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PRODUCING HOURS WORKED FOR THE SNA IN ORDER TO MEASURE
PRODUCTIVITY: THE CANADIAN EXPERIENCE[1]

Submitted by Statistics Canada

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Co-operation and Development

INTRODUCTION

1. This paper provides a brief description of the methodology currently used to produce the annual

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volume of hours worked consistent with the *System of National Accounts* (SNA).[2] These data are used for labour input in the annual and quarterly measures of labour productivity, as well as in the annual measures of multifactor productivity. For this purpose, hours worked are broken down by educational level and age group, so that changes in the composition of the labour force can be taken into account. They are also used to calculate hourly compensation and the unit labour cost and for simulations of the SNA Input-Output Model; as such, they are integrated as labour force inputs into most SNA satellite accounts (i.e., environment, tourism).

2. In this paper, each of the production stages will be described. We first describe how we adjust our data sources to correspond with the SNA, conceptually and terminologically. Next, we begin with the initial development of the source data for the labour input. Then, we reconcile our labour inputs with the income estimates contained in the *Industry Accounts*, while adjusting to an aggregate benchmark. The paper ends with a brief discussion of the strengths and weaknesses of this methodology.

WHAT IS PRODUCED IN CANADA

3. Since 2001, the *Canadian Productivity Accounts* (CPA) have produced data on the number of jobs and hours worked by category of worker for the 286 industries of the *Industry Accounts,* for the ten provinces and three territories of the Canadian North. Before the incorporation of the SNA (1993), the program aimed essentially to measure growth in labour productivity. In the 1990s, it became clear that our clients also used these data to compare productivity levels. This realization led to the development of the current database intended to estimate both trend and level.

METHODOLOGY

4. Canadian methodology was developed in the 1960s by analysts in Statistics Canada's Productivity Accounts group. Over the years, improvements have been made to both the methodology and the source data, but the basic principles have remained essentially unchanged. In short, the CPA produces detailed estimates of the hours worked by estimating the number of jobs on the one hand[3] and the average annual hours per job on the other. The volume of hours worked is obtained by multiplying these two components together. (See the equation below.)

5. When constructing estimates of the labour input, the CPA has three objectives:
- Compliance with the SNA's 1993 concepts
- Compliance with the primary input data from the SNA's *Industry Accounts*
- Respect for the trends and levels produced by the source survey data.

The use of a two-stage strategy gives us more latitude in the choice of the source survey data necessary to reach these objectives.

$$\sum\sum\sum\left(J_{cir}\times\overline{H_{cir}}\right)=Vh_{cir}$$

J = Number of jobs
$\overline{H}$ *= Average annual hours worked*
Vh = Volume of hours worked
Where c=class of worker, i= industry and r=region

6. In practice, there is no single source in Canada for estimating a labour input that corresponds

entirely, both conceptually and with respect to coverage, with the international standards set out in the SNA Manual of 1993. Canadian data on hours worked are therefore derived by integrating the results from several sources: firm-based employer surveys and household surveys, to which are added the results of quinquennial censuses and administrative data.

MAIN DATA SOURCES FOR LABOUR INPUT

7. Statistics Canada collects labour data mainly from the *Labour Force Survey* (LFS) and the *Survey of Employment, Payrolls and Hours* (SEPH).

8. The LFS is a monthly household survey providing data on persons, hours worked and payroll. In a specific week every month it collects information on 53,000 households (about 100,000 persons aged 15 and over). The sample is benchmarked to population censuses and inter-censal estimations. It constitutes the Canadian benchmark for the development of the labour market. Given its survey frame, this survey is considered the most reliable for estimates at the aggregate level. Its methodology has not changed since 1976 and the comprehensive nature of its questionnaire facilitates a conceptual harmonization of labour estimates with the SNA (1993). This requires that persons with more than one job be captured and, that persons absent from work who were not paid during the week of the survey be excluded. The concept of hours worked parallels the SNA's.

