horses, (2) sales to the non-farm sector, and (3) additions to the farm stock of horses. Separate series were constructed for farm and nonfarm stocks of horses. These were both based on census enumerations. Annual estimates for the nonfarm stock and the farm stock in the 1871–81 decade were made by smooth, linear interpolation. For the farm stock after 1881, the census number of Ontario and povinces to the east were interpolated on the pattern of annual stocks in Ontario. For the western region provincial government reports on the stock of horses in Manitoba were the basis for annual interpolations. All horses were assumed to be produced in the farm sector. Sales to the nonfarm sector were calculated as 10% of the previous year's stock plus the change in the stock between years. Exports were taken directly from the annual *Trade and Navigation* reports of the Canadian government. Exports were far from trivial and in several years were the largest component of production. The change in the farm stock of horses was then added (algebraically) to the sum of the other two components of production.

From 1891 onward the annual "production" of horses was valued at the 1911 census unit value adjusted annually on the pattern of unit values reported by the *Ontario Bureau of Industries*. For years before 1891 the price series is extended backward by multiplying the export unit value by a 12-year average of the ratio of *Ontario Bureau of Industries* (OBI) prices to export unit values.

Poultry: Based largely on the stocks of chickens reported in the censuses. Ratios of sales and slaughter to stocks are based on Ontario provincial government reports from 1891 onward. Prior to 1891 a fixed ratio is applied. Estimated sales and slaughter of chickens are adjusted for annual changes in inventories. Chicken production is then valued at the 1911 census unit values of sales projected backward on the basis of an average of OBI and Montreal wholesale prices. Prior to 1889–90 there are no available data on chicken prices and the pattern of variation in egg prices is used. The value of chicken production is adjusted upwardly by the ratio of total poultry to chickens in 1901 and 1911 to take account of poultry other than chickens. The maximum amount of that adjustment is 18%.

Eggs: From 1901 onward census data on egg production are used, interpolated annually on the basis of OBI reports for the province of Ontario. From 1881 to 1901 production per hen at the 1901 ratio is used to estimate egg production. For the decade 1871–81 production is estimated at a constant 1881 per capita consumption figure, adjusted annually for net exports. Prices are 1901 and 1911 unit values extrapolated on the time pattern of an average of export unit values and wholesale prices.

Table 14.A.1   (continued)

Wheat

This was by far the single most important field crop. A reasonably reliable national estimate is available for the years from 1908–09 onward. That is from the Dominion Bureau of Statistics *Handbook of Agricultural Statistics*. For earlier years the estimate of production is based on a fixed figure of 5.5 bushels per capita for domestic consumption, aggregated into a national consumption figure through multiplying by an annual population estimate and then adjusting for net exports either as wheat or flour. No provision is made for changes in farm-held stocks of grain. These appear to have been minor amounts in the years before the wheat economy of the Prairie provinces rose to prominence. A weighted average of eastern and western wheat crops is based on Toronto and Winnipeg wholesale prices.

Other field crops

These include oats, barley, potatoes, hay, corn, rye, and flaxseed. The first four are by far the most important until after 1903 when western flaxseed became significant. Production of flax, net of a seed allowance, is taken directly from annual surveys of crop production made by the federal Census and Statistics Office. Off-farm sales of hay were estimated from calculated feeding requirements of stocks of off-farm animals. The procedure followed for other crops was to adjust net exports for estimates of domestic human consumption based on fixed per capita consumption allowances. For barley there are good records of quantities of barley used for malt. The single most important of this list of crops, and the most precariously estimated, is potatoes. For census dates the estimates amount to reported production adjusted by what were essentially guesses about the proportion of the crop that went to animal feed or was lost as spoilage.

Other outputs

In approximate order of importance these are: vegetables, apples, other fruit, maple syrup and sugar, grass and clover seed, tobacco, hops, honey, and flax fiber. These are all assumed to be final products of the farm sector. Census production data are used, valued at 1911 unit values extrapolated on wholesale price series and unit values of international trade. Vegetables constitued by far the largest single item and, like potatoes, is probably quite precariously estimated.

