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Farm Household Incomes and Reforming the CAP

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At the time when the future of agricultural policy is again debated in many developed countries and new directions are examined, it is fundamental to assess to what extent low and unstable farm income prevails in contemporary agriculture and identify which factors determine incomes of farm households. In the 20th century, low and unstable farm income has historically been used to rationalise public support to farming in developed countries. However, an accumulation of evidence during the 1970s and 1980s discussed by Gardner (1992) dismisses the prevalence of a low-income problem among farmers in the United States (US) since the second half of the 1960s. Less evidence is available for other developed countries. Scattered national statistics collected by EUROSTAT (2002) between 1972 and 1999 suggest that farm households have on average income close or higher than other households in most of the 15 member states of the European Union (EU) during that period. An OECD (2003, p. 3) study also confirms that, "in most OECD member countries, farm households enjoy, on average, income levels that are close to those in the rest of the society."

To what extent income distribution and poverty incidence differ between the farm households and non-farm households are also relevant research questions for gearing future policy. In that respect Gardner (2000) reports that both income inequality and poverty continue to fall among US farm families during the 1970s, 1980s and 1990s to the point that the poverty rate for farm households falls below the poverty rate for non-farm households in the late 1980s. Another OECD (2001) study, however, concludes that income inequality and low-income incidence and intensity are greater among farm households than among other households in most of the 14 OECD member countries for which data are available from the middle of 1980s to the middle of 1990s. The study warns that these findings may, however, be affected by underestimating farm household incomes because incomes in-kind and asset values are not accounted for and incomes from self-employment, including from farming, may be under-reported in household income surveys.

Plausible causes of the prevalence of low farm incomes in the US until the early 1960s have been proposed in the literature on the farm problem. The review of these causes by Gardner (1992) distinguishes three complementary frameworks of possible explanations. The first framework corresponds to the basic farm problem model that focuses on the commodity market conditions. The second framework, instead, examines the factor market conditions to explain an earning disequilibrium between the farm and non-farm sectors. The third framework considers the compensating differential for skill differences and non-pecuniary aspects of farming to explain low farm relative to non-farm earnings. To understand growth in incomes of farm households relative to non-farm households that prevailed in the US since the 1940s, Gardner (2000) focuses on adjustments in the labour market with increasing economic integration between the farm and the non-farm sectors, in particular migration off farms and non-farm sources of income for households remaining on farms. He finds that labour-market integration is by far the predominant factor in the improvement of economic condition of low-income farm households between 1960 and 1980 in the US, not specifically agricultural variables such as government payments, agricultural productivity growth or farm-size growth.

Assessing the extent of low farm income is fraught with many measurement and accounting difficulties. Low farm income has generally been evaluated by comparing the average income of farm households to the average income of non-farm households at the country level using a combination of individual farm account data, household income survey data and sector-level aggregated income data. When income comparisons do exist, for example, from the U.S. Department of Agriculture (USDA, 2008), EUROSTAT (1999 and 2002) and OECD (1999 and 2003), they are sensitive to the sources of information, the methods of estimation and the definitions of incomes and farm households versus non-farm households that are used. Because sources, methods and definitions can also differ when estimating farm and non-farm household incomes and comparing their ratios across years and countries, analyses of income comparisons across years and countries are flawed and generalisations on the extent and origin of income differences impossible to make. These difficulties may also explain why factors identified in the economic literature, for example in Gardner (1992), which may result in low farm incomes have never been tested systematically across different years and countries using empirical data. The conclusion of the OECD (2003, p. 33) study acknowledges “the absence of adequate information on the income situation of farm

households" for properly designing and implementing income policies that are still prominent in most OECD countries.

This paper has the ambition to fill this gap by using meaningful income comparisons between farm and non-farm households for eleven developed countries over a period covering the last 30 years. The first section of this paper compares the average income levels of farm households to those of non-farm households by using the same harmonized data set for years and countries for which data are available and applying consistently the same definitions of household categories across the eleven selected countries over the 30-year period. The second section compares indicators of poverty and income distribution between farm households and non-farm households. The third section econometrically tests factors that may explain the disparity of incomes between farm and non-farm households across ten of the eleven countries over the last 25 years. This is the first time that such systematic comparative and explanatory study is proposed in the literature.

1. Comparisons of farm and non-farm household income levels

Both the comparative and econometric analyses use the microeconomic dataset from the *Luxembourg Income Study* (LIS). This dataset contains socio-demographic, expenditure and income data that are collected at the household level through national household-based budget surveys. These data are recorded in the LIS dataset in a harmonized way for the 30 countries that currently participate in the LIS. Using this microeconomic dataset that is harmonized across households, years and countries has the great advantage that the same source of information for household incomes and characteristics is used making comparisons across household categories, years and countries meaningful. Compared to macroeconomic or sector data, household data also allows the examination of the incidence of low income.

In this paper, average income levels as well as indicators of income distribution are calculated for farm and non-farm households for developed countries that have at least three waves of data survey in the LIS dataset. Furthermore, the income averages are calculated for survey waves that contain a minimum of 30 identified farm households to limit the risk that sampling errors affect the statistical results. Applying these selection criteria, 59 waves of data survey covering eleven developed countries are used for the comparisons of income levels.

Table 1 reports the eleven countries, the LIS databases and the survey waves that are used for the comparative and econometric analyses. The eleven selected countries include Australia, Canada, Finland, France, Germany, Ireland, Italy, Luxembourg, Norway, the United Kingdom (UK) and the United States (US). Canada and the US have the longest time series available spanning from the late 1960 to early 2000. Luxembourg has the shortest time series available from 1985 to 1994. After the middle of 1990s, national household-based budget surveys from many European countries (for example, France, Germany, Ireland, Italy and the United Kingdom) have ceased to separate incomes from farm self-employment and other self-employment.

Table 1 also gives the sample sizes according to household categories and the proportions of farm households in the household samples. In this paper, the distinction between farm and non-farm households is made according to the source of the household's net disposable incomes. A distinction is made between a 'broad' definition of a farm household in which the household's farm self-employment income is not null and a 'narrow' definition of a farm household in which the household's farm self-employment income is greater than half of its factor incomes. When the 'broad' definition of a farm household is used, then a counterpart 'narrow' definition of a non-farm household is that of a household whose farm self-employment income is null.[1] Similarly, when the 'narrow' definition of a farm household is used, then a counterpart 'broad' definition of a non-farm household is that of a household whose farm self-employment income is lower than halve of its factor incomes. The definition of these household categories follows the same definition used in the OECD (2001) report that has evaluated the incidence of low income among farm households compared to other households for 17 OECD countries using also the LIS dataset but for survey waves between the middles of 1980s and 1990s. As in this OECD (2001) report, the net disposable income of a household is adjusted to account for its size using an equivalence elasticity of 0.55 (see Förster, 1994). The farm self-employment income corresponds to the profit from the

[1] For income comparisons between farm and non-farm households, a 'narrow' definition of a non-farm household would be that of a household whose farm self-employment income is null but non-farm self-employment is greater than half of its factor incomes and a 'broad' definition of a non-farm household would be that of a household whose farm self-employment income is lower than half of its factor incomes but non-farm self-employment is not null. Katchova (2008) compares the economic well-being of farm and non-farm households in the US for 2004 and finds that average incomes are not significantly different when they are compared between commercial farms and entrepreneurial non-farm households but they are significantly different when they are compared between entrepreneurial and non-entrepreneurial non-farm households.

unincorporated enterprise in the agricultural sector and is recorded gross of social insurance contributions but net of expenses.

