

17 Productivity trends and employment across industries in Canada

*with Pierre Mohnen**

Introduction

In a famous article of 1967, William Baumol predicted that services would price themselves out of the market, given their lower productivity growth and the consequent rise of their relative price, compared to non-service goods. Twenty years later, we observe that measured productivity growth in services is indeed relatively low, but that at the same time the modern economy is based less on manufacturing and more on service. Economic activity has substantially shifted away from manufacturing towards services, as it had moved from the primary sector to manufacturing in the first half of the last century. How to reconcile these observations?

In this chapter, we examine the apparent paradox in the light of the Canadian experience. We first look at the facts. In the next section, we trace productivity trends and employment shifts for the Canadian economy over the period 1962–91. Second, we review a list of potential explanations. Labour productivity growth provides only a partial picture of productivity performance since it ignores the role of capital accumulation, so we look at total factor productivity (TFP) growth. In the third section, we distinguish between value added and final demand. Their macro identity breaks down at the sectoral level and this has implications on the issue. Value added might be more concentrated in services than before, reflecting a crowding out of services from manufacturing, and yet final demand composition has barely changed. We then examine shifts in final demand composition at both the commodity and final demand category levels. In the fourth section, we explore the hypothesis that Canadian services may have gained a comparative advantage in international trade. Last, but not least, production and final demand for services may have gained ground as a result of technical change. The verdict on the latter mechanism is provided in the fifth section. We conclude in the sixth section by summarizing the results of our analysis of the Canadian experience.

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Labour employment and productivity

To assess the extent to which economic activity has shifted towards services and to examine the sluggishness of productivity in services, we use the input–output (I–O) data of the Canadian economy at the medium level of aggregation (50 sectors and 92 commodities) and the KLEMS database (Johnson 1994; Statistics Canada, various issues). We report results for ten groups of sectors: the primary sector, manufacturing, construction, transportation, communication, wholesale trade, retail trade, FIRE (finance, insurance and real estate), business services and personal services.¹ We compare three periods, the 1960s, 1970s and 1980s, which are not exactly decades, but cover the periods 1962–74, 1975–81 and 1982–91. The two years separating the periods are slump years. This choice enables us to compare productivity and employment as much as possible over comparable phases of the business cycles. Table 17.1 reveals the changing pattern of labour employment by sector. The big losers are the primary sector and manufacturing. Their combined employment share has dwindled by 11.7 percentage points. Employment in services has gone up, except for construction and transportation. The big winners are business and personal services with a surge in total employment share of 9.2 percentage points.

The shift of employment towards the services can to some extent reflect the stagnant productivity in services. The story is usually cast in terms of labour productivity. Table 17.2 shows real value added per unit of labour for the ten groups of sectors and the three time periods. Value added is the value of the net output vector of commodities for a group of sectors. The figures are in 1986 \$C(Canadian) per hour worked. Table 17.2 reveals the Baumol disease. The top five groups of sectors, the ‘nuts-and-bolts’ chamber of the Canadian economy, all show dramatic increases in real value added per hour from the 1960s to the 1980s, ranging from

Table 17.1 Labour distribution (sectoral shares in per cent)

<i>Groups of sectors</i>	<i>1960s</i>	<i>1970s</i>	<i>1980s</i>	<i>60–80s</i>
Primary	15.4	11.8	9.8	–5.6
Manufacturing	27.7	24.4	21.6	–6.1
Construction	9.8	9.3	8.6	–1.2
Transportation	6.4	6.3	5.8	–0.6
Communication	3.1	3.6	3.5	0.4
Wholesale trade	5.7	6.2	7.0	1.3
Retail trade	14.3	15.2	14.9	0.6
FIRE	5.0	6.3	7.0	2.0
Business services	4.2	6.8	9.6	5.4
Personal services	8.4	10.1	12.2	3.8
Total economy	100	100	100	0

Notes

1 The 1960s correspond to the period 1962–74, the 1970s to 1975–81 and the 1980s to 1982–91.

2 At the M-level of disaggregation, primary regroups sectors 1–7 and 39, manufacturing 8–28, construction 29, transportation 30–32, communications 33–34, wholesale trade 35, retail trade 36, FIRE 37, 38 and 40, business services 41, 47–50 and personal services 42–46.

