Can ICT Measurement Issues Explain the Canada-U.S. ICT Investment per Worker Gap?

Andrew Sharpe
Executive Director, Centre for the Study of Living Standards

Annual Meeting of the Canadian Economics Association
Montreal, QC
June 1, 2013

Outline

I. The Canada U.S. ICT Investment per Worker Gap

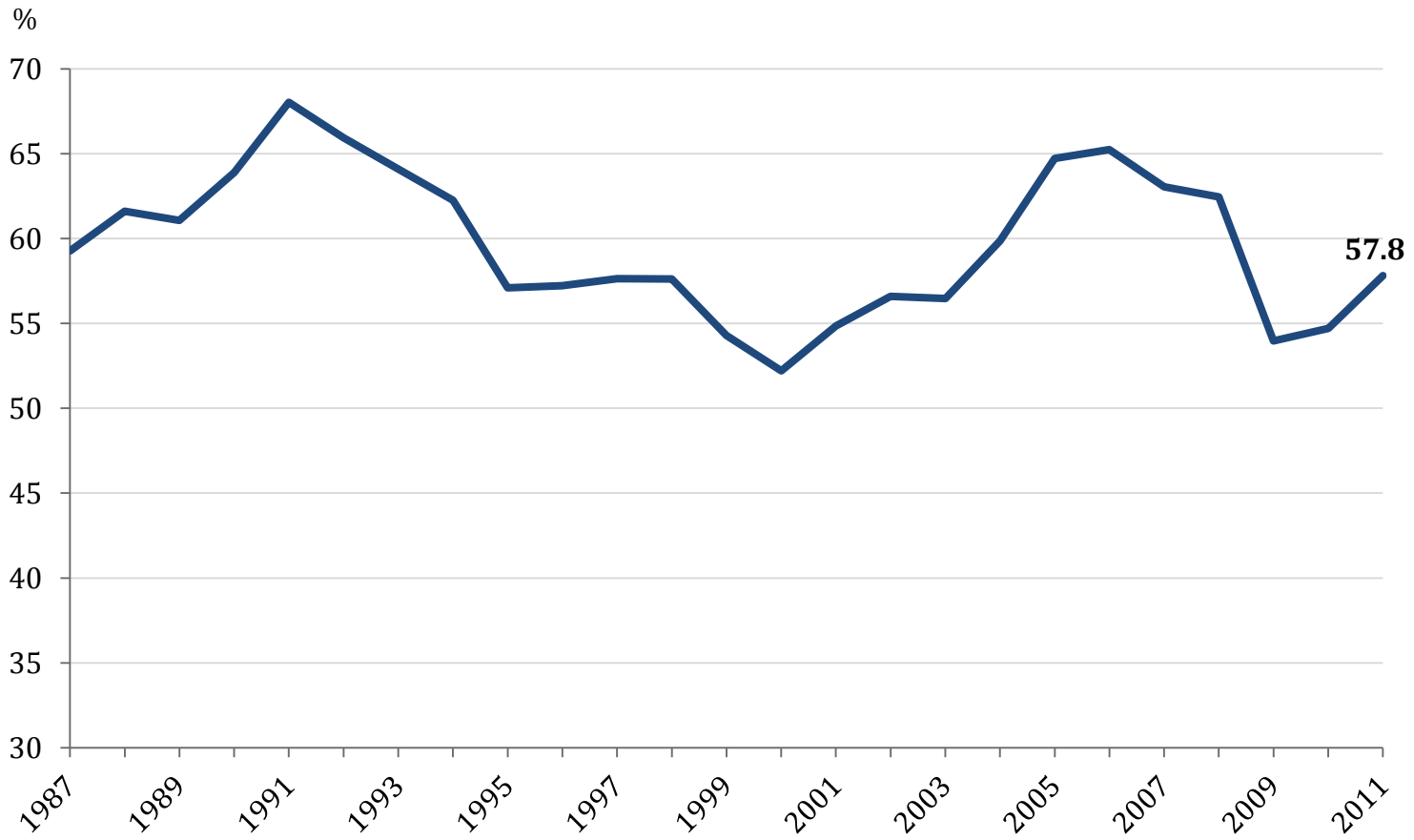
II. Proximate Causes of the Gap

III. The Measurement of ICT Investment in Canada and the United States

IV. Conclusion

The Canada-U.S. ICT Investment per Worker Gap

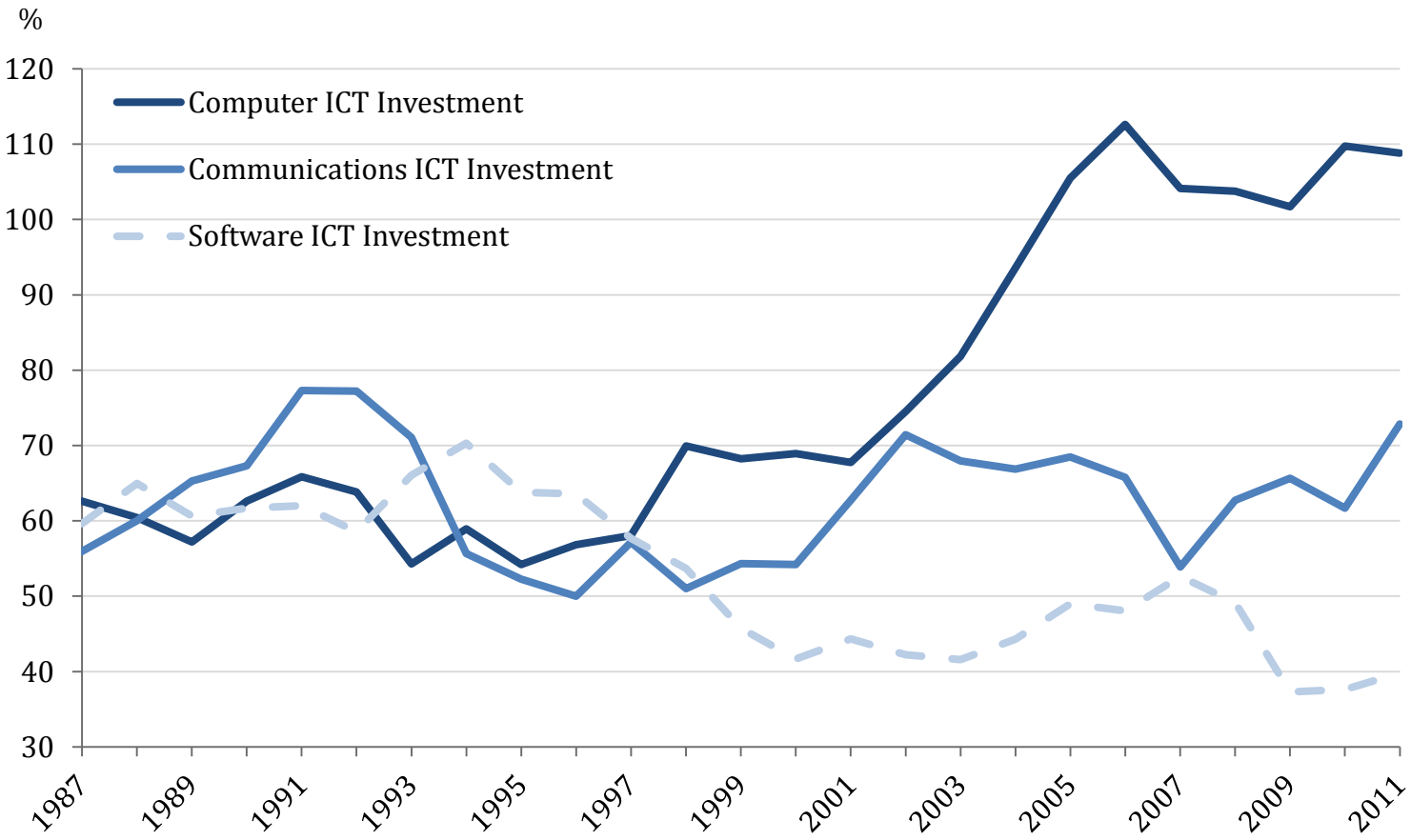
