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A Success Story:
Canadian Productivity Performance in Auto Assembly

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I. Introduction

Canada's automotive industry was a strong point of the national economy through most of the 1990s. About 35,000 relatively high-wage jobs have been created in the industry since 1992 (30,000 in parts production, and 5,000 in vehicle assembly). The job-creation in the assembly industry is all the more impressive in light of the fact that employment in most other auto assembling nations declined during the decade. Fixed investment expenditure has been very strong since the end of the last recession. And the auto industry has made a vastly disproportionate contribution to Canada's international trade performance. The net trade surplus in the overall automotive sector (with a large surplus in finished vehicles partly offset by a deficit in parts) totaled some $10.7 billion in 1998, accounting for over half of Canada's total merchandise trade surplus that year.

There are numerous factors which have contributed to the success of the Canadian auto industry. Perhaps one of the least-recognized among them is the fact that average productivity in the industry actually exceeds that in the U.S. auto industry. The auto industry is one of a handful of manufacturing sectors in which Canadian productivity exceeds that of the U.S., and the Canadian productivity advantage has grown through the 1990s. This impressive productivity performance is both a cause and a consequence of the general success which the auto industry has enjoyed in Canada in recent years. Good productivity contributes to cost competitiveness which in turn is a key determinant of both new investment spending and output levels, both of which in turn reinforce the initial productivity advantage. This "virtuous circle" has produced a strong growth dynamic in the Canadian industry. While the productivity momentum created thanks to strong investment and output growth will certainly reinforce the Canadian industry's productivity performance in the medium-term, policy-makers will also want to monitor several factors which could contribute to slowdown in the longer-run.

This paper will review several different measurements of labour productivity in the Canadian auto industry, with comparisons to U.S. productivity performance. The paper will then discuss several factors which have contributed to strong productivity growth, and will conclude by briefly considering the future outlook for the industry.

II. Canada's Productivity Performance

It is generally easier to improve productivity in a growing industry than in a declining one. Growing industries enjoy higher capacity utilization and a greater likelihood for fixed capital formation, which in turn is likely to embody recent technological developments (many of which will further enhance productivity).[1]

In this context, Canada's auto industry has enjoyed a head start over its U.S. counterpart. Total assembly of cars and light trucks (including pickups, minivans, and sport utilities) grew 40 percent in Canada between 1986 and 1998 (see Figure 1). Canadian assembly was not dramatically affected by the recession of the early 1990s; U.S. assembly plants absorbed most of

the downturn in continental auto demand that was associated with that recession. Canadian output then grew substantially during the subsequent recovery.[2] In the U.S., on the other hand, assembly declined steeply (by about one-quarter) during the recession, motivating the closure of several assembly plants. And U.S. output has grown less vibrantly during the recovery, only just regaining its pre-recession peak in 1994 and subsequent years.

These contrasting growth paths are also reflected in data on auto industry employment. Employment in the total auto industry (considering both auto assembly and parts production) fell more steeply in Canada than in the U.S. during the recession (see Figure 2). Subsequent job-creation has been only slightly faster in Canada than in the U.S. The auto parts sector (which is responsible for two-thirds of auto industry employment in Canada, and 60 percent in the U.S.) accounts for most of this similarity in employment trends between the two countries. In the assembly sector alone, the employment trends have been quite divergent (see Figure 3). By 1998 total employment in the Canadian assembly industry was some 12 percent higher than in 1986, while in the U.S. assembly employment declined by some 15 percent during the same period.