9. Since the LFS is a household survey, the data are not the most reliable source for detailed industry coding.[4] In this respect, the SEPH data obtained from an establishment survey are more suitable. A census of the industries covered by this survey is made each month and the industrial coding of the base units – i.e., the establishments - is taken from, a business register of firms that uses a standardized classification system (NAICS). This is the common register for all establishment surveys on specific industries. The SEPH collects monthly data on employee jobs and payroll from all establishments in Canada, except agriculture, fishing and trapping, services to agriculture, services to private households, religious organizations and defence services. Since 1998, when remitting payroll deductions, all employers must report the number of their employees and gross payroll, ideally for the last pay period of the month, to the national tax authority (*Canada Revenue Agency*).[5]

10. In light of the available data, our strategy is to capitalize on the strengths of each survey, while reducing the impact of its weaknesses. The choice of data sources is determined by their degree of correspondence with the objective, their degree of accuracy at various aggregate levels, their extent of coverage, their conformity with sources used to measure production and their methodological consistency over time (no historical break).

ESTIMATION OF HOURS WORKED

11. The estimation of hours worked takes place in four stages:
- Estimation of average hours
- Construction of regional benchmarks
- Industrial and sectored distribution of jobs and compensation in the source data
- Calibration of the results with the *Industry Accounts.*

ESTIMATION OF AVERAGE HOURS

12. In estimating average hours, the CPA relies mainly on LFS data. This survey consists of a series of questions on the weekly work schedule of employed persons. Respondents are first asked about their regular schedule, paid or unpaid overtime and hours lost. Then they are asked to specify the number of hours worked during the reference week. In the event that respondents were absent from work during the reference week, they are also asked to state the main reason for their absence.

13. Hours worked in LFS reference weeks are adjusted by the CPA to eliminate sporadic events (civic holidays, strikes, etc.). They are then interpolated to produce estimates for all weeks in the year. When they are annualized, sporadic events identified by the survey are systematically reintroduced into the calendar. Lastly, a final series of adjustments is made to account for the day on which each year begins or ends. (See Figure 1 in the Appendix.) As can be seen in Table 2 of the Appendix, if LFS hours worked are not adjusted for sporadic civic holidays, the estimates of the level and trend of average hours worked will be biased.[6]

14. Interpolated hours are calculated by region, industry and class of worker. An overall benchmark for average annual hours worked is produced at a more aggregate industrial level (2 digits) for each region.[7] At the most detailed industrial level, average hours worked are annualized by combining interpolated hours and employment derived from various information sources. (See section H.)

CALCULATION OF BENCHMARKS

15. At the aggregate level, the LFS is the main source of data for jobs and hours worked per job for each province and territory, as well as for the three labour categories (paid workers, self-employed with paid help and self-employed own account). The results of this survey are used as the core benchmark. To complete the spatial coverage and harmonize the regional labour concept of this survey with the SNA's,[8] other sources have been added: the Census estimate of inter-provincial flows, SEPH administrative data, Canada's northern territories and aboriginal reserves and data from the Public Institution Division for employees of different levels of government. (See Table 1 in the Appendix for an example.) The aggregate payroll data are taken from administrative data for the entire economy.

CALCULATION OF INDUSTRY DETAILS

16. The industry breakdown of the initial job and payroll matrices by province and territory is based on surveys of various job categories.

17. The main source for **employees** is the SEPH, with the exception of industries excluded from this survey, such as construction, retail trade and accommodation and food services,[9] whose source is the LFS. (See Stage 1 of Table 6 in the Appendix).

18. The main source for **self-employed workers** is Population LFS data that is reconciled with the detailed industrial distribution interpolated from quinquennial Censuses. These results are adjusted to special LFS[10] sub-totals used as annual benchmarks for each province and category of self-employed worker (employer or own-account) (Stage 6 of Table 6 in the Appendix). Since the *Labour Force Survey* uses the *Population Census* to benchmark its population weights, labour

market data collected from the survey are consistent with the Census.