Table 14.A.2   Gross Value Added, Canadian Agriculture 1870–71 to 1926–27

Years	Final Agricultural Product		Implicit Price Deflator	Constant $ Purchases from Other Sectors	Gross Value Added in Agriculture (Constant 1913 $)
	Current	Constant			
1870–71	139	146	97	10	136
72	144	148	99	11	137
73	144	154	94	8	146
74	145	153	95	11	142
75	154	154	100	11	143
76	147	162	91	10	152
77	142	161	88	12	149
78	147	167	88	11	156
79	137	173	79	13	160
80	162	191	85	13	178
1880–81	160	190	84	12	178
82	194	202	96	14	188
83	206	210	98	15	195

Table 14.A.2   (continued)

Years	Final Agricultural Product		Implicit Price Deflator	Constant $ Purchases from Other Sectors	Gross Value Added in Agriculture (Constant 1913 $)
	Current	Constant			
84	185	189	98	15	174
85	174	207	84	15	192
86	166	210	79	15	195
87	158	205	77	17	188
88	180	214	84	18	196
89	171	201	85	16	185
90	181	229	79	18	211
1890–91	189	228	83	20	208
92	193	230	84	20	210
93	194	240	81	23	217
94	185	226	82	23	203
95	177	233	76	24	209
96	171	244	70	23	221
97	162	249	65	26	223
98	193	264	73	28	236
99	197	274	72	29	245
00	214	285	75	30	255
1900–01	217	293	74	27	266
02	255	327	78	32	295
03	294	359	82	35	324
04	279	321	87	33	288
05	293	349	84	33	316
06	319	367	87	34	333
07	330	379	87	37	342
08	369	373	99	36	337
09	353	360	98	36	324
1909–10	426	430	99	43	387
11	426	422	101	46	376
12	497	487	102	51	436
1912–13	514	514	100	52	462
14	564	553	102	63	490
15	538	476	113	60	416
16	752	621	121	65	556
17	852	539	158	61	478
18	1,014	539	188	43	496
19	995	513	194	49	464
20	1,033	474	218	59	415
1920–21	1,155	563	205	55	508
22	788	540	146	73	467
23	829	619	134	86	533
24	879	715	123	85	630
25	888	569	156	66	503
26	1,111	677	164	76	601
1926–27	1,035	651	159	83	568

(*continued*)

Table 14.A.2   (continued)

Sources and methods:

1. Current dollar estimates of final agricultural product are from table 14.A.1.

2. Constant dollar final product is based on the quantity series underlying table 14.A.1 with each commodity valued at fixed 1913 prices. Because the price series used in table 14.A.1 are often weaker in quality than the quantity series, the constant dollar figures are probably more reliable than the current dollar figures.

3. The implicit price deflator is directly calculated from the relationship between current and constant dollar estimates.

4. Purchases from other sectors include the following:

Mill feed. Over most of the period this was the largest single item. Available quantities of bran, shorts, and middlings were calculated from the series on flour production on the basis of 15.8 pounds of by-product per bushel of wheat milled. Exports were deducted and the remainder valued at export unit values for bran.

Blacksmith expenses. For 1870–71, 1880–81, and 1890–91 this was calculated as an estimated rural share of census-reported production or sales of blacksmiths. For 1900–1901 through 1920–21 it was the number of own-account blacksmiths by occupation multipled by an average wage rate for blacksmiths and marked up by a factor of 1.66.

Fertilizer. This was never an item of any real consequence in Canada. From 1891 and later it is census-reported production less exports plus imports. For earlier years only imports are included.

Binder twine. Introduced only in 1883, it was initially mostly imported. Domestic production of 1901 was projected backward on the time pattern of imports of undressed hemp and added to imports of twine.