As with any industry, numerous methodological choices are encountered in efforts to measure productivity in the auto industry. The present review will focus on measuring labour productivity.[3] A typical approach is to measure real value-added in an industry per unit of labour input. Since the normal hours of labour worked by an employee will vary over time and space, it is preferable to measure value-added per hour worked (rather than value-added per worker). As indicated in Figure 4, however, average hours of work in the auto industry have not changed much over the past dozen years in either Canada or the U.S. Hours of work (pictured here for production workers) rose during the early years of the 1990s recovery (as producers initially responded to growing demand through longer working hours rather than new hiring). They have since fallen back to levels similar to those experienced during the latter half of the 1980s. The differing working hours pictured in Figure 4 are due mostly to longer hours worked in the U.S. parts industry. Weekly hours of work in the assembly sector are roughly identical in the two countries. Workers in the U.S. auto parts industry, however, presently work almost 5 hours more per week than their counterparts in Canada. Because of the broadly similar historical *trends* in working hours in the two countries, there will be little difference between comparative labour productivity *trends* measured in terms of output per worker or output per hour worked (although differences in the *level* of hours worked will be important in estimating comparative productivity *levels* between the two countries, particularly in the parts sector).

Value-added measurements of productivity also suffer from the numerous well-known problems associated with choice of deflators, adjustments for quality, and–in the case of international comparisons–the selection of appropriate exchange rates.

Table 1 summarizes the growth of real GDP per hour worked in the auto industries of the two countries. According to the respective industrial data published in the two countries, real labour productivity in Canada's auto industry grew strongly over the past dozen years, by a total of nearly 60 percent between 1986 and 1998.[4] The most rapid growth experienced was during

the recovery phase of the 1990s business cycle: from 1991 through 1998. In contrast, apparent real value-added per hour has stagnated in the U.S. over the same time period–it declined sharply during the recession, and has recovered less vibrantly since then (growing 25 percent between 1991 and 1998, compared to 43 percent in Canada). The sharp decline in U.S. labour productivity in the early 1990s probably reflects the impact of the disproportionate number of assembly plant closures in that country; since assembly is a higher-value segment of the overall auto industry, the compositional shift toward more auto parts production will depress average productivity levels.[5] In Canada, in contrast, output and employment in the assembly sector grew during this period, so this negative compositional effect was avoided.

While it is clear that average labour productivity was growing more quickly in Canada than in the U.S. during this period, the comparison of productivity *levels* is made difficult by the issue of price level comparability. Numerous estimates have been made of an appropriate purchasing power parity exchange rate for Canada-U.S. comparisons; most of these estimates for the Canadian dollar fall between 75 and 85 cents (U.S.). Table 1 estimates comparative common-currency productivity levels in the two countries, using these two "outer bounds" for a purchasing power parity exchange rate. In 1986 Canada's auto industry was clearly less productive than its U.S. counterpart. By 1998 the productivity gap had been closed, and indeed real output per hour worked was higher in Canada than in the U.S.–by less than a percentage point assuming a 75 cent equilibrium exchange rate, and by a more impressive 14 percent at an 85 cent exchange rate.[6]

The comparative trends in labour productivity growth between the two countries are summarized visually in Figures 5 and 6. The contrast between the strong growth of Canadian productivity, and the stagnation of the U.S. experience, is equally visible in both instances, whether measuring output per hour worked (Figure 5) or output per worker (Figure 6).[7]

Since the auto industry produces an output which can be conveniently measured in physical units (number of cars and trucks assembled), it is also common to measure labour productivity in the industry in physical terms. This approach is typically applied to the assembly sector of the industry (in light of the highly varied outputs of auto parts manufacturers, which makes the measurement of such a heterogeneous output in physical terms impossible). Measuring productivity in physical (rather than value) terms creates its own set of conceptual and measurement difficulties, of course. For example, measures of simple assembly productivity will not capture improvements in the quality or value of assembled vehicles, and will thus tend to understate true productivity growth over time.

