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Capitalization of software in the National Accounts

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Capitalization of Software in the National Accounts

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1.0 Introduction

A new accounting treatment of software as investment was implemented in the Canadian System of National Accounts during 2001. Preliminary estimates of software capital stocks were included for the first time in the National Balance Sheet Accounts (NBSA) released in March 2001. Software investment was then included in GDP with the first quarter 2001 release (31 May 2001) of the National Economic and Financial Accounts (NEFA). Later in the year, it was included in the Input-output (I/O) Accounts, Provincial Economic Accounts (PEA) and the Industry Measures Accounts (IMA) with the release of 30 October 2001.

This mini historical revision brings Canada in line with a number of countries, including the U.S. and other G-7 member nations, who introduced software into their GDP over the last few years. It also brings Canada in line with the 1993 SNA recommendation that business and government acquisition of software be treated in national accounts as an investment as opposed to a current expense.[1] Software is now treated like any other capital input that is used repeatedly in production over a year or more whereas, formerly, it was treated as if it were fully used up during the production period like any other intermediate input. This new accounting for software has raised the level of GDP although the effects on GDP growth turn out to be relatively small.

Software is characterized by three types: pre-packaged, custom-design and own-account.[2] Pre-packaged software is of the sort that can be purchased 'off-the-shelf' and is typically mass-produced and sold or licensed in standardized form. It is intended for generalized uses common to the every-day operations of businesses and governments. Custom-design software, by contrast, is intended for specialized uses. It is typically developed for and tailored to a specific organization's needs by some third party software developer under contract. Customized software has limited application beyond the particular 'business problem' it is designed to solve. Like custom-design, own-account software is specialized to a specific organization's needs, and distinguished only insofar as its development is undertaken 'in-house' by employees within the organization rather than being contracted out.[3]

Because expenditures on software are not always tracked separately or treated uniformly in organizations' accounting records and because Statistics Canada's surveys haven't always asked for the details of these specific expenditures, the estimation of software investment relies on indirect methods.[4] In the case of purchased software, pre-packaged and custom-design, the method involves estimation of the components of the software market in Canada, with investment determined residually as the amount that equates demand with supply. In the case of own-account, the method rests on an estimation of the wage bill for computer programmers and systems analysts as a starting point for assessing the costs of software developed in-house for own-use.

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[1] *The 1993 SNA also recommended treating large databases as capital assets. Database software either purchased (e.g. Oracle, Microsoft SQL Server) or developed on own-account have been capitalized here, but the database content, its creation and its updating have not. This latter remains for future consideration.*

[2] *Software refers in general to the encoded instructions executed by electronic devices including computers for performing operations and functions. This includes both systems software and user tools (operating systems, network control, performance measurement and job accounting tools, utilities, compilers, CASE tools, etc.) and applications software (CAD/CAM, reservation management systems, word processing, spreadsheets, payroll systems, etc.).*

[3] *Making the distinction between these three types of software is easier said than done. Software developed 'in-house' for own-use may have viable applications elsewhere and may be sold, leased or licensed to other organizations, blurring the distinction between own-account and custom software. Specialized software may also be integrated with more generalized software packages, blurring the boundary between custom and pre-packaged software.*

[4] *Statistics Canada's industry surveys capture expensed software under a catch-all category for 'other office supplies', with the Survey of Computer Services (SCS) being one of the few to explicitly provide for software.*

Not all purchases or costs related to software acquisition are included as investment. In particular, expenditures on repair and maintenance (e.g., Y2K and other emergency fixes, routine de-bugging and re-coding to accommodate changes to input data) are not included, nor is spending on employees' training on software (unless part of a package deal).[5] Purchased software that gets embedded in hardware and then re-sold continues to be treated as an intermediate use to avoid double-counting (i.e., the initial purchase is deemed to be intermediate, while the subsequent purchase of hardware (with embedded software) is treated as investment). As well, the costs of developing software that is to be sold are excluded from the own-account estimates in order to avoid double-counting with purchased software.

Software investment here covers organizations' capital plus non-capital spending, essentially treating all of their software purchases and own-account development costs as capital outlays, irrespective of how these outlays are treated on their books.[6] Some direct estimates for the actual capital spending component (as reported in accounting records) are now available, as a result of the introduction of 'software' as an explicit asset category on Statistics Canada's 1998 Survey of Capital and Repair Expenditures (CAPEX). The Survey has been capturing a significant portion of software investment in the past, but under computer hardware.[7] An adjustment to the hardware investment series is made to remove these amounts in order, again, to avoid a double-count. The resulting downward revision to hardware goes a long way to explaining the minimal effects of the new treatment of software on GDP. Moreover, because the prices for hardware have fallen even faster than those for software, the reduction to hardware reduces real GDP growth more than the equivalent amount of software adds to it.

With the changes made in 2001, the estimates of software investment are now available in the NEFA on a quarterly seasonally adjusted and unadjusted basis at current, constant 1997 and chained 1997 prices, by sector, from the first quarter 1981. They are available also by industry, at current and constant prices, in the national I/O Accounts, annually for 1981-1998, and by industry and province/territory in the provincial I/O Accounts for 1997 and 1998. No details on software are available in the NBSA, PEA or IMA because it gets subsumed under broader aggregates.

As with most series in the national accounts, the correspondence between definitions and underlying concepts, the data sources and the estimation methods are revisited, refined and further developed over time. The software investment series are no exception. Indeed, these are likely to undergo refinements if only because the source surveys undergo modification in order to keep up with the rapidly evolving market for software. In addition, with each quarterly and annual

[5] *It can be difficult to make these distinctions and remove such amounts in practice. In the case of own-account repair and maintenance of software, related costs are deemed to be removed through an adjustment for the time computer programmers and systems analysts spend on non-software-development tasks. With respect to purchased software repair and maintenance, training, systems and technical consulting and other professional services, these are not removed when they are priced in with, and an integral part of, a software sales contract. When such services are purchased separately from software they are excluded. Repairs and maintenance, however, is an exception. The SCS gathers information on industry revenues from a number of specific services, but revenue from software repairs and maintenance is not explicitly asked for, nor is any guidance given to respondents on where to report it. It may be reported as revenue from custom software development, but it could also be reported under a catch-all category for other professional services. To the extent it gets reported as the former, some repair and maintenance gets included as investment in custom software. The 1999 SCS has introduced a new revenue category for after-sales support and maintenance which may shed some light on this issue.*

[6] *This includes license fees paid for the use of software in production, regardless of the term of the license agreement (although, almost all are thought to be for terms of one year or more). A* de facto *transfer of ownership rights is assumed here, and the licensee is deemed to make an investment in software despite the fact there is no legal transfer of ownership. This treatment better reflects the economic reality and helps in economic analyses, for instance, of productivity by industry. Still, the question has arisen as to whether license fees should continue to be treated as intermediate in the case of software, with the licensor, not the licensee, viewed as having made the investment. A joint OECD/Eurostat Task Force has been set up to consider this issue among others related to software investment. See OECD, "Software Measurement: Issues Paper," OECD Meeting of National Accounts Experts, Paris, September 2001.*

[7] *More precisely, starting in 1988, respondents to CAPEX were asked to include capital spending on software along with that on hardware under a combined hardware and software asset category that has been associated typically only with 'hardware' and treated as such. In the first year software was explicitly identified (CAPEX 1998), roughly $2.8 billion was reported as capital spending on software, representing almost one-quarter of reported capital spending on both software and hardware combined. Based on the estimates here, business and government software expensed was three times the amount of capital spending on software in that year.*

update of the estimates, experience is gained in terms of how they fit with other aggregates in the national accounts. This on-going process can indicate refinements to both the sources and methods in order to improve the software estimates.

The estimates for 1998-2001 will be open for revision at the time of the next annual revision of the national accounts, scheduled for May 2002. This will allow the incorporation of more recent data, including results from the 1999 Annual Survey of Software Development and Computer Services, the 1999 Survey of Capital and Repair Expenditures, the 2000 surveys on International Transactions in Commercial Services, updated merchandise trade statistics, and preliminary I/O Accounts for 1999 and the final ones for 1998. Some parameters underlying the estimates will be updated as well, including business/government split factors, the share of intermediate costs in the own-account estimates, and the margin rates on software sales to the domestic market.

There is room for more substantive improvements in the future. Results from the 2001 Census will provide new benchmark data next year for the own-account estimates. A new made-in-Canada price index for pre-packaged software is under development and will eventually replace the U.S. pre-packaged software index currently in use. The feasibility of developing a provincial dimension to the various software price indexes and the quality-adjustment of software prices warrant further investigation. As well, the adjustment made to avoid double-counting the work of programmers and systems analysts on software that gets sold and the adjustments for software embedded in hardware, which all rest largely on assumptions, stand to be revisited. Last, following a recent survey and review of national practices, the OECD/Eurostat joint Task Force on Software Measurement in the National Accounts will make recommendations later this year on best practices in this area, and these will be considered in due course.

The following section looks at the effects of the new accounting treatment of software on GDP, its components and on GDP growth. Next comes a summary of the software investment results for Canada, followed by a comparison with those for the U.S. A brief outline of the approach to estimating the software benchmarks for 1997 and 1998 is then provided. A more detailed description follows of the data, sources and methods for the full annual time series, 1981-2000, the quarterly series, and the industry and provincial distribution of software investment. Appendix Tables A.1-E.3. summarize the data, sources and methods.

2.0 The effects of capitalizing software on GDP

The new treatment of software as investment affects a number of series in the Income and Expenditure Accounts. The net effect on GDP is to raise it by the amount of business investment in software (net of the reduction to business hardware investment) plus the software capital consumption of government (net of the reduction to government hardware capital consumption).[8]

On the expenditure-side, government current expenditure on goods and services is reduced by the amount of government software expensed, while government gross fixed capital formation is raised by the same amount. Government current expenditure on goods and services is raised by capital consumption of software formerly treated as expensed. Business gross fixed capital formation is raised by the amount of software expensed by businesses.[9]

On the income-side, corporation profits before taxes, government business enterprise profits before taxes and the net income of unincorporated businesses are each raised by the amount of software expensed, and reduced by capital consumption on software formerly treated as expensed. Capital consumption allowances are raised by both business and government capital consumption of software formerly treated as expensed.

[8] *The own-account software development costs of non-profit institutions serving households are explicitly re-allocated to the government sector and treated as government investment. Their purchases of software, on the other hand, are implicitly allocated (i.e., through residual derivation) to the business sector. This was done to avoid re-opening the historical series on personal expenditure for the sake of some relatively small changes.*

[9] *Software expensed by business is derived indirectly as estimated software purchases minus amounts that are capitalized by business. This is adjusted for amounts that continue to be treated as intermediate.*

In terms of value-added, for the business sector, gross output is raised by the cost of own-account software development and intermediate use is reduced by the amount of purchased software formerly treated as expensed. For government, costs are raised by capital consumption of software formerly treated as expensed.

The Table over shows the actual revisions to GDP, its components, and GDP growth stemming from the new accounting treatment of software. Revisions to GDP over 1981-1996 are entirely attributable to the capitalization of software. For 1997-2000, however, the revisions are due both to software and the usual sources of annual revision in the national accounts (i.e., the incorporation of more complete and up-to-date data). Only the former are shown in the Table. The new accounting treatment for software raises GDP by $0.9 billion in 1981 and $10.2 billion in 2000. While these revisions are small, in relative terms they increase steadily over time, going from 0.3% of GDP (revised) in 1981 to 1.0% in 2000. Because some software had already been included in GDP, the revision due to software capitalization is considerably less than the estimate of software investment, about one-fifth less for 1981 and one-third less for 2000.[10]

Revisions due to software capitalization are more significant for the affected components of GDP. On the expenditure-side, government current expenditure on goods and services is reduced by $789 million in 2000, reflecting the net effect of moving government current spending on software to investment and adding in the software capital consumption. In relative terms, this adjustment is small, ranging from 0.1% of government current expenditure (revised) in 1981 to 0.4% in 2000. The revision to government gross fixed capital formation, on the other hand, is relatively large, raising the total by $263 million for software in 1981 (2.4% of the revised total) and by $2.4 billion in 2000 (9.7% of the revised total). Business investment in machinery and equipment is raised by $8.6 billion for software in 2000, 10.1% of the revised total (versus 2.4% for 1981).

On the income-side, most of the software adjustment is recorded as an increase in capital consumption allowances and, to a lesser degree, an increase in corporation profits before taxes, with smaller adjustments (both in absolute and relative terms) recorded for government business enterprise profits and net income of non-farm unincorporated business. Capital consumption allowances (CCA) are raised by $7.3 billion for software in 2000. The revision here grows steadily against total CCA, from 1.3% of the revised total in 1981 to 5.4% in 2000. Corporation profits before taxes are raised $2.8 billion for software in 2000, reflecting the net effect of removing software expenses (which raises profit) and adding a charge for software depreciation (which reduces profit). This revision fluctuates against corporation profits ranging from 0.8% of the revised total in 1981 to 2.2% in 2000, with its largest impact in 1993, at 2.7% of the revised total.

The effect on GDP growth of capitalizing software is minimal, raising it by approximately 0.01 percentage points per quarter on average over 1981-2000.[11] Cumulated over the eighty quarters during this period, this translates into a 1.2 percentage point increase of GDP.

[10] *Substantial amounts of software were already included in GDP under hardware investment and government current spending. These amounts are simply transferred to the new software investment category, with no effect on GDP. Software investment exceeds the revision to GDP due to software by these amounts net of the software capital consumption of government (which equals only two-thirds of government software investment). Moreover, because the prices for hardware have fallen even faster than those for software, the reduction to hardware investment reduces real GDP growth more than the equivalent amount of software adds to it. These two factors help to explain the paradoxical result that the capitalization of software has relatively small effects on GDP and GDP growth while, at the same time, software investment makes a significant contribution to GDP and GDP growth.*

[11] *Owing to a new treatment of inventory change in the Fisher Volume measure of GDP growth, it is not possible do a before and after comparison of GDP growth to determine the effect of capitalizing software, even though this is the only revision to GDP over 1981-1996. Instead, a close approximation is made based on a before and after comparison of growth in Final Domestic Demand, one that is free of confounding effects due to changes in the Fisher measure itself. The effect on GDP is also approximated over 1997-2000, in this case on the basis of calculations of GDP before incorporating the usual sources of annual revision.*

May 2001 revisions to GDP, its components, and GDP growth due to the capitalization of software, 1981-2000

Millions of current dollars (except where noted)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
GDP, revised	361355	380793	412386	450731	486847	513805	560390	614530	659270	681657
Revisions to GDP due to software	861	1059	1226	1482	1708	2009	2284	2745	3080	3522
as a % of GDP, revised	*0.2%*	*0.3%*	*0.3%*	*0.3%*	*0.4%*	*0.4%*	*0.4%*	*0.4%*	*0.5%*	*0.5%*
Expenditure-side components of GDP, revised (1)										
Government current expenditure on goods and services	76647	87150	93610	98338	106297	111682	118127	128157	138698	151640
revision due to software	*-95*	*-110*	*-120*	*-129*	*-127*	*-179*	*-206*	*-251*	*-302*	*-337*
Government gross fixed capital formation	10926	12154	12007	13030	14716	14648	15295	16436	18564	20221
revision due to software	*263*	*321*	*369*	*424*	*469*	*559*	*637*	*737*	*852*	*975*
Business investment in machinery & equipment	28370	25912	25338	26875	30196	33547	37854	44158	47472	45478
revision due to software	*693*	*848*	*977*	*1187*	*1366*	*1629*	*1853*	*2259*	*2530*	*2884*
Income-side components of GDP, revised (1)										
Corporation profits before taxes	35831	26697	36730	45686	49728	45217	57888	64891	59661	44936
revision due to software	*282*	*340*	*361*	*442*	*482*	*586*	*635*	*831*	*854*	*948*
Government business enterprise profits before taxes	4954	2509	4432	4936	4937	4564	5126	6829	7246	6460
revision due to software	*10*	*11*	*12*	*15*	*15*	*20*	*23*	*29*	*28*	*31*
Net income of non-farm unincorporated business, including rent	14680	16984	20901	23473	25904	28574	30761	33113	34856	35544
revision due to software	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Capital consumption allowances	43012	46717	49648	53316	58365	62640	66253	70477	75940	82244
revision due to software	*569*	*708*	*853*	*1025*	*1211*	*1403*	*1626*	*1885*	*2198*	*2543*
Revisions to quarterly GDP growth (Fisher), annual averages										
GDP growth, revised (%)	-0.1	-0.9	1.5	1.4	1.2	0.1	1.6	0.9	0.5	-0.3
Revision to GDP growth due to software (percentage points) (2)	*0.01*	*0.01*	*0.01*	*0.01*	*0.00*	*0.02*	*0.00*	*0.01*	*0.01*	*0.01*