Table 17.2 Value added/labour (1986 \$C per hour)

<i>Groups of sectors</i>	<i>1960s</i>	<i>1970s</i>	<i>1980s</i>	<i>60–80s (%)</i>
Primary	15.66	19.32	23.96	+53
Manufacturing	17.37	22.63	26.47	+52
Construction	17.60	21.90	25.83	+47
Transportation	15.42	19.11	23.11	+50
Communication	26.52	39.81	53.87	+103
Wholesale trade	16.32	19.01	22.32	+37
Retail trade	10.62	11.86	12.82	+21
FIRE	58.52	64.08	70.30	+20
Business services	13.28	14.95	16.23	+22
Personal services	15.72	17.86	16.27	+3
Total economy	17.92	22.30	25.41	+42

Note

See Table 17.1 for the definition of periods and sectors.

Table 17.3 Capital–labour ratios (1986 \$C per hour)

<i>Groups of sectors</i>	<i>1960s</i>	<i>1970s</i>	<i>1980s</i>	<i>60–80s (%)</i>
Primary	55.81	93.36	128.99	+131
Manufacturing	31.75	43.48	58.41	+84
Construction	5.71	7.90	11.41	+100
Transportation	106.54	107.00	121.90	+14
Communication	253.51	309.64	424.04	+67
Wholesale trade	12.33	11.92	11.76	–5
Retail trade	9.01	8.94	9.85	+9
FIRE	35.45	52.52	86.17	+143
Business services	13.41	10.60	15.42	+15
Personal services	22.65	22.39	26.57	+17
Total economy	38.69	48.62	61.26	+58

Note

See Table 17.1 for the definition of periods and sectors.

47 per cent (in construction) to 103 per cent (in communication). The bottom five groups of sectors, the ‘soft’ chamber of the economy (wholesale and retail trade, FIRE, and business and personal services), depict increases in real value added per hour below the total economy’s average over the same period, with personal services trailing at 3 per cent. At the M-level of aggregation, labour productivity growth is thus negatively correlated with employment growth. Services, except for construction and communication, display the greatest growth in employment but also the lowest growth in labour productivity.

Now, we know that labour productivity is not the ideal way to measure productivity since it relates output only to the labour input. A stagnant labour productivity is not a problem if labour substitutes for capital and the factor savings are just on another input. Table 17.3 reports the capital–labour ratios, also in 1986 \$C per person-hour. All sectors but wholesale trade have increased their capital intensity.

Table 17.4 TFP-growth rates (annualized percentages)

<i>Groups of sectors</i>	<i>1960s</i>	<i>1970s</i>	<i>1980s</i>	<i>60–80s</i>
Primary	−0.83	−2.11	1.10	+1.93
Manufacturing	0.94	0.16	−0.20	−1.14
Construction	−0.17	1.92	−0.39	−0.22
Transportation	2.82	0.08	1.03	−1.79
Communication	3.91	1.50	0.64	−3.27
Wholesale trade	2.04	1.39	0.98	−1.06
Retail trade	1.58	−0.16	0.81	−0.77
FIRE	1.09	1.31	0.40	−0.69
Business services	0.48	0.62	−0.12	−0.60
Personal services	−0.12	−1.02	−1.87	−1.75
Total economy	1.41	0.47	0.17	−1.24

Note

See Table 17.1 for the definition of periods and sectors.

The question is whether the ‘soft’ part of the economy has done so at a lower pace and thereby compensated for its poorer labour productivity performance. The answer is ‘yes’ for retail trade and for business and personal services, but ‘no’ for FIRE. Because of the relative capital savings in at least four of these five sectors, the Baumol disease may be less severe if we measure the performance of sectors in terms of TFP instead of labour productivity. It can be shown that, under constant returns to scale, TFP growth is equal to labour productivity growth minus the growth in the capital–labour ratio multiplied by the cost share of capital.