A very rough measurement of labour productivity in the assembly sector is provided by the number of vehicles assembled in each country for each production employee of the assembly sector.[8] Comparative trends in this measure are provided for Canada and the U.S. in Figure 7. Canada has traditionally exhibited a higher level of final assembly per employed production worker; and the gap between the countries was stable, with Canada maintaining an advantage of about 20 percent through the 1990s. This simple comparison may be clouded somewhat,

however, by statistical differences between the two countries (regarding the definition of production and non-production workers, for example, and the categorization of auto assembly and parts production).[9]

More complete and detailed measurements of physical labour productivity are provided by the annual survey of automotive assembly operations conducted by Harbour and Associates, a Michigan-based consulting firm. This survey is based on plant visits and company-supplied data, and is a closely-watched indicator of efficiency and competitiveness in the North American assembly industry. Like any measure of physical productivity, the Harbour approach abstracts from improvements in the quality of assembled vehicles. These quality improvements have been very important in the auto industry in recent years. Consider, for example, the data on price indices of finished vehicles in Canada illustrated in Figure 8. The "average selling price" of a new vehicle in Canada approximately doubled between 1986 and 1998. Much or even most of this rise, however, was due to changes in the mixture of vehicles purchased by Canadians: more trucks, more luxury vehicles, and more sport utility vehicles. The compositional effects of this shift were more important than any increase in the average price of any particular class of vehicle. For example, the selling price of a standard midsize sedan grew by only 20 percent over the same period–less than the rise in the general consumer price index.[10] Since the mix of assembled vehicles will shift to keep up with changing consumer preferences, the "average" assembled vehicle today reflects a noticeably higher quality than in previous years, but this form of qualitative growth is missed by any measure of simple physical productivity.

For similar reasons, inter-company or inter-country comparisons are also affected by potential differences in the vehicle mix produced by each entity being considered. For example, General Motors produces less light trucks than Ford and DaimlerChrysler; since trucks (and associated products such as minivans and sport utility vehicles) normally require more labour time for assembly, a simple aggregate comparison of physical labour productivity across these three firms will be misleading, and will overstate GM's apparent relative productivity. Similarly, the Canadian auto industry assembles relatively less light trucks than is the case in the U.S., and hence international comparisons based on the Harbour data must be considered carefully for the same reason. As indicated in Figure 9, light trucks have accounted for a relatively stable share of Canadian vehicle assembly–about 45 percent–in recent years. In the U.S., in contrast, the output share of light trucks has grown steadily, and now exceeds 50 percent.

The Harbour estimates of labour productivity may also be affected by corporate decisions regarding the extent of in-plant sourcing and sub-assembly of various components and sub-systems of assembled vehicles. A company can improve its apparent labour productivity in the Harbour survey by simply outsourcing one or more sub-assembly processes to satellite facilities or subcontracting suppliers; this reduces the apparent labour required in the assembly process without necessarily translating into true productivity growth in a vertically integrated sense. While the Harbour survey attempts to make some adjustments to its estimates to capture the effect of these sourcing decisions, this effort is acknowledged to be incomplete, and the Harbour estimates need to be interpreted cautiously as a result. As discussed in the nest section, there is

some evidence that particular Canadian automakers–and General Motors in particular–have "outsourced" their way to high levels of (apparent) labour productivity.

One additional aspect of the Harbour methodology which is important to Canada-U.S. comparisons based on the data is the fact that the survey measures hours of work paid in each assembly plant, not hours actually *worked*. This will result in an overestimation of labour input at three major Canadian assembly plants which operate on an innovative three-shift assembly schedule. Workers at the Bramalea and Windsor assembly facilities of DaimlerChrysler, and the Oshawa truck plant of General Motors, receive 8 hours of wages for 7.5 hours of work, in order to facilitate shift changeovers within a three-shift system. Reported hours worked in the Harbour survey are thus approximately 7 percent higher (and hence estimated productivity is 7 percent lower) than is actually the case.

Despite these important methodological concerns and cautions, the Harbour survey nevertheless provides an interesting and detailed comparison of labour productivity and work organization in most North American assembly plants.[11] Tables 2 and 3 provide a summary of comparative physical labour productivity levels in Canada, the U.S., and Mexico according to the Harbour survey.

