Polarization of Job Losses: Canada and the USA, the Role of ICT

Leonard WAVERMAN
Dean DeGroote School of Business, McMaster University

Abstract: Canada-USA comparisons are used to examine whether recent wage polarization is a general phenomenon, or more of a U.S. experience (it is the latter). The role of Information and Communications Technology (ICT) in "polarization" is examined and the Canadian productivity and ICT lags relative to the U.S. are discussed. ICT is a recent tool and thus discussions of its "demise" need to be cautious.

Key words: polarization, Canada/U.S. ICT comparisons.

Since 2000, three issues have arisen in prominence for economists and politicians – first, the productivity decline since at least the mid 2000's – Where is the vaunted productivity impact of ICT? Second, polarization – defined as a decline in jobs and wages in the "middle" of the income distribution. And third, is ICT investment the cause of this polarization?

Since 2005 productivity growth has stalled in most western countries: that is, it is not growing as fast as in the previous ten years. This poor performance has negatively impacted economic growth since productivity is one of the three sources of long term economic growth, the other two being the rate of growth of labor (population growth and the participation rate) and the growth rate of capital. Of these three sources, productivity is the one most examined, discussed and written about as it appears to be the one factor that countries can affect in the medium term. Thus, the preoccupation with productivity is because it appears to be something more controllable than long run trends in population growth or capital accumulation.

Another issue is the rise in income inequality across many western nations, particularly the USA and Israel. This was brought to prominence with Thomas PIKETTY's best-selling book, *Capital in the Twenty-First Century*.

The potential measures of income inequality used in the literature are many, and can be measured as inequality of total income, inequality of income with or without capital gains and dividends, inequality of wage income, inequality of wealth, etc.

The ways to measure income (or wage) inequality are also many, and include: the percentage of total country income earned by the top x %, usually the top 10% or 1%; the Gini Coefficient measuring deviations from equal income distribution; and now the "polarization" effect: comparing wage changes over time for certain classes of wage earners, generally "low", "middle" (the middle class) and "high".

The data, at least for the USA, the most studied country in the recent literature, suggest a decline in the returns to the middle wage group, and this decline of the middle class has led to much consternation. The role of ICT has taken on a potential major role for both the productivity decline as well as "the fall of the middle class" but in two quite different ways: first, was not ICT the third major Industrial Revolution and if so, why is its impact on productivity so fleeting? And second, are ICT investments to blame for job polarization since ICT replaces routine jobs: bank tellers, middle managers even lawyers whose jobs can be done more cheaply by software programs?

Note that these two concerns about ICT are in essence mutually exclusive since if ICT does remove many jobs, then productivity (which is measured as output change minus capital and labor force changes) should be growing.

To shed some light on these issues some key concepts are analyzed: relative wage and income performance is compared between Canada and the USA and one measure of relative ICT performance between Canada and the USA is examined.

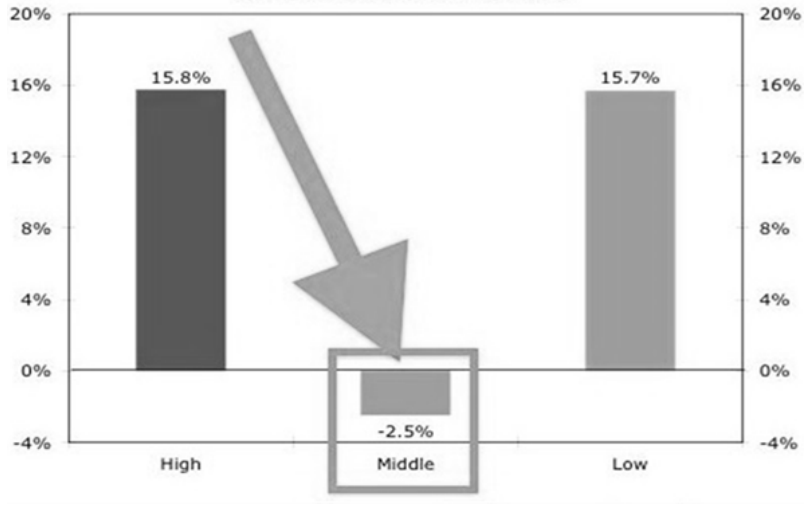
Furthermore, the route of productivity performance is likely always uneven, and with the impact of the great recession still here, it is impossible to conclude that ICT's role is over. Indeed, I would expect ICT's role principally through smartphones to yield large productivity advances in the future.