Automobile and truck expenses. These are included only from 1904–5 forward. They were estimated by projecting backward the official estimate for 1926 on the trend in registered numbers of farm automobiles and trucks adjusted for changes in petroleum prices.

Tractor fuel. This is included only from 1907–8 onward. The procedure is the same as for automobiles and trucks.

Other expenses. This covers a variety of things including mainly bags, sacks, cooperage, and other containers. It is estimated as 4% of final agricultural product.

Current dollar estimates of farm expenses are deflated on an equally weighted index of prices of grain mill products and iron and steel products. This deflation procedure is very crude, but errors in it could make little difference to the final estimate of gross value added.

Notes

1. This fuller report is at present in preparation. An early, abbreviated version was presented as R. M. McInnis and M. C. Urquhart (1981).

2. This study being done by the author of the present paper is part of a project to produce an economic and social *Historical Atlas of Canada*. That project is also supported by the Social Science and Humanities Council of Canada.

3. An example of how a lean estimate of output may be compared with inputs where an appropriate adjustment is made on the input side is Lewis and McInnis (1980).

4. Gavin Wright, in his comment on this paper, rightly seizes upon the procedure here as rather chancey, as I also point out in the text. The issue boils down to a question of how serious is the problem. The whole issue is even more complicated than Wright suggests. The problem he points to concerns the appropriateness of the estimating procedure if the expansion were demand led, by rising world prices. Several points should be made in connection with this problem. One is that the whole picture is complicated by the multiplicity of commodities and variations in the historical experience with regard to each commodity. Market conditions varied a great deal for each commodity.

One might note that, generally, over much of the period under study, world prices were falling, not rising. It is relative prices that matter, however, and we do not have adequate data to be able to show that relative prices were in fact declining in the appropriate sense. Partly, the issue hinges on what is the appropriate way to model the expansion of an economy with strong export markets. Was it a matter of rising export demand, or mainly just a highly elastic foreign demand for Canadian agricultural products? A case could be made for the latter formulation. That in turn directs attention to whether demand should be conceived of as f.o.b. Canada or at the export market in Britain. Where much of the change involved concerns the wedge of transport and other transactions costs between the two markets, how much does the outcome depend on just how one chooses to set the problem up? Wright has certainly raised a valid point, but the answers are considerably more complex than he indicates.

5. These estimates of county net agricultural output have been prepared for the *Historical Atlas of Canada* project. Details have yet to be published. The methodology used, however, is similar to and builds upon that used for Quebec parishes in Lewis and McInnis (1980). Census data are used and the principles underlying the estimates are essentially the same, but the estimation is made at a low level of regional aggregation. When the county estimates for 1891, e.g., are aggregated across the country, they add up to a total that is only 4% short of the national total of the series being presented here.

6. In 1881 the improved land area of the regions added to Canada since the previous census amounted to a little less than 5% of the national total.

7. It should be pointed out that the new series merges quite smoothly with the officia Bureau of Statistics series in 1926.

8. Gavin Wright, in his comment on this paper, seems to think of unimproved farmland as essentially grazing land on which animal products were produced. In fact, wood lot and forest land was the predominant type of unimproved land. The products of that land have been excluded from the measure of output. The more serious concern is that the cooperating inputs, capital and labor, may have been used in production on unimproved land. For a fuller treatment of this problem, see Lewis and McInnis (1980).

9. The contraction of improved farmland between 1891 and 1901 was especially pronounced in Nova Scotia. The largest area was withdrawn in Ontario—almost 1 million acres—but that amounted only to 6.6% of the province's total area of improved land.

10. That is the procedure adopted in Lewis and McInnis (1980).

11. Female contributions to farm output consisted very largely of those products which have not been counted in the measure of output used here. The main exception would be the value added in butter making.

12. The substantial rise of the productivity in the 1870s probably reflects a recovery from the aftermath of the Civil War. The sudden and sharp rise in the 1890s shows up dramatically in Kendrick (1961, chart 18, p. 176).