Until recently, the Harbour productivity estimates were generated in terms of the number of workers (both production and in-plant supervisory) required to assemble one finished vehicle in a regular day of work. The resulting estimate hence carried the unit "workers per vehicle." It was calculated by dividing the regular in-plant workforce by the plant's regular daily output. This approach was found over time to be less-than-satisfactory, however, primarily because it missed the effects of overtime and other irregularities in production. An assembly plant which seemed productive in terms of regularly scheduled workers per vehicle, could actually prove to be less efficient in practice due to plant down-time, overtime, and other factors which were neglected in this approach. Since 1998, therefore, the Harbour results have been stated in terms of hours worked[12] per assembled vehicle, based on year-total output and hours. For intertemporal comparisons, however, the original workers-per-vehicle comparison must be used, since the data required to recalculate previous years' estimates on an hours-per-vehicle basis were not collected.

Table 2 summarizes physical labour productivity for the three North American countries in 1998, on both a hours-per-vehicle and a workers-per-vehicle basis. In hours per vehicle terms, Canadian car assembly utilizes 13 percent less labour per unit of output than is the case in the U.S. Truck assembly, however, is found to utilize 4 percent more labour input per unit of output. On a combined basis, labour productivity in assembly is 6 percent higher in Canada.[13] Utilizing the former workers per vehicle methodology, the Canadian labour productivity advantage is slightly more apparent: 10 percent in cars, 3 percent in trucks, and 7 percent overall.[14] Labour productivity in Mexican assembly operations is found to be about 60 percent lower than in Canada.

The Harbour data also indicate that labour productivity has grown more quickly during

the current upswing of the business cycle in Canada than in either of the other two countries surveyed.[15] In both cars and light trucks, Canada's productivity grew more quickly between 1992 and 1998 than that of the U.S., increasing by 26.5 percent and 18.4 percent, respectively. For cars, this translates into an annual decrease in the unit labour input to assembly of about 4 percent; for trucks, the annual rate of productivity improvement has been just under 3 percent. The weighted average productivity advantage for Canada's auto industry as a whole doubled between 1992 and 1994, to some 7 percent.

III. Understanding Canada's Success

Productivity measurements are notoriously complex, uncertain, and even subjective. This is especially true of international comparisons. By numerous different indicators, however, it seems clear that productivity growth in Canada's auto industry has vastly surpassed that of its U.S. counterpart during the 1990s. In the auto assembly sector at least, and possibly in the auto parts industry as well (or particular segments of it), it also seems relatively safe to conclude that absolute productivity levels in Canada's industry are now higher than those in the U.S. Further research will naturally make a welcome contribution to a more accurate and complete portrayal of this productivity advantage.

A wide range of factors has clearly contributed to the emergence and strengthening of the Canadian productivity advantage in this crucial export-oriented industry. Moreover, since many of the benefits which accrue as a result of good productivity–export competitiveness, output growth, and strong investment–also tend to reinforce productivity growth, it is difficult to disentangle which factors in this circular process "came first". This section will briefly discuss some of the more important factors contributing to productivity growth in the Canadian auto industry.

Fixed Capital Formation

Canada's auto industry enjoyed a historically unprecedented investment boom during exactly the same period–the upswing of the 1990s–during which its productivity growth notably accelerated. As indicated in Figure 10, total fixed investment in the assembly and parts sectors of the industry averaged about $3.5 billion per year between 1993 and 1999; this is a considerably faster pace of investment than was experienced during the expansion of the 1980s. The connection between strong rates of fixed capital formation and resulting productivity growth seems relatively straightforward. Virtually every assembly plant in Canada has been completely refurbished and re-equipped with new production technology (including important ancillary facilities, such as paint shops) during this period. The re-tooling of a plant is also typically associated with various changes to work organization which may also be reflected in improved productivity.[16]

Cost Competitiveness

Canadian assembly facilities received a disproportionate share of new capital investment during the 1990s; a less-than-proportionate number of these plants were closed during the downturn earlier in the decade. The attractive cost competitiveness of Canadian-based vehicle assembly was surely an important factor behind these corporate investment decisions.