For these countries and waves, Figures 1 and 2 show the ratios of the net disposable income (DPI) of farm households narrowly defined to the DPI of non-farm households for years and countries that are selected. For Australia, Canada and the US, farm household income ratios reported from 1969 to 2004 in Figure 1 fluctuate between 60 and 160 per cent around the income parity level of 100 per cent. For the US, fluctuations of this ratio around the income parity level in the 1970s and 1980s reflect the boom and the bust of farming during that period. For Australia and Canada, the fall in the farm household income ratio in the 1990s and the early 2000s fellows a period during which the ratio was close to or higher than the income parity level of 100 per cent. These new series of farm household income ratios support the conclusion already reached in Gardner (1992) for the US that farm household incomes in these three countries are not chronically low on average.[2]

For European countries, farm household income ratios reported from 1973 to 2004 in Figure 2 are generally close to or higher than the income parity level of 100 per cent. For six of the eight European countries, there is a noticeable trend of increase in the farm household income ratios during the observed period. These farm household income ratios fluctuate less than those recorded in Australia, Canada and the US. Although the series of farm household income ratios stop short after the middle of 1990s for several European countries, they show that farm household incomes in all these eight European countries have definitively ceased to be low on average since the late 1980s.[3]

[2] Large discrepancies exist between this new series of US farm household income ratios reported here and the series reported by USDA and used in Gardner (1992). They result from the use of different sources of information and definitions of households and incomes. For example, USDA uses a broad definition of a farm household that includes all households in which one member is an operator associated with a farm business that has a minimum annual sale of USD 1,000 of agricultural products. This definition applies to some 2,050,000 US farms in 2004 and 2005.

[3] Differences in information sources and household definitions prevent the comparisons of these new series of farm household income ratios reported here for eight European countries with those reported in EUROSTAT (2001). Both series, however, confirm that average incomes of farm households are higher than those of non-farm households for most of the European countries and years.

Table 1. Unweighted sample size in the LIS by definition

			Sample size					Sample size (% to all hh)	
				Non-farm households		Farm households		Farm households	
Country	**LIS Database**	**Wave**	**All hh**	**Narrow def. (a)**	**Broad def. (b)**	**Broad def. (c)**	**Narrow def. (d)**	**Broad def. (c)**	**Narrow def. (d)**
Australia	AU81H	1981	17021	16804	16897	217	124	1.27	0.73
	AU89H	1989	16331	15967	16083	364	248	2.23	1.52
	AU95H	1995	6819	6667	6737	152	82	2.23	1.20
	AU01H	2001	6786	6657	6703	129	83	1.90	1.22
	AU03H	2003	10210	10044	10113	166	97	1.63	0.95
Canada	CA71H	1971	25927	24243	25007	1684	920	6.50	3.55
	CA75H	1975	26569	25102	25707	1467	862	5.52	3.24
	CA81H	1981	15136	14064	14605	1072	531	7.08	3.51
	CA87H	1987	11960	11249	11345	711	315	5.94	2.63
	CA91H	1991	21647	20639	21258	1008	389	4.66	1.80
	CA94H	1994	40849	39414	40276	1435	573	3.51	1.40
	CA97H	1997	33843	32555	33299	1288	544	3.81	1.61
	CA98H	1998	31218	29865	30749	1353	469	4.33	1.50
	CA00H	2000	28970	27647	28557	1323	413	4.57	1.43
Finland	FI87H	1987	11863	8836	10517	3027	1346	25.52	11.35
	FI91H	1991	11749	9058	10828	2691	921	22.90	7.84
	FI95H	1995	9262	7392	8414	1870	848	20.19	9.16
	FI00H	2000	10423	7742	9301	2681	1122	25.72	10.76
	FI04H	2004	11229	8696	10362	2533	867	22.56	7.72
France	FR79	1979	11044	10132	10432	912	612	8.26	5.54
	FR84BH	1984	11977	11391	11478	586	499	4.89	4.17
	FR89H	1989	9038	8524	8630	514	408	5.69	4.51
	FR94H	1994	11294	10999	11089	295	205	2.61	1.82
Germany (e)	DE73H	1973	46770	45177	45661	1593	1109	3.41	2.37
	DE78H	1978	46068	44751	45194	1317	874	2.86	1.90
	DE83H	1983	42752	41449	42068	1303	684	3.05	1.60
	DE84H	1984	5194	5136	5157	58	37	1.12	0.71
	DE89H	1989	4411	4350	4376	61	35	1.38	0.79
	DE94H	1994	6379	6332	6349	47	30	0.74	0.47
Ireland	IE87H	1987	3294	2629	2899	665	395	20.19	11.99
	IE94H	1994	3192	2755	2856	437	336	13.69	10.53
	IE95H	1995	2830	2458	2540	372	290	13.14	10.25
	IE96H	1996	2644	2297	2385	347	259	13.12	9.80
Italy	IT87H	1987	8027	7861	7898	166	129	2.07	1.61
	IT89H	1989	8274	8088	8142	186	132	2.25	1.60
	IT91H	1991	8188	8031	8070	157	118	1.92	1.44
	IT93H	1993	8089	7969	8004	120	85	1.48	1.05
	IT95H	1995	8135	7986	8044	149	91	1.83	1.12
Luxembourg	LU85H	1985	2049	1971	1990	78	59	3.81	2.88
	LU91H	1991	1957	1888	1909	69	48	3.53	2.45
	LU94H	1994	1813	1752	1771	61	42	3.36	2.32
Norway	NO79H	1979	10414	9713	10080	701	334	6.73	3.21
	NO86H	1986	4975	4542	4830	433	145	8.70	2.91
	NO91H	1991	8073	6331	7433	1742	640	21.58	7.93
	NO95H	1995	10127	9236	9810	891	317	8.80	3.13
	NO00H	2000	12919	11849	12596	1070	323	8.28	2.50
UK	UK79H	1979	6777	6702	6717	75	60	1.11	0.89
	UK86H	1986	7178	7115	7130	63	48	0.88	0.67
	UK91H	1991	7056	6997	7020	59	36	0.84	0.51
	UK95H	1995	6797	6742	6755	55	42	0.81	0.62
USA	US69H (f)	1969	11978	10710	11313	1268	665	10.59	5.55
	US74H	1974	12328	11100	11698	1228	630	9.96	5.11
	US79H	1979	15928	15463	15690	465	238	2.92	1.49
	US86H	1986	12600	12348	12500	252	100	2.00	0.79
	US91H	1991	59038	57933	58608	1105	430	1.87	0.73
	US94H	1994	66014	64446	65628	1568	386	2.38	0.58
	US97H	1997	50320	49269	50040	1051	280	2.09	0.56
	US00H	2000	49633	48503	49392	1130	241	2.28	0.49
	US04H	2004	76447	74553	76074	1894	373	2.48	0.49
Sum	59	59	1029833	980119	1007014	49714	22519	4.83	2.19

Source: The LIS database

(a) Incomes from farm-self-employment are null.