RECONCILIATION OF JOBS WITH THE INDUSTRY ACCOUNTS

19. In the next stage, the CPA modify the initial job and payroll matrices by comparing them with those in the *Industry Accounts.* It forces the resulting estimates to provincial benchmarks. It should be noted that the *Industry Accounts* rely on various data sources to estimate the Input-Output accounts. In particular, they use annual administrative tax data as a benchmark for salaries and wages, whereas industry coding is mainly derived from specific surveys of each industry.[11] In the process of reconciliation by industry, the CPA consider known occurrences, such as: opening and closing of establishments, massive layoffs, strikes, power outages, etc. which lead to unusual job fluctuations. Also taken into consideration are retroactive payments, annual bonuses and pay in lieu of notice, which cause sudden fluctuations in compensation (Stage 2 of Table 6 in the Appendix).

20. The reconciliation involves a multi step algorithm. In the first stage of the reconciliation, the survey payroll is compared to the wages and salaries of the *Industry Accounts* for employees. If there are large discrepancies, the breakdown of jobs between industries is adjusted. For a given industry, the degree of adjustment for jobs will depend on the relative variance of job and average compensation estimates. The more reliable the quality of a cell, the less it will be affected by the reconciliation algorithm. Our variance estimates take into account not only sampling errors, but also non-sampling errors. Once the calibration of job estimates has been completed, the volume of hours is obtained by multiplying the job by the average hours previously calculated (Stage 5 of Table 6). Finally, the number of jobs and the volume of hours are forced to their benchmark value. A similar exercise is applied to self-employed jobs via the mixed incomes of unincorporated businesses contained in the *Industry Accounts* (Stage 7 of Table 6).

21. In the *Canadian Economic Accounts*, the construction industry includes both contracted-out and own-account activity.[12] The employment level of own-account construction is estimated from the available or projected payrolls in *Industry Accounts.* Jobs are then derived from relative salary rates captured by the LFS for professions likely to fall in this category. Estimated jobs are removed from the industry of their employer and added to construction. In 2002, own-account construction represented about 13% of the hours worked in total construction activities in Canada (Stage 3 of Table 6).

22. Data for jobs, hours worked and compensation are available for SNA sectors, as well as for industries. For this purpose, the non-commercial sector is based on job statistics in the *Public Institution Division* and on the imputation of work in non-profit organizations serving private households. The business sector is obtained residually (Stage 4 of Table 6 in the Appendix).

STRENGTHS AND OBSTACLES

23. A comparison of our results with a 1998 time use survey in Canada indicates that our method of annualizing hours worked is reliable. The derivation of hours lost also corroborates the validity of our estimates, since hours lost because of annual vacations and civic holidays are consistent with Canadian labour legislation (See Tables 3 and 4 in the Appendix).

24. Since 2001, labour statistics in line with the SNA have been produced by province and territory from 1997. Each region expects to obtain data of a similar quality. Unfortunately, Canada is made up of regions of diverse size and population and the availability and quality of labour force data is relatively poorer for the North and for the Atlantic provinces.

CONCLUSION

25. Statistics Canada has no single source enabling the direct production of annual data for hours worked that are consistent with the *Canadian System of National Accounts* in respect of coverage and concepts. Therefore, labour data that are consistent with the CSNA are derived by integrating the results of various surveys and statistical programs. Despite the use of multiple sources, labour force estimates at the aggregate level of the CPA's provincial program are consistent and reconcilable with the results of the *Labour Force Survey*, the seminal survey of the Canadian labour market.

26. For the CPA, the *Labour Force Survey*, a household survey, is the primary source for estimating the volume of hours worked. Its coverage is the closest to the production boundaries in the *System of National Accounts.* With a professionally designed sampling process, it is designed to provide exhaustive coverage of the population being examined. Its use as a benchmark also avoids the risk of double counting, since its coverage includes all working categories and the civil population of age 15 and over in the ten Canadian provinces for all industries (about 99% of the total).