Labour costs in Canada's auto industry are considerably lower than in the U.S. In the auto assembly sector, labour costs per hour worked (including the cost of various fringe benefits, non-wage costs, and payroll taxes) are approximately 30 percent lower, on a common-currency basis, than in the U.S.[17] The depreciation of the Canadian dollar during much of the 1980s and 1990s has obviously contributed to the emergence of this labour cost advantage. Canada's public health care system is also an important factor; lower premiums for private health insurance services reduce Canadian hourly labour costs by about $4 (U.S.) per hour, accounting for roughly one-third of the total labour cost advantage.

Manufacturing firms in Canada incur a modestly lower rate of corporate taxation than is the case in the U.S. This may also be a factor in the investment location decisions which have so clearly benefitted Canada's auto industry.

Low labour and other production costs alone, of course, are not a sufficient basis for industrial development and expansion. Good productivity and quality results are also essential to stable and sustainable industrial success. If an initial cost advantage helps to attract sufficient incoming investment, however, to generate strong productivity growth, then the momentum for investment and growth is simply reinforced. At one time lower labour costs were needed in the Canadian auto industry to offset lower labour productivity; now, however, high productivity has become part of the cost appeal for further investment in the industry.

Work Organization

There is some evidence that, in certain cases, Canada's apparent productivity advantage in the auto industry may be related to more aggressive efforts on the part of vehicle manufacturers to reorganize and restructure the work process. As discussed above, efforts such as these can produce apparent but potentially misleading improvements in simple measurements of assembly productivity.

It is difficult to make any general statements about the degree of work reorganization which has occurred in the two countries, and since the Canadian assembly operations ultimately fall under the direction of foreign (usually U.S.-based) managers following corporate-wide policy directives, it is unlikely that any strong differences in management style would be exhibited at Canadian plants. In some cases, however, an especially strong effort by Canadian managers to "lean" their operations might be important to the apparent growth of Canadian productivity.

In three Canadian assembly operations, it is possible to contrast the extent of in-plant sourcing with U.S.-based facilities producing directly comparable product lines. These

comparisons are illustrated in Table 4. The Oshawa truck assembly plant of General Motors exhibits a significantly lower amount of in-house sourcing and sub-assembly than corresponding plants producing the same vehicle in the U.S.; this may account for some of the Oshawa plant's productivity advantage. On the other hand, Ford's Ontario truck plant and DaimlerChrysler's Windsor minivan plant exhibit similar degrees of in-plant content as its sibling operations in the U.S. In the case of the Ford trucks, ironically, it is the plant with the *most* in-house content (in Kansas City) which has attained the *best* productivity rating. The Ontario plant's productivity is comparable to the other Ford truck plants, despite the fact that the Ontario plant operates on only a single shift (and hence suffers a productivity disadvantage resulting from higher unit inputs of fixed labour such as maintenance and supervisory functions). DaimlerChrysler's Windsor minivan plant demonstrates notably higher productivity than its U.S. counterpart, despite encompassing identical levels of in-plant content.

On the whole, then, it is not likely that management decisions regarding in-plant content and outsourcing have played a systematic role in explaining the superior productivity performance of Canada's auto industry, although this may have been a factor in certain cases (particularly at General Motors). It would be desirable for the measurement methodology utilized in the Harbour survey and similar studies to be improved to take fuller account of these sourcing decisions in deriving its productivity estimates.