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
GDP, revised	686971	702393	729580	772827	812460	839064	885022	915865	975263	1056010
Revisions to GDP due to software	3732	3849	4620	5321	5372	5994	6841	7480	8725	10229
as a % of GDP, revised	*0.5%*	*0.5%*	*0.6%*	*0.7%*	*0.7%*	*0.7%*	*0.8%*	*0.8%*	*0.9%*	*1.0%*
Expenditure-side components of GDP, revised (1)										
Government current expenditure on goods and services	162431	168925	171271	171729	172648	171351	171883	176842	183287	192771
revision due to software	*-334*	*-337*	*-359*	*-344*	*-299*	*-293*	*-296*	*-300*	*-615*	*-789*
Government gross fixed capital formation	20261	19959	19805	21634	21406	20587	20104	20014	22463	24740
revision due to software	*1052*	*1123*	*1246*	*1336*	*1370*	*1433*	*1506*	*1570*	*1995*	*2411*
Business investment in machinery & equipment	41932	41715	41411	46897	50787	53453	67346	73881	78685	85555
revision due to software	*3014*	*3063*	*3733*	*4329*	*4301*	*4854*	*5631*	*6210*	*7345*	*8607*
Income-side components of GDP, revised (1)										
Corporation profits before taxes	32920	32648	41102	65464	76270	80335	87932	85851	104689	127513
revision due to software	*819*	*670*	*1106*	*1346*	*961*	*1200*	*1638*	*1765*	*2309*	*2748*
Government business enterprise profits before taxes	5179	5993	4694	5827	6709	6143	6653	7052	8490	11702
revision due to software	*26*	*22*	*41*	*51*	*36*	*33*	*49*	*56*	*82*	*99*
Net income of non-farm unincorporated business, including rent	37022	39406	42068	44931	46363	49278	54663	57643	60629	63237
revision due to software	*0*	*8*	*21*	*23*	*26*	*30*	*20*	*44*	*56*	*64*
Capital consumption allowances	85906	89573	94035	99631	105021	110818	116574	122303	127723	134315
revision due to software	*2887*	*3149*	*3452*	*3901*	*4349*	*4731*	*5134*	*5615*	*6279*	*7318*
Revisions to quarterly GDP growth (Fisher), annual averages										
GDP growth, revised (%)	-0.1	0.2	0.7	1.3	0.4	0.6	1.1	1.0	1.2	0.9
Revision to GDP growth due to software (percentage points) (2)	*0.00*	*0.00*	*0.02*	*0.01*	*-0.01*	*0.01*	*0.00*	*0.02*	*0.04*	*0.00*

1) Showing only components of GDP affected by software capitalization. For 1981-96, the revised component minus the revision due to software gives the previous estimate.

2) Approximation based on effect on Final Domestic Demand for 1981-96 and, for 1997-2000, based on GDP including near final software estimates but no other source of revision.

3.0 Trends of software investment in Canada

Charts 1-13 on the following pages show some summary results. Software investment reached $15 billion in Canada in 2000. Pre-packaged software made up 44% of the total, with own-account and custom-design software making up just under 30% each. The share going to pre-packaged software has more than doubled since 1981 (the first year for which the software estimate is made), while the share going to own-account is less than half what it was in 1981.

The business sector is accounting for a growing share of overall software investment, with 74% of the total in 1981 and 81% in 2000. Its share varies markedly by type of software, with businesses accounting for 94% of investment in customized software in 2000, 84% of pre-packaged software, and only 67% of software developed on own-account. Substitution towards pre-packaged software is taking place in businesses and governments, although own-account is still predominant for government, while pre-packaged has become the predominant type for business.

The shift towards pre-packaged software reflects not only its growing popularity and more widespread applicability, but also declines in its price relative to specialized software contracted out or developed in house. The quality-adjusted price of pre-packaged software has fallen over 80% since 1981, with most of the decline taking place during the eighties and early nineties. The cost of own-account software development on the other hand nearly doubled over 1981-2000, while the price of custom-design software remained relatively flat. In contrast to the price measure for pre-packaged software, the one for own-account software is not quality-adjusted, and the one for custom-design is only partially adjusted.

Software investment is making up a growing share of GDP, going from 0.3% of GDP in 1981 to 1.4% in 2000. It accounted for 7% of all investment in fixed capital in 2000, and now makes up the single largest component (at the detailed level) of investment in machinery and equipment. Investment in software generally outpaced investment in computer hardware throughout 1981-1993, surpassing it in 1990. Since the mid-nineties, the reverse has been the case, although software investment was still 20% greater than investment in hardware in 2000.

Software investment has grown much more rapidly than GDP over the last two decades. It grew an average 5% (Fisher volume) per quarter over the 1980's, seven times faster than GDP. With the impact of the recession of the early nineties, the growth of investment in software over 1990-1995 slowed to 3% per quarter, still much higher than the 0.4% quarterly growth of GDP. With the high-tech boom of the late nineties and hardware/software upgrades and replacements in preparation for Y2K, software investment regained momentum, growing an average 4% per quarter over 1996-2000, versus 1% for GDP. Despite its small share of GDP, and because of its rapid growth, software investment makes a significant contribution to overall GDP growth, an average 0.05 percentage points per quarter over 1996-2000.

In a relatively recent development, Canada has become a net exporter of software. The trade deficit in software peaked in 1990 and has declined ever since, turning into surplus in 1998. In 2000, Canada exported over $2.2 billion in software, about $0.3 billion more than it imported. This was the first year in which trade in software fell in nominal terms over the previous year. This turnaround stemmed from a drop in both imports and exports of pre-packaged software which outweighed the smaller increases in imports and exports of customized software.

Close to 45% of software investment took place in Ontario in 2000, followed by Quebec (23%), Alberta (14%) and British Columbia (10%). Alberta has gained ground (at the expense of Ontario and Quebec) since 1981, when it held just over 9% of the total. Compared to provincial and territorial GDP, software investment varies across the provinces and territories within a fairly narrow range. Ontario leads, with software investment making up 1.6% of the province's GDP in 2000. Quebec and Alberta are close behind, with all three provinces above the national average (1.4% of GDP).