Total ICT Investment per Worker in Canada Relative to the United States, business sector, 1987-2011



Source: CSLS Canada-U.S. ICT Database.

The Canada-U.S. ICT Investment per Worker Gap (II)

ICT Investment per Worker by Component in Canada Relative to the United States, business sector, 1987-2011



Source: CSLS Canada-U.S. ICT Database.

The Canada-U.S. ICT Investment per Worker Gap (III)

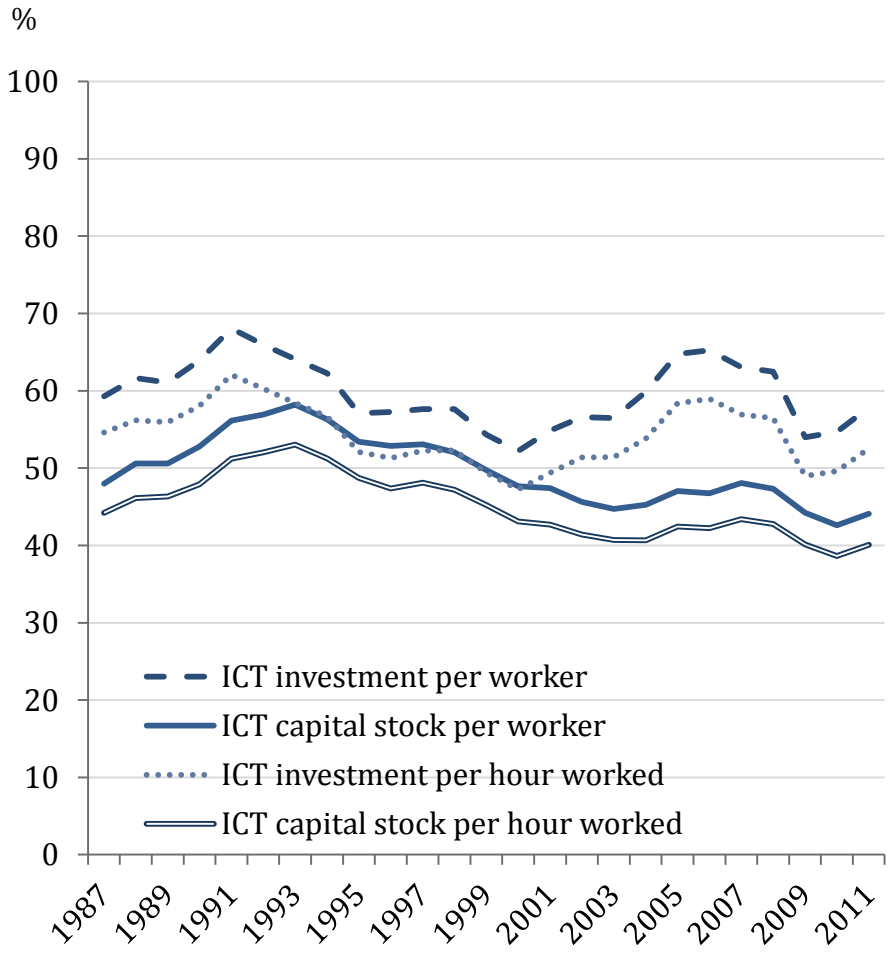
Contributions of the Component Gaps to the Overall Canada-U.S. ICT Investment per Worker Gap, 2011