(b) Incomes from farm self-employment are lower than 50% of incomes from all sources.

(c) Incomes from farm-self-employment are not null.

(d) Incomes from farm self-employment are greater than 50% of incomes from all sources.

(e) Datasets earlier than 1994 refer to the former 'West-Germany' only; datasets after 1994 refer to the unified West- and East-Germany.

(f) Farm household sample sizes are calculated on the basis of gross income, not disposable personnel income as in the other countries and waves.

When the broad definition of a farm household is used, the income picture (not showed here) slightly changes. For Australia, Canada and the US, the farm household income ratios are higher and more stable than those calculated on the basis of a narrow definition of a farm household. For the US, the farm household income ratios are consistently above the income parity level of 100 per cent for the thirty years of observations while, for Canada, the ratios are also above the income parity level of 100 per cent except for two years of observations.

For the selected European countries, the farm household income ratios are slightly higher for three of the eight countries. A more diversified source of incomes out of farming indeed tends to stabilise and increase the farm household incomes for a total of six countries out of the eleven that are surveyed. That on average farm household incomes are not chronically low is even more evident for these eleven developed countries when a broad definition of farm households is considered. The farm income problem no longer exists in the eleven developed countries for which data of farm household incomes are available.

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Figure 1. Ratio of average DPI of farm households (narrow definition) to non-farm households (%) in Australia, Canada and USA

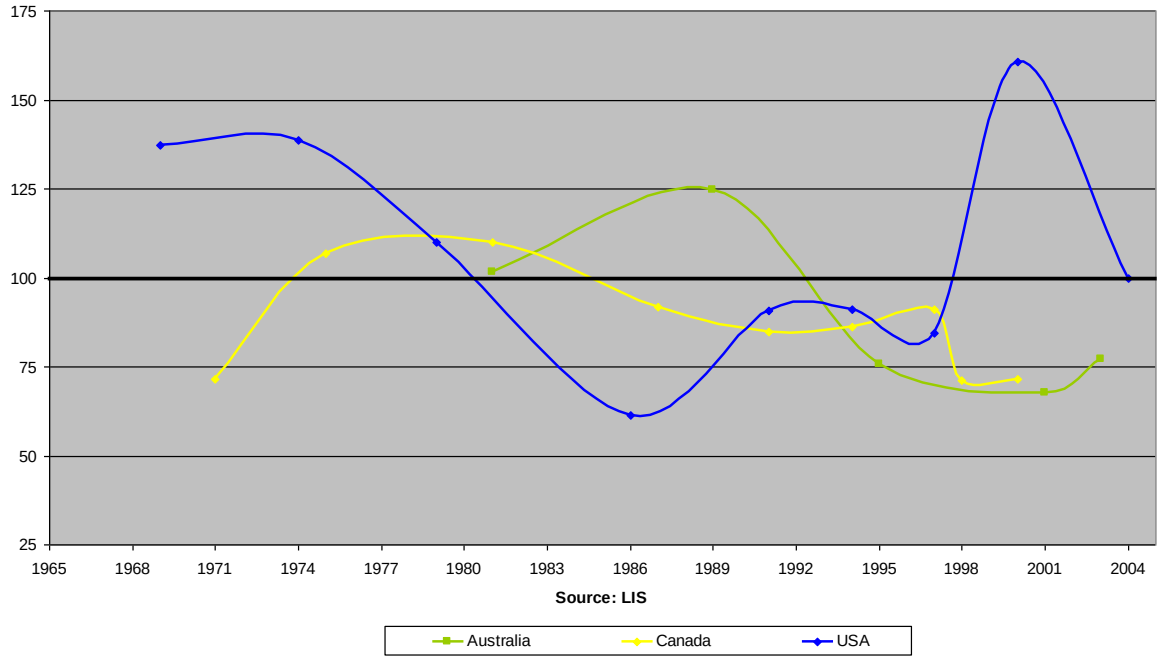
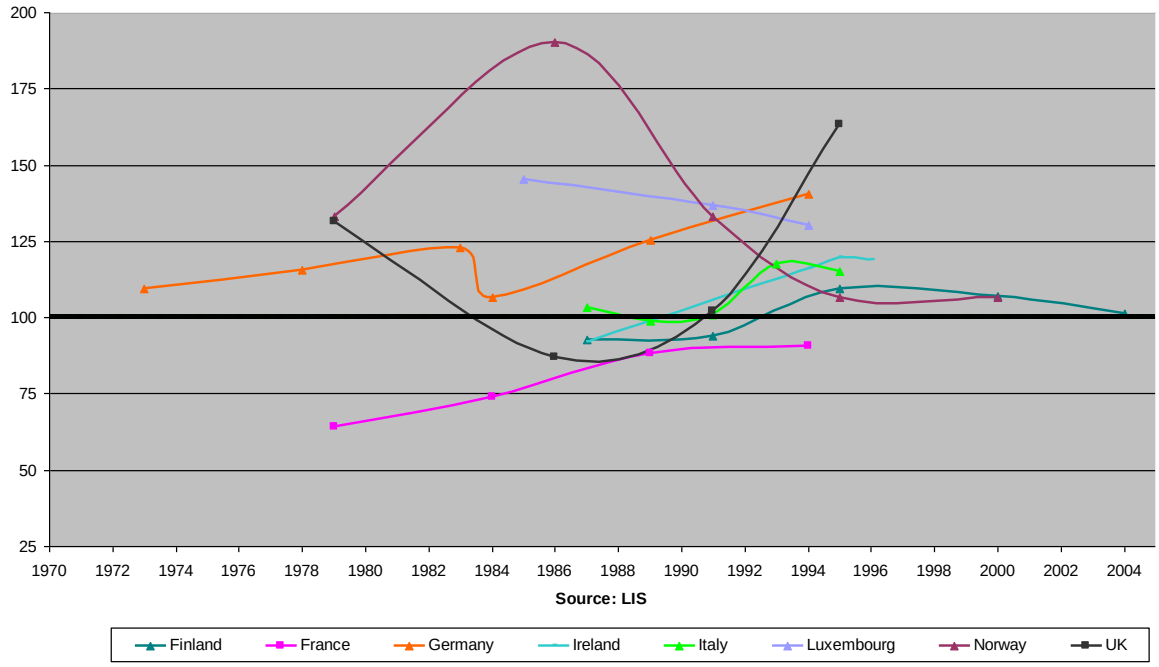


Figure 2. Ratio of average DPI of farm households (narrow definition) to non-farm households (%) in selected European countries



2. Comparisons of farm and non-farm household income distributions

The distribution of farm household incomes is now compared to the distribution of non-farm household incomes using the narrow definition of a farm household and its counterpart definition of a non-farm household. Four indicators of income distribution are calculated for each household category, wave and country. They include the low income rate, the low income gap, the Gini income distribution index and the Sen index. As in the OECD (2001) report, the low income is defined as being 50 per cent of the median income of all households in the sample, so that the situation of the low income farm household is assessed relative to all households of the country in a particular year. This relative approach to the definition of low incomes facilitates cross-country comparisons. The first two indicators of income distribution are calculated from survey waves that contain a minimum of 30 identified farm households that are below the low income to limit the risk of sampling errors. This threshold restricts the analysis of the relative income distribution to five countries: Canada, Finland, France, Germany and the US. The ratios of one particular indicator for farm households to the same indicator but for non-farm households are then calculated and compared through the available observed period across countries.