■ Productivity and polarization

Wage inequality and rising income inequality are not new topics of the 2010s. Simon KUZNETS won the Nobel Prize for his studies on income and wage inequality beginning in the 1940s. His 1954 Presidential address to the American Economic Association highlighted growing income equality accompanied by rapid increases in per capita income in the USA since the 1920s. In the mid to late 1970s, income inequality began to rise in the USA and PIKETTY & SAEZ (2003) state: "a new industrial revolution has taken place, thereby leading to increasing inequality, and inequality will decline again at some point, as more and more workers benefit from the innovations."

Technical change does not bring the same rewards to all. Originally economists modeled (SOLOW, 1954) technical change as labor saving. Note crucially that this does not mean that permanent unemployment would result from labor saving inventions. Quite to the contrary, labor saving inventions make society better off since the demand for labor is an economy wide macroeconomic phenomenon. In the shorter run, there are dislocations for that labor that is displaced. Consider agricultural advances in productivity displacing agricultural workers who then migrate to towns in search of employment.

Figure 1 - Job growth and decline by skill level in the USA from 2003 to 2013

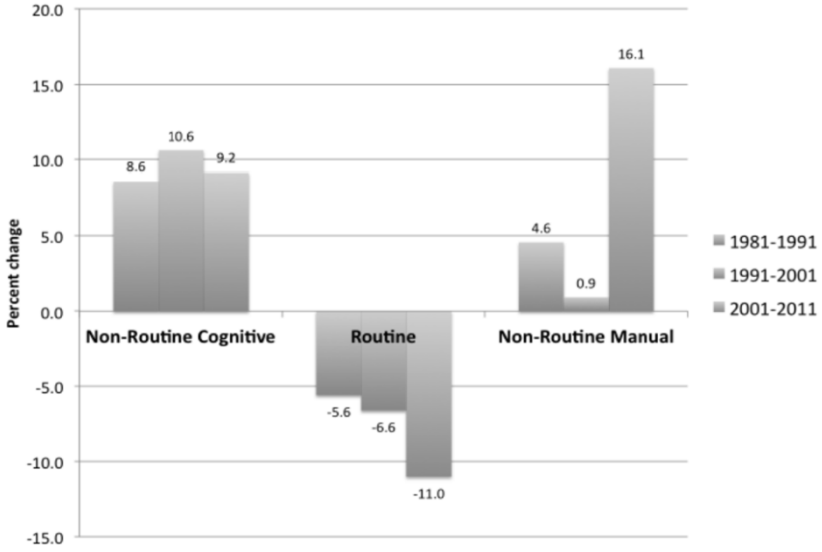


Source: Wells Fargo (2014)

A new hypothesis – that technical change was "skills biased" (Skills Based Technical Change - SBTC) and a result of the rise of microprocessors in the 1980's emerged in the 1990s (see JOHNSON, 1997). David CARD & John DiNARDO (2002) showed however that SBTC did not explain the patterns of wage inequality of the 1980s and 1990s or other labor market facts such as the returns to education.

In 2003 another hypothesis was advanced – that ICT enables the elimination of jobs which are routine based (RBTC). Thus the hypothesis became that the disappearing middle class was due to that class having repetitive routine type jobs while high skilled jobs were more "cognitive" and low skilled service jobs were non- routine. For example, one cannot at this point replace low skilled hospital orderly jobs with ICT.