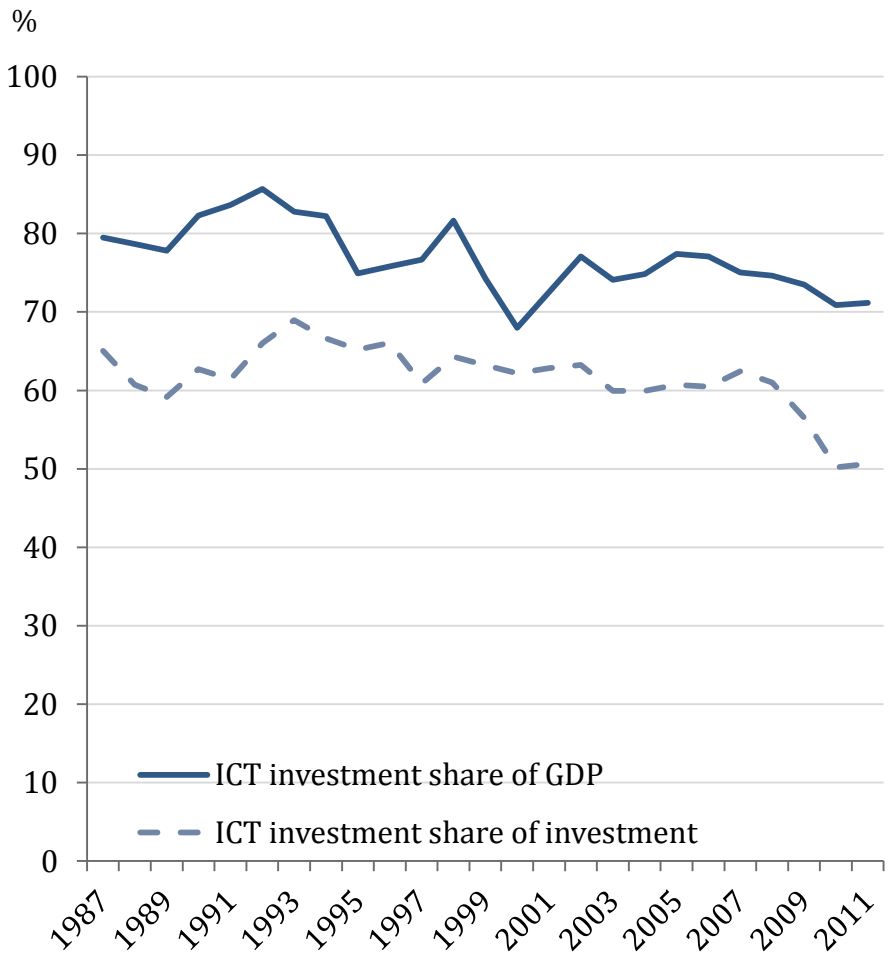
	Canada (U.S. dollars)	United States (U.S. dollar)	Canada relative to the United States (per cent)	Difference (U.S. dollars)	Relative contribution to gap (per cent)
	A	B	C = A/B	D = A - B	E = D/-1658
Computers	752	691	108.8	61	-3.7
Software	1,011	2,540	39.8	-1,529	92.2
Communications	510	700	72.9	-190	11.5
Total	2,273	3,931	60.1	-1,658	100.0

Source: CSLS (2013, forthcoming) “Can Measurement Issues Explain the Canada-U.S. ICT Investment per Worker Gap?”.

The Canada-U.S. ICT Investment per Worker Gap (IV)