Table 17.4 reports annualized TFP growth rates for our ten groups of sectors over the three periods. The Canadian economy was healthy in all periods. In fact, the aggregate Solow residual, that is, the Domar weighted averages of the sectoral Solow residuals are 1.41, 0.47 and 0.17, respectively for the three periods. Notice the pervasive TFP slowdown between the 1960s and the 1980s, except for the primary sector, which went through a tremendous recovery in the 1980s. It is interesting to see that, with the exception of personal services, the weak services sectors that we have identified so far did not perform worse than manufacturing. In fact, Canadian manufacturing TFP growth declined throughout the three periods. It even became negative in the 1980s. Personal services match this downward trend, but wholesale and retail trade, business services and FIRE outperformed manufacturing. As we suspected, the Baumol disease is more localized when measured in terms of TFP growth. It mainly applies to personal services. Now that we have clarified the symptom, let us turn to some of the possible explanations.

Value added versus final demand

Perhaps the clue in understanding the persistence of services is the presence of intermediate inputs. Most economic models treat sectors as production units that map factor inputs, labour and capital, into ‘output’. Summation of these ‘outputs’

over the sectors yields national product. In such a framework, national product and income are equal, not only in the aggregate, but also sector by sector. The presence of intermediate inputs preserves the macro-identity between national product and national income, but invalidates it at the sectoral level. The contributions of services to the national product and national income differ.

To obtain a concise understanding of the issue, let $(u_{ij})_{i=1,\dots,n;j=1,\dots,m}$ be the use table, where n is the number of commodities and m the number of sectors. Here u_{ij} is the amount of commodity i used by sector j . Similarly, let $(v_{ij})_{j=1,\dots,m;i=1,\dots,n}$ be the make table, where v_{ji} is sector j 's output of commodity i . The use and make tables are the heart of the System of National Accounts. Subtracting the use table from the transposed make table one obtains the net output table, where the typical element is $(w_{ij})_{i=1,\dots,n;j=1,\dots,m} = (v_{ji} - u_{ij})_{i=1,\dots,n;j=1,\dots,m}$. The dimension is commodity by sector. Column totals yield value added by sector, while row totals yield final demand by commodity. Total value added equals total final demand, as the sum of the column totals must be equal to the sum of the row totals. This is the identity between national income and national product, but there is no need for an equality between any column total and any row total. In particular, the contributions of the services to value added and final demand may differ. This is particularly true of the business services. Although value added is high (a large column total), final demand may be negligible (a small row total). Many sectors outsource their service activities to the business service sector. As a result, much activity is carried out in the business service sector, creating value added. However, this sector does not produce many commodities for final demand. As said, most studies measure the contribution of services in terms of value added, so it is of interest to contrast the latter with the contribution of services to final demand. Tables 17.5 and 17.6 show the shares of services in value added and in final demand, respectively.

Table 17.5 Real value added distribution (sectoral shares, 1986 \$C in per cent)

<i>Groups of sectors</i>	<i>1960s</i>	<i>1970s</i>	<i>1980s</i>	<i>60–80s</i>
Primary	13.1	10.2	9.2	−3.9
Manufacturing	26.8	24.7	22.4	−4.4
Construction	9.6	9.1	8.7	−0.9
Transportation	5.6	5.4	5.2	−0.4
Communication	4.7	6.5	7.4	+2.7
Wholesale trade	5.2	5.3	6.2	+1.0
Retail trade	8.5	8.1	7.5	−1.0
FIRE	16.2	18.1	19.4	+3.2
Business services	3.1	4.6	6.2	+3.1
Personal services	7.3	8.0	7.8	+0.5
Total economy	100	100	100	0

Notes

The 1960s correspond to the period 1962–74, the 1970s to 1974–81 and the 1980s to 1981–91. For the groups of sectors see Table 17.1.

Table 17.6 Final demand distribution (commodity shares, 1986 \$C in per cent)

<i>Groups of commodities</i>	<i>1960s</i>	<i>1970s</i>	<i>1980s</i>	<i>60–80s</i>
Primary	2.7	1.6	3.1	+0.4
Manufacturing	29.9	27.8	24.1	−5.8
Construction	19.5	18.6	16.7	−2.8
Transportation	2.5	2.4	2.3	−0.2
Communication	2.5	3.5	4.1	+1.6
Wholesale trade	3.4	4.0	5.0	+1.6
Retail trade	8.4	8.7	8.5	+0.1
FIRE	15.5	16.9	18.7	+3.2
Business services	5.4	5.7	6.7	+1.3
Personal services	10.2	10.9	10.7	+0.5
Total economy	100	100	100	0

Notes

At the M-level of disaggregation, primary corresponds to commodities 1–13 and 93–94, manufacturing to 14–69, construction to 70–72, transportation to 73–74, communication to 75–79, wholesale trade to 80, retail trade 81, FIRE to 82–83, business services to 84, part of 89, 90–92 and personal services 85–88, part of 89. For the definition of periods, see Table 17.1.