Figure 2 - Percent change in employment shares by occupation group- USA



Source: GOOS & MANNING (2007)

GOOS & MANNING (2007) show the changes in employment shares by occupation group in the USA for three time periods and for the three divisions of occupations discussed above- non-routine manual (low skilled), non-routine cognitive (high skilled) and the "middle" (routine).

The hypothesis appears to be borne out for the USA - routine type jobs have been disappearing and at an accelerating rate for three decades. Of course, many changes have been occurring in the U.S. economy as well

over these 30 years, some but not all of these perhaps aided by ICT – outsourcing; the growth of Chinese manufacturing; the move to more of a service based economy; new trade agreements (NAFTA for example), to name four major changes. The rise of China and Chinese manufacturing was based on low skilled Chinese labor (routine biased) migrating to cities from rural areas, like the previous industrial revolutions in the west. ICT and global supply chains enabled some of this rise, and the Chinese labor supply replaced routine jobs in the west. But clearly, to say that Chinese success is due to ICT (and no one does) is wrong. Nor are new trade agreements "due" to ICT advances, nor is the rise of services due to ICT, the percentage spent on services rises as incomes grow. Thus, we must be very careful in assessing the role of ICT in labor market changes- a complete general model is needed.

There are also questions as to our ability to credibly assess job and occupational categories as routine, non- routine, cognitive etc. The studies cited above are undertaken at the economy wide level, and assessing jobs/occupations even at 3 or 4 digit levels omits firm specific details which are crucial. For example, in the auto sector in the 1980s, assembly line jobs may have been "routine" at many firms but clearly at Toyota they were "routine cognitive".

These caveats are substantial but still the economy wide data do show clear trends in polarization of wage, income and job classifications especially for the USA. I turn to USA-Canada comparisons as Canada is at the same development level as the USA and the two countries share the world's largest open border, language and culture.

■ Canada and the USA

Canada and the USA have many similarities in their economies; many industries even have the same players. Yet Canada has a different profile in ICT use and in its proliferation.

WAVERMAN & DASGUPTA (2005) developed "The Connectivity Scorecard (CS) concept". This scorecard measured and ranked a country's combination of communications infrastructure, usage of this infrastructure, skills as well as measures of business adaptability of advanced web and ICT applications and services. For 25 advanced economies, CS utilized 25 different attributes, for the three major GNP components: consumers,

businesses and government with weights drawn from the economics literature (as well as GNP shares). The country that did "best" in any single component received a score of 10 for that component and all other countries were scored relative to that country. Countries were then ranked on their aggregate index; the maximum was 10. In 2011, the last time WAVERMAN & DASGUPTA authored the Connectivity Scorecard, Sweden ranked first, the U.S. second and Canada eighth.

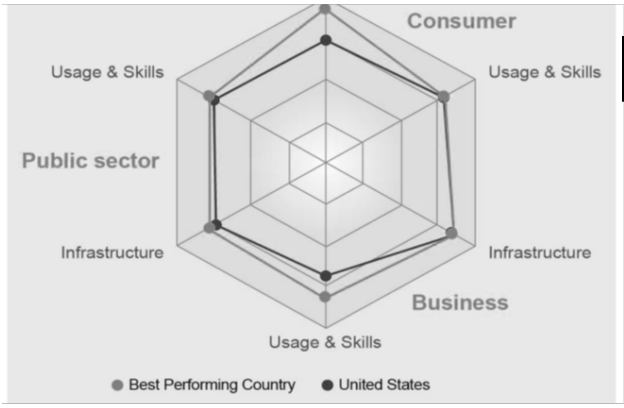
Below are VENN diagrams for the USA and Canada showing three major sectors, business, consumers, and government for each country as well as infrastructure and usage and skills scores. Observing the VENN diagram for the USA, one can see that the USA is the leader among all countries in consumer usage and skills and in business infrastructure. However, the USA lags behind the best country primarily in business usage and skills (mainly due to a fall in higher education in STEM areas) as well as in consumer infrastructure (at that time, a lag in broadband relative to the world leaders Japan and Korea).