Union Representation

Canada's auto assembly industry is approximately 90 percent unionized; its auto parts industry (including the in-house parts production of major auto assemblers) is approximately 50 percent unionized. Union representation is slightly lower in the U.S. assembly sector (due to the larger presence of non-union offshore companies), and much lower in the parts industry (where less than 20 percent of the workforce belongs to a union). Union representation in the U.S. industry is proportionately smaller than in Canada. Just as importantly, the U.S. auto union has traditionally followed a more "accommodating" strategy in its dealings with automakers than has the Canadian union–being much more open to various "cooperative" ventures such as wage concessions, profit-sharing schemes, and the introduction of workplace "teams." In theory, this might be seen to give U.S.-based producers an advantage in implementing various restructuring initiatives aimed at boosting productivity.

On the other hand, in principle, any unionization which is successful in improving wages and benefits is likely to be associated with a corresponding increase in labour productivity within the unionized firm, if for no other reason than that the firm can no longer afford to perform (in-house, at any rate) certain lower-productivity functions, which are then either out-sourced or else canceled altogether. Other literature suggests that unions can have productivity-enhancing effects through the provision of secure means for employees to offer opinions, the reduction of employee turnover, and other factors.[18]

Canada's major auto union, the Canadian Auto Workers (CAW), has adopted a relatively

complex and subtle approach to bargaining over the causes and consequences of productivity growth. The union has attempted to protect its employees against negative consequences which may result from productivity growth or outsourcing. But it has attempted to do this in a manner which preserves the operational flexibility and effectiveness of the automaker. For example, in an innovative 1996 agreement, the CAW allowed auto assemblers to outsource certain sub-assembly functions to independent suppliers, provided that the workers who subsequently performed that work were covered by the same terms and conditions of work. Outsourcing which resulted in real operational or technological benefits could therefore explicitly occur; outsourcing which was motivated solely by efforts to sidestep the union contract would not.

The union adopted a similar approach in a 1999 agreement regarding modular production methods. Rather than opposing the modular concept in a blanket fashion, the union negotiated an agreement which allowed companies to experiment with this approach, so long as the union contract continued to govern employment in the satellite operations attached to a modularized facility. Once again, if there is a true productivity benefit to be captured through modularization, then the automakers are free to pursue it.

Similarly, the CAW has placed great emphasis on measures to preserve employment levels in the assembly industry through reduced working hours. This effort has been explicitly linked to ongoing course of productivity growth. When productivity is growing faster than demand (as has been the case in the last two decades), it is only possible to preserve aggregate employment levels through a continuous reduction in average working hours; this has been the explicit goal of the CAW's shorter working time initiatives. Shorter work time arrangements have been structured in a manner which does not negatively impact on the utilization of capacity.[19]

Thanks to these and other initiatives, Canadian auto workers may feel they have less to fear from productivity growth in the industry, and hence are less likely to resist measures which are reasonably aimed at productivity growth. In this context, it is interesting to note that Canada's apparent productivity advantage in the auto assembly sector is located *solely* within unionized auto assemblers (see Table 5). The only non-union Canadian assembly firm which participated in the Harbour survey demonstrated *lower* labour productivity than its U.S. partner.[20] The productivity advantage enjoyed by the Canadian operations of General Motors is particularly striking; whereas GM has a continent-wide reputation as being a productivity "laggard", the company's Canadian facilities are virtually as efficient as those of productivity-leading Toyota.[21] This data would seem to reinforce the notion that the particular practice of unionism in the Canadian auto industry has been a positive factor in recent productivity growth.