Chart 1

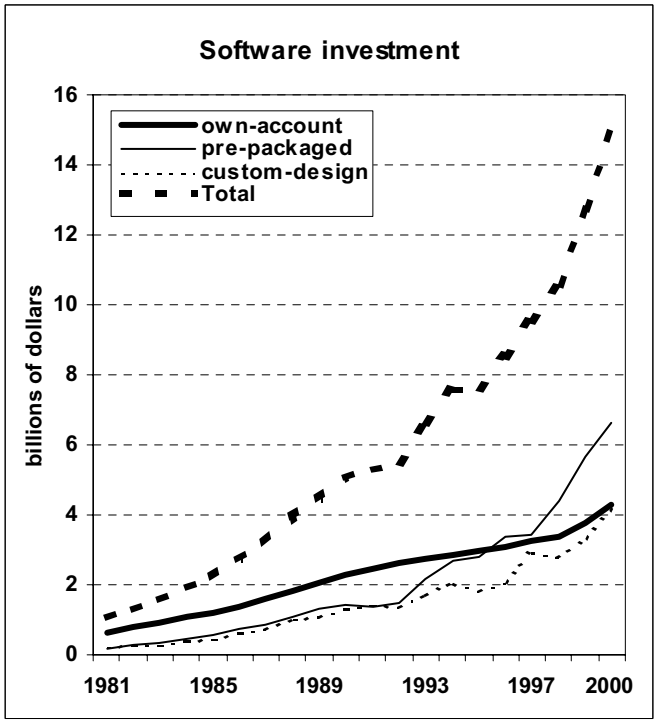


Chart 2

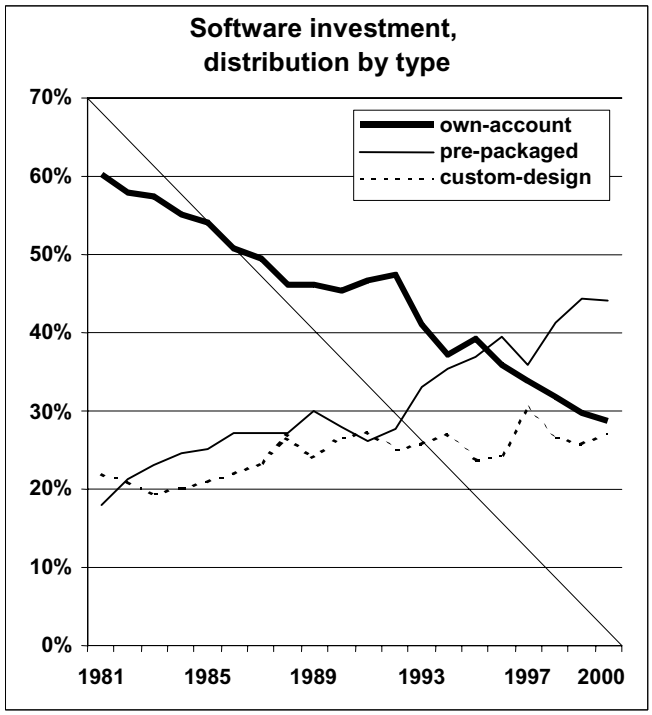


Chart 3

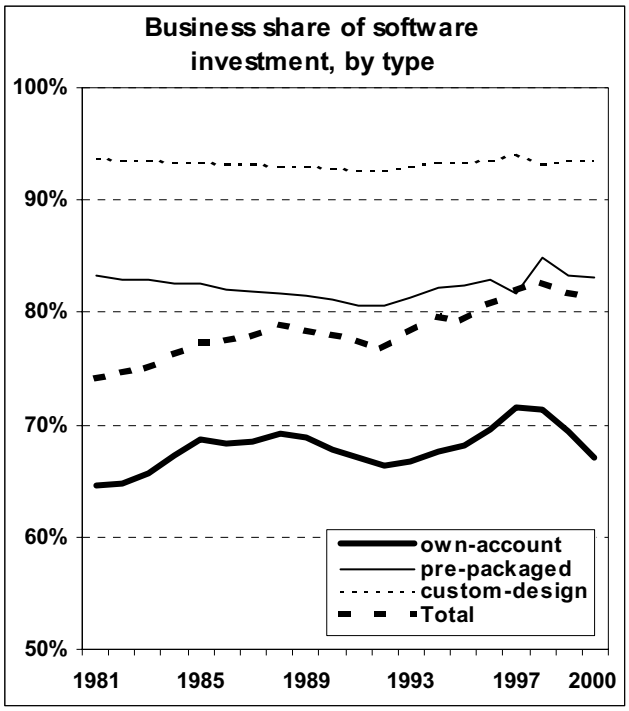


Chart 4

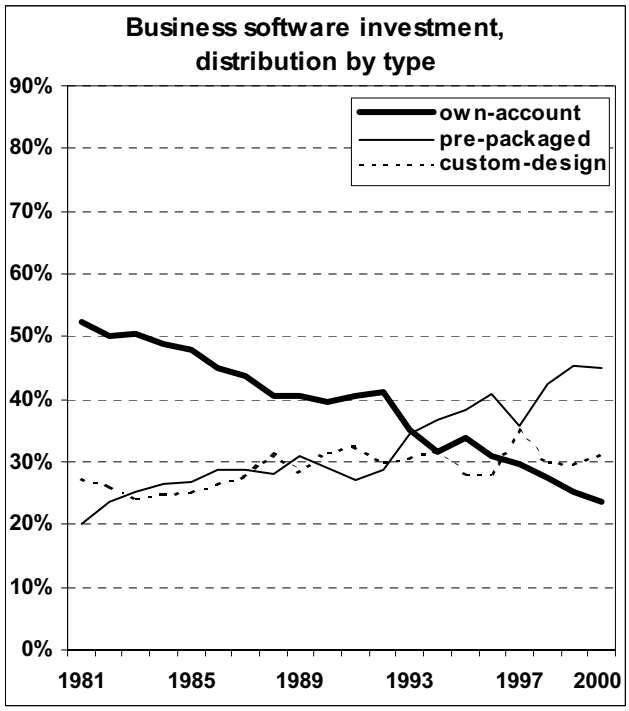


Chart 5

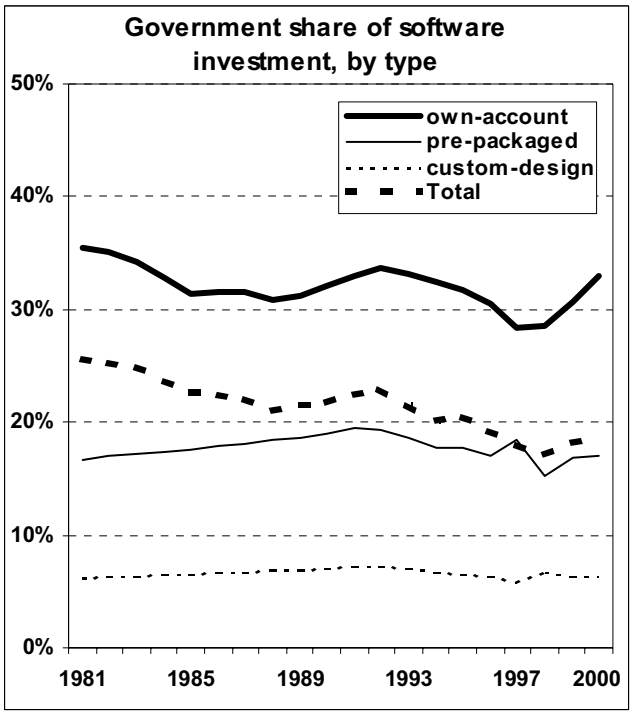


Chart 6

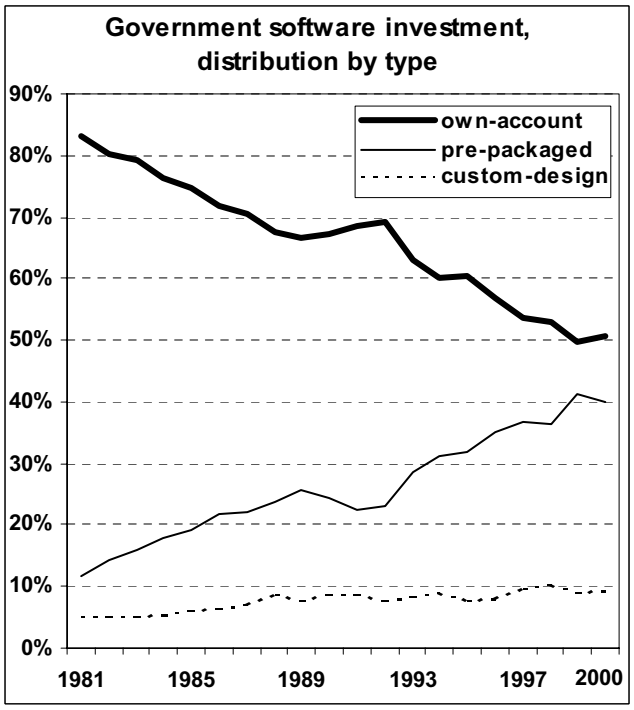


Chart 7

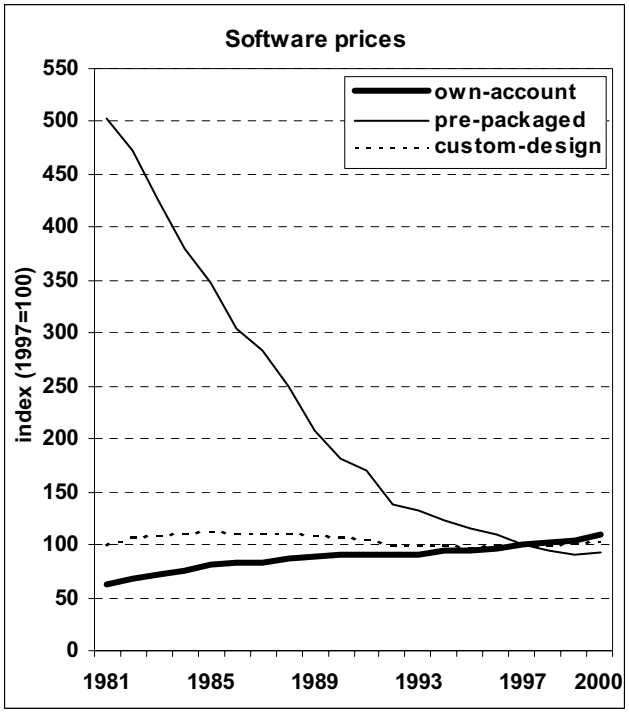


Chart 8

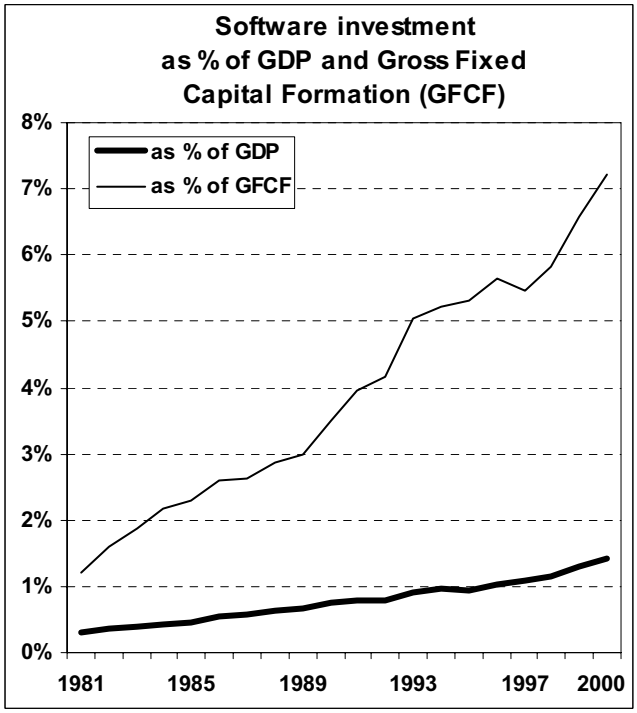


Chart 9

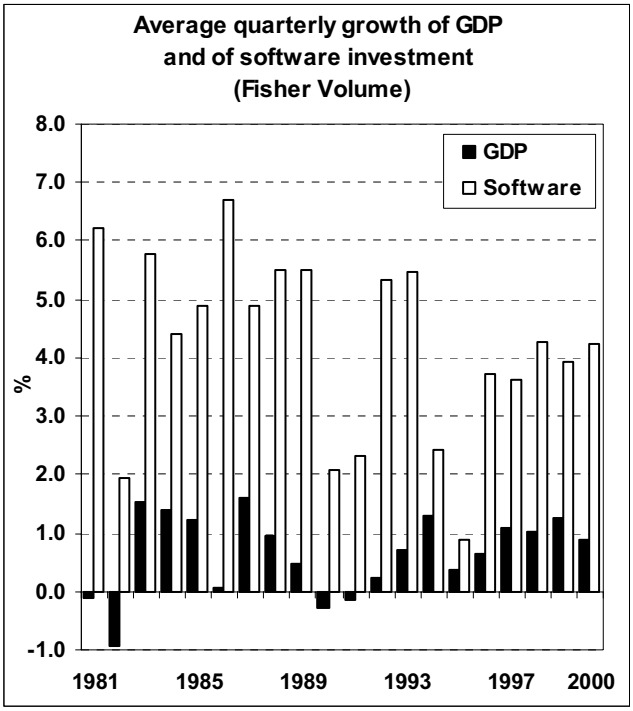


Chart 10

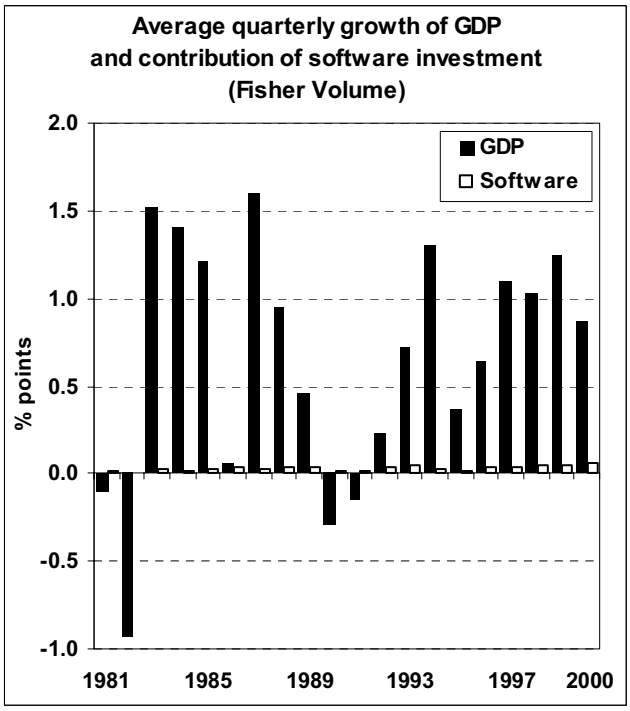


Chart 11

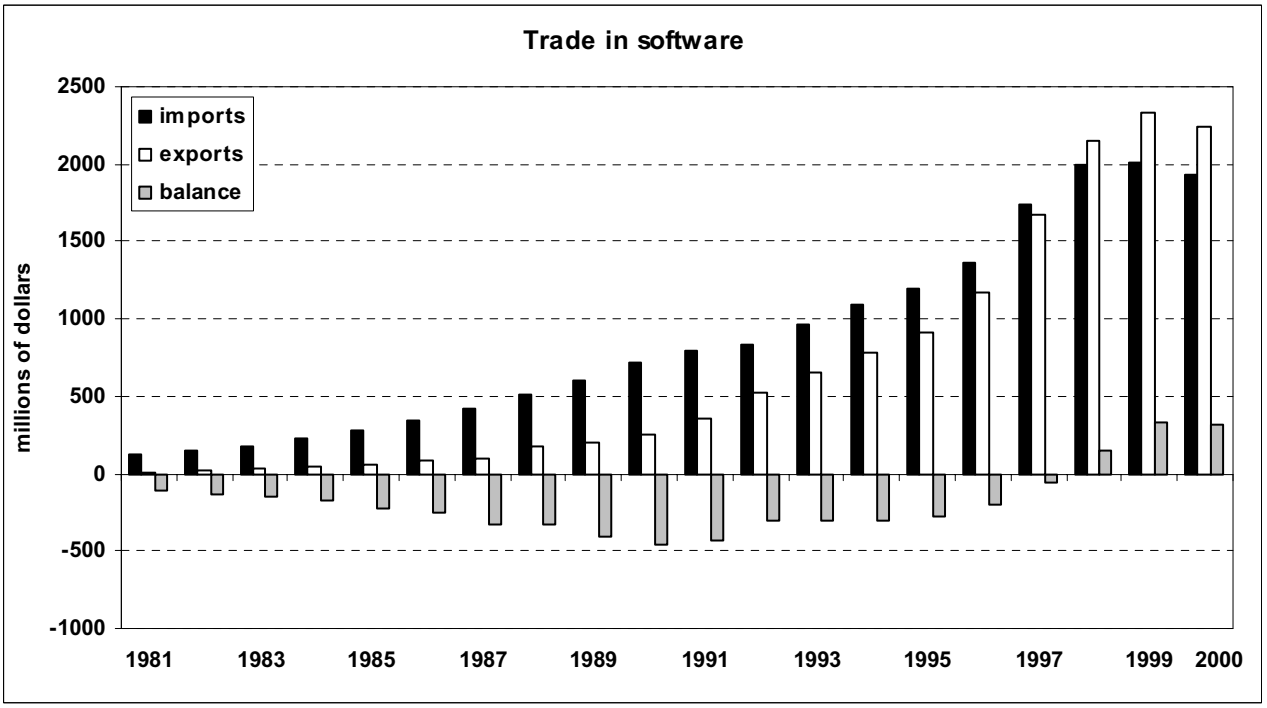


Chart 12

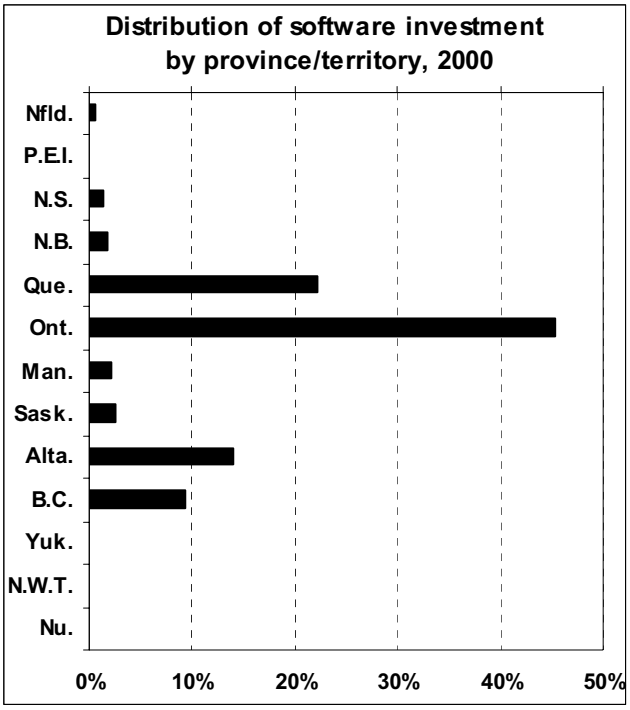
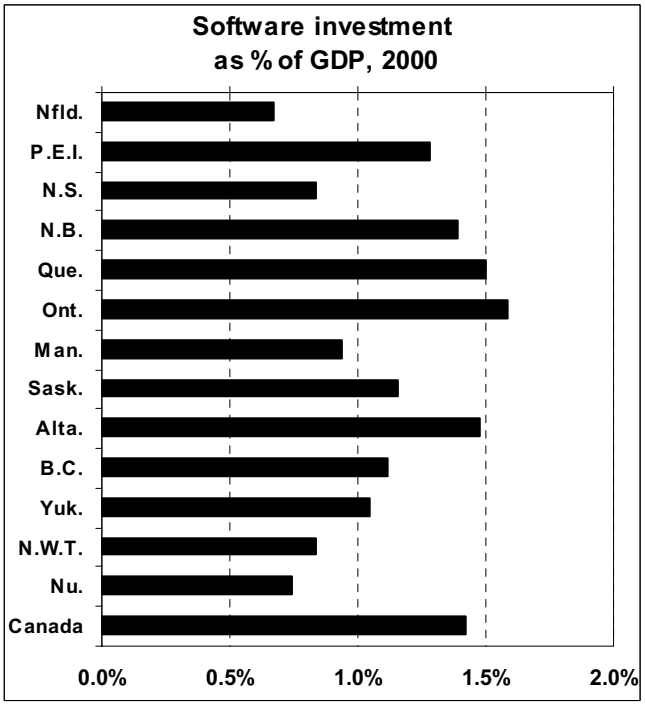


Chart 13



4.0 Software investment in Canada and the U.S. compared

Many observers will no doubt be interested to compare the software results for Canada with those of the U.S. Charts 14-23 give some comparisons for 1981-2000, based on the Canadian software estimates as of 31 May 2001 and the U.S. estimates as of 27 July 2001.[12] All but the last two Charts show ratios of some variable for Canada relative to the same variable for the U.S.; when a ratio equals one, there is equality between the two countries in the variable compared.

Software investment in Canada, in nominal terms, outpaced that in the U.S. over 1981-88, 1993-94 and 1999-2000, while it led in the U.S. over 1989-92 and 1995-98. Over the entire period, growth in total software investment was slightly higher in Canada. By 2000, software investment in Canada was 14.0 times its level in 1981, while in the U.S. it was 13.2 times its 1981 level. Looking at the different types of software, own-account grew at roughly the same pace in Canada as in the U.S. until the early nineties but has grown faster in the U.S. since then. Spending on pre-packaged software grew slightly faster in the U.S. over the entire period, while the growth of investment in custom software has been much greater in Canada, especially during the eighties.

In 1981 the Canadian and U.S. investment mixes by type of software were markedly different. The share of customized software in total software investment expenditure in Canada was only one-half (0.5 times) its share in the U.S. The shares of pre-packaged and own-account software, on the other hand, were 1.7 and 1.2 times their respective shares in the U.S. These differences narrowed throughout the eighties, and while they have widened somewhat since then, the investment mixes were still more alike in 2000 than in 1981. By 2000, the shares of custom, pre-packaged and own-account software in Canada were 0.75, 1.5 and 0.9 times their respective shares in the U.S. This convergence was driven mostly by the trend of software investment expenditure in the business sector. Canada/U.S. software spending patterns in the government sector in contrast are quite different and have shown little tendency to converge.

Businesses account for roughly the same, growing share of total software investment in both countries, three-quarters of the total in nominal terms in 1981 and four-fifths in 2000. Business sector shares by type of software, however, are notably different, especially for custom and own-account software. This stems in part from differences in the software spending of governments. The relatively low share of total custom software investment accounted for by U.S. businesses compared to their Canadian counterparts (67% versus 94% in 2000), reflects the relatively large market impact of U.S. government spending on highly specialized software for space and defence applications. In the case of software developed on own-account, the relatively low share of the total accounted for by Canadian businesses compared to their U.S. counterparts

[12] *While the methodology here largely follows the U.S. Bureau of Economic Analysis (BEA), a few key differences between the two should be borne in mind when making comparisons. First, the effect of treating software as investment appears to have had a more substantial effect on GDP in the U.S. than in Canada. This stems in good part from differences in how software (purchased separately from hardware but reported as capital spending in organizations' accounting records) was treated in the U.S. and Canada prior to its inclusion in GDP as investment. It was explicitly reclassified as a current expense by the U.S. BEA while, at Statistics Canada, it was implicitly classified as hardware investment. Thus, in order to include software as investment in GDP, all business and government spending on software was added to GDP as 'new investment' by the U.S. BEA while, for Canada, only the non-capital spending is added. Second, trade in software services (as measured in Balance of Payments (BOP)) isn't taken into account in the U.S. work, while it's taken into account here. The BEA plans however to expand its coverage of software trade in the future. Third, the adjustment for custom-design software embedded in hardware and/or sold is more substantial for Canada than in the U.S. The adjustment here covers a range of industries and leads to a 10% reduction of custom software investment. In the U.S. case, the adjustment is limited to custom software inputs to the computer manufacturing industry only and has a negligible impact on custom software investment. Last, while the methodology for own-account investment is essentially the same, its total cost is estimated at just over twice the labour cost in the U.S., but only 1.5 times the labour cost here in Canada. Details of the U.S. methodology can be found in the Survey of Current Business, August 1998 and December 1999 issues, as well as the paper "Software Prices and Real Output: Recent Developments at the Bureau of Economic Analysis" (April 2000) by Robert Parker and Bruce Grimm. For a more recent summary, including an outline of planned improvements, see Carol Moylan, "Estimation of Software in the U.S. National Accounts: New Developments," for OECD Meeting of National Accounts Experts, Paris, September 2001.*

(67% versus 84% in 2000), partly reflects the greater tendency of governments in the U.S. to contract out to the private sector.