Turning to Figure 3, the VENN diagram for Canada (3B), the differences with the USA (3A) are clear. Even though the two economies have similar styles of business and government, and have the largest bilateral trade in the world, ICT adaption, use and skills varies markedly. The VENN diagram for Canada would be inside that of the USA for five of the six components – however business usage and skills are similar for the two economies and among the highest in the world. The differences are especially marked for consumer and government infrastructure and for business infrastructure.

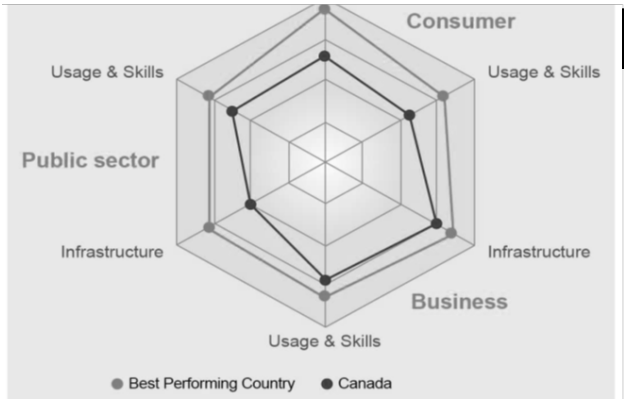
Canadian productivity growth has consistently lagged behind that of the USA, as has the contribution to productivity from ICT. Figure 4 derived from FUSS & WAVERMAN (2005) disaggregates the 2003 twenty-one percent productivity gap between the USA and Canada into its components. We choose 2003, as that was a year when productivity performance in both economies was high and it is also a year when most researchers agree that ICT was a major cause of productivity growth in the USA and elsewhere.

Figure 4 is interpreted in the following way. Non-ICT capital differences between Canada and the USA account for only 5% of the 21 point difference between Canadian and USA productivity. Differences in the scale of the two economies (the U.S. is a much larger country) accounts for 15% of the 21 point productivity difference. Significantly, the lower ICT level in Canada relative to that in the USA accounts for over half of the productivity difference between the two countries!

Figure 3 – Ven diagrams, connectivity scorecard 2011, USA and Canada

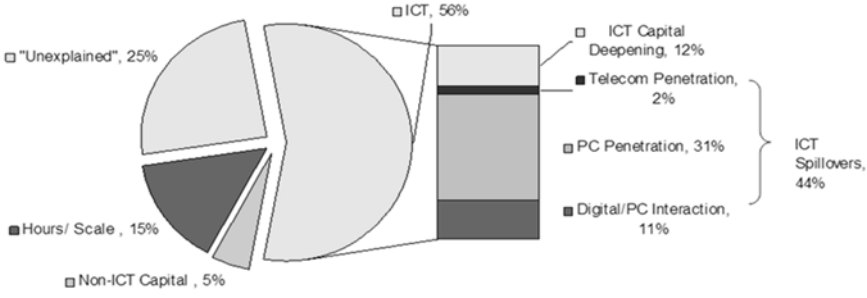


A USA



B CANADA

Figure 4: Contributions to U.S. Canada productivity gap, 2003



Source: Fuss Wawerman 2005

At the right of Figure 4, the components of this lower level of ICT are disaggregated. Of the 56% difference explained, only 12% is due to the ICT capital stock itself. The majority or 44% is due to what we label the ICT spillovers or the characteristics of ICT. A lower level of PC penetration in Canada accounts for 30 percentage points of this 56 percentage point difference.

Thus, two very similar economies, geographically next door to each other, with many U.S. subsidiaries being major operating firms in Canada, have very different ICT characteristics and performance. Productivity differences are large, ICT levels, usage and skills differ and explain over half of the productivity differences between the two economies. And these differences persist for decades.

Explaining Canadian poor productivity performance and the role of ICT in that performance is a focus of research in Canada, yet it remains a puzzle.