Figure 3 shows the ratios of the low income rate (LIR) for farm households narrowly defined to the LIR for non-farm households across years for the five countries. The LIR measures the cumulative proportion of households within the population below the low income. It is a measure of the incidence of low income. Except for Germany during the 1973-83 observed period, the US in 1974 and Finland in 2000, the incidence of low income is much higher among farm households than non-farm households. The farms to non-farm LIR ratios, however, vary widely across countries and years making difficult to discern a pattern. These ratios fluctuate between 100 and 170 per cent for the US and 150 and 250 per cent for Canada during the 30-year period. In contrast to what Gardner (1992) reports, this new series of ratios of farm to non-farm poverty rates for the US indicates that the farm poverty rate has not converged and fallen under the non-farm poverty rate during the last three decades. Except for Germany before the middle of the 1980s, the proportion of low income households is also much higher among farm households than non-farm households in the other two European countries. France has a particularly higher proportion of low income households among farm households than non-farm households between 1979 and 1994. Even when the average incomes of farm households are close to or higher their parity level, the incidence of low

income tends to be higher among farm households than non-farm households except for Germany.

Figure 4 shows the ratios of the low income gap (LIG) for farm households narrowly defined to the LIG for non-farm households for the same five countries. The LIG measures the difference between the average income of the low income households and the low income as a percentage of the low income. It is a measure of the intensity of low income. Except for Germany during the 1973-83 observed period, France in 1984 and 1989 and Finland in 2000, the intensity of poverty is much higher among farm households than non-farm households. Even when the average incomes of farm households are close to or higher their parity level, the intensity of low income tends to be higher among farm households than non-farm households except for Germany and, to a lesser extent, Finland and France.

Figures 5 and 6 show the ratios of the Gini income concentration index of farm households narrowly defined to the same Gini index of non-farm households. Here the income distribution analysis is extended to survey waves that contain a minimum of 30 identified farm households that are narrowly defined. Incomes are generally less equally distributed among farm households than non-farm households except for Germany during the observed 1973-83 period and Norway and the UK since 1991. Otherwise the Gini indexes are up to about 40 per cent higher for farm households than non-farm households suggesting a higher inequality in the distribution of farm household incomes than non-farm household incomes.

Figure 3. Ratio of low income rate of farm households (narrow definition) to non-farm households (%) in selected OECD countries

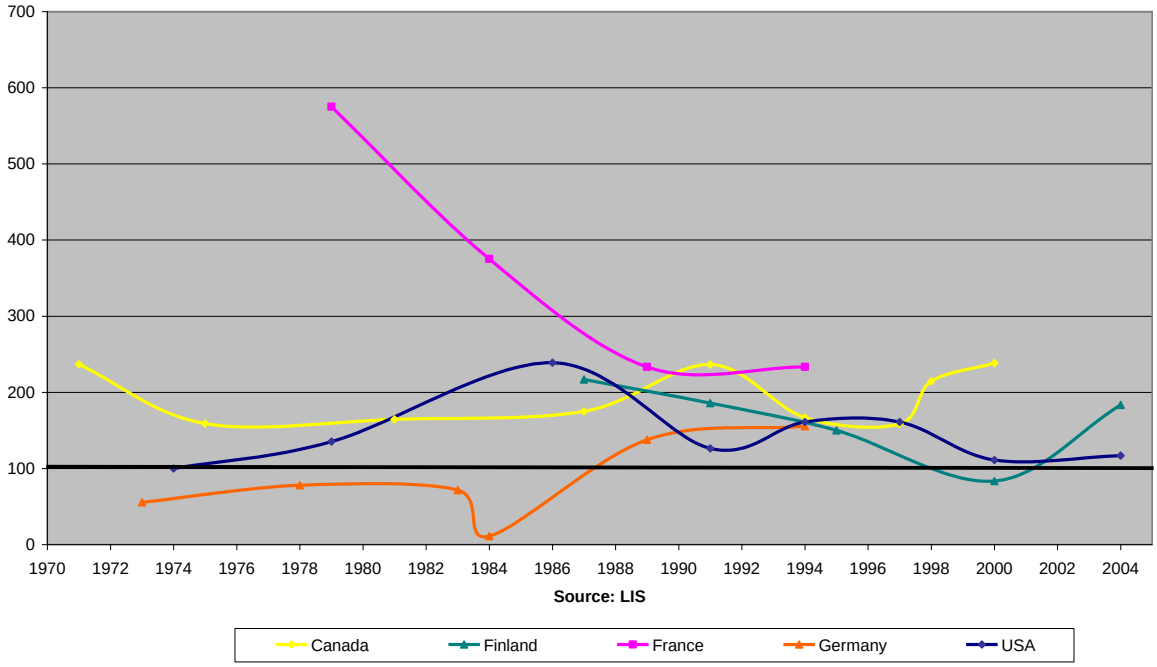


Figure 4. Ratio of low income gap of farm households (narrow definition) to non-farm households (%) in selected OECD countries