27. In Canada, only the *Labour Force Survey* measures hours worked according to the SNA concept.[13] It closely approximates the estimates of hours worked per person derived from the 1998 *Time Use Survey.*

28. While the Canadian methodology relies primarily on the *Labour Force Survey* to estimate the economy as a whole, as well as several groups of industries at the 2-digit level, the productivity program makes extensive use of establishment surveys and of the Census to estimate industries in more detail. However, we ensure that the national total of all of these data corresponds to a benchmark derived from the *Labour Force Survey.*

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ANNEX – TABLES AND FIGURES

Table 1. Constructing the national employment benchmark based on the average annual number of employed persons from the Labour Force Survey

	Stage	1998	1999	2000	2001	2002	2003	2004
1	ILO_LFS all persons employed	14,019	14,390	14,759	14,947	15,308	15,665	15,950
2	Plus: multiple job holders	674	694	691	693	758	764	787
3	Plus: jobs in aboriginal reserves + military personnel	123	118	114	114	115	121	123
4	Plus: all jobs in the Territories + civil servants working outside Canada	54	54	54	54	54	53	55
5	Minus: unpaid absentee paid workers	411	418	434	474	518	558	579
6	Minus: self-employed with "zero" hours worked	225	223	208	179	199	201	188
7	SNA benchmark – all jobs	14,235	14,614	14,976	15,154	15,518	15,843	16,149

Source: Statistics Canada, National Accounts and Analytical Studies, MEAD, Canadian Productivity Accounts and CANSIM Table 383-0009.

Figure 1. Adjustment of hours worked for the year 2002 in Manufacturing, Ontario
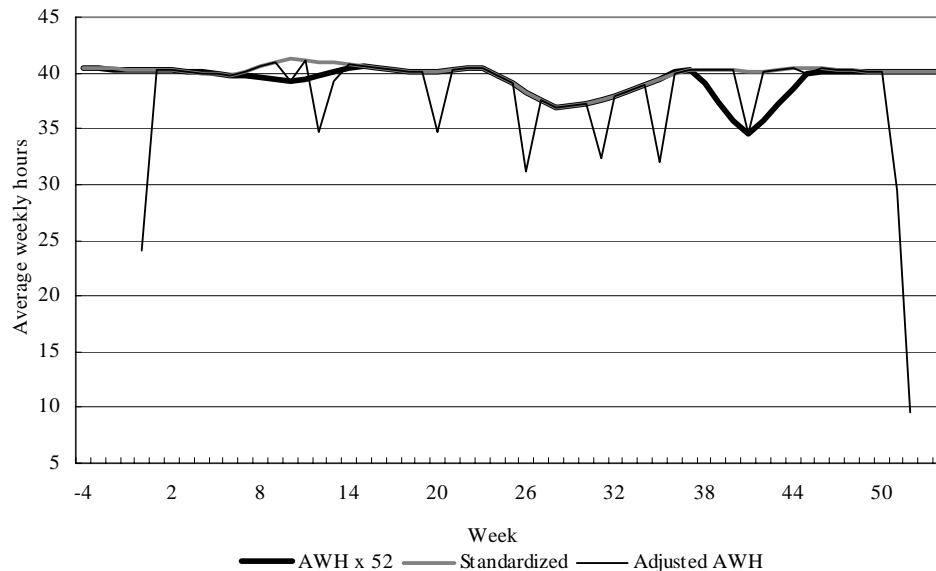
Legends of the figure 1

- AWH x 52: Average weekly actual hours obtained from the twelve reference weeks of the Labour Force Survey.
- Standardized: Represents the average weekly hours worked after that we have added back the hours lost due to a special event (civic holiday, March break,…) and that was captured by the Labour Force Survey.
- Adjusted AWH: Represents the average hours worked adjusted for special events and that are used in the SNA.