Alternative Measures of the Canada-U.S. ICT Investment Gap

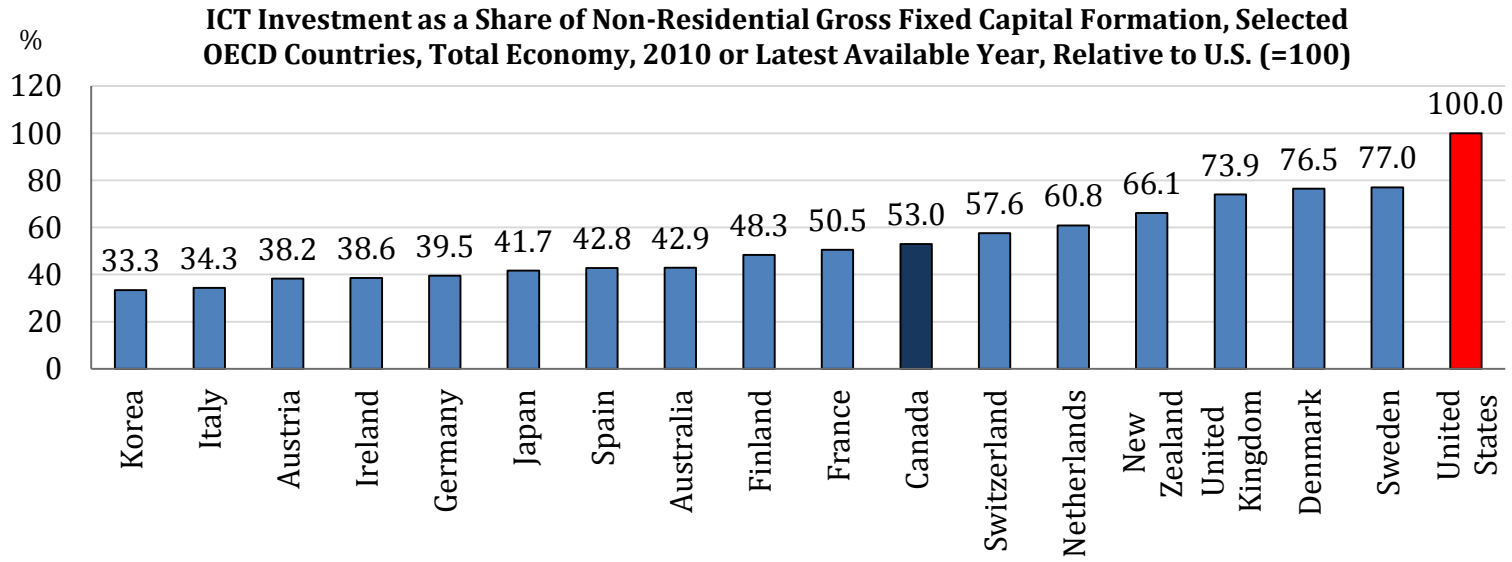


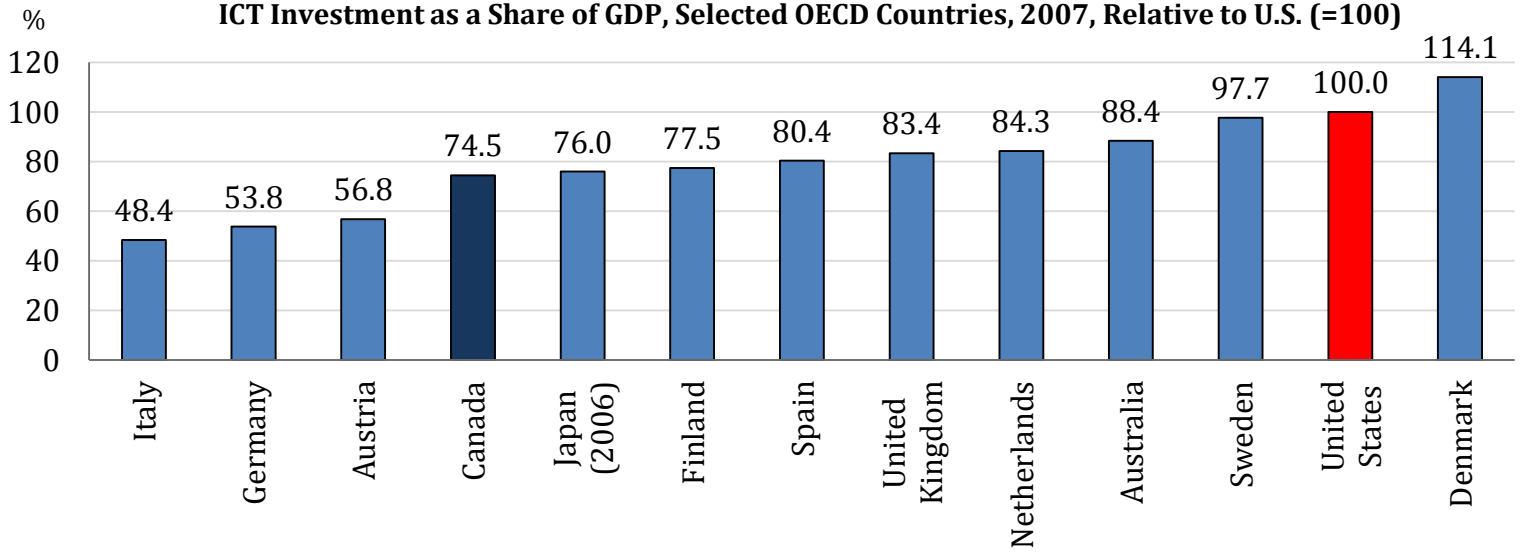


Source: CSLS (2013, forthcoming) “Can Measurement Issues Explain the Canada-U.S. ICT Investment per Worker Gap?”.

The Canada-U.S. ICT Investment per Worker Gap (V)