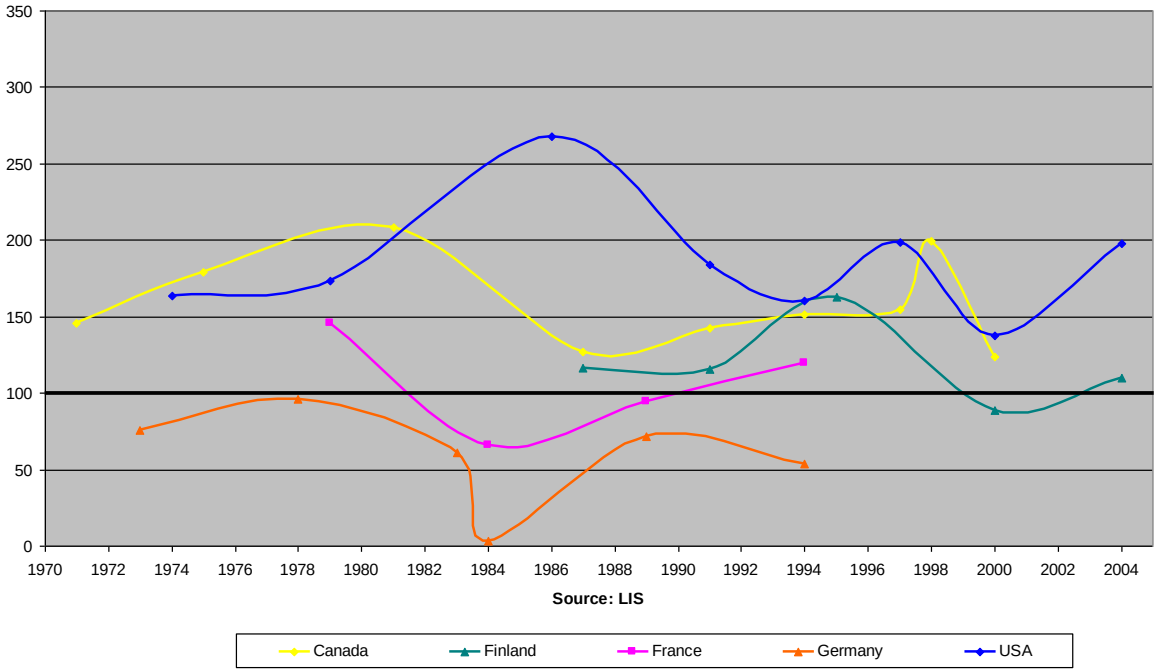


Figure 5. Ratio of the Gini index of farm households (narrow definition) to non-farm households (%) in Australia, Canada and USA

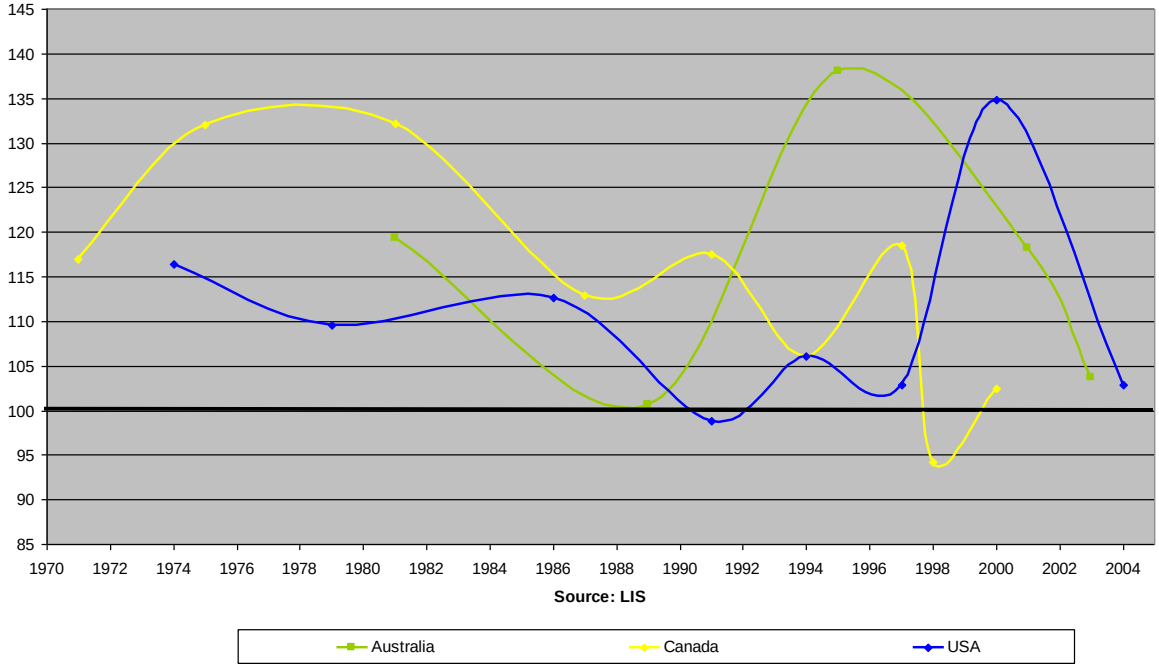


Figure 6. Ratio of the Gini index of farm households (narrow definition) to non-farm households (%) in selected European countries

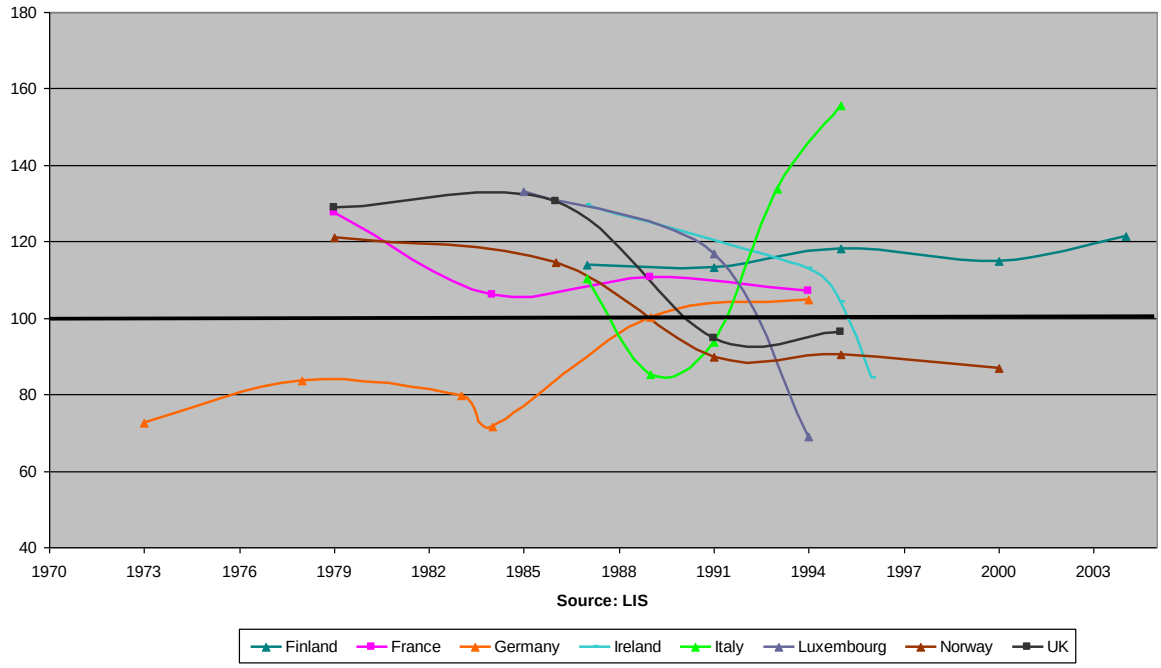
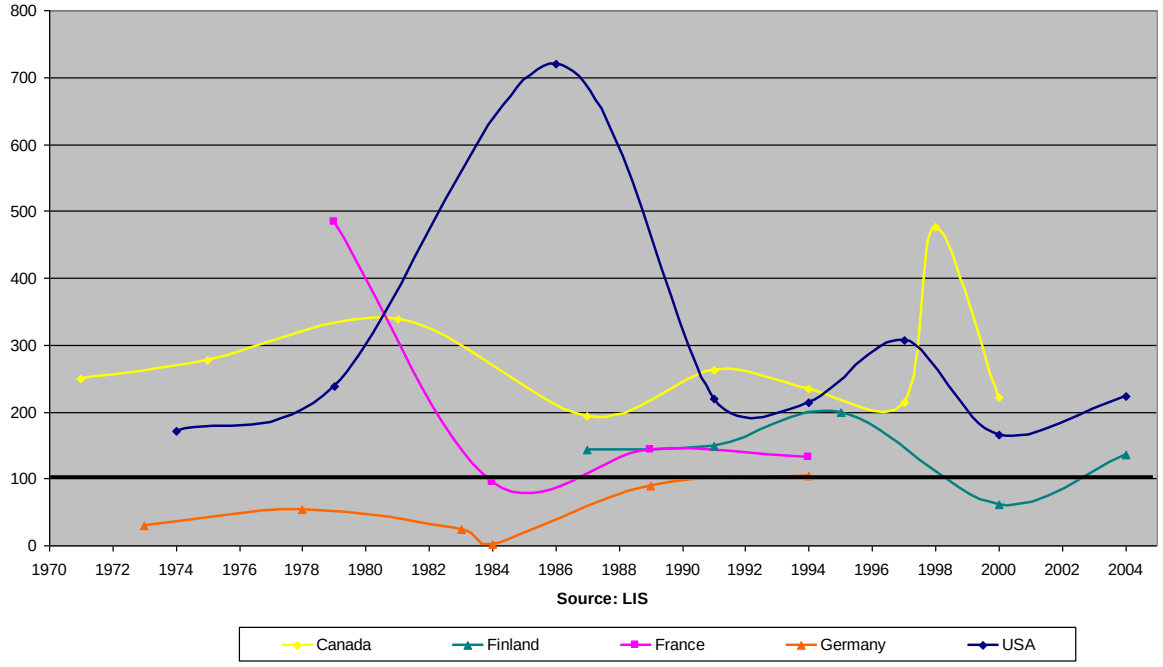