Table 17.5 confirms the growing importance of services as sources of earning. The primary sector and manufacturing saw their shares of real value added substantially and continuously decline. Between the 1960s and the 1980s, roughly 8.3 per cent of real value added moved from agriculture and manufacturing towards the services. A continuous but less severe relative loss of activity also took place in construction, transportation and retail trade. Whereas personal services saw their relative value added share increase only slightly, all other services, in particular FIRE and business services, became much more important in relative terms.

Table 17.6 shows the final demand shares for the commodity groups roughly corresponding to our ten groups of sectors. The correspondence is not exact, as sectors may be active in more than one line of product, but it is sufficiently close for comparison. The pattern is basically the same as for value added, that is manufacturing shrinks and services expand. The shift of final demand towards services amounts to 5.3 per cent, which is three percentage points less than the shift of value added. So indeed, the rise of the services in terms of commodities is not as dramatic as in terms of value added. Among the services, construction, transportation, retail trade and personal services are the weakest growth performers. The increase in final demand for services is less pronounced when expressed in terms of the categories of final demand.

In Table 17.7, consumption can be split into goods, housing and other services. Housing and other services together explain 3.6 percentage points of the shift in final demand towards services. Investment and government expenditures are not broken down into goods and services, which could in part explain the lower increase in services when analysed in terms of categories of final demand. If we compare our results with those reported by Joe Matthey (2001, ch. 5), the apparent

Table 17.7 Final demand distribution by categories of final demand (category shares, 1986 \$C in per cent)

<i>Categories of final demand</i>	<i>1960s</i>	<i>1970s</i>	<i>1980s</i>	<i>60–80s</i>
Goods	40.6	38.9	35.5	–5.1
Housing	11.3	12.3	14.1	2.8
Services other than housing	17.8	17.9	18.6	0.8
Investment	27.8	28.2	26.8	–1.0
Government	5.0	6.6	7.5	+2.5
Net trade	–2.4	–3.9	–2.5	–0.1

Notes

At the M-level of disaggregation, goods correspond to final demand categories 1–9, housing to 10, services other than housing to 11 and 13, investment to 14–23, government to 27 and 28, and net trade to 12, 24–26. For the definition of periods, see Table 17.1.

Table 17.8 Domestic final demand distribution (commodity shares, 1986 \$C in per cent)

<i>Groups of commodities</i>	<i>1960s</i>	<i>1970s</i>	<i>1980s</i>	<i>60–80s</i>
Primary	2.3	2.3	2.2	–0.1
Manufacturing	32.9	31.3	28.6	–4.3
Construction	19.1	17.6	16.2	–2.9
Transportation	1.9	1.9	2.0	+0.1
Communication	2.4	3.1	3.8	+1.4
Wholesale trade	2.7	3.2	4.0	+1.3
Retail trade	8.2	8.3	8.2	0
FIRE	15.5	16.5	18.7	+3.2
Business services	5.1	5.5	5.8	+0.7
Personal services	10.0	10.4	10.5	+0.5
Total economy	100	100	100	0

Note

For the definition of commodities and periods, see Table 17.6.

shift towards services in final demand is even less pronounced in the USA than in Canada.

However modest, it remains a fascinating challenge to explain the increase of the real share of services in final demand. As a first step towards solving the mystery of increasing demand for services, we must distinguish between domestic final demand and net exports. Table 17.8 shows the domestic final demand share for the ten commodity groupings. Compared to Table 17.6, it includes all final demand categories but net exports. The shift from the primary and secondary sectors of activity towards services is down to 4.4 per cent only. This further reduction prompts us to explore the possibility that the Baumol disease in Canada has been countered by a shift in comparative advantage towards services.

A shift in comparative advantage?

Canada is a small, open economy. The output of services is determined not only by preference and technology, but also by the terms of trade. In other words, even when productivity developments are relatively unfavourable to services and when shifts in the preferences of consumers are insufficient to counter this trend, the output of services may still be strong if the Canadian comparative advantage has shifted towards the production of services.