13. See Tostlebe (1957). To make the comparison suggested it is necessary to make a rough and rather arbitrary separation in Tostlebe's figures of farm residences from other farm buildings.

14. See also Gallman (1975) on this point.

15. What I am arguing here, as Wright emphasizes in his comment, is that under some circumstances the growth of aggregate output and increasing productivity can be substitutes. The economy may benefit from the growth of a sector regardless of which source of growth predominates. The Canadian experience exemplifies the point that in some circumstances, at some points in time, output may grow rapidly for reasons that detract from productivity growth. On the other hand, productivity may be rising substantially in periods when resources are being shifted out of an industry, and hence net output grows relatively slowly.

16. The comment on this paper by Gavin Wright seems to me to give an impression of rather more disagreement between myself and him than is probably the case. Wright reminds readers that there is a broader context of Canadian economic development within which the agricultural change I have examined is set. In my presentation I have perhaps taken too much of that for granted. The prevailing interpretation of that development emphasizes a leading role for agricultural exports in fostering Canadian economic growth during what is popularly referred to as the "wheat boom era." My paper is considerably less than a full-blown commentary on the export boom based on western Canadian wheat. It is not the case, however, that the main conclusions reported here are at variance with the popular "staples" interpretation of the role of wheat in Canadian economic development. I show that one part of the direct contribution of agricultural expansion to overall economic development was quite modest. Agricultural expansion in Canada in the wheat boom era was not associated with big gains in total factor productivity. I am sure that comes as no great surprise to historians of Canadian economic development, but it is probably worth trying to determine the actual magnitudes. It has long been recognized that if there were big gains attributable to the wheat staple, they must have been in the indirect effects. It is well enough to reiterate that, but we can also recognize that there remains much to be done in putting numbers to those indirect effects. I have to agree, then, with at least part of what Wright has raised. It mostly concerns issues that I did not think I had space to pursue.

There remains an element of disagreement. Wright worries that I may have neglected a possibly important direct contribution to growth originating on the demand side. To the extent that there was an important shift in the terms of trade in favor of agricultural products, it would have to be acknowledged that a gain accrued to Canadian agriculture. Two issues remain unresolved. One concerns the construction of the terms-of-trade index given by Wright, the other is an empirical question of just how much gain in the terms of trade really did occur. On the first matter, Wright relates the implicit price deflator for agricultural output from my table 14.A.2 to a readily available index of import prices. Both, however, are current weighted indexes, and the resulting ratio reflects changes in the composition of the commodity weights as well as price changes. Indeed, we know that there were major changes in the commodity mixes in both indexes. Second, there is the matter of whether world demand for agricultural products increased in such a way as to produce the extent of improvement in the terms of trade that Wright suggests. I remain doubtful. The largest amount of the upward movement in the terms of trade depicted by Wright came in the second decade of the twentieth century, largely in connection with World War I. Moreover, the shift was mostly a result of a relative decline in import prices. The index used by Wright gives more a portrayal of what was happening to the prices of iron and steel and their products than of Canadian agricultural exports.

Admittedly, we do not yet have an adequate account of what really happened to Canada in the early years of the twentieth century. I am probably less content even than Gavin Wright with the state of what we think we know about this episode of economic development. The full story, though, is a lot more complicated than either my paper or Wright's comment might suggest.

Comment   Gavin Wright

Marvin McInnis presents to us a new set of aggregate output and input measures for Canadian agriculture, for the 55 years prior to 1926 when the official Bureau of Statistics series begins. The research is part of the larger project directed by M. C. Urquhart on Canadian national income statistics. In this specialized study, however, McInnis goes on to develop indices of partial and total factor productivity, offering new evidence on the contribution of agriculture to Canadian growth and inviting comparison with the United States experience as portrayed by earlier work using similar methods. In this comment I review briefly the highlights of McInnis's techniques and conclusions, raise some questions about the measurement, and then discuss the interpretation of the figures.