Figure 7 shows the ratios of the Sen index of farm households narrowly defined to the Sen index of non-farm households. The Sen index combines the LIR, the LIG and the Gini index of the low income households into a single indicator of poverty.[4] It is a synthetic measure of poverty (Sen, 1976). Here the income distribution analysis is scaled down to survey waves that contain a minimum of 30 identified farm households that are below the low income to limit the risk of sampling errors. The Sen index is lower among farm households than non-farm households in Germany during the observed 1973-83 period. The Sen index is generally higher among farm households than non-farm households in the other two European countries but much higher in Canada and the US. In sum, all indicators of income distributions show that, except for Germany between 1973 and 1983, the incidence and the intensity of low income as well as the disparity of income distribution are often much higher among farm households than non-farm households for the developed countries for which data of farm household incomes are available. These comparisons of income distributions between farm households and non-farm households confirm the conclusion reached in the OECD (2001) report. The incidence of low income and the disparity in incomes are most often higher among farm households than among non-farm households in the same country.

Figure 7. Ratio of the Sen index of farm households (narrow definition) to non-farm households (%) in selected OECD countries



[4] The Sen index S is defined as follows: $S = LIR\,[LIG + (1-LIG)\,G_p]$ where LIR is the low income rate, LIG the low income gap and G_p the Gini income concentration index among the low income population.

3. Testing factors explaining income disparity between farm and non-farm households

From the literature review of Gardner (1992), it is possible to distinguish three sets of plausible reasons for low income of farm households. First, low and unstable farm income is explained by a supply-demand model of aggregate commodities. The essential features of the model include very inelastic demand and supply of agricultural products, a faster growth rate of supply than demand and small transitory shocks of output or demand (Schultz, 1945; Cochrane 1958; Hathaway, 1964; Tweeten, 1971). The economic consequences of this basic model are declining and volatile farm prices and low incomes of farm people. This commodity-based supply-demand model prevails in the 1940s and 1950s to explain the farm income problem and remained classic among agricultural economists until the 1980s. According to Gardner (1992), no econometric work has, however, established commodity price trends as the cause of farm income trends.

It became evident that low farm incomes relative to non-farm incomes should not be primarily a matter of relative farm and non-farm commodity prices, but rather of factor market conditions that only a general equilibrium approach can incorporate. Consequently, chronically low farm income is, here, explained by the persistence of a disequilibrium between the farm and non-farm labour markets that keeps farm people with lower incomes in the farm sector (Johnson, 1959). To explain a lack of factor mobility and consequently low farm incomes, two approaches are investigated. The first approach considers factor-market disequilibrium as a short-run phenomenon attributable to adjustments costs in labour movement, in particular job search and moving expenses. These adjustment costs result in a short-term income differential when the demand for farm labour declines as a result of labour-saving technical change, even when similar skills are involved. The second approach considers that long-run income differences are a matter of skill and age differences, non-pecuniary preferences for farming, income measurement problems, or other non-comparabilities between farm and non-farm people (Johnson, 1963). This second approach actually constitutes an application to labour of the neoclassical view that emphasizes fixities and irreversibilities in agricultural investment (Gardner, 1992): farm-specific skills are less valuable off the farm and shifting employment is costly. Both approaches would also imply that the farm labour force tends to become older as the demand for farm labour declines. The earning disequilibrium between the farm and non-farm sectors constitutes the second set of

plausible reasons for low farm income. According to Gardner (1992), no empirical work has been able to test either the short or the long-run explanation of the earning disequilibrium.

However, empirical evidence has rendered it doubtful that income differences are still a matter of disequilibrium between the farm and non-farm labour markets in the US. In advanced well-integrated economies, income differences are more likely a compensating differential for skill differences or non-wage aspects of the two employments. This constitutes the third set of plausible reasons for low farm income. Johnson (1953) has tested this hypothesis but he could not attribute at that time the full difference of real labour returns between the average farm and non-farm workers to just the differences in income-earning capacity as a result of age, sex, and skill differences. That the income difference was substantially larger than what these differences in income-earning capacity can be accountable for has actually motivated the hypothesis of a disequilibrium between the farm and non-farm labour markets.

Using that theoretical background and empirical data, Gardner (2002) proposes and discusses leading plausible causes of growth in incomes that farm households have experienced in the US since 1950. These causes include agricultural productivity growth, saving and investment by farm people, expanding export markets, adjustment to disequilibrium via out-migration of labour, off-farm work opportunities for farm people in a growing general economy and improved skills of farm people. He adds that these causes may themselves result from more fundamental developments in research and extension, improved rural infrastructure, marketing services and rural schooling, lower costs of inputs and services, government subsidies and support and economic growth in the non-farm economy. It is, however, not certain how some of these causes such as technological progress and the resulting agricultural productivity increases may actually have contributed in the long run to farm income growth. Although empirical evidence suggests a close correspondence between growths in productivity and farm income in the US, some other causal factors listed above need to be considered as explanations for farm income growth.