It is not easy to determine the comparative advantage of a national economy. The standard approach is to compare costs across countries, but there are two problems with this line of analysis. First, the observed costs reflect not only technology, but also market distortions, such as monopoly power, tariffs and rents resulting from barriers to entry or to trade. Second, the abundance of factor inputs co-determines the comparative advantage. Ricardian technology and Heckscher–Ohlin factor abundance effects are equally crucial in the determination of comparative advantage (Trefler 1995). Leamer and Levinsohn (1995) note that empirical testing of comparative advantage along the lines of the Heckscher–Ohlin–Vanek theory of the factor content of trade, requires independent data on endowments, technology and trade, but that one ingredient, usually technology, is missing in applied work. Instead, we have analysed the optimal allocation of activity across sectors for the Canadian economy, given real I–O data describing the structure of domestic absorption and technology, given data on factor availabilities from Statistics Canada KLEM's database, and finally given proxies for world prices.

Formally, we maximize the level of domestic final demand (given the observed proportions across commodities), subject to the material balance, the labour, capital and the balance of payment constraints. The latter constraint is evaluated at world prices. We equate the world prices with the US prices, given that Canada is a small and open economy, and that most of Canadian trade is with the USA. The maximization of the level of domestic final absorption subject to the aforementioned constraints constitutes a linear programme. The shadow prices of the tradable commodities can be shown to be proportional to the US prices. The shadow prices of the factor inputs measure their productivities. The shadow prices of the non-tradable commodities are equal to their costs. The primal variables, the activity levels of the sectors, reveal the comparative advantages. They signal which sectors would expand or contract under perfectly competitive conditions and free trade. We have run the linear programme for every year in the period 1962–91. A shift of comparative advantage is indicated by (dis)activation of sectors. A fuller presentation of the model is contained in ten Raa and Mohnen (1998); see Chapter 15.

The pattern of comparative advantage is surprisingly stable, even at the medium level of aggregation comprising 50 sectors. Crude petroleum or pipeline transport enjoys a comparative advantage for all years but one. The industry of fabricated metal products enjoys a comparative advantage through 1988. Tobacco products and printing and publishing do so from 1981 onwards. All these primary and manufacturing sectors share the comparative advantage with essentially one service sector each year: first FIRE (the 1962–72 period), then health services (the 1973–80 period, except for 1976 when it is amusement and recreational services),

and lastly travel, advertising and promotion (the 1981–91 period), accompanied by accommodation and food services through 1988. There is no shift from the primary sectors and manufacturing towards services. We can therefore conclude that international trade cannot explain the persistence of Canadian activity in services.

Technological change

Another potential explanation for the shift of value added and final demand towards the service sectors is technological change. First, new products appear at a much faster rate than before and at affordable prices: videos, CD-ROMS, laser discs, cellular phones, roller-blades, notebooks, scanners and so on. Second, with these new products, entirely new services emerge. Think of video stores, computer stores, cybercafes, internet server providers, software companies, internet search companies, central alarm systems, new telecommunication companies and so on. Third, Information and Communication Technologies (ICT) have changed the way of doing business. Many tasks along the product value chain are now outsourced: advertising, programming, after-sales service and so on. New business units specialize in these tasks, which partially explains the rise in value added in business services. Because of the pressure of competition and innovation in business services, companies specialize in their core activities and tend to outsource secondary activities, which they used to perform in-house. Even households switch from non-business services to market services. Time is devoted to earning money and letting the personal services sector perform part of the household chores, such as housekeeping, babysitting, financial planning and so on. Fourth, new products and services often carry higher value added, because of customer snobbishness, low competition at the beginning of the product life-cycle, product differentiation, tied-in sales, high income elasticities and low substitution possibilities. Demand for old, but especially for new, services have a higher income elasticity than demand for traditional manufactured goods. Competition shifts value creation from the manufacturing stages towards the various stages of servicing, for example providing life-time service plans, product-life insurance contracts, purchase on credit options, car-leasing instead of car-selling. There might also be a saturation effect for manufactured goods, whereas demand for services can be boundless. For example, a household's demand for cars is pretty dry after owning two or three cars, but demand for health services, leisure, or travel can increase by much more than a factor of two or three. Fifth, some companies producing manufactured goods have diversified into offering new services connected with their manufactured product. The service arm of the company may have grown so much that the whole company becomes classified into services.²