International Comparisons

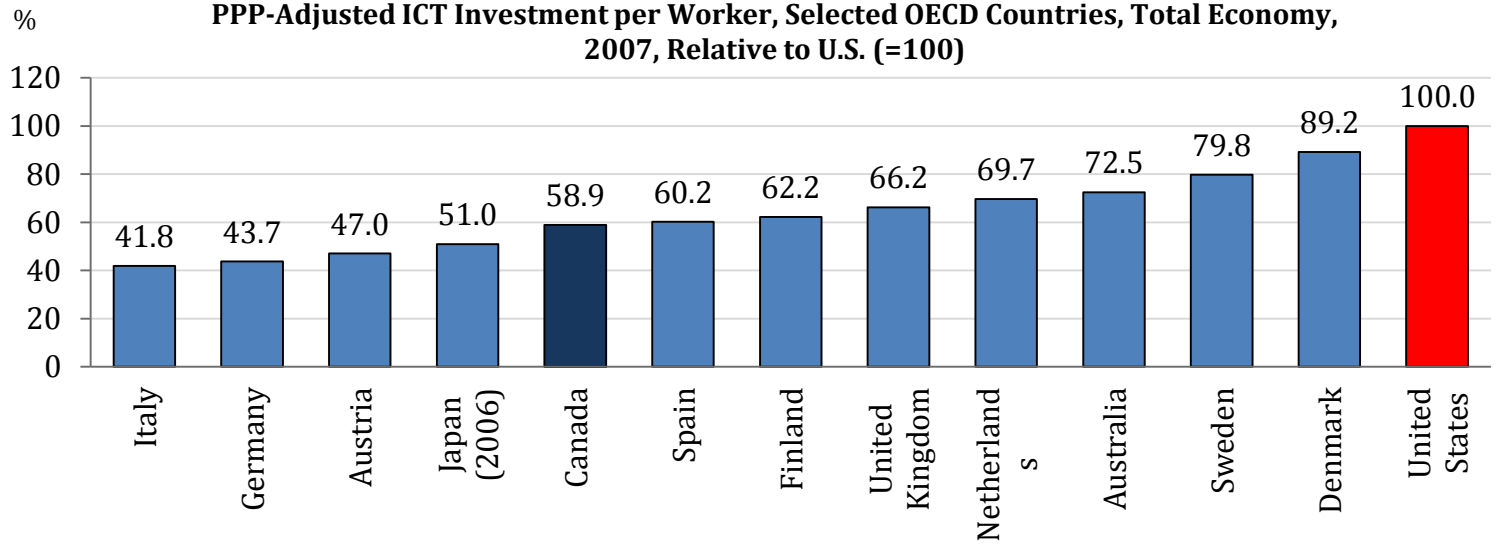


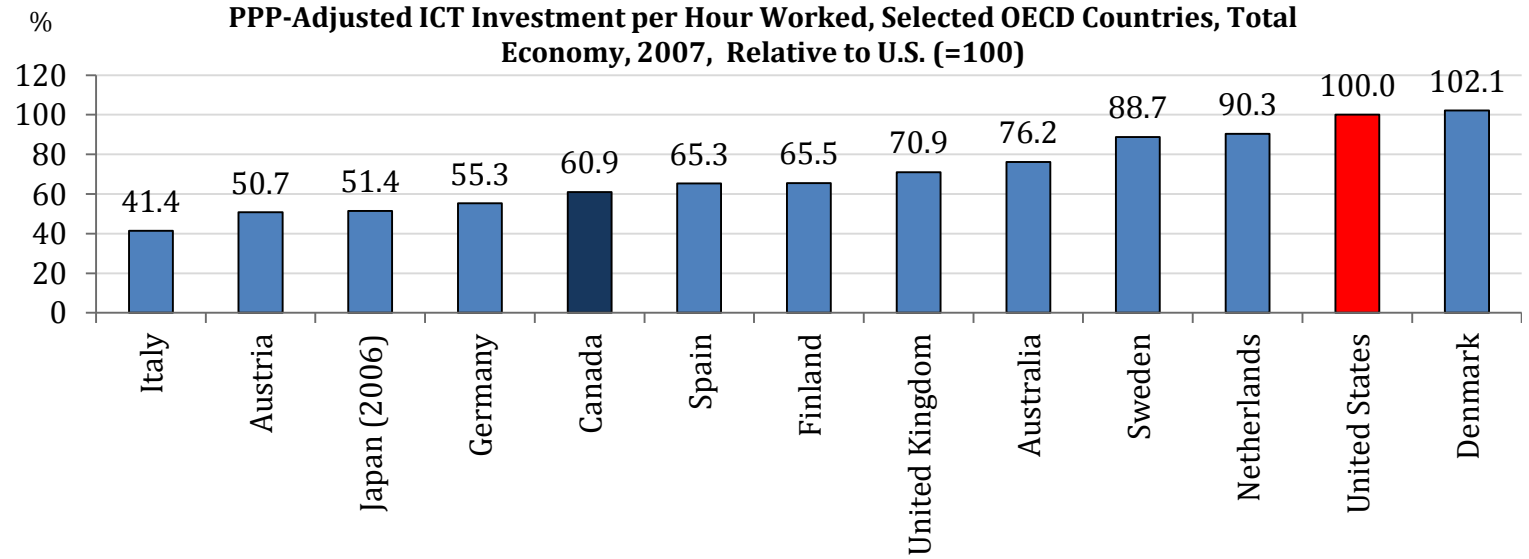


Source: CSLS (2013, forthcoming) “Can Measurement Issues Explain the Canada-U.S. ICT Investment per Worker Gap?”.

The Canada-U.S. ICT Investment per Worker Gap (VI)

International Comparisons (II)





Source: CSLS (2013, forthcoming) "Can Measurement Issues Explain the Canada-U.S. ICT Investment per Worker Gap?".

The Canada-U.S. ICT Investment per Worker Gap (VII)

Industry Contributions to the Canada-U.S. ICT Investment per Worker Gap, 2011

	Employment Shares		ICT Investment per Worker		Difference Between Canada and U.S.	Industry Contributions to Canada-U.S. ICT Investment per Worker Gap	
	Canada	**United States**	**Canada**	**United States**			
	A	**B**	**C**	**D**	**E=C-D**	**F=(B/100)*E**	**G=(E_{ind}/E_{tot})*100**
	(per cent)		(U.S. dollars)		(U.S. dollars)	(U.S. dollars)	(per cent)
Business Sector	**100.0**	**100.0**	**2,273**	**3,931**	**-1,658**	**..**	**100.0**
Agriculture	2.9	2.2	324*	216	108	3	-0.2
Mining and Oil	2.1	0.8	2,158*	5,130	-2,971	-24	1.4
Utilities	1.1	1.2	11,892*	5,853	6,040	74	-4.5
Construction	9.7	8.9	230*	248	-19	-2	0.1
Manufacturing	13.5	14.2	1,693	2,853	-1,160	-164	9.9
Wholesale Trade	4.9	3.8	3,510*	5,834	-2,324	-87	5.3
Retail Trade	15.6	15.7	923*	1,066	-143	-23	1.4
Transportation	6.5	5.9	2,220*	1,095	1,125	66	-4.0
Information Industries	2.9	3.1	17,491	38,326	-20,835	-649	39.1
Finance and Insurance	5.8	6.5	5,795	9,926	-4,131	-270	16.3
Real Estate	2.5	2.7	5,300*	2,317	2,983	82	-4.9
Professional Services	10.1	9.4	1,738	5,700	-3,962	-371	22.3
MCE	0.0	0.2	22,615*	195,964	-173,349	-334	20.2
ASWMRS	5.1	6.1	1,464*	3,173	-1,710	-104	6.3
Arts	3.0	2.9	1,232*	415	818	24	-1.4
Accommodation	8.4	9.7	320*	116	204	20	-1.2
Other Services	5.8	6.6	1,453*	685	769	51	-3.1

Source: CSLS (2013, forthcoming) “Can Measurement Issues Explain the Canada-U.S. ICT Investment per Worker Gap?”.