The polarization of wages/incomes, the major research focus in labor economics in the USA over the past decade is now examined. Aggregate U.S. data show the loss of middle class/routine jobs. An interesting question is: do Canadian data on wages/incomes show a similar polarization story?

■ Income/wage/job polarization: USA and Canada

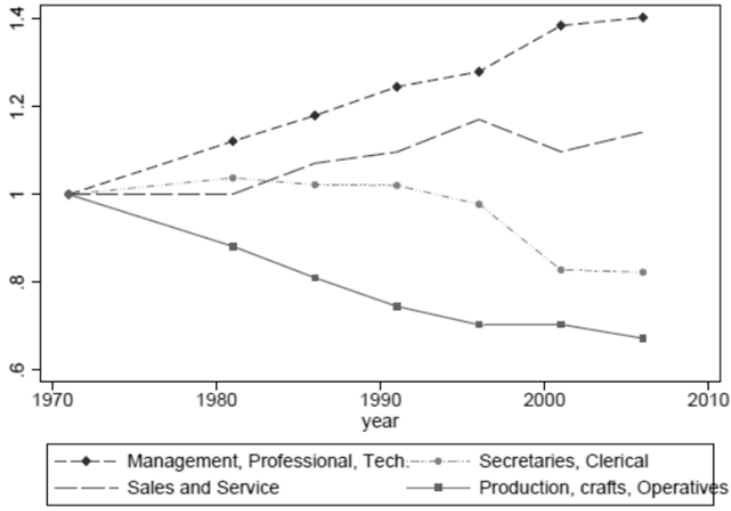
A number of recent analyses examine the issues of polarization in Canada. I rely on one particular paper here as it provides an examination of both U.S. and Canadian data. (GREEN & SAND, 2013). Such comparisons between two countries are not easy to make because of a variety of issues: lack of comparability of data is a primary one. At a deeper issue are the questions of which data to analyze even if data sources were identical.

Canada has a more progressive tax and welfare system than does the US; Canada has a well-functioning universal health care system; the U.S. health care system is privately funded except for the new provisions of Obamacare. Are we interested in before tax income or after tax and after entitlement income? Should medical care be included as this is funded in Canada through payroll deductions and taxes? So, the issues of before tax or after tax income, and income before or after entitlements such as welfare or medical care payments are important components in the issue. Countries

with more progressive tax and welfare schemes will have less polarization in after tax income than in before tax wage income.

Figure 5 presents a general picture of employment trends across occupations in Canada from GREEN & SANDS (2013). The data show Canadian employment distribution (hours worked) among four classifications: management, professional, technical; sales and service; secretaries, clerical: production, crafts and operatives for the 1970 to 2010 period. The latter two job classifications are more likely to be routine based jobs. Normalizing at 1 for all four job categories in 1971, one can see relative growth in the first category, managerial, professional technical. In the second category, sales and service employment share rose from 1980 but falls from 1995 to 2000 and then increases again.

Figure 5 – Canada: Share of hours worked 1970 to 2010



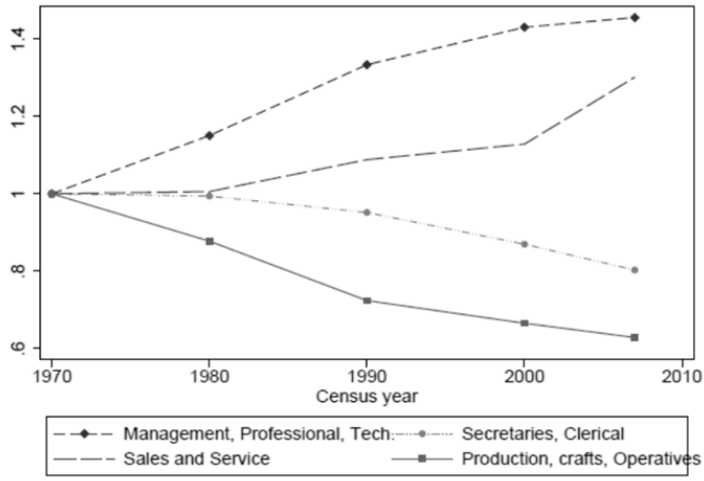
Data comes from the Canadian Census Master Files from 1971-2006. The figure represents the share of hours worked among four broad occupation classifications, indexed to 1 in 1971.