Summary

The information underlying the new annual production series is primarily foreign trade data. The strategy is to convert exports into production by adding estimates of domestic consumption for each major commodity, on-farm consumption included. The output concept is gross value added, gross of depreciation but net of farm products used within the agricultural sector and inputs from other sectors. The output measure is a substantial improvement over that of Firestone, which applied a fixed adjustment coefficient to the aggregate total of all agricultural outputs (including intermediates), thus missing a significant type of structural change. Since McInnis constructs both a current price aggregate (based on separate price series for each commodity) and a constant price aggregate (1913 price relatives), his efforts also generate an implicit price index for agricultural products.

The coverage of this output measure is much more limited than those used in the United States studies. It omits forest products, household manufactures, and the increase in land value attributable to improvement (e.g., clearing). The input measures are correspondingly narrowed, using improved acreage rather than total occupied farmland, and omitting female workers on the grounds that most of their production has also been excluded. Census year estimates of the agricultural workforce involve a substantial effort to correct inconsistencies in census categories, though McInnis fears there may still be an upward bias in the earlier years. Estimates of farm capital are scrappy and tentative, but it still may be that the broad output and productivity history does not depend crucially on precision in measuring the capital input.

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The output picture which emerges (fig. 14.1) shows a plateau from 1883 to 1895, with the most rapid spurt coming in the first decade of the twentieth century. The McInnis series revises the Firestone estimates of growth between 1910 and 1920 *upward* by a factor of more than two. What McInnis presents as a "striking finding" of his paper, however, is not this output growth but the fact that labor productivity growth was more rapid in the late nineteenth century than in the early twentieth century. Turning to total factor productivity estimates (table 14.8), he finds that the falloff in growth was even more dramatic, from rates greater than 1% per year (1870–1900) to a ratio between 0.09% and 0.44% per year, 1900–1920. Total factor productivity accounts for almost half of output growth during the first period, a trivial share (between 3% and 15%) of output growth in the second period. These figures serve, according to McInnis, as "a reminder that western settlement entailed substantial resource costs." He concludes: "We are left, then, with some serious questions about the direct contribution the agricultural sector could have made to Canadian per capita income growth in the period of the 'Wheat Boom,' the most glorified period of Canadian economic development."

Aspects of the Estimates

The McInnis estimates are a significant new resource for students of Canadian and American agricultural history. The output measure clearly is preferable to Firestone's. McInnis expresses surprise that the gap between the new series and Firestone's remains wide even in 1911, but in fact this gap tracks closely the changing share of field crops in final agricultural product—precisely the structural change missed by Firestone. The share of field crops *declined* between 1880 and 1900, and was barely higher in 1911 than in 1871 (table 14.2). As Ankli (1980) has recently stressed, the big rise in wheat comes after 1910. The share of purchased inputs in gross value added has a different impact. It drifts up very gradually from 7%–8% in the 1870s to 11% in 1920–21, jumping sharply to 13%–15% in the 1920s (table 14.A.2). Both adjustments show the inappropriateness of applying structural coefficients from the interwar years to earlier periods.

The productivity estimates are also valuable, but here (as with all such figures) they should be used only with full awareness of their origins and characteristics. The adoption of a "lean" measure of agricultural output may be matched by "lean" measures of farm inputs, but a change in definitions like this is often not neutral with respect to total factor productivity. In this case, the measures becloud one of the true sources of rising efficiency, improved allocation of factors among types of production (Gallman 1975, p. 40). The change from "unimproved" to "improved" acreage status is really a transition from low-

intensity to higher-intensity land use. The range cattle industry may not have had a giant share in total output, but this sort of shift may be a large part of overall efficiency growth in an era where the growth of factors generally predominated. If both inputs and outputs are restricted, this effect is missed. But if labor is measured grossly as men on farms, and no account is taken of the changing allocation of labor time between unimproved and improved acres, the effect is a mismeasurement of the main input, a much more serious bias in the other direction. This consideration may go a long way toward explaining the high rate of total factor productivity growth before 1900, to me the most remarkable finding in the paper.