Table 2. Impact of not adjusting the Labour Force Survey hours worked data for special events on level and growth of annual hours worked per job in manufacturing, Canada

	a) LFS x 52	b) Adjusted	Diff	c) LFS x 52	d) Adjusted	Diff
	Level	Level	b - a	Growth %	Growth %	d - c
1999	1811.5	1768.4	-43.0			
2000	1823.8	1766.5	-57.3	0.7	-0.1	-0.8
2001	1788.6	1760.6	-28.0	-1.9	-0.3	+1.6
2002	1775.9	1743.9	-32.0	-0.7	-1.0	-0.3
2003	1745.1	1734.0	-11.1	-1.7	-0.6	+1.1
2004	1762.6	1752.2	-10.4	1.0	1.1	+0.1

Note :   The first column titled Diff shows the difference in levels between adjusted and raw hours. The last column shows the impact of not adjusting the hours on labour productivity growth.

Table 3. Average annual hours worked per category of worker, 1998

	Canadian Labour Force Survey	Canadian Time Use Survey	Difference (hours)
All jobs	1796.4	1809.6	-13.2
Employee jobs	1786.6	1804.4	-17.8
Self-employed jobs	1856.6	1840.8	15.8

Source: For comparison purpose, the data in this table shows hours worked per person employed (International Labour Organization concept) For more details, see Chung, Maynard and Sunter, 2004.

Table 4. Absences from work in hours and days, employee jobs, Canada—2002

Reason for absence	Hours lost	Days lost	Percentages
Annual leave	90.2	12.0	42
Holidays	50.3	6.7	20
Short-time	4.0	0.6	2
Illness or accident	51.0	6.8	20
Bad weather	1.0	0.2	0
Industrial disputes	1.0	0.2	1
Personal and family responsibilities	9.2	1.7	3
Maternity	20	2.7	8
Other	11	1.5	4

Source: Statistics Canada, National Accounts and Analytical Studies, MEAD, Canadian Productivity Accounts and Labour Statistics Division.

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Table 5. Comparison of the number of employee jobs for 2-digit industry where industry is theoretically comparable in terms of coverage—in thousands

Industry name (NAICS code)	SEPH	LFS	SEPH / LFS (%)	Correlation coefficient (%)
	2002	2002	2002	1987 to 2003
Mining, oil and gas extraction	140	165	85	62
Utilities (22)	114	131	87	87
Construction (23)	615	666	92	96
Manufacturing (31-33)	2,052	2,219	92	74
Wholesale trade (41)	737	511	144	90
Retail trade (44-45)	1,550	1,741	89	88
Transportation and storage (48-49)	612	674	91	82
Information and communication (51)	334	371	90	67
Finance, insurance and real estate (52,53,55)	886	811	109	66
Professional services (54)	654	798	82	98
Admin. and support, waste mgmt. and remediation services (56)	563	474	119	98
Education (61)	953	983	97	86
Health and social services (62)	1,311	1,481	89	96
Arts, entertainment and recreation (71)	232	287	81	98
Accommodation and food (72)	957	949	101	88
Public administration (91)	725	824	84	81
Total excluding 11 and 81	12,399	13,085	95	93

Source: Statistics Canada, National Accounts and Analytical Studies, MEAD, Canadian Productivity Accounts and Labour Statistics Division.