Software prices in both countries evolved in tandem over 1981-2000, with a steep decline for pre-packaged software, in quality-adjusted terms, a relatively flat profile for custom software and a near doubling of own-account costs. The relative (Canada-U.S.) price for pre-packaged software was only 5% higher in 2000 than in 1981, following an 81.7% decline in Canada over the entire period, versus a slightly greater 82.5% decline in the U.S. Prices for pre-packaged software in Canada fell more slowly than in the U.S. during the early eighties, more rapidly during the late eighties, and more slowly again through most of the nineties, reflecting movements in the exchange rate.[13] The relative (Canada-U.S.) price for own-account software stood about 6% lower in 2000 than in 1981, reflecting slower growth in the earnings of programmers and systems analysts in Canada compared to their U.S. counterparts, especially from the mid-eighties to the mid-nineties. The relative price for custom software moved in line with that for own-account.[14]

As a share of GDP and Gross Fixed Capital Formation (GFCF), in nominal terms, software investment in Canada has fallen well below its share in the U.S. throughout 1981-2000, an indication perhaps that Canada has lagged in terms of the computerization of the workplace.[15] In 1981 software investment accounted for only 0.3% of GDP in Canada, one-half its 0.6% share of GDP in the U.S. Since then software investment has grown against GDP in both countries, and Canada has narrowed the gap (at least in relative terms). By 2000, software investment accounted for 1.4% of GDP in Canada, nearly two-thirds of its 2.4% share in the U.S.

The growth of software investment in real, inflation-adjusted, terms has been nothing short of phenomenal. Over 1981-2000, software investment grew an average 4.2% per quarter in Canada compared to 3.7% in the U.S. Canada's edge during this period, is mostly attributable to its lead over the eighties, one that subsequently disappeared. During the 1980s, software investment in Canada outpaced that in the U.S. on average by 1.2 percentage points per quarter, with 5.1% quarterly growth in Canada versus 3.9% in the U.S.[16] The recession of the early nineties, which impacted the Canadian economy more severely, brought the growth in software investment down to 3.1% per quarter in Canada and 3.0% in the U.S. With the high-tech boom and software upgrades, replacements and preparations for Y2K in the latter half of the nineties (1996-2000), software investment regained momentum, rebounding to 4.2% per quarter in the U.S., slightly above the 4.0% growth posted in Canada.

Software investment contributed an average 0.03 percentage points to quarterly GDP growth in Canada and the U.S. over 1981-2000. With its growing share of GDP and the quickened pace of investment over 1996-2000, its contribution to GDP growth stepped up in both countries. Over this period, software investment contributed an average 0.05 percentage points per quarter to GDP growth in Canada, somewhat below its 0.06 percentage point contribution in the U.S.

[13] *The pre-packaged software price index for Canada is an exchange-rate adjusted version of the U.S. index.*

[14] *This is because the price index for custom software in both countries is a weighted average of the price indexes for own-account and pre-packaged software, with most of the weight (75%) on the former.*

[15] *In addition to differences in domestic price structures for software, this stands as a possible explanation for the different shares of pre-packaged and customized software in Canada and the U.S. in the early eighties. The rapidly developing innovations at that time in personal computers and pre-packaged software applications may have diffused more readily in Canadian workplaces than in the U.S., where heavier investments had already been made in mainframes and mini-computers and specialized software applications (which at one time had been the only software option). Hence, a higher share of pre-packaged software in Canada, and a lower share for custom software.*

[16] *The more rapid growth in Canada over this period reflects the relatively high share of pre-packaged software in the Canadian software investment mix. Because pre-packaged software has experienced a fall in its price relative to specialized software (custom and own-account), each dollar invested in it gives a bigger boost to growth, in real terms, than a dollar invested in specialized software.*

Chart 14

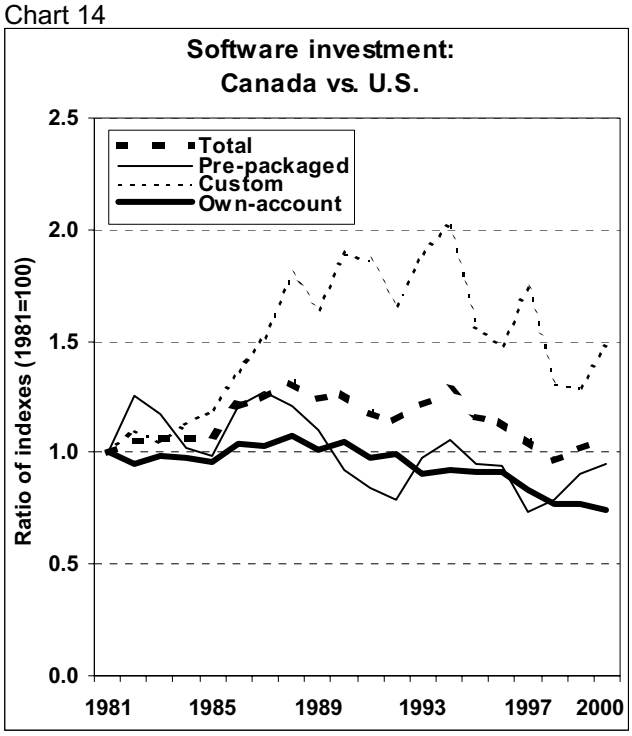


Chart 15

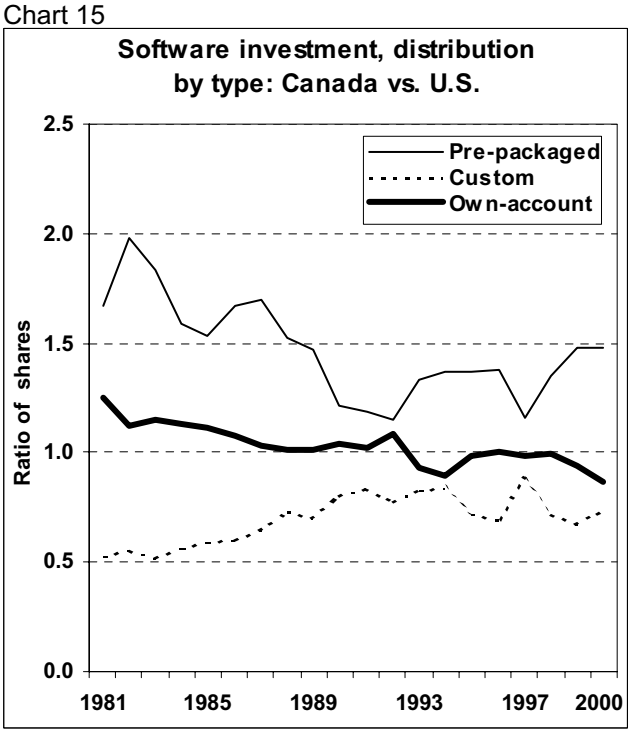


Chart 16

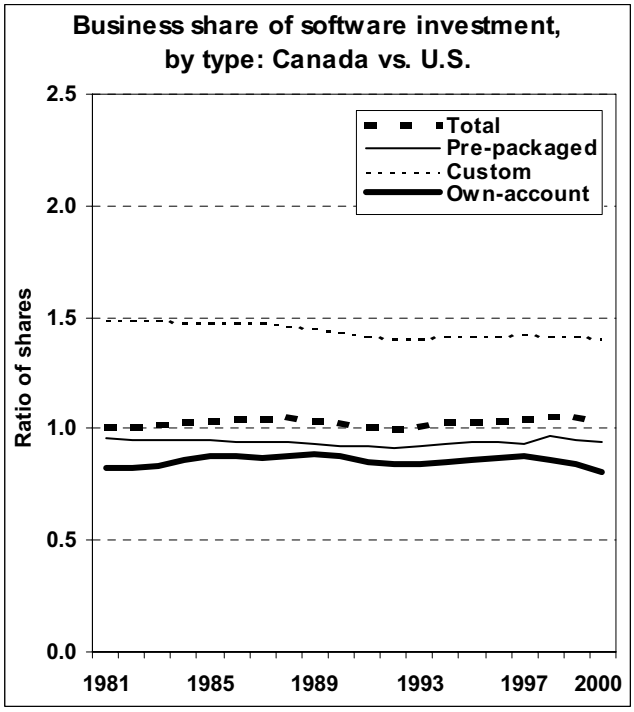


Chart 17

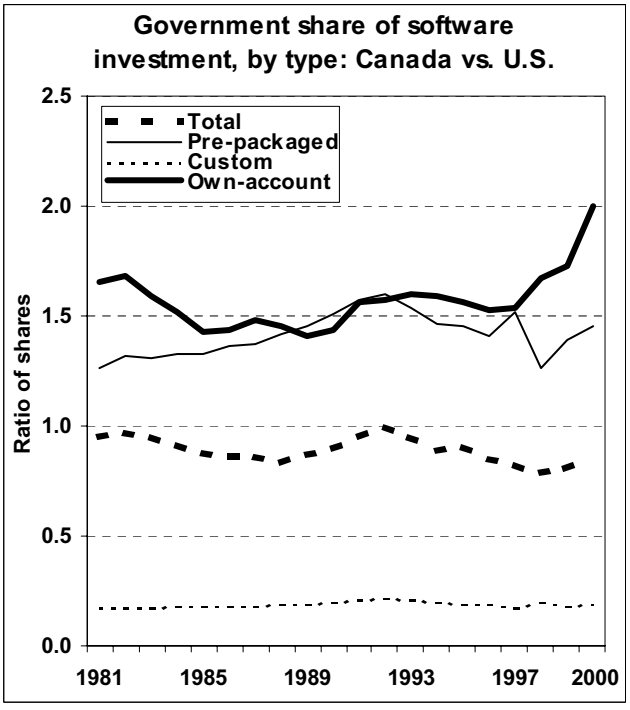


Chart 18

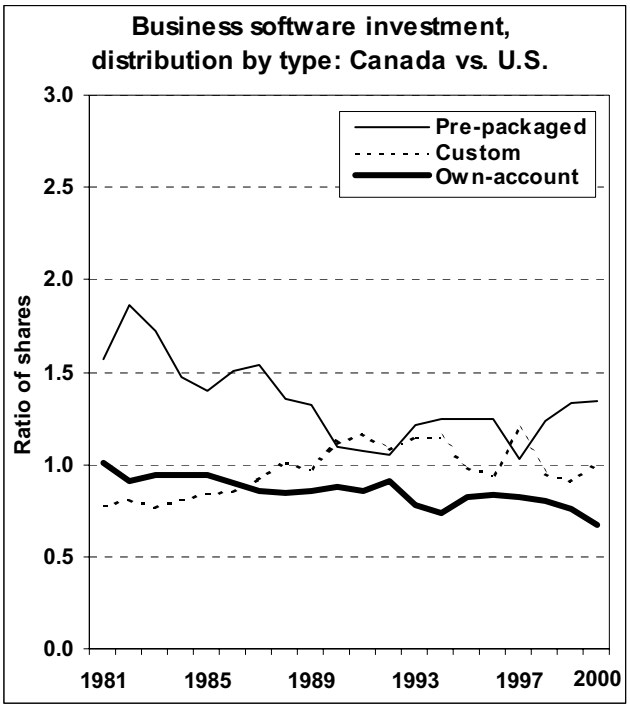


Chart 19

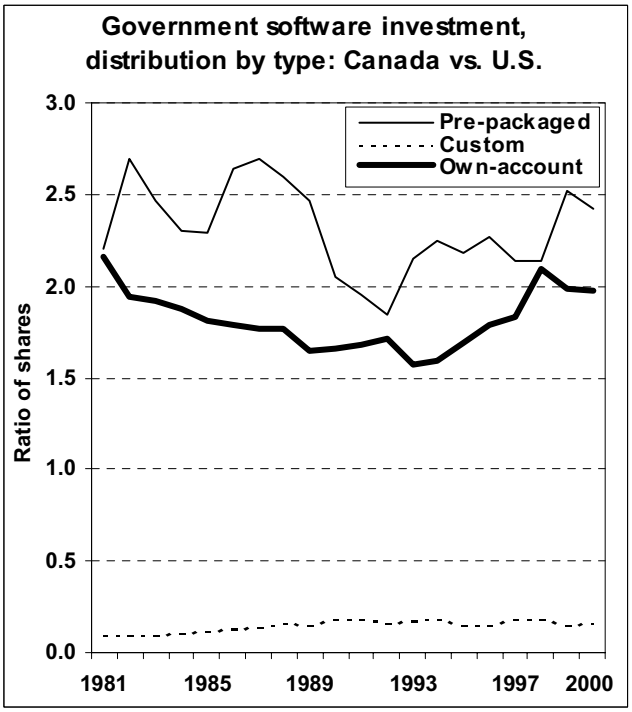
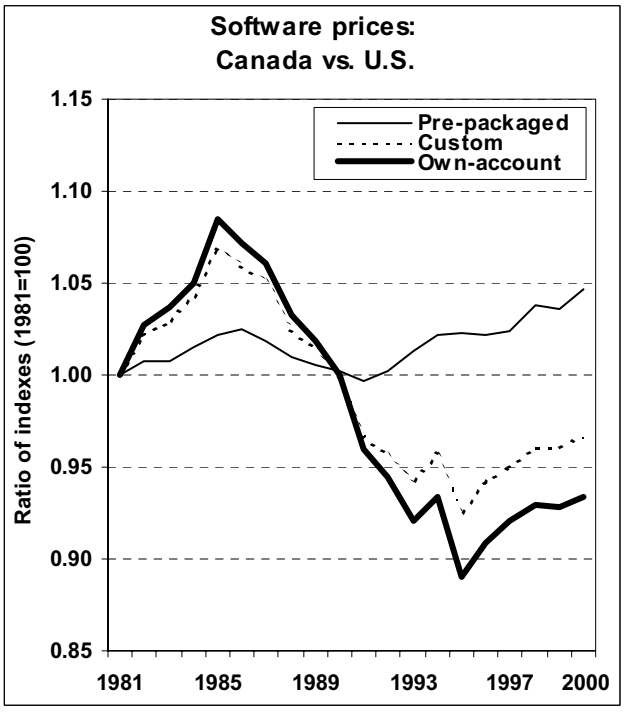


Chart 20



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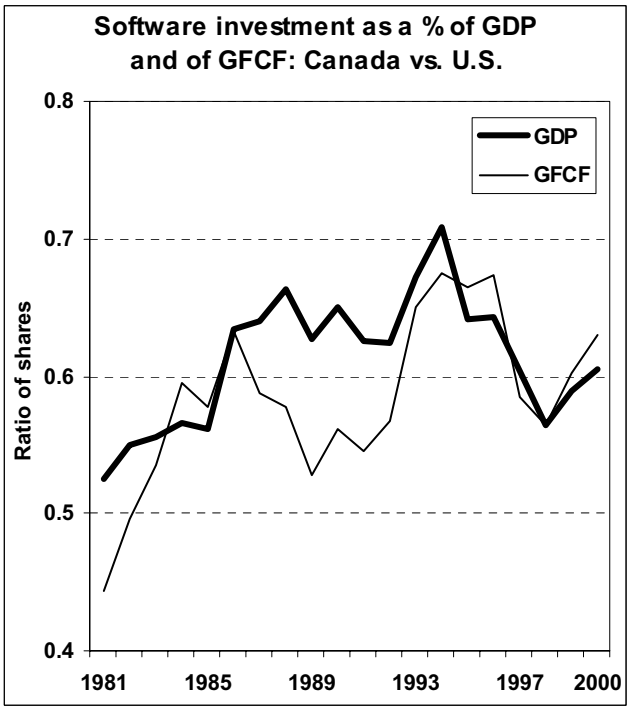