It is also possible that the use of an export basis for estimating farm production neglects some inputs into food processing. Cheese, for example, was produced for export by hundreds of cheese factories which bought milk from farmers (Bogue 1947, pp. 164–66). Butter was in transition from a home industry for women to a factory basis during the 1870s (Lawr 1972, p. 249). The number of these factories grew rapidly in the late nineteenth century, and the share of dairy products in final agricultural product grew correspondingly, reaching a peak in precisely the census year 1900–1901 (table 14.A.1). The share of dairying declined after 1900, and the number of cheese factories and butter creameries in particular declined sharply, as they were outbid for the milk supply by the fresh milk trade, the condensed milk industry, and the rising ice cream market. This consideration may also contribute to the rise and subsequent decline in total factor productivity growth between the two periods.

The use of export data plus domestic consumption estimates raises a broader methodological issue. The passage of the text which describes the estimation procedure also describes a market process, but a peculiar one in which "relatively stable domestic consumption demands took precedence and . . . exports were catered to out of left-over supply." As a devotee of the safety-first model, I can hardly object to this characterization of a farm household's behavior with respect to its own consumption, but can this specification be extended to the level of a whole country, producing for domestic *buyers* as well as on-farm consumption? Especially a country which textbooks describe as one for which "the prices of many traded goods were established internationally" (Marr and Paterson 1980, p. 4)? I think it is unreasonable to do so as a specification of market dynamics, but estimation procedures do not have to map market dynamics. The question is, how does this procedure allocate measurement error? If we take the simplest model, in which domestic demand and supply have normal slopes but price is determined exogenously, we can reach the following conclusions: (1) So long as output increases because of *shifts of the supply curve* (either

factor growth or productivity change), McInnis's procedure is exactly right. The rise in output will go entirely into exports, and domestic consumption will be unaffected; estimation of production should focus on the variable item in demand (exports), which fortunately happens also to be the best-measured component. (2) But if output rises because of a rise in the world price, domestic consumption will decline and exports will overstate the growth. The effect will depend on the elasticity of domestic demand, which may be greater for a commodity like meat, for which there are cheaper substitutes in the diet. It does not necessarily mean that the McInnis figures will be fundamentally misdirected over long periods, because he adjusts the consumption estimates at each census year. But the census year benchmarks thus acquire strategic importance for the output series as well as the input series, for reasons that may well be transitory.

Aspects of Interpretation

I very much doubt whether any of the foregoing considerations would alter the overall contours of the evidence, given the basic conceptual framework. But do these figures justify the conclusion questioning the contribution of agriculture to per capita income growth during the wheat boom? The basic framework focuses on the supply side, and as the preceding paragraph points out, supply-side assumptions are built into the estimation procedure itself. But the wheat boom period has a demand side as well. McInnis gives it little emphasis, but as a by-product of his research he has produced a new price index, which may be used to follow the course of agricultural terms of trade. Using Taylor's import price index (Urquhart and Buckley 1965, pp. 300, 302) as the denominator (the quickest way to get a price series not heavily influenced by Canadian farm prices), I obtain the following:

1871–75	70	1891–95	85	1911–15	96
1876–80	75	1896–1900	82	1916–20	97
1881–85	81	1901–1905	80	1921–25	95
1886–90	81	1906–10	85		

These figures seem to indicate that secular terms-of-trade improvement is part of the basic experience of Canadian agriculture before World War I, as it is for United States agriculture. But the years 1911–20 were characterized by extraordinary terms of trade, 20% higher than 1896–1905. Translated into growth rates, the effect adds 0.84 percentage points per year to productivity growth.