Source: GREEN & SAND (2013)

The production crafts and operatives category has been in decline since 1971 with a leveling out in the 1995 to 2000 period and a decline again post 2000. The category secretaries and clerical rose slightly to 1980, fell slightly to 1990 then fell to 2000, especially in the 1995 to 2000 period.

The U.S. data in Figure 6 show similar but more pronounced movements particularly in the post 2000 period.

Figure 6 – USA : Share of hours worked 1970 to 2010



Source: Green and Sand (2013)

GREEN & SAND (2013) summarize their results as follows:

> "We find that there has been faster growth in employment in both high and low paying occupations than those in the middle since 1981. However, up to 2005, the wage pattern rejects a simple increase in inequality with greater growth in high paid than middle paid occupations and greater growth in middle than low paid occupations. Since 2005, there has been some polarization but this is present only in some parts of the country and seems to be related more to the resource boom than technological change. We present results for the U.S. to provide a benchmark. The Canadian patterns fit with those in the U.S. and other countries apart from the 1990s when the U.S. undergoes wage polarization not seen elsewhere. **We argue that the Canadian data do not fit with the standard technological change model of polarization developed for the U.S.**" (emphasis added)

GREEN & SAND also state:

> "In a study that compares movements in both employment and wages between the U.S. and Germany, Antonczyk, DeLeire, and Fitzenberger (2010) find that, although there are similarities in occupational employment between the two countries that is consistent with technological change, the differences in the evolution of the wage distribution between the two countries is so large that technology alone cannot explain the wage trends."

Figures 7 and 8 reproduce data from GREEN & SAND(2013) on the percentage change in weekly wages (e.g. change in weekly wages by wage

percentile 1991-2001) for Canadain and U.S. men. Thus we now examine percentile wage changes. The "hollowing out" hypothesis is that wage changes in the middle should be negative.

Figure 7 – Change in log weekly wages by percentile - Change from 1991 to 2001

Source: GREEN & SAND (2013, pp. 12-13)

Figure 8 – Change in log weekly wages by percentile - Change from 1990 to 2000

Source: GREEN & SAND (2013, pp. 12-13)

For Canada (Figure 7), in the 1990s, median wages were constant and a near linear relationship over the entire distribution of wages saw wage decreases below the 40th wage percentile and increases above that level, with no polarization. The U.S. wage data pattern in the 1990s (see Figure 8) is markedly different from these Canadian data (and from most European patterns as well). In the US, the pattern is not linear, but shows modest wage increases up to the 30th wage percentile, modest decreases to the 70th percentile and increases thereafter.

For the period 2001-2006, the wage patterns are as follows for Canada and the USA:

Figure 9 – Change in log weekly wages by percentile - Change from 2001 to 2006

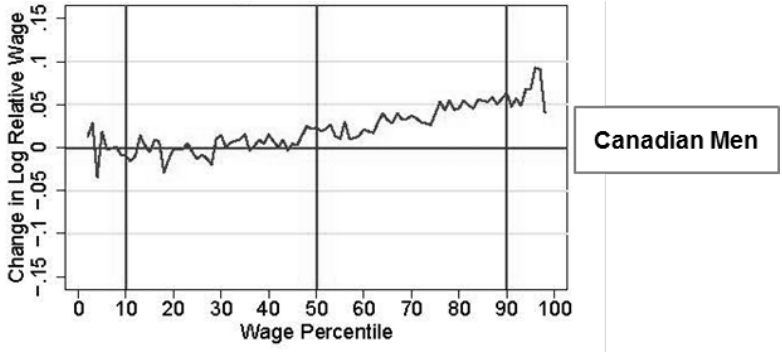
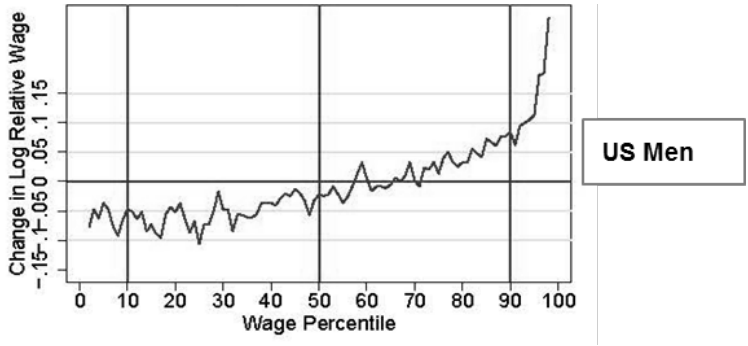