In certain cases, the union has explicitly worked with management to attain better capacity utilization and productivity. For example, the CAW pioneered an alternative work schedule which facilitated the introduction of unique three-shift operating systems at major assembly facilities in Windsor, Bramalea, and Oshawa.[22]

Trade and Investment Policy

The 1965 Auto Pact, which eliminated (under certain conditions) tariffs on trade in finished vehicles and automotive parts between Canada and the U.S., provided a crucial boost to the early development of Canada's auto industry. Canadian-based firms could take advantage of the economies of scale resulting from intra-industry trade on a continental basis, and automakers were encouraged to invest in Canada by the Canadian-content provisions of its preferential tariff system. The Auto Pact was not directly a factor in the strong productivity growth evidenced by the Canadian auto industry during the 1990s (since Pact-member companies, by that time, were already performing well in excess of the Pact's Canadian-content requirements, and hence their additional investments in Canada were motivated by stand-alone cost and profitability calculations). Nevertheless, the historic role of the Pact in sparking the initial creation of a competitive "critical mass" in Canada's auto assembly industry should be noted. Other trade and investment policies (such as the duty remission program on auto parts which initially attracted Japanese-based manufacturers to invest in Ontario) may also have been important to the more recent strength in Canadian auto investment and productivity growth.

At time of writing, it appears that a dispute-settlement panel of the World Trade Organization has ruled that the preferential tariff system embodied in the Auto Pact contravenes WTO rules. The Canadian government is expected to appeal this decision. In light of the WTO decision, and given that the incentive power of the Auto Pact was already largely eroded as a result of the Canada-U.S. Free Trade Agreement (and the subsequent NAFTA with Mexico), Canadian policy-makers may wish to consider the longer-run development of alternative policies aimed at stimulating investment in the sector.

Conclusion

Canada's auto industry has benefitted from a virtuous circle, in which initial investments and output facilitated improvements in productivity and cost competitiveness, which in turn elicited still more investment, and still higher productivity. This powerful growth dynamic has allowed Canada to become perhaps the premiere auto manufacturing nation in the world (Canada assembles more vehicles per capita than any other major auto producer).

In many ways, the productivity success of Canada's auto industry is surprising, given the emphasis that has been placed in many recent discussions of productivity performance on the need for pro-market reforms such as deregulation, labour market flexibility, and tax cuts. Canada's auto industry is one of the most regulated and unionized sectors of the entire economy. Producers and sellers are subject to an array of government interventions regarding trade, safety, and environmental matters. The undervalued Canadian dollar has clearly been a factor in attracting the capital investment that has been so important to productivity growth (in contrast to the argument that the low dollar has "protected" inefficient Canadian firms); so too has been a socialized health care system which is financed largely out of personal income taxes which are consequently higher, on average, than in the U.S. According to the traditional wisdom of free-

market economists, Canada's auto industry should be a productivity disaster. Yet in reality it has been one of our brightest productivity performers, and consequently a major source of economic strength through an otherwise disappointing decade.

Chains of causation can be broken, however, and policy-makers and industry participants alike should probably not be too sanguine about the Canadian industry's future prospects. The current Canadian productivity advantage can only have been reinforced by continuing major capital investments in the industry. In the longer-term, however, several potential threats to the Canadian industry's well-being need to be monitored. Exchange rate fluctuations, of course, can always affect cost competitiveness and hence future investment levels (although given the high productivity that is now typical of at least the assembly sector of Canada's auto industry, it is unlikely that any foreseeable trading range for the Canadian dollar could cause too much damage).

Mexico's auto industry has grown steadily through the 1990s; while productivity levels there are low, they are growing, and are more than offset (in cost terms) by extremely low hourly labour costs. As the Mexican industry expands and diversifies, it may ultimately reach the same sort of "critical mass" which once fueled the rapid expansion of the Canadian industry ; in this case, Canada's favourable cost competitiveness *vis a vis* the U.S. industry may be superceded by a growing disadvantage relative to NAFTA's newest player.

Similarly, renewed growth in sales of offshore imports in the North American new vehicle market since 1995 is another source of potential concern. Thanks to the post-1995 depreciation of the Japanese currency, the effects of the Asian financial crisis of 1997 and 1998 (which forced Asian automakers to divert production more aggressively to export markets), and to innovative product designs in some market segments (such as the mid-size sport utility vehicles marketed by several Japanese-based firms, the new Volkswagen Beetle, and other new models), offshore market penetration roughly doubled in Canada during the latter half of the 1990s. The U.S. experienced a more modest increase in offshore import penetration.[23] If this trend continues to cut into demand and capacity utilization at Canadian facilities, it should be expected that future investment and hence productivity growth will also suffer.