Chart 22

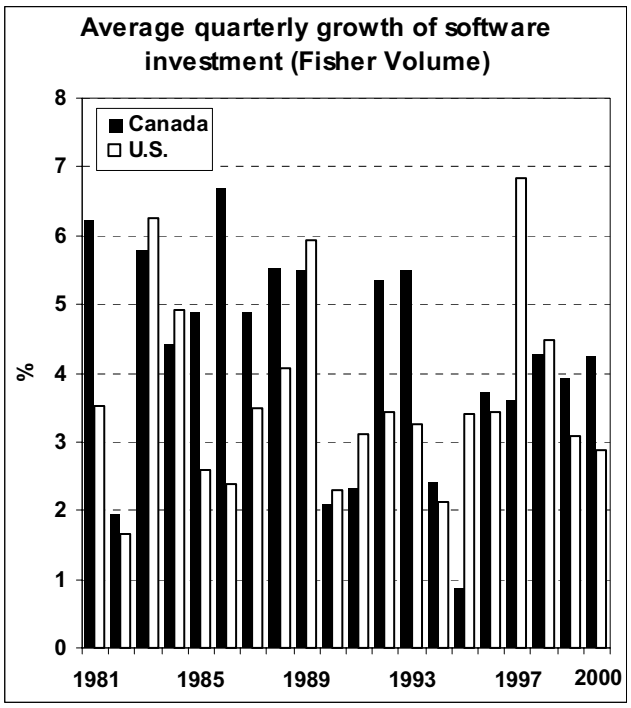
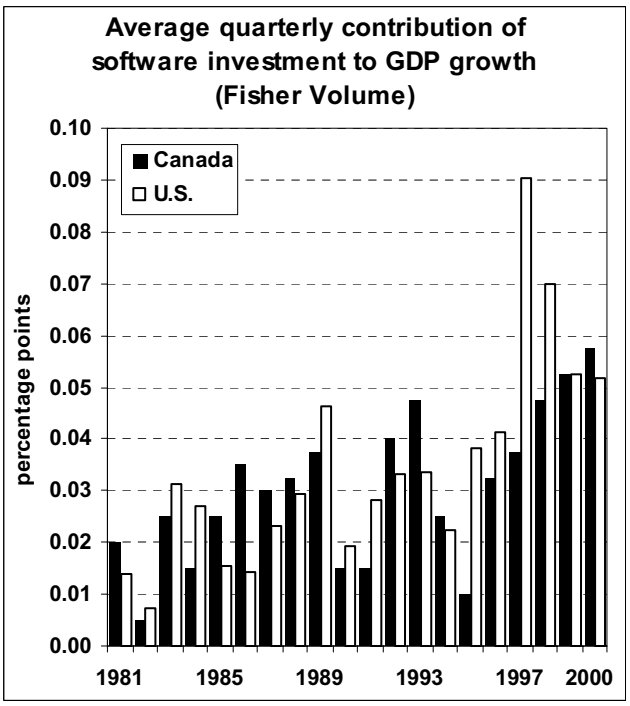


Chart 23



5.0 The estimation of software investment benchmarks for Canada

The following describes the sources and methods for software investment and its implementation in the Canadian System of National Accounts.

5.1 Purchased software

As mentioned above investment in prepackaged and custom-design software is derived indirectly via estimation of both the supply and demand for software. The supply consists of domestic production, plus imports, plus the wholesale, retail and tax margins on software sales in Canada. Investment in software is then determined as the amount that equates demand to supply or, more precisely, as the total supply of software net of the purchases by resident households and by non-residents.[17] The table below shows how this approach works in practice, using the 1998 benchmarks (reconciled with the I/O Accounts) as an example and omitting some of the details.

SOFTWARE COMMODITY-FLOWS, 1998 ($ millions)	
Domestic production	6389
+ Margins on domestic sales (incl. imports)	1728
+ Imports	2002
= Total supply of software	**10117**
- Exports	2151
- Personal expenditure	410
= Intermediate use of software (former accounting)	**7557**
- Software embedded in hardware	373
= **Investment in software (new accounting)**	**7185**
Note: Figures may not add due to rounding	

Domestic production of software (valued at producer prices, i.e., prices at the 'factory gate') includes receipts from sales as well as licensing of pre-packaged software and, in the case of custom software, it includes receipts from sales as well as royalties paid from abroad.[18] The main sources are Statistics Canada's annual surveys of Computer Services and of International Transactions in Commercial Services. Software Publishing (NAICS 511210) accounts for 85% of domestic production of pre-packaged software, while Computer Systems Design and Related Services (NAICS 541510) accounts for 92% of domestic production of custom software. As a whole, the computer service industries account for virtually all software production in Canada.[19]

Margins are added in order to balance supply with demand at prices paid by purchasers (which reflect additional distribution costs and taxes, on top of producer prices). The margin amounts

[17] *The change in software inventories is assumed to be zero, with the result that inventory change gets swept in with the estimates for investment.*

[18] *For custom software, which covers two revenue items on the 1997 and 1998 SCS ('custom software development' and 'contract programming'), systems and technical consulting as well as training and other professional services may be included if they are an integral part of the custom software development contract. Regarding integrated (hardware and software) custom products/services, the SCS asks to unbundle and include only that part of revenue attributable to customized software. In the case of pre-packaged software, the SCS collects information on revenue from multiple sale, rental, license or lease. It asks to include as well any revenue from sales of custom developed software to a client who intends to re-market as part of a software package. It might be considered useful to separate out revenues from software rentals and short term (i.e. less than one year) licenses/leases and exclude them (i.e., continue to treat them as intermediate expense, and not investment). However, while these items are covered by the survey, the details are not available. Moreover, at present, the rental of software is negligible and the vast majority of software license/lease arrangements are for terms of at least one year, so this is not a major problem for the estimation of software investment. Nonetheless, the technology is advancing such that software rental may become a more common practice, and thus present a measurement problem in the future. It would be useful to distinguish between revenues from (payments for) the right to use software and the right to replicate it for on-selling, enabling treatment of the former as investment and the latter as intermediate but, again, such details are not available on the survey (or from any other source). For now, the adjustment for embedded software serves to fill this data gap.*

[19] *This is considering only pre-packaged and custom-design software. Most own-account software is developed outside of the computer services industries.*

come from the I/O Accounts, which in turn draw on Statistics Canada's Wholesale and Retail Trade Surveys and detailed information on commodity taxes. In the case of custom-design, wholesale and retail channels are largely avoided, so the relatively low margins here reflect only taxes.

Imports cover merchandise imports of software as well as royalties paid to non-residents, in the case of custom software (from the surveys of International Transactions in Commercial Services).[20] Some 25% of software goods imports (1998) are actually customized software coming into Canada on physical media (e.g., tapes, diskettes). Since custom-software is viewed as a service, it is regularly removed from merchandise import data via a Balance of Payments (BOP) adjustment to avoid double-counting with BOP payments for computer services. The amount removed is included above as an import of custom software, while the amount left over is included as a pre-packaged software import.

Exports cover both merchandise exports and re-exports (which are treated here entirely as pre-packaged software), foreign receipts, excluding royalties, from custom software (from the Survey of Computer Services), as well as receipts of license fees and other software royalties paid from abroad (from the surveys of International Transactions in Commercial Services). Merchandise exports include a BOP adjustment, supplied by the U.S. BEA, which raises the Customs export values by over 50%.[21] The adjustment is to correct an underestimation stemming from media-valuation in the U.S. Customs data on imports of software (there's no similar concern with Canadian import data, where valuation is on content).[22] Receipts from license fees are wholly attributed to pre-packaged software, while receipts of other software royalties are attributed to exports of custom-design software.

Personal expenditure covers consumer spending on pre-packaged software, obtained from Statistics Canada's annual Survey of Household Spending. These figures exclude spending on electronic games (as do software imports and exports, where there's a separate set of codes to capture games, electronic encyclopedias, and the like).[23]

Regarding software that gets embedded in hardware (and counted as hardware investment), a deduction is made to avoid counting it a second time under software investment. There's no direct source of information for the amounts involved, so this deduction rests on assumptions that stand to be revisited. The deduction is arbitrarily set at 50% of the purchases of pre-packaged software by the computer manufacturing industry, on the assumption that this is the only industry engaged in purchasing and installing pre-packaged software in hardware and that some of its

[20] *There are some limitations with respect to coverage of the surveys of International Transactions in Commercial Services. First, in the case of site licenses for software, end-users who deal with Canadian distributors may consider the transaction to be with a resident and thus report no import, while distributors report only commission income, but no imports. A coverage adjustment is made for such transactions. Second, governments and non-profit organizations are not included in the surveys. Last, while the surveys cover business payments made abroad for software downloaded over the internet (in principle at least), such payments are not identifiable from imports of other computer services and thus not included above.*

[21] *In level terms this adjustment adds $50 to $60 million to software merchandise exports, a relatively small amount compared to over $2 billion in software service exports.*

[22] *The bulk of Canada's merchandise export data are based on US Customs data on imports from Canada, under a trade data exchange agreement. In the case of exports of pre-packaged software, the amounts reported in merchandise export statistics are substantially less than receipts reported to BOP surveys. This difference was thought to arise from an undervaluation of software in the former (i.e., it was thought that U.S. Customs valued imports of software at media-value). While this was partly the case, a significant difference remained even after correction to content-valuation. This turned out to be largely attributable to payments of license fees, captured only in the BOP surveys. The difference between software merchandise exports adjusted to content valuation and BOP receipts from pre-packaged software exports is now taken as a measure of receipts of license fees on exported software.*

[23] *While there is some domestic output of multi-media products (games, reference and educational material, etc.) the SCS 1998 picked up no revenue under this category. Whatever games production there is in Canada, it is relatively small, with little implication for the estimates of software investment. There is a small underestimation of software investment to the extent that some firms in the personal entertainment business (video arcades, casinos, etc.) invest in gaming software.*

purchases are for this purpose (and others for investment).[24] It is arbitrarily set at 40% of the purchases of custom-design software in printing, publishing & allied, machinery & transportation equipment, electrical and electronics and other manufacturing, as well as business services (which includes computer services), on the assumption that these industries embed some of their purchased custom software in their products.

Last, the investment in pre-packaged and custom-design software is split between business and government. Government investment is estimated from administrative data on software purchases, survey data on industry sales to government (Survey of Computer Services), and capital spending on software (CAPEX). Business investment is residually derived.[25] It might be noted that, starting in April 2001, the federal government has included capitalized software on its own books, thus providing a direct source of information for use in the GDP accounts.

5.2 Own-account software

There's no source of direct information on the value of in-house software developed for own-use. Thus, as is the practice elsewhere, own-account software investment is built up from estimates of the labour cost for persons engaged in software development. The estimates (which are done at a detailed industry and provincial/territorial level) are benchmarked on quinquennial Census of Population data on the annual aggregate wage and salary income of computer programmers and systems analysts.[26,27,28] These figures are raised for additional costs faced by

[24] With pre-packaged software, installation is almost certainly on computers and can only (or mostly) take place in a few industries (e.g., computer manufacturing, wholesale, retail). For customized software, however, embedding in hardware is taking place in a wider range of industries over a much wider range of products. Customized software may be just a few lines of code intended to perform very simple binary operations (switches) or it may be a more complex program embedded on a chip monitoring all on-board systems in an aircraft.

[25] As a result of this derivation, business investment includes purchases of pre-packaged and custom software made by non-profit organizations.

[26] The benchmarks here are based on 1991 and 1996 Census data for two occupations in Statistics Canada's Standard Occupational Classification, 1991 (SOC), 'computer systems analysts' (SOC C062) and 'computer programmers' (SOC C063). The former covers occupations 'primarily concerned with analyzing information processing or computational needs; designing computer systems which provide solutions to these problems or performing the needed computations; analyzing data bases; and supervising computer programmers. Also included are specialists in the development of computer languages and software packages.' The latter covers occupations 'primarily concerned with writing computer programs by coding sets of instructions into machine readable form. Computer programmers may specialize in writing programs suitable for a specific application such as business, commercial, scientific or engineering.' The two were combined as one occupation 'computer programmers, systems analysts and related' in the previous SOC 1980 used in the 1981 and 1986 Censuses. Some software development is no doubt carried out by persons in other occupations. For instance, 'software engineers' are included with the occupation grouping for 'computer engineers' (SOC C047), but cannot be separately identified (there were about 5,000 'computer engineers' in Canada in 1996, compared to some 150,000 computer programmers and systems analysts, so this is a relatively small exclusion). Also, and as is the practice elsewhere, the programming done by non-software professionals (e.g., economists and statisticians) is ignored in the calculations. On the other hand, some occupations falling within the 'computer programmer and systems analysts' groupings have little to do with software development, especially in the case of systems analysts. The extent of overestimation in this case is difficult to gauge.

[27] In addition to coverage of 'computer programmers' and 'computer systems analysts' as defined in the SOC, there are other reasons why the own-account benchmarks exclude the earnings of some 'software developers' while the earnings of some 'non-software developers' are included. Because the occupational variable on the census relates to the job held in the reference week (the week prior to the census) and the earnings variable relates to the reference year (the calendar year prior to the census), the earnings of someone who becomes employed as a programmer/systems analyst between the reference year and the reference week are included, even if this person had a different occupation in the reference year. Conversely, the earnings of someone who was a programmer/systems analyst during the reference year but who held a different occupation during the reference week are excluded. Similar effects occur in the case of someone with more than one job at the same time. In this case, a person's earnings from all jobs are included in the own-account benchmark if the main job is as a programmer/systems analyst, despite the fact that part of these earnings come from other jobs which need not be in the same field. If the main job is not as a programmer/systems analyst, no earnings are included in the benchmark, despite the fact that part of these earnings could stem from a second job as a programmer/systems analyst. These cases are deemed to be largely offsetting, having little implication for the own-account benchmarks.

[28] Benchmark estimates are based on the Census of Population question on wage and salary income earned in the Census reference year, selecting persons who (1) reported positive wage and salary income in the reference year, (2) reported at least one week of employment in the reference year and (3) who were classified as a computer programmer or systems analyst (either in the main job held in the reference week or, if none, in the main job held since January of the

employers, such as employment insurance, public and private pension plan premiums, etc. to arrive at a more comprehensive labour cost. [29] The table below shows the various steps for own-account for the most recent benchmark year, omitting some of the details.

OWN-ACCOUNT SOFTWARE BENCHMARKS, 1995 ($ millions)	
Labour cost for computer programmers and systems analysts	7117
- Deduction for work on software to be embedded or sold	3032
- Deduction for time spent on non-investment related work	2042
= Labour cost of own-account software development	**2043**
+ Cost of other inputs	939
= Investment in own-account software	**2982**
Note: Figures may not add due to rounding.	

A deduction is made (along the lines of the U.S. method) to avoid double-counting software to be embedded or sold, which is already accounted for under hardware investment or purchased software. In those industries not engaged either in producing software or embedding it in hardware, the labour cost for programmers and systems analysts is about 1% of all wages, salaries and supplementary labour income. This percentage is used to cap the labour cost of programmers and systems analysts in software producing and embedding industries, on the assumption that costs over and above this threshold are related to software production and/or embedding, not the everyday running, maintenance and development of software systems that is nowadays integral to operations in most industries.[30]

The cap results in an overall deduction of $3 billion (about 43% of the total labour cost attributable to programmers and systems analysts). Almost two-thirds of this deduction is centered in the computer service industries, which employ about one-third of all programmers and systems analysts. Labour income for the industry as a whole is about $4 billion (1995), 50% of which is attributable to programmers and systems analysts, well above the threshold value of 1%. Applying the cap to total labour income for the industry gives $40 million allowed as own account software development, while the remaining $1.96 billion in programmer and systems analysts labour income is removed to avoid double-counting with purchased software.

A second deduction is made to avoid counting the time spent on, and labour cost associated with, the routine running and maintenance of computer systems. It is assumed that only half of the work of programmers and systems analysts is on own-account software development and the rest on routine operations, leading to a further 50% reduction. This step simply repeats the U.S. BEA methodology which, in this case, is based on a study of how programmers spend their time.