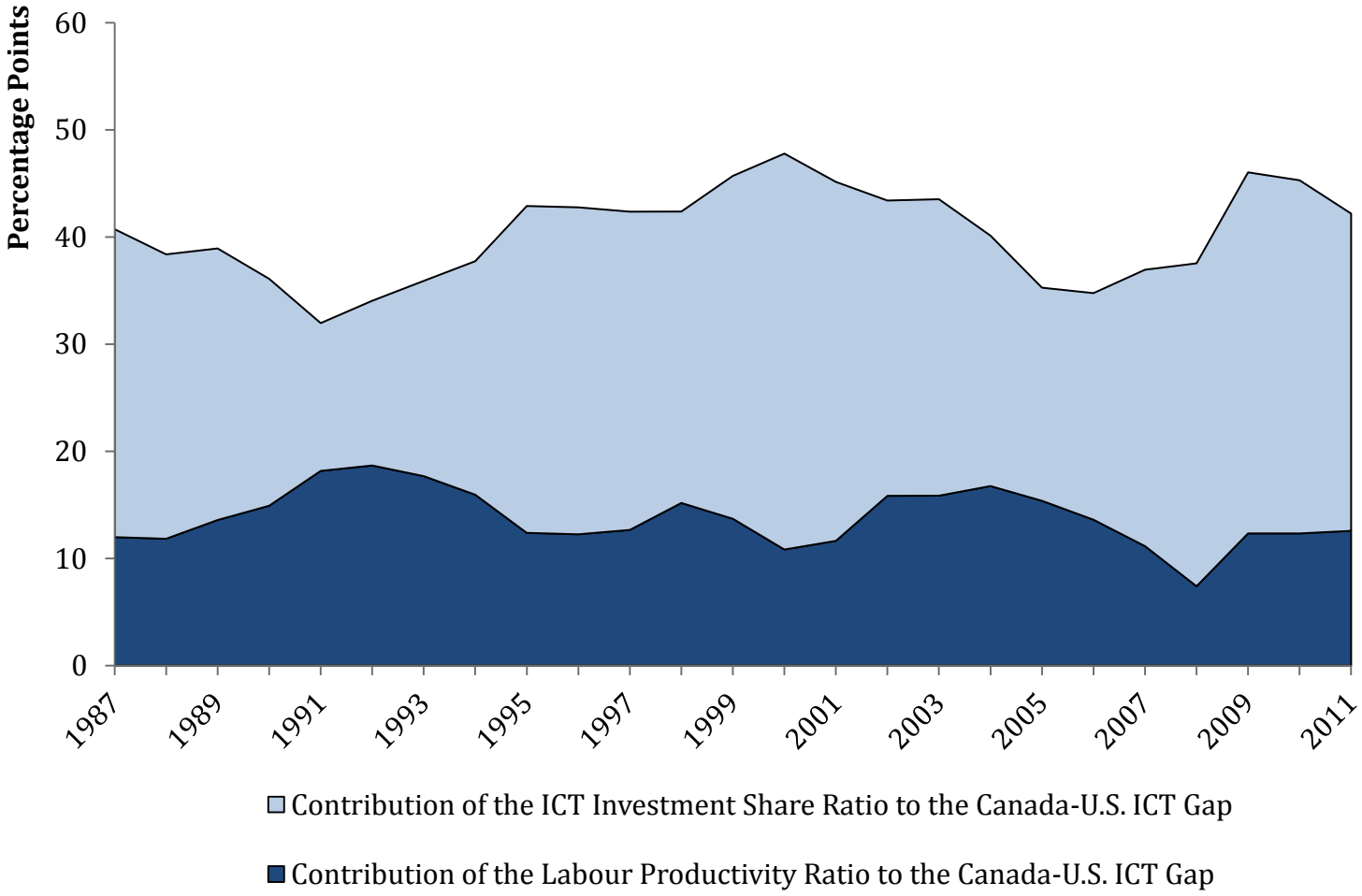
The Canada-U.S. ICT Investment per Worker Gap (VIII)

Summing Up

- **Robustness:** A large Canada-U.S. ICT investment gap is found regardless of the measure used;
- **Average or Slightly Below Average International Performance:** The Canada-U.S. ICT investment gap is close to the average gap between the United States and most OECD countries;
- **A Business Sector Phenomenon:** Using OECD data, we find that there is no Canada-U.S. ICT gap outside of the business sector;
- **Total Gap Driven by the Software Gap:** The software gap accounted for 92.2 per cent of the overall Canada-U.S. ICT investment per worker gap in 2011.
- **Industry Specific:** The Canada-U.S. ICT investment per worker gap is largely concentrated in a few, ICT-intensive industries – namely: information and cultural industries and professional, scientific and technical services.