Table 6. Example of the different steps to produce the volume of hours worked consistent with the Canadian System of National Accounts—Part 1 (in thousands)

Year 2002 Industry	A Step 1 Employee Source data	Employee Average salary: implicit/ source	B Step 2 Employee Micro adjustments to the benchmark	C = A+B Employee Source data adjusted to the benchmark	D Step 3 Employee Adjustments for own-account construction	E = C+D Employee SNA Concept – Total Economy	F Step 4 Employee Non commercial
Agriculture, forestry, fishing and hunting	224	0.96	4	228	-2	226	10
Mining and oil and gas extraction	139	1.20	18	157	-14	143	0
Utilities	114	1.16	21	135	-30	105	15
Construction	668	1.11	13	681	95	776	0
Manufacturing	2,052	0.95	-103	1,949	-5	1,944	0
Wholesale trade	737	1.13	91	828	0	828	0
Retail trade	1,746	0.99	-13	1,733	0	1,733	2
Transportation and warehousing	677	1.04	25	702	-9	693	39
Information and cultural industries	334	1.20	50	384	-2	382	30
Finance, insurance, real estate and renting and leasing	886	1.08	54	940	-3	938	36
Professional, scientific and technical services	654	1.04	19	673	0	673	5
Administrative and support, waste management and remediation services	563	1.04	20	582	0	582	2
Education services	939	1.07	-2	937	-4	933	889
Health care and social assistance	1,305	1.04	-43	1,261	-7	1,254	866
Arts, entertainment and recreation	287	1.04	-26	262	-2	260	45
Accommodation and food services	952	1.14	141	1,092	-1	1,092	4
Other services (except public administration)	572	1.25	150	723	0	723	207
Public administration	774	1.13	25	799	-16	783	783
Total Economy	**13,623**	**1.06**	**444**	**14,067**	**0**	**14,067**	**2,932**

Source: Statistics Canada, National Accounts and Analytical Studies, MEAD, Canadian Productivity Accounts and CANSIM Table 383-0009.

Table 6. Example of the different steps to produce the volume of hours worked consistent with the Canadian System of National Accounts—Part 2 (in thousands)

Year 2002 Industry	G = E - F Step 4 Employee Business sector	H Step 5 Employee Average hours Total economy	I Step 5 Employee Average hours Non-commercial	J= E x H Step 7 Volume of hours worked Total economy	K= F x I Step 7 Volume of hours worked Non-commercial	L=J - K Step 7 Volume of hours worked Business sector
Agriculture, forestry, fishing and hunting	216	2,008	1,785	453,405	17,525	435,880
Mining and oil and gas extraction	143	2,182	0	312,450	0	312,450
Utilities	90	1,836	1,895	192,454	28,210	164,244
Construction	776	1,996	0	1,549,463	0	1,549,463
Manufacturing	1,944	1,950	1,891	3,790,622	938	3,789,684
Wholesale trade	828	1,951	1,905	1,615,177	478	1,614,700
Retail trade	1,731	1,578	1,541	2,734,168	2,790	2,731,378
Transportation and warehousing	654	1,938	1,890	1,342,491	72,953	1,269,537
Information and cultural industries	352	1,741	1,756	665,201	52,450	612,751
Finance, insurance, real estate and renting and leasing	901	1,753	1,730	1,643,236	62,643	1,580,593
Professional, scientific and technical services	668	1,874	1,826	1,260,767	8,845	1,251,922
Administrative and support, waste management and remediation services	581	1,710	1,676	995,535	2,869	992,666
Education services	44	1,549	1,557	1,444,805	1,384,393	60,413
Health care and social assistance	388	1,525	1,534	1,911,975	1,328,101	583,873
Arts, entertainment and recreation	215	1,520	1,584	395,272	70,919	324,353
Accommodation and food services	1,088	1,494	1,840	1,631,474	6,512	1,624,961
Other services (except public administration)	515	1,634	1,636	1,180,838	338,882	841,956
Public administration	0	1,695	1,695	1,328,226	1,328,226	0
Total Economy	**11,135**	**1,738**	**1,605**	**24,447,559**	**4,706,735**	**19,740,824**

Source: Statistics Canada, National Accounts and Analytical Studies, MEAD, Canadian Productivity Accounts and CANSIM Table 383-0009.