Using an expanded error-correction model with US state data as well as US county data to test determinants of the annual rate of state-level as well as county-level median incomes of farm households between 1950 and 1990, Gardner (2002) shows that farm household income growth has little relationship from farming or its determinants such as farm productivity,

government programs, or investment in agriculture but, rather, from adjustment in labour markets, with off-farm migration and off-farm work by farm household members being the main mechanism of adjustment. Four hypothetical factors have received sustained attention to explain in particular growth in farm household incomes: (1) the development and diffusion of new agricultural technology, (2) the expansion and commercialisation of agricultural commodity markets, (3) the integration of farm people into the growing non-farm economy after 1945, and (4) government policies including regulatory institutions, public investment in infrastructure and commodity programs. Gardner (2002) concludes that evidence points firmly in the direction of the third hypothesis, the integration of farm and non-farm economies, to explain rising incomes of farm households in the US since 1945.

We now investigate to what extent factors that this literature review has revealed to explain convergence of incomes between farm and non-farm households in the US since 1950 also apply for the ten developed countries for which income data are available over the last three decades. We are particularly interested in testing whether the commodity market conditions, the government subsidies, the labour market conditions, the skill differences as well as the long term interest rates and agricultural productivity growth could explain the fluctuations and trends in farm household income ratios that are observed for these ten developed countries.

Commodity market conditions that can be favourable to farm household incomes are traced through the agricultural terms of trade. The agricultural terms of trade are calculated as the ratio of the deflated price indexes of agricultural products and means of agricultural production. These indexes are taken from national statistics (Australian Bureau of Agricultural and Resource Economics, Canada Statistics, Finland Statistics, National Agricultural Statistics Service of the USDA and Norway Statistics) for the non-EU countries and EUROSTAT for the EU member states.

Because farm household incomes can also depend on government subsidies, we also test whether subsidies allocated to farm direct payments and general agricultural services affect their incomes relative to those of non-farm households. Subsidies for farm direct payments and general agricultural services are taken from OECD. Subsidies for farm direct payments are expressed in percentage of the total value of agricultural production at farm gate and direct payments; subsidies for general agricultural services in percentage of the total value of agricultural production at farm gate only. The OECD reports subsidies for farm direct

payments and general agricultural services for the EU as a whole, not by EU member state. Since 1986, it, however, specifies the output, the area, the animal and the input on which subsidies for farm direct payments are based. To calculate subsidies for farm direct payments by EU member state, each EU specific subsidy of farm direct payments is disaggregated by EU member state by applying the member's share in the EU corresponding output, area, animal number or input from EUROSTAT. The member's specific subsidies are then aggregated at the member level and, then, expressed in percentage of the member's total value of agricultural production at farm gate and direct payments.[5]

The labour market conditions that may facilitate labour mobility between the farm and non-farm sectors and, hence, reduce the earning disequilibrium between the farm and non-farm labour markets are uneasy to translate in measurable variables. In the short run, higher unemployment in the general economy is expected to increase adjustment costs in labour movement, in particular job search, as a result of fewer off-farm job opportunities. Greater economic growth is expected to affect relatively less the incomes of the farm working population because of longer adjustment lags to economic opportunities in farming than in other occupational activities. Greater economic growth is also expected to be centred on urbanized areas and, hence, affect rural areas last. A higher population density in rural areas may be a factor that would reduce off-farm job search and commuting or eventually moving expenses in rural areas. In the long run, a lower education and a greater age are expected to make employment shifting less attractive.

The annual standardised unemployment rates are taken from OECD. The growth rates of real GDP per capita at 2000 constant prices (chain series) are taken from the Penn world table of Heston *et al.* (2006). To reflect the unemployment and the economic growth of the country that have accumulated until a particular year to have an effect on the farm to non-farm household income ratio, five-year averages of the annual unemployment rates and annual growth rates of real GDP per capita that precede that year are also used. As a crude indicator of population density in rural areas, population densities given by United Nations Data Demographic Statistics at the country level are used.

[5] The disaggregation of EU subsidies for farm direct payments by EU member state from 1986 to 2004 is available from the authors.

Higher long term real interest rate is a macroeconomic event that may affect farm household incomes by increasing debt services and generating financial hardships that can eventually lead to farm business failures such as during the US farm crisis in the middle of 1980s. Long term interest rates and producer prices for manufacturing are taken from OECD to obtain the long term real interest rates. Technological progress has been found to reduce the demand for labour in farming but should not affect in the long run the earnings of people employed in farming. Differences in labour earnings should rather depend on people's time spent on working and their managerial and entrepreneurial capabilities and efforts in taking advantage of innovations (Gardner, 2002). The relative growth of total factor productivity (TFP) in the EU member states and the US is taken from Ball *et al*. (2007).[6] Assuming constant returns to scale, TFP in these countries can be measured as the ratio of an inter-country index of input prices to an inter-country index of output prices for the 1973-93 period and coincides to the more traditional direct measure of TFP, i.e., the ratio of an index of output quantities to an index of input quantities. Inputs include labour, land, capital and intermediate inputs.

Income-earning capacity as a result of skill and age differences can also be captured by education level and age differences. Following the international standard classification of education from UNESCO (1999), three educational levels are distinguished using the highest attained level of education. The low education level corresponds to the primary and lower secondary education or any other formal education until the minimum age of 16 years. The medium education level corresponds to the upper secondary general and vocational education or any other formal education from the minimum age of 17 until the maximum age of 20 years. The high education level corresponds to the university and specialized vocational education or any other formal education from the minimum age of 21 years. For each education level, a ratio of the percentage of household heads having reached that education level among the farm households to the percentage of household heads having reached that same education level but among the non-farm households is calculated per country and survey year from the LIS databases. A ratio of the average age of the heads of farm households to the average age of the heads of non-farm households is also calculated per country and survey year from the LIS databases.

[6] TFP growth is unavailable for Australia, Canada, Finland, Luxembourg and Norway. TFP growth from Sweden is applied to Finland and Norway and TFP growth from Belgium to Luxembourg.

An error components model, estimated by instrumental variable (*IV*) using generalized Hausman-Taylor instruments as described in Wyhowski (1994), is used to test whether above variables can explain the ratio of the average income of farm households narrowly defined to the average income of non-farm households across the ten developed countries over the 25-year period. Whereas Hausman and Taylor (1981) construct two instruments, $x_{i\bullet} = T^{-1}\sum_t x_{it}$ and $(x_{it} - x_{i\bullet})$, for every variable x_{it} that varies freely over time *t* and country *i*, Wyhowski (1994) constructs three instruments: $(x_{i\bullet} - x_{\bullet\bullet})$, $(x_{\bullet t} - x_{\bullet\bullet})$, and $(x_{it} - x_{i\bullet} - x_{\bullet t} + x_{\bullet\bullet})$. This decomposition allows the isolation of any possible correlation between error components and regressors in case of a two-way error components model (Wyhowski, 1994). Given that the observations are not evenly spaced in time and given the size of our dataset, even the simplest dynamic specification becomes prohibitively complicated. However, an error-correction model to account for adjustments towards a long-run equilibrium of farm and non-farm household incomes would have been preferable over the static specification we use.