Last, an amount is added for other, non-labour, costs of own-account software development. This is arrived at by examining the cost structure of a sub-sample of firms in the Survey of Computer Services who derive the majority of their revenues either from custom software development or contract programming. These 'custom software developers' are more labour

reference year). Note that the earnings from self-employment as a computer programmer/systems analyst are not included here, because these are covered already under purchases of customized software services.

[29] Anecdotal evidence suggests that computer programmers and systems analysts are much more highly compensated in the private sector than in the public sector. While all the censuses, 1981 through 1996, show higher annual earnings in the private sector, the gap is relatively small, 1% to 8%, declining since 1986, and more than explained by longer working hours. On an hourly basis, the census shows programmers and systems analysts earning 3% to 8% more in the public sector. The Labour Force Survey, which gives more recent data, show a small and declining gap in hourly earnings in favour of public sector programmers and systems analysts over 1997-2000, while (actual) weekly hours of work are about 10% higher in the private sector. One possible explanation for the divergence between the anecdotal evidence and the data is that stock options are not included in census income or LFS earnings data. No adjustment is made here for any gains on stock options, and this would seem to be a potentially significant omission. However, the stock option phenomenon is primarily associated with the information and communications technology sector, and most of the earnings of programmers and systems analysts working in this sector are excluded anyway, to avoid double counting.

[30] This departs somewhat from the U.S. approach. The BEA determines and applies the cap on employment of programmers and systems analysts, not on their labour income.

intensive than the industry as a whole, with labour costs averaging just over two-thirds of total operating expenses (i.e., non-labour costs are about 50% of the labour cost).[31] The estimate from the previous step is then raised by 50% to arrive at own-account software investment. This assumes that the cost structure facing custom software developers adequately represents the cost structure (i.e., the technology) for own-account software development across all industries (business and government); an assumption that merits further investigation.

5.3 Software prices

At present there's no made-in-Canada price index for pre-packaged software, although Statistics Canada is currently developing one aimed for release in 2002. In the meantime, an adjusted version of the U.S. BEA price index for pre-packaged software is used to fill the gap.[32] The price used to deflate pre-packaged software investment here is just an average of the U.S. BEA price index, weighted by the domestic share of supply to the domestic market, and an exchange-rate adjusted version of the same index, weighted by the import share of supply to the domestic market. It is assumed, somewhat controversially, that exchange rate fluctuations are fully passed through to the domestic price of imported software.

The price index used to deflate own-account software investment is a fixed-weighted average of an index of the average hourly earnings for programmers and systems analysts (established separately for business and government) and an index of the costs of non-labour inputs to the computer services industry, with weights of about two-thirds and one-third, respectively. The hourly earnings index is derived from and benchmarked on Census of Population data on the derived hourly earnings of programmers and systems analysts.[33] Fixed-weighted average hourly earnings indexes from the Survey of Employment, Payrolls and Hours are used to interpolate and extrapolate the benchmarks over 1981-97.[34] Average hourly earnings indexes from the Labour Force Survey are used to bring the indexes forward to the current year. It is assumed that there's no change in the productivity of programmers and systems analysts, an assumption that stands to be revisited.

The price index for non-labour inputs to own-account software development is the implicit price index for intermediate inputs to the computer services industry, obtained from the I/O Accounts up to 1997. From then on, it is updated with a Laspeyres (1997 fixed-weighted) price index for those inputs accounting for 1% or more of intermediate input costs.

Following the U.S. BEA methodology, movements in the price index for custom-design software are derived as a weighted average of the changes in the price indexes for pre-packaged software and own-account software development, with arbitrary weights of 25% and 75%, respectively.

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[31] On the valuation of software, the SNA93 (10.92) says "software purchases on the market is valued at purchaser's prices, while software developed in-house is estimated at its basic price, or at its costs of production if it is not possible to estimate the basic price". The mark-up here covers occupancy costs, utilities, property taxes, permits and licenses, materials and supplies and intermediate business services, depreciation, insurance, interest and bank charges, management fees, development charges and royalties among other (non-labour) expenses. Software that continues to be treated as intermediate is covered by the mark-up. There is no mark-up for advertising and promotion expenses, on the grounds that own-account software is not marketed. And while there is a mark-up for the depreciation component of gross operating surplus, there is none for a net profit margin.

[32] This index has several parts: the BEA price index for computers and peripherals in private fixed investment (1981-84); an average of the BEA hedonic price index and a matched model price index for spreadsheets and word-processors (1985-93); the BEA matched-model price index (bias-corrected) for selected pre-packaged software (1994-97); and the U.S. Bureau of Labor Statistics producer price index (bias corrected) for pre-packaged applications software (1998 on).

[33] Hourly earnings of programmers and systems analysts are derived from census variables on their annual wage and salary income and their annual weeks of work (for the reference year) and their actual weekly hours of work (for the reference week). The actual weekly hours variable is taken as an approximation to the average actual weekly hours of work during the reference year.

[34] SEPH data only go back to 1983. The indexes are carried back to 1981 by linear extrapolation.

5.4 Software already capitalized

Prior to 1998, and going back to 1988, Statistics Canada's Survey of Capital and Repair Expenditures (CAPEX) had listed 'software' only as an item to be included under a broader asset category which up until now has been identified as 'computer hardware'. Insofar as organizations have been capitalizing software (purchased separately from hardware) and reporting this capital spending under the broader 'computer hardware' asset category, there's a double-count of software between the estimates discussed above and previously published estimates of investment in office machinery and equipment. This is quite apart and different from the issue of double-counting software that is physically embedded in hardware.

To avoid this double-count, a deduction is made to hardware investment, arrived at as follows. Results from a follow-up survey with CAPEX respondents who reported software, seeking a breakdown of their capital outlays by type (pre-packaged, custom-design, own-account), are used to breakdown the 1998 CAPEX software total to estimate capital spending by type of software.[35] These estimates are compared to capital plus non-capital spending to establish the fraction of spending on software (by type) that is capitalized.[36] These 'capitalization ratios' are assumed to have been constant over 1988-1997, and applied to the software investment series to arrive at capitalized software deemed to be previously reported to CAPEX but under hardware investment. Starting with reference year 2000, CAPEX will gather details of capital spending on software by type, allowing for continuing updates of these ratios.

Prior to 1988, CAPEX made no mention of software in the description for the hardware asset category, and it is unclear how respondents with capital spending on software would have reported it, if at all. Rather than drop the adjustment altogether, which would create a significant break in the hardware series, the capitalization ratios are gradually reduced going back to 1981 to half their initial values.

This deduction is allocated to the business and government sectors on their respective shares of hardware investment, in the case of purchased software, and 100% to the business sector, in the case of own-account.

5.5 Software capital stocks and capital consumption

Software capital stocks are estimated using the Perpetual Inventory Method (PIM), with straight-line depreciation, assuming service lives of 3 years (pre-packaged) and 5 years (own-account and custom-design). The service lives used here are the same as in the U.S., and are consistent with results on lives found in CAPEX and the follow-up.[37] The stocks are built up from the software investment series, net of the reduction to the hardware investment series.[38] Initial

[35] *The follow-up was faxed out and gathered usable information from 72 out of 116 respondents who had reported software capital spending to both the 1998 and 1999 CAPEX. It asked for a breakdown of capital spending by type of software, whether and how much software was expensed and about expected useful lives for capitalized software. Unsolicited comments were received on rules for capitalization of software indicating a variety of practices including varying thresholds over and above which a software purchase would be capitalized as well as different treatments depending upon the type of software (e.g., custom-design would be capitalized and pre-packaged would be expensed). Some 90% of respondents reported capital spending on pre-packaged software, 62% reported custom-design, and 25% reported capitalized own-account software. About two-thirds of respondents reported both expensed and capitalized software.*

[36] *For pre-packaged software the fraction is 0.36. In other words, the part of total capital spending on software reported to CAPEX 1998 attributed to pre-packaged amounted to 36% of the estimate for pre-packaged software flowing from the commodity balancing exercise. The ratios for custom-design and own-account software are 0.21 and 0.18 respectively. Ideally, these ratios would have been established by sector and even industry, but owing to the relatively small sample this was not possible. For reference year 2000, CAPEX will gather details on capitalized software by type, and given the larger sample, it will be possible to investigate sector and industry variation, if any, in the propensity to capitalize.*

[37] *In the 1998 CAPEX, 30% of respondents with capital spending on software reported a three year expected useful life for software, 40% reported a five year life. In the follow-up survey, the modal expected useful life reported for own account and custom software was five years, and for pre-packaged, three years.*

[38] *Ideally, estimates of gross stocks of software and stocks of software already capitalized, employing software price indexes and service lives for the former and hardware price indexes and service lives for the latter would have been*

stocks for 1981 are obtained via PIM by carrying the software investment series back (on their growth over 1981-82) to 1978 or 1976, depending on the service life. Estimates for capital consumption, coming out of PIM, are on an historic cost basis for the business sector and a replacement cost basis for the government sector. This is in line with the estimates of business and government CCA currently in the accounts.

6.0 The estimation of annual and quarterly, industry and provincial time series for software investment

While the general approach described above applies to the full time series, sources and methods vary over time due to data gaps in earlier periods or because survey results are not yet available for more recent years. Appendix Tables A.1-E.1 and A.3-E.3 give details for the annual, national software investment series 1981-2000, while Tables A.3-E.3 include details on the quarterly, national series for 1997 onwards. The following summarizes these details and discusses briefly the industrial and provincial/territorial distribution of software investment for the I/O Accounts and the Provincial Economic Accounts.

6.1 Annual national estimates by sector

On the supply-side, domestic production 1986-98 for pre-packaged and custom software come from the I/O Accounts and the Survey of Computer Services (SCS), respectively. Selected receipts from the SCS (1981-85) are used to carry these series back to 1981. Payroll data from the Survey of Employment, Payrolls and Hours (SEPH) for the Software Publishing and Computer Design and Related Services industries, respectively, are used to carry them through to 2000. Margins on pre-packaged software are estimated as a fixed percentage of domestic sales, with the percentage based on I/O data for 1997-98. For custom software, they are set at the same rate as margins on 'professional and processing computer services' with the 1997 rate held up to 2000. Merchandise imports of software (including custom software on physical media) come from Customs data from 1996 on. This series is taken back to 1988 on imports of all commodities that 'include software' (according to HS commodity descriptions),[39] and by linear extrapolation back to 1981. Custom software is deemed to make up 25% (based on the 1996-99 data) of software merchandise imports over 1981-95. Software royalties paid abroad 1990-2000 from BOP are carried back to 1981 on custom software imports.

On the demand-side, merchandise exports of software (treated as pre-packaged) come from Customs data for 1997 on. Custom software exports for 1997-98 are from the SCS, carried to 2000 on BOP computer services receipts. Both series are taken back to 1981 on foreign revenues from the SCS. The BOP adjustment for under-valuation of software merchandise exports, available for 1989-2000, is set at 57% for 1981-88, with the percentage based on 1989 data. License fees for prepackaged software and other software royalties from abroad for 1990-2000 are from BOP. The former series is carried back to 1981 assuming a fixed ratio to merchandise exports at content-value, with the ratio based on 1990 data. The latter series is set equal to 28% of custom software exports for 1981-89, with the percentage based on 1990 data. Last, personal expenditure on software comes from the I/O Accounts (1981-98), from the SHS,

calculated, although this approach turned out to be difficult to implement. Subsequent to the preparation of these estimates however, Investment and Capital Stock Division (ICSD) of Statistics Canada revisited and resolved this problem on a gross as opposed to a net basis. Their estimates for more recent years will be incorporated into the SNA on an on-going basis. Their estimates for the back-period (1981-1997) will be incorporated at the earliest opportunity. It might be noted that ICSD employed the PIM method, the same life assumptions and the same prices as employed here. Moreover, it prepared estimates according to three forms of depreciation, straight-line, infinite geometric and hyperbolic.

[39] *Software has been essentially identified in merchandise import statistics since 1996. Prior to then it is listed under several HS codes going back to 1988, but can't be separately identified from recorded tapes/discs in general. Software wasn't even mentioned in earlier Canadian import classifications. Examination of the import data 1996-1999 on software and those commodities with which software had formerly been grouped (i.e., other recorded tapes/discs) showed that software imports, on average, were growing about 3.3 percentage points faster. This is assumed to have been the case over the period 1988 through 1995, and a corresponding adjustment is made in carrying back the software import series.*

1999, and is grown to 2000 on personal expenditure on 'office machines and equipment' from IEA.

The adjustments for software embedded in hardware are based on I/O data for 1981-97. For pre-packaged software, a negligible amount, is trended forward for 1998-2000 on a judgmental basis. The adjustment for custom-design is set at 11% of domestic sales for 1998-2000, with the percentage based on 1997 data.

Government investment is built up from two series, for both pre-packaged and custom, one for software already reported as capital spending and one for non-capital spending. As mentioned earlier, the former is arrived at by allocating estimates for total software already capitalized to government and business on their respective shares in hardware investment. The latter series is obtained as a fixed percentage of total investment, in software of each type, with the percentages based on I/O data for 1997-98. The series for business investment are residually derived.

The own-account benchmark estimates for 1981, 1985, 1990 and 1995, follow the steps outlined earlier.[40] The adjustment for other employer costs increases over time, from 10% of gross wages and salaries in 1981 to 14% in 1995. The adjustment for work on software to be embedded and/or sold also rises over time, from an overall deduction of 34% in 1981 to 43% in 1995. The deduction rises through time because employment of programmers and systems analysts is increasingly concentrated in the computer service industries, where almost all their labour cost is removed to avoid double-count. The 50% reduction to avoid counting routine, non-development work is made in each year, [41] as is the 50% add-on for other non-labour costs. This add-on is fixed for 1981-1997, but will be updated for more recent years on the latest SCS results with annual revisions of the accounts.

Inter-censal estimates are obtained by straight-line interpolation, between benchmarks, of the ratio of own-account investment to labour income by industry, with the interpolated ratios then applied to labour income. For 1996 and 1997, the 1995 benchmark ratios are used. Thereafter, business own-account investment is raised from 1997 levels on annual Labour Force Survey (LFS) data on the growth of aggregate earnings of programmers and systems analysts employed outside of the public sector and, to avoid double-count, outside of the computer service industries.[42] Own-account investment in the government sector is grown on the earnings of programmers and systems analysts employed there. This assumes a fixed distribution of own-account investment across industries within each sector, to be revised when the 2001 Census data become available.

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[40] Two special steps should be noted. First, the 1981 estimate is based on 1980 earnings data from the 1981 Census (the Census asks for earnings in the previous year) indexed one year ahead in order to start the investment series in 1981. Second, a switch from the 1980 Standard Occupation Classification (SOC) to the 1991 version during the 1991 Census (which is double-coded to both versions) shows lower estimates (10% lower) for 'computer programmers' and 'systems analysts' as defined in the 1991 SOC. Using the double-coded results, the 1981 and 1985 estimates are ratio-adjusted (i.e., reduced) to be comparable with the subsequent estimates on a 1991 SOC basis.

[41] The implicit assumption that this 'ratio' doesn't change significantly over time is particularly suspect in and around the year 2000. Leading up to Y2K many own-account software development projects were likely put on hold as programmers and systems analysts became increasingly focussed on Y2K priorities. Since then, there has been a return to business as usual, with programmers/analysts devoting more of their time to development projects as opposed to Y2K. An adjustment is however made to remove a significant jump in employment of programmers and systems analysts in the public sector in 1999, which was thought to be clearly Y2K induced. This is tantamount to adjusting the ratio to remove Y2K effects.