I do not see why this fact should be neglected. Demand-generated earnings are no less a part of income to those that receive them than supply-generated earnings. They may be consumed or invested in the same way. There seems to be an implicit view that our concerns are

with long-run factors, and economic growth is a supply-side phenomenon in the long run, demand effects being transitory. But if we take that view, then we should not apply these tools to evaluating performances of relatively short periods, "glorified" in large part because of beneficient demand conditions. And for a small open economy producing specialized resource-intensive goods, demand elements will always be a fact of life, and the effects may not be transitory over long epochs.

But the supply-side interpretation should be questioned as well. In recent years there has been a lively debate among Canadian economic historians dealing with this very question, how to measure the effects of the wheat boom on per capita income (Chambers and Gordon 1966; Caves 1971; Bertram 1973; Lewis 1975). Many of the effects discussed would not be reflected in *agricultural* total factor productivity, even if the expansion originated in agriculture: induced domestic savings, induced capital inflow, scale economies in manufacturing, and the increase in the percentage of the population which is of working age, for examples. Marvin McInnis, of course, never set out to measure all of the indirect effects of the wheat boom, and it would hardly be fair to criticize him for not doing so. But the discussion raises the question whether the rise in agricultural factors is a measure of "resource costs" involved in the expansion.

For a country with a vast reserve of land unutilized because it is "outside the feasible region," the expansion of acreage under cultivation is not a good measure of resource costs. Depending as it did on breakthroughs in farming techniques and transportation, the expansion is in a sense a measure of the economy's achievement, not its costs (Caves 1965; Marr and Percy 1980, p. 352; Lewis 1981). The fact that land was being abandoned in the east is neither here nor there; it is evident that western lands and eastern lands were not homogeneous. The rise in western land values, which is omitted from the output index, was quite large, large enough presumably to motivate the adventure for many farmers (Bertram 1973). The expansion of farm capital is harder to be certain about, but much of this may also have been induced (internally or externally) by the very process of expansion under discussion. The main point is that we cannot get quick answers to these questions from total factor productivity, and we should not try.

By far the larger share of nineteenth-century productivity growth in United States agriculture (and indeed for the entire economy) was factor growth rather than total factor productivity (Gallman 1971, 1975; Abramovitz and David 1973), and in many ways the Canadian wheat boom expansion may be viewed as a continuation of the same process. By the straightforward standard of labor productivity, Canada gains steadily on the United States from 1890 onward (table 14.6). The slow-

down in productivity growth after 1900 is extremely modest (from 1.46% to 1.20%) and would be an increase rather than a decrease if terms-of-trade effects were added. The *levels* of total factor productivity in the two countries may not be at all meaningful, but the 30-year trend in relative output per worker is not easily dismissed. For both countries, there is broad plausibility in the idea that factor expansion and productivity growth have a relationship of substitution; what is most interesting about the Canadian pattern is that an earlier period of high total-factor-productivity growth gives way to a new wave of resource growth, suggesting that there really was a breakthrough and a rejuvenation of Canadian agriculture after 1900. To me, these figures show that the wheat boom era amply deserves its glorification.

References

Abramovitz, Moses, and David, Paul. 1973. Reinterpreting economic growth. *American Economic Review* 63:428–39.

Ankli, Robert E. 1980. The growth of the Canadian economy, 1896–1920. *Explorations in Economic History* 17:251–74.

Bertram, G. W. 1973. The relevance of the wheat boom in Canadian economic growth. *Canadian Journal of Economics* 6:545–66.

Bogue, Allan. 1947. The progress of the cattle industry in Ontario during the eighteen-eighties. *Agricultural History* 21:163–69.

Britnell, G. E. 1939. *The wheat economy.* Toronto: University of Toronto Press.

Canada. Dominion Bureau of Statistics. Various years. *Handbook of agricultural statistics.* Ottawa: Queen's Printer.

Caves, Richard. 1965. Models of trade and growth. In *Trade growth and the balance of payments,* ed. R. E. Baldwin et al. Chicago: Rand-McNally.