Table 6. Example of the different steps to produce the volume of hours worked consistent with the Canadian System of National Accounts—Part 3 (in thousands)

Year 2002 Industry	M Step 6 Self employed Number of jobs	N Step 5 Self employed Average hours worked	O = M x N Step 7 Self employed Volume of hours worked	P = E + M Total number of jobs	Q = J + O All jobs estimate Volume of hours worked	R = Q/P Annual average of hours worked
Agriculture, forestry, fishing and hunting	188	2,080	391,451	414	844,856	2,041
Mining and oil and gas extraction	3	1,951	6,033	146	318,483	2,177
Utilities	0	2,009	533	105	192,987	1,837
Construction	141	1,926	272,047	918	1,821,509	1,985
Manufacturing	31	1,984	61,731	1,975	3,852,353	1,950
Wholesale trade	37	1,738	65,003	865	1,680,180	1,942
Retail trade	126	1,884	238,241	1,860	2,972,409	1,598
Transportation and warehousing	82	2,217	180,793	774	1,523,284	1,968
Information and cultural industries	25	1,507	38,016	407	703,217	1,726
Finance, insurance, real estate and renting and leasing	65	1,742	112,503	1,002	1,755,739	1,752
Professional, scientific and technical services	212	1,699	359,639	884	1,620,406	1,832
Administrative and support, waste management and remediation services	107	1,335	142,268	689	1,137,803	1,652
Education services	41	1,177	48,779	974	1,493,585	1,533
Health care and social assistance	163	1,848	300,690	1,417	2,212,665	1,562
Arts, entertainment and recreation	62	1,491	92,766	322	488,037	1,514
Accommodation and food services	41	2,324	94,535	1,133	1,726,009	1,524
Other services (except public administration)	126	1,655	209,309	849	1,390,148	1,637
Public administration	0	0	0	783	1,328,226	1,695
Total Economy	**1,451**	**1,802**	**2,614,337**	**15,518**	**27,061,896**	**1,744**

Source: Statistics Canada, National Accounts and Analytical Studies, MEAD, Canadian Productivity Accounts and CANSIM Table 383-0009.

[2] For a more detailed description, consult *J.-P. Maynard, Annual Measure of the Volume of Work: the Canadian Experience*, Catalogue no. 11F0026MIE2005005, Statistics Canada.

[3] As opposed to the term "employed persons".

[4] The LFS's data are less reliable for detailed industries for two reasons: first, because the sample is often too small and, second, because it is difficult to assign a precise industry code to a respondent at this level of detail.

[5] This administrative source is supplemented by a monthly survey of approximately 11,000 establishments in order to collect data on paid hours of production workers and paid or usual hours for other workers.

[6] The bias has been particularly noticeable since 2000. See Galarneau, Maynard and Lee. *Whither the workweek?*, Statistics Canada, Fall 2005.

[7] See Table 5 in the Appendix comparing for jobs estimates derived from the LFS compared to SEPH at the NAICS 2-digit level.

[8] The basis of LFS statistics is the respondents' province of residence, whereas the SNA has to estimate jobs on the basis of the province of employment.

[9] We use the LFS for these three industries as they are barely covered by the *Accounts by Industry* and are likely to be affected by the incidence of clandestine work, which is more easily captured by a household survey; moreover,

they are characterized by a high turnover of businesses opening and closing, which in turn creates coding arrears in the *Business Register.*

[10] The LFS sub-groups are divided into 12 industry aggregates. These industry sub-groups are created by taking into consideration the similarities of self-employed characteristics and by minimising the coefficient of variation of each sub-group (by choosing a reasonable sample size).

[11] For an overview of the integration of the CPA with the SNA, see J.R. Baldwin and T.M. Harchaoui (2005).

[12] Own-account construction is a construction activity carried out by an industry's own workers.

[13] The SNA's concept of hours worked refers to the resolution adopted by the International Labour Office (ILO) in 1962 at the 10th International Conference of Labour Statisticians. See *System of National Accounts,* 1993, p. 451.

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