Proximate Causes of the Gap

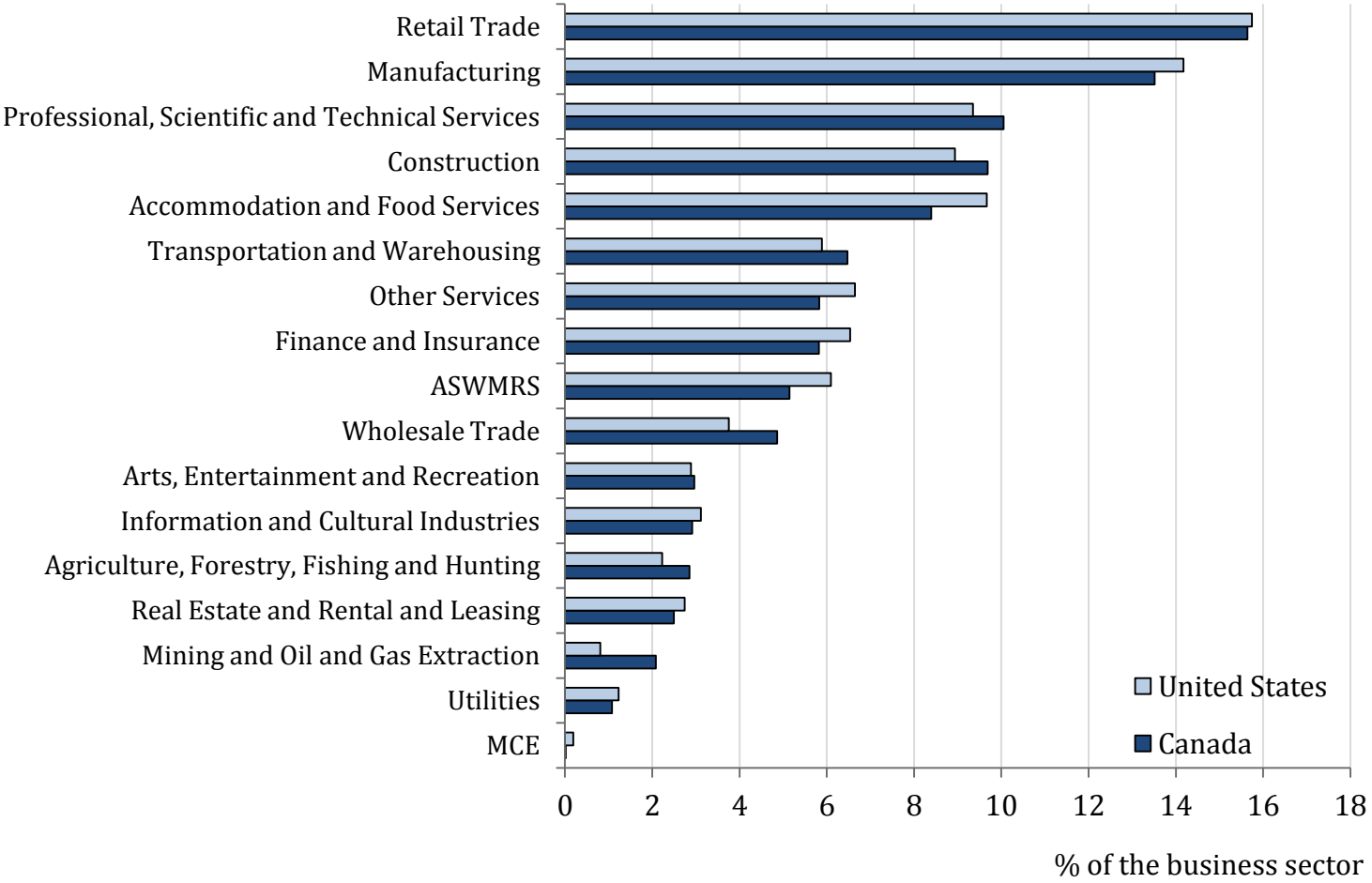
Labour Productivity and ICT Share Contributions to the Canada-U.S. ICT Investment per Worker Gap, percentage points, 1987-2011



Source: CSLS (2013, forthcoming) "Can Measurement Issues Explain the Canada-U.S. ICT Investment per Worker Gap?".

Proximate Causes of the Gap (II)

Industrial Structure: Employment Shares by Industry in the Business Sector, Canada and the United States, 2011



Source: CSLS (2013, forthcoming) "Can Measurement Issues Explain the Canada-U.S. ICT Investment per Worker Gap?".

Proximate Causes of the Gap (III)

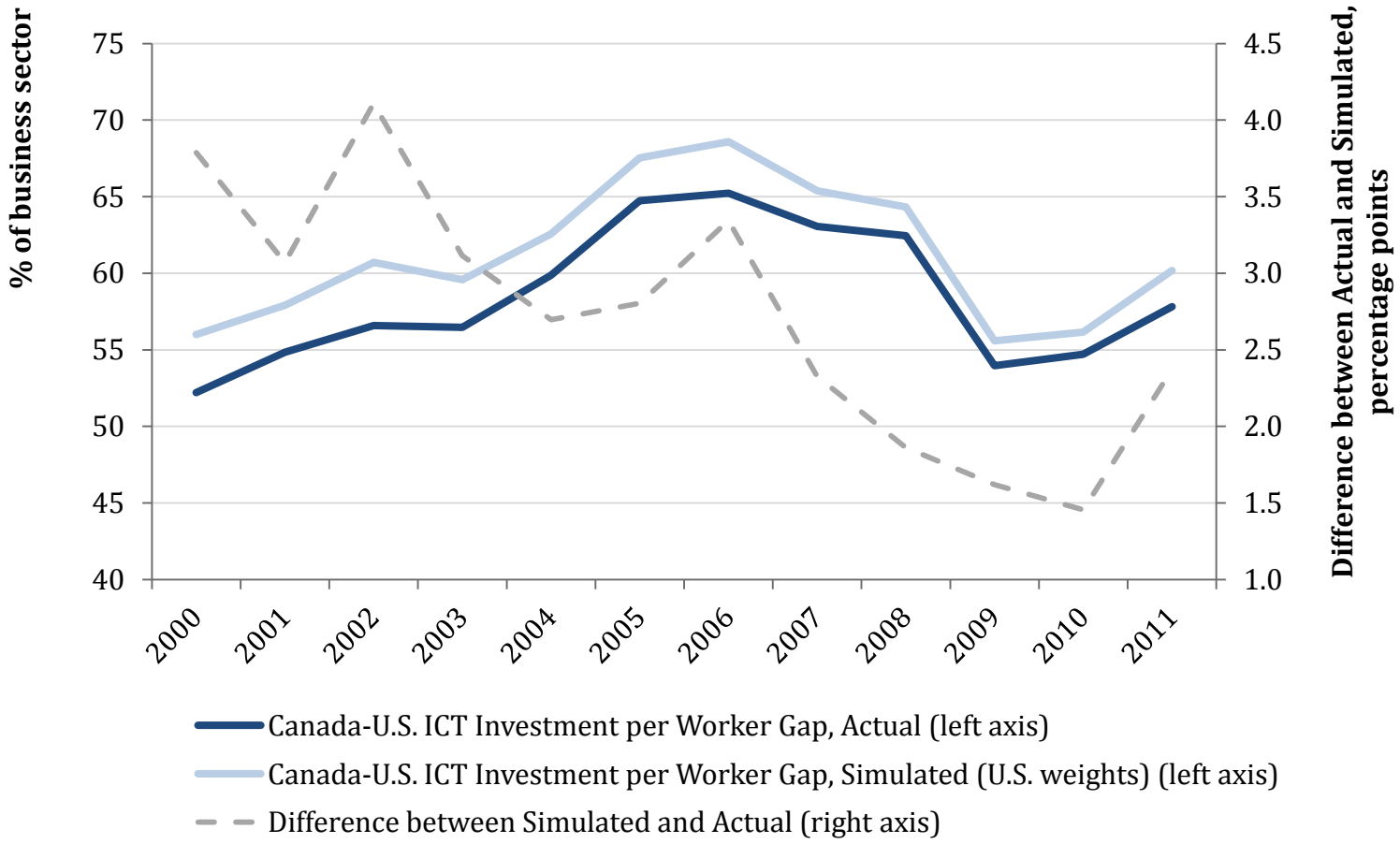
Industrial Structure: Canada-U.S. ICT Investment per Worker Relative (PPP-adjusted U.S. Dollars), Actual x Simulated (U.S. Employment Share Weights), 2011