To give some substance to the hypothesis of technological change, we examine in Table 17.9 the sectoral evolution of R&D stocks. Those stocks represent not yet obsolete stocks of knowledge accumulated from past R&D expenditures. Although R&D is only an input in the generation of technological change, it is one of the most revealing indicators of innovation. Table 17.9 shows that the proportion of total R&D stock residing in manufacturing has dropped sharply

Table 17.9 R&D stock distribution (sectoral shares, 1986 \$C in per cent)

<i>Groups of sectors</i>	<i>1960s</i>	<i>1970s</i>	<i>1980s</i>	<i>60–80s</i>
Primary	4.6	5.9	5.3	+0.7
Manufacturing	91.1	84.3	75.2	−15.9
Construction	0.1	0.1	0.2	+0.1
Transportation	0.6	1.2	0.8	+0.2
Communication	1.8	5.0	7.2	+5.4
Wholesale trade	0.1	0.2	0.8	+0.7
Retail trade	0.1	0.2	0.8	+0.7
FIRE	0.4	0.7	2.3	+1.9
Business services	0.6	1.2	3.8	+3.2
Personal services	0.6	1.2	3.8	+3.2
Total economy	100	100	100	0

Note

For the definition of sectors and periods, see Table 17.1.

from 91.1 per cent in the 1960s to 75.2 per cent in the 1980s. Manufacturing still remains the sector where most R&D is done, but services are rapidly gaining ground, especially in communication and in business and personal services. Since, as a first approximation, we can assume that the efficiency of converting R&D into new products is the same in all industries, differential growth in R&D stocks across sectors implies differential growth in economic activity across sectors.

Conclusion

In the period spanning the three decades from 1961 to 1992, the Canadian service sectors accounted for an ever greater share of employment in the economy, even though their productivity growth was lower than in the primary sector and in manufacturing. To reconcile this apparent contradiction with the so-called Baumol disease, which predicts a decline in the share of services given their relative poor productivity performance and ensuing rising relative price, we have explored four potential explanations. First, the incorporation of capital in productivity analysis makes the disease less acute. Indeed, over this period annualized TFP-growth rates were not worse in the two most expanding service sectors (FIRE and business services) than in manufacturing. Second, the proper accounting of intermediate inputs drives a wedge between the income and product shares of the services, rendering them less buoyant in terms of product share: for all service sectors combined, the real value-added share rose by 8.3 percentage points, whereas the commodity output share rose by only 5.3 percentage points. Third, limitation to domestic final demand shares makes the role of services become even more modest: an increase of only 4.4 percentage points. Fourth, and related to this, we found no validity to the argument that a shift in comparative advantage towards services may have countered the decline of services due to their higher relative prices. In short,

Canadian services suffer little from the Baumol disease when capital is taken into account. However, their share of domestic final demand does not keep pace with their employment and value-added shares. Yet the service shares of domestic final demand do rise and this remains a puzzle to be explained. One explanation could be a shift of innovation towards services and, related to this, a shift of consumer preferences towards these new services. If R&D figures are anything to go by, they tend to bolster this explanation.

One final remark is in order. The very figures of labour productivity or TFP in services might be seriously mismeasured. Services are hard to measure and, for some of them, accurate estimates of output are not even available. Moreover, in the presence of technological change, quality improvements in services and the prices of entirely new services are even harder to measure correctly. It is very likely that services are undervalued, as their output is often measured by their cost of production, given the lack of reliable price data and a proper definition of what services are actually supposed to measure. Hence it may well be that there is no real Baumol disease in services, as prices are rising by less and TFP by more than what is actually measured in the official statistics.

Acknowledgements

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Notes

- 1 Sectors 41–50 were allocated to business or to personal services according to their ratio of shipments to domestic intermediate and final demand. Business services are characterized by a preponderance of deliveries to intermediate domestic demand.
- 2 For more documentation on some of these dimensions of technological change and their impact on productivity and activity in services, see Neef (1998), Coyle (1999) and Shapiro and Varian (1999).

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