We test instrument exogeneity by the Lagrange multiplier (LM) or score test as described by Magdalinos (1988). It has been proposed by Hausman (1983) as an overidentification restriction test. On this LM statistic we base a downward sequential testing procedure which consistently results in the correct vector of instruments, under the conditions stated in Andrews (1999). The actual algorithm that is used for instrument selection not only makes use of the LM-statistic, but also of the individual t-statistics of an auxiliary regression of the residuals on the excluded instruments. This dual testing makes use of information on the likely source of the misspecification. It can be argued in close analogy to Chatelain (2007), that tests on individual instruments have greater local power compared to the overall LM test and that a sequence of tests with greater local power improves the moment selection procedure with respect to a sequence of tests with less local power. Finally, we also test instrument relevance, i.e., weak instruments, by means of Shea's (1997) "partial R^2" measure for each endogenous regressor, corrected for degrees of freedom.

Table 2 shows two series of similar econometric results whether unemployment rate and growth in GDP per capita are measured at the current year or over the preceding five years. All the variables are expressed in natural logarithm to have directly their elasticity, except the long term real interest rate because it is negative for four observations. Since our sample is extremely small, we chose 0.3 as cut-off *p*-value in our downward sequential testing

procedure, both for the overall LM-statistic and for the individual *t*-statistics, which seems very conservative. As a result, over-identifying restrictions tests on the final choice of instruments have a *p*-value above mentioned cut-off value. Shea's (1997) "partial R^2" (not reported in table 2) lies above 0.64 for the regression using contemporaneous unemployment rate and GDP growth. It is higher than 0.60 when unemployment rate and GDP growth are measured as five year averages. It is thus safe to assert that a weak instrument situation does not apply to our regressions.

Table 2. IV estimation of the ratio of average farm household income to average non-farm household income

Independent variable (in ln)	**Coeff.**	**s.e.**	**P>|t|**	**Coeff.**	**s.e.**	**P>|t|**
Agricultural terms of trade	0.32	0.36	0.39	0.44	0.39	0.26
Farm direct payments support	0.12	0.04	0.01	0.15	0.04	0.00
General agricultural services support	-0.16	0.07	0.03	-0.15	0.08	0.07
Standardised unemployment rate	-0.48	0.13	0.00			
Standardised unemployment rate (5-year average)				-0.47	0.16	0.01
Growth in GDP per capita	-0.82	0.30	0.01			
Growth in GDP per capita (5-year average)				-0.85	0.29	0.01
Population density	-0.01	0.03	0.82	-0.03	0.03	0.33
Long term real interest rate	-0.02	0.01	0.05	-0.02	0.01	0.03
Low education ratio	-0.41	0.20	0.04	-0.41	0.23	0.08
High education ratio	0.10	0.06	0.14	0.13	0.08	0.11
Age ratio	-0.76	0.52	0.15	-0.53	0.48	0.28
Constant	19.22	3.67	0.00	18.08	3.77	0.00
Number of observations		46			46	
F-test of regression	**F(10,35)**		**P>F**	**F(10,35)**		**P > F**
	9.65		0.00	8.96		0.00
LM-test of over-identifying restrictions	**X^2(10)**		**P>X^2**	**X^2(10)**		**P>X^2**
	8.16		0.32	4.52		0.61

In line with previous econometric work for US households, the market conditions that are here encapsulated into the agricultural terms of trade play no significant role in explaining income differences between farm and non-farm households. In contrast, government programs such as farm direct payments and general agricultural services are significant at one per cent for both models. The positive association between these direct payments and the farm household income ratio does not come as a surprise. These farm direct payments are relatively recent for the EU member states included into the econometric analysis and are not yet fully capitalised into the farm fixed assets such as farmland. Instead, the negative association between subsidies for general agricultural services and the farm household income ratio that is significant at less than five per cent in the first model and ten per cent in the second model does come as a surprise. The largest part of these subsidies is actually used for

public stockholding in the EU until 1993 and for marketing and promotion in the other countries included into the econometric analysis during the whole recorded period. It is only in 1994 that these subsidies become more oriented to infrastructure, marketing and promotion in the EU. Since subsidies for public stockholding in the EU tend to be disbursed in years of unfavourable market conditions, the negative association between these subsidies and the farm household income ratio may rather reflect market conditions that temporally depress farm household incomes.

Variables that reflect labour market conditions for farm households such as unemployment rate and per capita economic growth are negative and significant at one per cent in both models. Per capita economic growth has a stronger negative effect on differences between incomes of farm and non-farm households than unemployment in both models. Population density is too crude an indicator for proximity to job opportunities to be significant. As expected, higher long term interest rates also have a negative effect on the farm household income ratio that is significant at less than five per cent in both models. Not showed in this table, total factor productivity (TFP) has no significant effect on the farm household income ratio. Because adding TFP in the econometric estimations reduces the number of observations from 46 to 33, it is removed from the final regressions showed in table 2.

As expected, low and high education levels respectively have a negative and positive effects on the farm household income ratio. Low education level is significant at less than five per cent in the first model and ten per cent in the second model while high education level is not significant at less than ten per cent in both models. The average age ratio has the expected negative sign but turns out to be not significant at less than ten per cent in both models. Its coefficient is, however, large in both models.

In sum, accounting for the size of the reported elasticities in table 2, the econometric analysis confirms that incomes of farm households relative to non-farm households are strongly influenced by the general labour market conditions in the economy and the marketable skills of farm household heads. It also shows that farm household incomes are weakly influenced by farm direct payments and, to an even lesser extent, long term real interest rates. Government programs such as output price support or input price subsidies and technological progress have on average no impact on the well-being of farm households relative to the other households. Because of risk of endogeneity excess labour in farming and income

diversification out of farming are not tested. It is also our intention to extend this econometric analysis to the Canadian provinces and the US regions for which the sample size of farm households from the LIS dataset has a minimum of 30 households.

4. Conclusions and recommendations

Limitations (OECD, 2001, P. 45, bottom)

Improvement

- Extend the descriptive & econometric analysis to Canadian provinces and US regions
- Compare to average income of non-farm entrepreneur households
- Switch to an analysis at farm household level

Conclusions

- Low farm income is not a problem anymore in the surveyed developed countries
- Greater income inequality and poverty incidence and intensity among farm households
- Relative farm household incomes depend:
    - more on general labour market conditions and marketable skills
    - less on direct payments and LT interest rates

Recommendations

- Switch to a comprehensive rural policy:
    - Rural employment
    - Rural infrastructure
    - Education & training
- Target farm direct payments on provision of positive externalities and public goods. Extra source of income not captured into farmland values. Break the link.
- Pay attention to cost of capital
- Revisite distributional policy for targeting it better to the low income group of farm households
- OECD, 2001, p. 46

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