		Variable	Unit	Value
Canada	A	ICT Investment per Worker, actual	(dollars)	2,525
	B	ICT Investment per Worker, simulated	(dollars)	2,629
	C=B-A	Difference between Simulated and Actual	(dollars)	104
	D=(C/A)*100		(per cent)	4.1
	E	Canada-U.S. Purchasing Power Parity		0.90
	F=A*E	ICT Investment per Worker, actual	(PPP-adjusted U.S. dollars)	2,273
	G=B*E	ICT Investment per Worker, simulated	(PPP-adjusted U.S. dollars)	2,366
United States	H	ICT Investment per Worker	(U.S. dollars)	3,931
Canada as a Share of the United States	I=(F/H)*100	ICT Investment per Worker, actual	(per cent)	57.8
	J=(G/H)*100	ICT Investment per Worker, simulated	(per cent)	60.2
	M=K-L	Difference between Simulated and Actual	(percentage points)	**2.4**

Source: CSLS (2013, forthcoming) “Can Measurement Issues Explain the Canada-U.S. ICT Investment per Worker Gap?”.

Proximate Causes of the Gap (IV)

Industrial Structure: Canada-U.S. ICT Investment per Worker Relative (PPP-adjusted U.S. Dollars), Actual x Simulated (U.S. Employment Share Weights), 2000-2011



Source: CSLS (2013, forthcoming) "Can Measurement Issues Explain the Canada-U.S. ICT Investment per Worker Gap?".

The Measurement of ICT Investment in Canada and the United States

Similarities

- The methodology for data collection, quality control, and the entities surveyed are substantially the same;

- We identify no significant inconsistencies in the definition of ICT assets or the survey and data collection methodology for ICT investment data in Canada and the United States

The Measurement of ICT Investment in Canada and the United States (II)

Differences: Business Sector Definitions

- The definition of the business sector in Statistics Canada's Fixed Capital Flows and Stocks tables is inconsistent with the Fixed Asset Accounts in the United States.

- The Fixed Asset Accounts classifies investment as business sector based on the type of establishment making the investment, while the FCFS classifies investment as business sector based on the industry in which it occurs, excluding from total investment 3 out of 20 two-digit NAICS industries: health care and social assistance, educational services, and public administration.

- Using estimates from the Statistics Canada's Canadian Productivity Accounts, which uses the same definition of the business sector as the U.S. Fixed Asset Accounts, we find that in 2008, the total Canada-U.S. ICT investment per worker gap had been underestimated by 5.5 percentage points due to inconsistencies in the definition of the business sector.

The Measurement of ICT Investment in Canada and the United States (III)

Differences: Intermediate Purchases of Pre-Packaged and Custom Software

- The methodology used to account for intermediate purchases of pre-packaged and custom software differs in Canada and the United States.
- The United States assigns intermediate purchases of software to both pre-packaged and custom software, while Statistics Canada assigns all intermediate purchases of software to pre-packaged software.
- This does not affect the total level of ICT or software investment in either country, but it does mean that Statistics Canada is slightly overestimating the share of custom software and underestimating the share of pre-packaged software.

The Measurement of ICT Investment in Canada and the United States (IV)

Differences: Purchases of Used Equipment

- The treatment of purchases of used equipment differs in Canada and the United States.

- The estimates of investment in the United States include dealers' margins on the sale of used assets, while the estimates for Canada do not. This has the potential to have an impact, although perhaps a marginal one, on the comparability of investment in computers and communications equipment. This issue requires further study.

The Measurement of ICT Investment in Canada and the United States (V)

Differences: Own Account Software

- Investment in internally developed or own account software is based primarily on the labour cost to employers of their software developers.
- This means that, even if two software developers spend the same amount of time developing the same software for internal use, a higher level of investment in the United States than in Canada would result due to higher salaries.
- We estimate that this conceptual challenge to valuing own account software results in the gap being overestimated by as much as 4 percentage points (10 per cent of the gap).

Conclusion

- On balance, we find that differences in measurement explain approximately 10 per cent of the gap in ICT investment per worker in Canada and the United States.

Summary of factors contributing to the Canada-U.S. ICT Investment per Worker Gap

		Contribution to the Gap in 2011	
Reference	Factor	Percentage Points	Share
Table 1	Canada-U.S. ICT Investment per Worker Gap	42.2	100.0
Non-Measurement Factors or Proximate Factors			
Table 31	Labour Productivity	12.6	29.8
Table 33	Industry Structure	2.4	5.7
Measurement-Related Factors			
Table 46	U.S. Salary Premium for Software Developers	3.7	8.8
Non-Quantifiable Factors Contributing to the Gap			
Dealer's margins on sales of used ICT equipment (measurement)			
Firm Size			
Education of Managers			
Business Attitudes and Culture			
Total Gap Explained by Factors		18.5	44.3

Source: CSLS (2013, forthcoming) "Can Measurement Issues Explain the Canada-U.S. ICT Investment per Worker Gap?".