Figure 10 – Change in log weekly wages by percentile - Change from 2000 to 2007



Source: GREEN & SAND (2013, pp. 12&13)

Again, very different patterns emerge for this most recent period. Canadian wages (Figure 9) had little change up to the 60th percentile and wages increased some 5% for the higher wage group (with odd movements at the very top of the range). In the U.S. (Figure 10), wages below the 50th percentile fell and wages above that percentile rose appreciably by 10 to 15% and more for the top 90th percentile. However, in the U.S. for the period 2000 to 2007, there is no sign of further 'polarization', as the middle of the wage distribution did not experience wage declines relative to lower wage earners. Here is however sharp growing wage inequality in the U.S. over this 2000 to 2007 period.

To summarize this brief survey, U.S. aggregate data do show job classification shifts away from "routine" jobs; Canadian data do not show

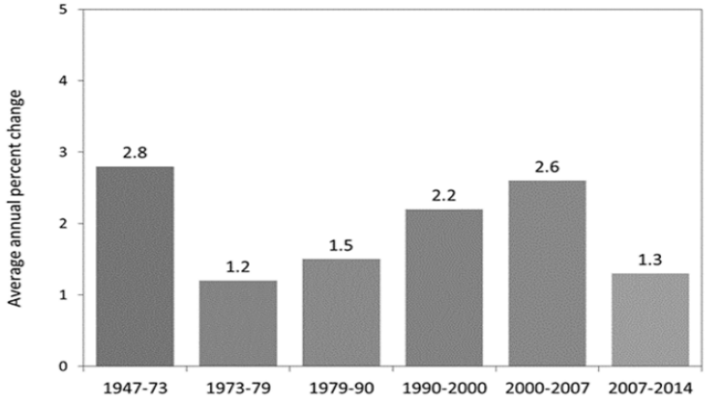
such shifts. Examining percentage changes in wage data, some hollowing out of the "middle class" is evident in the USA in the 1990's. No such pattern is seen in Canada. And these data are for pre-tax percentile wage distribution data. On an after tax basis, wage polarization would not appear to typify aggregate Canadian data 1991-2006.

■ Relation to ICT?

We saw earlier that Canada lags behind the U.S. in many types of ICT infrastructure, adaption, applications and usage. The largest gaps in 2011 were in business infrastructure, government and consumer infrastructure, as well as in consumer usage.

The fact that Canadian productivity performance is far poorer than that in the USA at least until 2005 cannot be because of differences in business ICT usage and skills as these are close to each other and their levels are among the highest in the world. And it is hard to see how the differences that do exist in ICT - in consumer and government infrastructure could have large productivity impacts. The data in FUSS & WAVERMAN (2005) do show a significant lower adaption of computers in Canada - these differences are suspicious and could be due to data errors but if these are true differences, this one ICT capital stock difference would be a significant factor.