———. 1971. Export-led growth and the new economic history. In *Trade, balance of payments and growth,* ed. J. Bhagwati et al. Amsterdam: North-Holland.

Chambers, E. J., and Gordon, Donald F. 1966. Primary products and economic growth. *Journal of Political Economy* 27:315–32.

Clark, Andrew H. 1959. *Three centuries and the Island: A historical geography of settlement and agriculture in Prince Edward Island.* Toronto: University of Toronto Press.

Coates, R. W. 1910. *Wholesale prices in Canada, 1890–1910.* Ottawa: King's Printer.

Firestone, O. J. 1958. *Canada's economic development, 1867–1952.* London: Bowes & Bowes.

Fowke, Vernon C. 1946. *Canadian agricultural policy: The historical pattern.* Toronto: University of Toronto Press.

Gallman, R. E. 1972. Changes in total U.S. agricultural factor productivity in the 19th century. *Agricultural History* 46:191–210.

———. 1975. The agricultural sector and the pace of economic growth: U.S. experience in the nineteenth century. In *Essays in nineteenth century economic history,* ed. David C. Klingaman and Richard K. Vedder. Athens: Ohio University Press.

Jones, Robert Leslie. 1942. French-Canadian agriculture in the St. Lawrence Valley. *Agricultural History* 16:137–48.

———. 1945. The agricultural development of Lower Canada, 1850–1867. *Agricultural History* 19:212–24.

———. 1946. *The history of agriculture in Ontario, 1613–1880.* Toronto: University of Toronto Press.

Kendrick, John W. 1961. *Productivity trends in the United States.* Princeton: Princeton University Press.

Lawr, D. A. 1972. The development of Ontario farming, 1870–1914. *Ontario History* 64:239–51.

Lewis, Frank. 1975. The Canadian wheat boom and per capita income: New estimates. *Journal of Political Economy* 83:1249–57.

———. 1981. Farm settlement on the Canadian prairies, 1898 to 1911. *Journal of Economic History* 41:517–86.

Lewis, Frank, and McInnis, Marvin. 1980. The efficiency of the French-Canadian farmer, in the nineteenth century. *Journal of Economic History* 40:497–514.

McInnis, R. M., and Urquhart, M. C. 1981. The net output of Canadian agriculture, 1870–1926. Paper presented to the Eleventh Conference on Quantitative Methods in Canadian Economic History, Queen's University, 27–28 February 1981, Kingston, Canada. Mimeographed.

Mackintosh, W. A. 1935. *Economic problems of the Prairie Provinces.* Toronto.

Marr, William L., and Paterson, Donald G. 1980. Canada: An economic history. Toronto: Macmillan of Canada.

Morton, Arthur S., and Martin, Chester M. 1938. *History of prairie settlement and "dominion lands policy."* Toronto.

Ouellet, Fernand. 1966. *Histoire économique et sociale du Quebec, 1760–1850.* Montreal: Fides.

———. 1980. *Lower Canada, 1791–1840.* Toronto: McClelland & Stewart.

Sequin, Maurice. 1970. *La "Nation canadienne" et l'agriculture.* Trois-Rivières: Editions Boreal Express.

Taylor, K. W., and Michell, H. 1931. *Statistical contributions to Canadian economic history.* Vol. 2. Toronto: Macmillan.

Tostlebe, Alvin W. 1957. *Capital in agriculture: Its formation and financing since 1870.* Princeton: Princeton University Press (for the National Bureau of Economic Research).

Towne, Marvin W., and Rasmussen, Wayne D. 1960. Farm gross product and gross investment in the nineteenth century. In *Trends in the American economy in the nineteenth century.* Studies in Income and Wealth, vol. 24. Princeton: Princeton University Press (for the National Bureau of Economic Research).

Urquhart, M. C., and Buckley, K. A. H. 1965. *Historical statistics of Canada.* Toronto: Macmillan of Canada.