[42] The earnings of programmers and systems analysts in the computer services industries is not included because, as mentioned earlier, most of these earnings are kept out of the own-account software estimates to avoid double-counting with purchased software. Insofar as the preparation (assessment, testing, patching, etc.) for Y2K was contracted out to computer services firms, this exclusion serves to temper Y2K effects on the own-account estimates for the business sector. The growth of private sector employment of programmers and systems analysts more than tripled between the first and second half of the nineties, from an average 5% per year over 1990-1994 to 16% over 1995-1999. All of this increase came in the computer services industries, where the growth of employment of programmers and systems analysts more than doubled, from 13% per year in the first half of the nineties to 27% in the second. In contrast, the employment of programmers and systems analysts in the rest of the private sector was relatively flat, growing an average 1% per year in both the early and late nineties. It is this latter, modest employment growth that drives the increase in the business sector own-account software in the late nineties (along with increases in the hourly earnings and the hours of work of programmers and systems analysts outside of the computer services industries).

6.2 Annual national estimates by industry

Annual estimates of supply and intermediate use have been built up from the commodity level for each industry in the I/O Accounts for 1981-1998. 'Software products development', a service commodity in I/O which formerly covered only pre-packaged software, is redefined to include pre-packaged software, custom-design (formerly part of the commodity 'professional and processing computer services') and own-account software (a new entry in the I/O system). In addition, some traded software is retained under the commodities 'recorded media' and 'royalties and license fees'.[43] Software purchased by businesses that is embedded in hardware and re-sold continues to be treated as intermediate consumption of the commodity 'software products development', and is allocated entirely to the computer services industries (on software expenses reported to the SCS).

The amounts now recorded as investment in 'software products development' for each business sector industry start from pre-packaged and custom-design software expensed. For 1981-1997, this is re-classified to investment from intermediate use for each industry (as estimated under the former accounts' definition).[44] For 1998, its industry distribution is based on SCS data on sales by client industry. Added to this is capitalized software. For 1981-1997, this is re-classified from hardware to software investment, and allocated across industries on the distribution for computer hardware investment. For 1998, the CAPEX estimates for capital spending on software by industry (and province/territory) are classified directly as software investment. Last, own-account software, which is determined at a detailed industry (and provincial/territorial) level, is added. Software retained under 'recorded media' and 'royalties and license fees' is also re-classified from intermediate use to investment. It is allocated across industries on the distribution of investment in pre-packaged software, in the former case, and on the industry distribution of software royalty payments from BOP, in the latter.[45]

Estimates of software investment for government sub-sectors for 1997 and 1998 are based on administrative data on software purchases, SCS data on industry sales to government and capital spending on software (CAPEX). Each sub-sector's share of government software purchases over this period is assumed to hold back to 1981. These shares are determined separately for expensed pre-packaged software, expensed custom-software, and capitalized purchases of software. They are applied to government sector capital and non-capital spending on pre-packaged and custom-design software (discussed earlier) over 1981-1996 to arrive at sub-sector details for investment in purchased software. Own-account software investment by government 1981-1998 is built up from the detailed sub-sector level, as discussed earlier.

6.3 Annual provincial/territorial estimates

Annual estimates for software investment at current prices are also built up by province and territory, as well as by industry, in the I/O Accounts starting with 1997 and presently up to 1998. These estimates are carried back to 1981 and forward to 2000 in order to incorporate software investment in the Provincial Economic Accounts. No deduction is required from hardware investment for software already capitalized in the PEA, because these accounts carry only aggregated information on investment by broad asset category. Instead, only a net addition is made to investment in machinery and equipment for the software expensed by organizations

[43] *It was not possible to re-classify all software under the 'software products development' commodity and at the same time maintain the historical series on Canada's trade in goods and in services. To maintain these totals, some software is retained under the good 'recorded media'.*

[44] *All of the former intermediate use of pre-packaged software, by industry, is reclassified as investment. However, because custom-design software was formerly part of the broader commodity 'professional and processing computer services', its use as an intermediate input was not explicitly identified. The amounts removed from intermediate use of this broader commodity are such that the national totals for software investment are satisfied. The distribution of this 'custom-design' component across industries is proportional to hardware investment by industry.*

[45] *The software retained under these two commodities is identifiable from other recorded media and other royalties and license fees in that only the software is classified as investment.*

(software capitalized by organizations is already included as investment in machinery and equipment).

The national I/O industry benchmarks for purchased software that is expensed (i.e., software investment net of own-account and software already capitalized, and excluding software that continues to be treated as intermediate) are distributed on industry GDP by province and territory, for 1984-1996. The 1984 results are carried back to 1981 on labour income by industry, province and territory, and constrained to meet the national I/O industry benchmarks for 1981-1983. [46] The 1998 benchmarks are carried forward to 2000 on real GDP by industry, province and territory, and constrained to satisfy the national estimates for the business and government sectors.

In the case of own-account software, the national estimates are allocated across the provinces and territories on the provincial/territorial distribution of wages and salaries of computer programmer and systems analysts within each industry. The distribution for each industry is based on census benchmarks for 1980, 1985, 1990 and 1995, interpolated between adjacent census benchmarks, for inter-censal years, and follows the 1995 distribution in the post-censal years through to 1998. For 1999-2000, LFS data on the aggregate earnings of computer programmers and systems analysts in the business sector (excluding the computer services industries) and in the government sector, by province, are used to distribute the national estimates for business and government own-account software investment.[47] These provincial distributions will be updated in the future with the results from the 2001 census.

Estimates at constant 1997 prices are arrived at by deflating the net addition to investment in machinery and equipment for software at current prices in each province/territory by the national implicit price index for all three types of software combined. There is room here for improvement in the future with the incorporation of provincial/territorial prices for each type of software.

6.4 Quarterly national estimates by sector

For 1981 to 1996, investment in purchased software and software already capitalized are both patterned after quarterly hardware investment, by sector. This is the case with the current and constant price, seasonally adjusted and unadjusted series, where the corresponding hardware series is used as a quarterly distributor. Regarding own-account, at current and constant prices, investment is equally distributed across the quarters within the year for both business and government (resulting in no seasonal pattern here). Quarterly price indexes, seasonally adjusted and unadjusted, are derived implicitly from the corresponding current and constant dollar software investment series.

From 1997, and reflecting the greater availability of quarterly data, the methodology is quite different. Rather than distributing the 'bottom-line' investment series (pre-packaged and custom), the various components of the commodity flow balances are estimated quarterly, on a seasonally adjusted and unadjusted basis. The quarterly software investment series fall out of the corresponding balances. Own-account investment is distributed on the quarterly earnings of programmers and systems analysts, by sector, available from the LFS starting in 1997 (introducing a seasonal pattern to the series). Last, the quarterly software price indexes are constructed and seasonally adjusted directly rather than being derived implicitly as in the back-period 1981-1996. The quarterly constant price series, seasonally adjusted and unadjusted, are

[46] *In order to determine software capital consumption, by province/territory, for business sector industries (as well as for government sub-sectors), the investment series (net of software already capitalized) are carried back even further to 1976 (own-account and custom-design) and 1978 (pre-packaged). This is done on the basis of labour income by industry, province and territory. The results are constrained to meet the national estimates for investment in each type of software, by sector, established to calculate software capital consumption at the national level.*

[47] *Yukon and the Northwest Territories are assumed to maintain their 1998 shares (which are based on the census benchmark for 1995) through 1999-2000, and LFS shares for the provinces are adjusted downwards accordingly. It might be noted that from 1999 on, estimates are made for the Northwest Territories (incl. Nunavut), and then split into Northwest Territories (excl. Nunavut) and Nunavut on the basis of each territories' share of GDP, by industry.*

derived implicitly from the corresponding current dollar software investment series and the software price indexes.

The software trade components of the pre-packaged and custom-design commodity flow balances are available quarterly, up to the current quarter. For other components, however, the estimates are obtained by distributing the annual on some quarterly indicator variable or by assuming that annual relationships between variables hold on a quarterly basis. Domestic production of pre-packaged software, for instance, is distributed on the quarterly payroll of the software publishing industry from SEPH. Likewise, personal expenditure on pre-packaged software, domestic production and exports of custom software, are distributed on the quarterly patterns of related indicators (see Tables A.3 and B.3). The quarterly investment in pre-packaged software of government and business, on the other hand, relies on the assumption that each sector maintains its annual share during each quarter. Likewise, the quarterly series on margins, the adjustment for embedded custom software and software already capitalized are all obtained on the assumption of fixed ratios from the most recent annual benchmarks (see Tables A.3 and B.3). These ratios are updated as new benchmark data become available.

Last, the sources and methods for 2000 (as detailed in Tables A.3-E.3) carry forward to the current quarter of 2001. Some series are available for the current quarter (e.g., software trade), others are brought forward either on the indicator series used to obtain their quarterly distribution in 2000 or on the assumption that relationships between variables observed in 2000 hold into 2001.

Table A.1: Pre-packaged software

$ millions

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Domestic production	98	153	203	278	332	450	525	673	851	927
+ Net imports (1)	30	35	39	43	52	59	75	66	74	71
+ Margins on sales to domestic market	71	105	134	178	213	281	332	409	512	553
= Supply to Domestic Market	**199**	**293**	**376**	**499**	**597**	**790**	**931**	**1148**	**1436**	**1551**
- Personal Expenditure	8	9	13	27	36	48	64	84	106	133
- Adjustment for software to be embedded	0	0	0	0	0	0	0	1	1	1
= Investment in pre-packaged software	**191**	**284**	**363**	**472**	**561**	**742**	**867**	**1064**	**1329**	**1417**
Of which:										
Government	32	49	62	82	98	133	157	195	247	268
Business	159	236	300	390	463	609	710	868	1082	1149

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Domestic production	976	1135	1604	1863	1918	2321	2491	3179	4005	4648
+ Net imports (1)	12	-47	-65	16	52	86	-63	-52	-40	-41
+ Margins on sales to domestic market	547	602	851	1040	1090	1332	1406	1669	2195	2550
= Supply to Domestic Market	**1535**	**1689**	**2390**	**2920**	**3060**	**3740**	**3834**	**4795**	**6160**	**7158**
- Personal Expenditure	151	179	192	231	242	369	389	410	464	492
- Adjustment for software to be embedded	1	1	2	4	6	11	11	12	13	14
= Investment in pre-packaged software	**1383**	**1509**	**2195**	**2686**	**2812**	**3360**	**3434**	**4373**	**5682**	**6652**
Of which:										
Government	269	292	409	476	497	572	632	664	955	1127
Business	1114	1217	1786	2210	2315	2788	2802	3709	4727	5526

1) Net imports = merchandise imports - BOP adjustment for custom-design imports - merchandise exports - BOP adjustment for undervaluation of exports - license component of pre-packaged exports.

Table A.2: Pre-packaged software, 1981-1996

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Domestic production (1)	Carried back from 1986 on growth of selected receipts (SCS)					Gross output of I/O commodity 634 at producer prices										
+ Margins	Estimated as 55% of supply to domestic market (net of margins), % based on average of 1997-98 annual benchmarks															
+ Merchandise imports (2)	Linear extrapolation from 1988 of growth rates over 1988-99								Carried back from 1996 on growth (raised by 3.3 % points) of imports of commodities that include software						Same as 1997	
- BOP adjustment for custom-design imports	Estimated as 25% of merchandise imports, % equals average over 1996-99														Same as 1997	
= Total supply																
- Merchandise exports	Carried back from 1997 on growth of foreign revenues of computer services industry (SCS)															
- BOP adjustment for undervaluation of exports	Estimated as 57% of merchandise exports, % based on 1989 annual benchmark									Annual data supplied by U.S. BEA						
- License component of pre-packaged exports	Estimated as 1.2 X merchandise exports, at content-value, in current and past two years, ratio based on 1990 annual benchmark										Annual data from BOP surveys of International Transactions in Commercial Services					
= Supply to Domestic Market																
- Personal Expenditure (3)	PE on I/O commodity 575					PE on I/O commodity 634										
= Intermediate use (former accounting)																
- Adjustment for software to be embedded	Assumed to be zero (negligible in 1986)					50% of intermediate use (purchasers prices) of I/O commodity 634 in computer manufacturing (I/O industry 128)										
= Investment in pre-packaged software																
Of which:																
Government	Estimated as 12% of total pre-packaged software investment, % based on average of 1997-98 annual benchmarks, plus government share of pre-packaged software already capitalized															
Business	Residually derived as total investment in pre-packaged software investment minus government investment in same															

1) *Survey of Computer Services (SCS). I/O commodity 634 is 'Software Products Development' or pre-packaged software for 1986-96. For 1997-98, this commodity has been redefined to include own-account and custom software.*
2) *Over the period 1988-1995, software is listed under several HS (Harmonised Commodity Classification System) codes, but cannot be separately identified from recorded tapes/discs in general. The 3.3% points added here, reflects the annual average difference in the growth of imports of this broader set of commodities compared to software over 1996-1999.*
3) *Personal Expenditure (PE); I/O commodity 575 is "Software development, computer service, and rental" which in the case of personal expenditure covers only pre-packaged software.*

Table A.3: Pre-packaged software, 1997-2000

	1997	1998	1999	2000
Domestic production (1)(2)	Gross output of I/O commodity 634, net of own-account & custom software, distributed quarterly as in 1999-00		1998 benchmark projected and distributed quarterly on wage bill for Software Publishing (NAICS 5112) from SEPH	
+ Margins	Margins on I/O commodity 634, ex. custom software, distributed quarterly on supply to domestic market (net of margins)		Estimated as 55% of supply to domestic market (net of margins), annually and quarterly	
+ Merchandise imports	Monthly Customs data on software imports			
- BOP adjustment for custom-design imports	Monthly Customs data on selected software imports			
= Total supply				
- Merchandise exports	Monthly Customs data on exports plus re-exports of software			
- BOP adjustment for undervaluation of exports	Annual and quarterly data built up from monthly data supplied by U.S. BEA			
- License component of pre-packaged exports	Annuals from BOP surveys of International Transactions in Commercial Services, with quarterly values interpolated on more aggregate information from quarterly BOP surveys			
= Supply to domestic market				
- Personal Expenditure (3)(4)	PE on I/O commodity 634, distributed quarterly with PE on 'office machines and equipment' (JT022) from IEA		Annual from SHS, distributed quarterly with JT022	1999 annual projected & distributed quarterly with JT022
= Intermediate use (former accounting)				
- Adjustment for software to be embedded	Same as 1996, equal distribution by quarter	Judgmental trend estimate for annuals, with equal distribution by quarter (small amounts)		
= Investment in pre-packaged software				
Of which:				
Government	Annual benchmarks from I/O, distributed quarterly on total investment in pre-packaged software		12% of investment in pre-packaged + government share of pre-packaged already capitalized, annually and quarterly	
Business	Residually derived as total prepackaged software investment minus government investment in same			

1) *I/O commodity 634 is 'Software Products Development' or pre-packaged software for 1986-96. For 1997-98, this commodity has been redefined to include own-account and custom software.*
2) *Survey of Employment, Payrolls and Hours (SEPH).*
3) *Income and Expenditure Accounts (IEA).*
4) *Survey of Household Spending (SHS).*

Table B.1: Custom design software

$ millions

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Domestic production (1)	175	205	221	289	343	452	551	866	834	1062
+ Net imports (2)	77	94	110	131	167	197	248	261	328	391
+ Margins on sales to domestic market	3	3	4	5	6	5	6	9	9	12
= Supply to Domestic Market	**254**	**303**	**335**	**424**	**517**	**653**	**805**	**1136**	**1171**	**1464**
- Adjustment for software to be embedded	20	23	27	34	47	50	63	91	101	122
= Investment in custom-design software	**234**	**279**	**308**	**390**	**470**	**603**	**742**	**1046**	**1071**	**1343**
Of which:										
Government	15	18	20	26	31	41	50	72	75	96
Business	219	262	288	365	439	562	692	973	996	1247

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Domestic production (1)	1120	1108	1490	2005	1797	2186	3081	3210	3950	4805
+ Net imports (2)	423	355	371	291	230	111	122	-96	-287	-271
+ Margins on sales to domestic market	32	28	35	44	32	39	60	59	69	85
= Supply to Domestic Market	**1575**	**1491**	**1896**	**2340**	**2059**	**2336**	**3264**	**3172**	**3732**	**4619**
- Adjustment for software to be embedded	128	123	192	280	250	274	371	361	424	525
= Investment in custom-design software	**1447**	**1368**	**1704**	**2060**	**1809**	**2062**	**2893**	**2812**	**3308**	**4094**
Of which:										
Government	106	100	119	137	120	132	170	191	209	261
Business	1341	1268	1585	1923	1689	1930	2723	2620	3099	3833

1) Domestic production includes software royalties, received from abroad.
2) Net imports = Custom-design imports + software royalties, payments abroad – foreign receipts for custom software – software royalties, received from abroad.