Figure 11 – Productivity change in the U.S. nonfarm business sector, 1947-2014



Source: U.S. Bureau of Labor Statistics

Of course, the widely reported and discussed fall in productivity world - wide, particularly in the USA since 2007 is a conundrum. Figure 11 shows the productivity experience in the USA since 1947. The period 1990-2007 is clearly well above the productivity performance of 1973-1990. Remember that the World Wide Web dates to 1996 and the iPhone only to June 2007. We are thus not far down the ICT path. Nor can we expect monotonic improvements in welfare and productivity given economic shifts unrelated to ICT such as the Great Recession of 2008, the dislocations of that still being felt worldwide.

Other general purpose inventions were slow to come to fruition and uneven in timing and impact. "[...] steam had a relatively small and long-delayed impact on productivity growth […]" (CRAFTS, 2002). In a well cited paper, Paul DAVID (1989) states "[…] the transformation of industrial processes by the new electric power technology was a long delayed and far from automatic business."

The explosion of social media, viral networks and applications spawned in 2007 by the iPhone is now eight years old! Most advances have been directed at the consumer market. We have not yet begun to tap the enormous business potential of the ubiquitous smart phone. Three features unique to mobile phones – identity through the SIM card, specifity of location through cell sites/GPS, and specifity of time enable functionality unavailable before. An example of such applications is the overlay of mobile/enterprise payment systems and expense reporting software which either eliminates or greatly decreases the costs, errors and potential fraud in employee expense reimbursement.

Productivity will improve as the ICT revolution continues to expand beyond consumer driven social media. However, the U.S. data do appear to show that ICT is, at least, in the short to medium term, a source of growing income disparity because of the displacement of "routine" jobs. However, there is potentially a more positive ICT story for the USA – that the enormous wealth generated by ICT firms in the USA increases income disparity but in a positive way as the Googlesque millionaires raise the top 1% share absolutely and relatively. Canada, which has few Google like firms, doesn't have the push at the top. However when we look at wages, not income in the USA, we do see the "middle" more routine jobs at risk. This may be Canada's future. And we need to prepare for these changes by identifying at risk groups and preparing counseling and training far better than we have in the past.

References

ANTONCZYK, D., DeLEIRE, T. & FITZENBERGER, B. (2010): "Polarization and Rising Wage Inequality: Comparing the U.S. and Germany", IZA DP No. 4842, Institute for the Study of Labour, mimeo.

CARD, D. & DiNARDO, J. E. (1997): "Skill Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles", *Journal of Economic Literature*, Vol. 20, No. 4, pp. 733-783.

CRAFTS, N. (2002): "Productivity Growth in the Industrial Revolution: A New Growth Accounting Perspective", *London School of Economics*, mimeo.

DAVID, P. (1989): "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox", American Economic Association, Papers and Proceedings.

FUSS, M. & WAVERMAN, L. (2006): "Canada's Productivity Dilemma: The Role of Computers and Telecom", Bell Canada's submission to the Telecommunications Policy Review Panel, Appendix E-1.

GOOS, M. & MANNING, A. (2007): "Lousy and Lovely Jobs: the Rising Polarization of Work in Britain", *The Review of Economics and Statistics*, February, 89(1), pp. 118-133.

GREEN, D. A. & SAND, B. (2013): "Has The Canadian Labour Market Polarized?", November, Vancouver School of Economics, University of British Columbia, mimeo.

JOHNSON, G. E. (1997): "Changes in Earnings Inequality: The Role of Demand Shifts", *Journal of Economic Perspectives*, 11(Spring), pp. 41-54.

KUZNETS, S. (1955): "Presidential Address American Economic Association", *American Economic Review*, Vol. XLV, Number One, p. 1.

PIKETTY, T. (2014): *Capital in the Twenty-First Century*, Harvard University Press, Cambridge, MA.

SOLOW, R. (1956): "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, Vol. 70, No. 1, February, pp. 65-94.

WAVERMAN, L. & DASGUPTA, K. (2011): "The Connectivity Scorecard", Nokia Siemens Networks, mimeo.

Wells Fargo, (2014): "The Face of Job Polarization", Special Commentary September 24, written by KHAN, A. & ALEMAN, E.