Table B.2: Custom design software, 1981-1996

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Domestic production (1)	Carried back from 1986 on growth of selected receipts (SCS)					Industry receipts from 'custom software development' and 'contract programming' (SCS)										
+ Software royalties, received from abroad	Estimated as 28% of foreign sales receipts for custom software, % based on 1990 annual benchmark									Annual data from BOP surveys of International Transactions in Commercial Services						
+ Margins (2)	Ratio of domestic production of custom-design to gross output of I/O commodities 575 (1981-85) and 636 (1986-97), of which custom-design is part, applied to margins on same commodities															
+ Custom-design imports	Equivalent to 'BOP deduction of custom-design imports' captured in merchandise imports in estimation of pre-packaged software, with reverse sign															
+ Software royalties, payments abroad	Estimated as 2.5 X custom-design imports in current and past two years, ratio based on 1990 benchmark									Annual data from BOP surveys of International Transactions in Commercial Services						
= Total supply																
- Foreign sales receipts for custom software	Carried back from 1997 on growth of foreign revenues of computer services industry (SCS)															
- Software royalties, received from abroad	Estimated as 28% of foreign sales receipts for custom software, % based on 1990 benchmark									Annual data from BOP surveys of International Transactions in Commercial Services						
= Supply to domestic market																
- Adjustment for software to be embedded (2)	Supply to domestic market allocated across industries in proportion to use of I/O commodities 575 (1981-85) & 636 (1986-97); deduction = 40% of amounts allocated to software producing/embedding industries															
= Investment in custom-design software																
Of which:																
Government	Estimated as 5% of total custom-software investment, % based on average of 1997-98 benchmarks, plus government share of custom-software already capitalized															
Business	Residually derived as total investment in custom-software investment minus government investment in same															

1) Survey of Computer Services (SCS).
2) I/O commodity 575 is "Software development, computer service, and rental"; I/O commodity 636 is "Professional and processing computer services".

Table B.3: Custom design software, 1997-2000

<table>
<tr><th></th><th>1997</th><th>1998</th><th>1999</th><th>2000</th></tr>
<tr><td>Domestic production (1)</td><td colspan="2">Annual sources and methods same as 1986-96, quarterly distribution as in 1999-00</td><td colspan="2">1998 annual projected & distributed quarterly on wage bill for Computer Design & Related (NAICS 5415) from SEPH</td></tr>
<tr><td>+ Software royalties, received from abroad</td><td colspan="4">Annuals built up from quarterly data from BOP surveys of International Transactions in Commercial Services (added here because receipts of software royalties not included in domestic production)</td></tr>
<tr><td>+ Margins</td><td colspan="2">Annual benchmarks from I/O, distributed quarterly on supply to domestic market (net of margins)</td><td colspan="2">Estimated as 2% of supply to domestic market (net of margins), annually and quarterly</td></tr>
<tr><td>+ Custom-design imports</td><td colspan="4">Monthly Customs data on selected software imports</td></tr>
<tr><td>+ Software royalties, payments abroad</td><td colspan="4">Annuals from BOP surveys of International Transactions in Commercial Services, with quarterly values interpolated on more aggregate information from quarterly BOP surveys</td></tr>
<tr><td colspan="5">= Total supply</td></tr>
<tr><td>- Foreign sales receipts (2)</td><td colspan="2">Foreign receipts from custom software development (SCS), distributed quarterly on BOP computer services, receipts</td><td colspan="2">1998 annual benchmark projected and distributed quarterly on BOP computer services, receipts</td></tr>
<tr><td>- Software royalties, received from abroad</td><td colspan="4">Annuals from BOP surveys of International Transactions in Commercial Services, with quarterly values interpolated on more aggregate information from quarterly BOP surveys</td></tr>
<tr><td colspan="5">= Supply to domestic market</td></tr>
<tr><td>- Adjustment for software to be embedded</td><td>Same as 1986-96, quarterly distribution on supply to domestic market</td><td colspan="3">11% of supply to domestic market, annually and quarterly</td></tr>
<tr><td colspan="5">= Investment in custom-design software</td></tr>
<tr><td>Of which:</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Government</td><td colspan="2">Government investment in custom software from I/O, distributed quarterly on total custom software investment</td><td colspan="2">5% of investment in custom + government share of custom already capitalized, annually and quarterly</td></tr>
<tr><td>Business</td><td colspan="4">Residually derived as total custom software investment minus government investment in same, annually and quarterly</td></tr>
</table>

1) Survey of Employment, Payrolls and Hours (SEPH).
2) Survey of Computer Services (SCS).

Table C.1: Own account software

$ millions

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Total W&S of programmers/systems analysts	1228				2347					4572
X ratio of WS&SLI to W&S (1)	1.10				1.10					1.11
= WS&SLI of programmers/analysts	**1344**				**2594**					**5058**
- Adjustment for software embedded/sold	458				934					1897
- Adjustment for non-development work	443				830					1581
= Labour cost of own-account software	**443**				**830**					**1581**
+ Other non-labour costs	204				382					727
= Investment in own-account software	**647**	**775**	**908**	**1067**	**1212**	**1398**	**1582**	**1818**	**2056**	**2308**
Of which:										
Government	229	273	311	349	380	442	499	560	642	742
Business	418	503	596	717	833	956	1083	1258	1415	1566

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total W&S of programmers/systems analysts					6240					
X ratio of WS&SLI to W&S					1.14					
= WS&SLI of programmers/analysts					**7117**					
- Adjustment for software embedded/sold					3032					
- Adjustment for non-development work					2043					
= Labour cost of own-account software					**2043**					
+ Other non-labour costs					940					
= Investment in own-account software	**2485**	**2609**	**2720**	**2832**	**2982**	**3065**	**3240**	**3372**	**3776**	**4310**
Of which:										
Government	818	877	903	918	947	933	921	965	1157	1421
Business	1667	1732	1817	1913	2035	2131	2319	2407	2619	2889

1) Wages and salaries (W&S); Wages, salaries and supplementary labour income (WS&SLI)

Table C.2: Own account software, 1981-1996

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Total W&S of programmers/ systems analysts(1)	Data for 1980, 1985, 1990 and 1995 from Census, by industry, using SOC91 C062 & C063 (1990/95), SOC80 2183 (1980/85), figures for 1980/85 ratio-adjusted for break in occupational classification, 1980 data indexed to 1981															
X ratio of WS&SLI to W&S, by industry (2)	Ratios for 1981, 1985, 1990 and 1995 from I/O, applied on assumption of same add-on to costs for programmers / analysts as all other workers in each industry; averages of industry ratios are 1.10 to 1.14 over 1981-95															
= WS&SLI of programmers/analysts																
- Adjustment for software embedded/sold	For 1981, 1985, 1990 and 1995, deduction of the part of labour costs in software producing/embedding industries in excess of thresholds; 34% overall reduction for 1981, 36% for 1985, 38% for 1990, 43% for 1995															
- Adjustment for non-development work	For 1981, 1985, 1990 and 1995, arbitrary 50% reduction across all industries															
= Labour cost of own-account software																
+ Other non-labour costs (3)	For 1981, 1985, 1990 and 1995, add 46% on top of labour cost, % based on ratio of operating expenses to labour cost for 'custom software developers' (SCS 1997), % assumed to apply to all industries															
= Investment in own-account software	Inter-censal & post-censal annual benchmarks obtained by straight-line interpolation of ratio of own-account investment to labour income (by I/O industry), with fitted ratios applied to labour income (by I/O industry) for 1981-1997															
Of which:																
Government	Sum of estimates for 'industries' belonging to government sector															
Business	Sum of estimates for industries belonging to business sector															

1) SOC80 and SOC91 are the Standard Occupation Classifications, 1980 and 1991; C062 and C063 are the codes for 'computer systems analysts' and 'computer programmers', while 2183 is for 'Systems analysts, computer programmers, and related'.
2) Wages and salaries (W&S); Wages, salaries and supplementary labour income (WS&SLI)
3) Survey of Computer Services (SCS).

Table C.3: Own account software,1997-2000

	1997	1998	1999	2000
Total W&S of programmers/systems analysts	not applicable			
X ratio of WS&SLI to W&S, by industry (1)	not applicable			
= WS&SLI of programmers/analysts				
- Adjustment for software embedded/sold	not applicable			
- Adjustment for non-development work	not applicable			
= Labour cost of own-account software				
+ Other non-labour costs	not applicable			
= Investment in own-account software				
Of which:				
Government	Same as 1981-96, quarterly distribution as in 1998-00	1997 benchmark projected and distributed quarterly on aggregate earnings of programmers and systems analysts in public sector from LFS		
Business	Same as 1981-96, quarterly distribution as in 1998-00	1997 benchmark projected & distributed quarterly on aggregate earnings of programmers/analysts in all industries, excl. public sector & computer services industry, from LFS		

1) Wages and salaries (W&S); Wages, salaries and supplementary labour income (WS&SLI).
2) Labour Force Survey (LFS).

Table D.1: Software already capitalized

$ millions

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Software already capitalized	117	172	231	318	409	554	700	931	1076	1209
of which:										
Pre-packaged	35	59	84	122	159	230	291	385	481	513
Custom-design	24	33	41	58	77	107	143	217	222	278
Own-account	59	80	106	138	173	217	266	329	372	418
of which:										
Government	13	19	24	33	40	57	69	91	112	131
Business	104	153	207	285	369	498	632	840	963	1078

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Software already capitalized	1251	1303	1641	1912	1933	2199	2430	2776	3426	4037
of which:										
Pre-packaged	501	546	794	972	1018	1216	1243	1583	2056	2407
Custom-design	300	284	353	427	375	428	600	583	686	849
Own-account	450	473	493	513	540	555	587	611	684	781
of which:										
Government	141	147	186	195	194	204	216	250	327	396
Business	1109	1155	1455	1717	1739	1995	2213	2526	3100	3641

Table D.2: Software already capitalized, 1981-1996

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Pre-packaged (1)	% capitalized declines linearly from 36% (1988) to 18% (1981) of total pre-packaged investment							Estimated as 36% of total investment in pre-packaged software, % based on follow-up to CAPEX								
Custom-design	% capitalized declines linearly from 21% (1988) to 10% (1981) of total custom-design investment							Estimated as 21% of total custom-design software investment, % based on follow-up to CAPEX								
Own-account	% capitalized declines linearly from 18% (1988) to 9% (1981) of total own-account investment							Estimated as 18% of total own-account investment, % based on follow-up to CAPEX								
Government/business split	Pre-packaged and custom-design software already capitalized allocated to government and business sectors on their respective shares in hardware investment, own-account already capitalized allocated 100% to business sector															

1) Survey on Capital and Repair Expenditures (CAPEX)

Table D.3: Software already capitalized, 1997-2000

	1997	1998	1999	2000
Pre-packaged (1)	Estimated as 36% of total investment in pre-packaged software, % based on follow-up to CAPEX, annually and quarterly			
Custom-design	Estimated as 21% of total investment in pre-packaged software, % based on follow-up to CAPEX, annually and quarterly			
Own-account	Estimated as 18% of total investment in pre-packaged software, % based on follow-up to CAPEX, annually and quarterly			
Government/business split	Pre-packaged and custom software already capitalized (quarterly and annual) allocated to government and business on their respective annual shares in hardware investment, own-account already capitalized allocated 100% to business			

1) Survey on Capital and Repair Expenditures (CAPEX).

Table E.1: Price indexes (1997=100)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Pre-packaged	502.1	473.4	426.0	379.7	347.3	303.6	283.8	250.2	207.7	180.5
Custom-design	101.1	107.6	109.2	111.2	114.3	112.0	111.8	111.0	108.8	107.1
Own-account	61.6	68.0	71.7	76.0	81.1	82.3	83.9	86.4	88.9	91.0
Government	63.0	69.2	72.6	77.3	81.7	83.4	85.1	86.9	89.1	92.0
Business	60.8	67.4	71.2	75.4	80.8	81.7	83.3	86.2	88.8	90.5

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Pre-packaged	170.7	137.5	132.6	122.2	115.8	109.1	100.0	93.6	91.0	91.8
Custom-design	105.3	100.5	100.0	100.4	98.6	99.3	100.0	100.1	101.2	104.7
Own-account	90.6	91.0	91.5	94.4	93.7	96.4	100.0	102.3	104.7	109.2
Government	91.1	92.5	94.6	96.7	95.8	96.7	100.0	102.7	105.2	110.1
Business	90.4	90.2	89.9	93.3	92.7	96.2	100.0	102.1	104.5	108.8

Table E.2: Price indexes (1997=100), 1981-1996

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Pre-packaged	U.S. BEA pre-packaged software price index, exchange-rate adjusted, weighted by import share of supply to domestic market plus same index, unadjusted for exchange rate, weighted by domestic share of supply to domestic market															
Custom-design	Price index constructed from weighted average of the annual % changes in the price indexes for own account software (arbitrary 75% weight) and pre-packaged software (arbitrary 25% weight)															
Own-account	Weighted average of own-account price indexes for government and business, with respective shares in own-account investment as weights															
Government	Weighted average of indexes for labour cost for government (68.5% weight) and other non-labour costs for own-account software (31.5% weight)															
Business	Weighted average of indexes for labour cost for business (68.5% weight) and other non-labour costs for own-account software (31.5% weight)															
Own-account - labour cost																
Government (1)	Index of average hourly earnings (AHE) of government programmers/analysts; 1980, 1985, 1990, 1995 benchmarks from Census, with inter/extrapolation of annuals on fixed-weighted index of AHE in government services (SEPH)															
Business	Index of average hourly earnings (AHE) of programmers/analysts in business; 1980, 1985, 1990, 1995 benchmarks from Census, with inter/extrapolation of annuals on fixed-weighted index of AHE in business services (SEPH)															
Own-account - other non-labour costs	Implicit price index for intermediate inputs to I/O industry 202 (Computer and Related Services)															

1) Survey of Employment, Payrolls and Hours (SEPH).

Table E.3: Price indexes (1997=100),1997-2000

	1997	1998	1999	2000
Pre-packaged (1)	Same method as 1981-1996, but on a quarterly basis, with annuals built up from quarterly values			Built up from monthly PPI, pre-packaged software (BLS)
Custom-design	Same method as 1981-96, but on a quarterly basis, with annual data built up from quarterly data			
Own-account	Same method as 1981-96, but on a quarterly basis, with annual data built up from quarterly data			
Government	Same method as 1981-96, but on a quarterly basis, with annual data built up from quarterly data			
Business	Same method as 1981-96, but on a quarterly basis, with annual data built up from quarterly data			
Own-account - labour cost				
Government (2)	Index constructed from quarterly % change in average hourly earnings of programmers and systems analysts employed in public sector, from LFS			
Business	Index constructed from quarterly % change in average hourly earnings of programmers and systems analysts employed in all industries (excl. public sector and computer services industry), from LFS			
Own-account - other non-labour costs	Laspeyres (1997 fixed-weighted) index of prices of intermediate inputs to I/O industry 202 (Computer and Related Services) on a quarterly basis, with annual values built up from quarterly values			

1) The U.S. Bureau of Labor Statistics (BLS) monthly Producer Price Index (PPI) for pre-packaged software (ID: PCU7372#2) is used to update the BEA pre-packaged software price index. Following the BEA, the BLS PPI is adjusted down by 3.15 % points per year.

2) Labour Force Survey (LFS).

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