For all of these reasons, then, it would not be justified to conclude that since Canada's auto industry is at present a world leader in productivity, it can simply be left to fend for itself. Timely and effective policies and strategic choices–by governments, by companies, and by workers and their union–have been crucial to the success of this strategic industry. Deliberate and interventionist multilateral efforts to stimulate, plan, and direct industrial expansion paid off in an industry that is a crucial source of jobs, incomes, and exports for Canada. Refreshing and updating the tools of that active strategizing may be essential to the industry's continued success in the future.

Notes

1. This positive two-way relationship between growth and productivity in manufacturing is commonly known as "Verdoorn's Law." See Nicholas Kaldor, "The role of increasing returns, technical progress and cumulative causation in the theory of international trade and growth," *Economique Appliqué*, 4, 1981, pp. 593-617.

2. Canadian light vehicle assembly reached an all-time record of over 3 million vehicles during 1999, but the unavailability of consistent data does not yet allow us to portray this more recent growth in the accompanying figures.

3. Estimates of total factor productivity, and other conceptions of productivity, are obviously also of interest. TFP measurements are highly contingent, however, on methodological and theoretical assumptions. It is the author's view that average labour productivity measures provide a more robust guide to productivity growth, although one which conflates the effects of capital deepening with those of technological progress more purely considered. As argued by Maurice Fitzgerald Scott, among others, the very notion that pure TFP growth is separable from the process of accumulating the new vintages of fixed capital which embody new technologies is highly controversial; see Scott, *A New View of Economic Growth* (Oxford: Clarendon. 1989). In terms of the impact of productivity growth on cost competitiveness and living standards, labour productivity also seems to be an especially relevant measure. Comparisons of TFP between Canada and the U.S. seem to reinforce the conclusion that productivity levels are now higher in the Canadian auto industry. For example, Frank C. Lee and Jianmin Tang find that TFP in motor vehicle assembly was 4 percent higher in Canada than in the U.S. by 1988, and this gap grew to 7 percent by 1995; see Lee and Tang, "Competitiveness comparisons between Canadian and U.S. industries," mimeo, Industry Canada, 1999.

4. Total employment in each industry is multiplied by average weekly hours of production workers to obtain an estimate of total hours worked; the implicit assumption is that non-production workers work similar hours to their hourly-paid counterparts.

5. The proportion of total U.S. auto employment accounted for by auto parts production grew from 50 percent to 60 percent during the period covered by Table 1. In Canada, in contrast, the proportions remained roughly constant. Because of the importance of these compositional effects, it would be preferable to estimate labour productivity trends separately for the parts and assembly sectors of the industry; this comparison will be conducted pending receipt of unpublished U.S. GDP data.

6. It is interesting to note that if the comparisons conducted in Table 1 were performed in terms of real output per worker, Canadian productivity would still appear 10 percent lower in 1998 at a 75 cent exchange rate, and just 2 percent higher on the 85 cent assumption. The shorter hours of work in the Canadian industry, particularly in the parts sector, are thus an important factor in the overall comparison of productivity levels between the two countries.

7. The assumption, indicated in Note 4, regarding the hours of work of non-production employees is thus not important to the conclusion regarding relative rates of productivity growth between the two countries.

8. Since management, research, and marketing staff of the North American automakers tend to be concentrated in the U.S., it is important to construct this calculation using only production workers.

9. One indication of definitional differences is provided by a comparison of official data on production worker employment in the two countries, with estimates of production employment in assembly published in the annual Harbour survey (discussed in detail below). The Harbour survey's plant-by-plant tally of assembly employment suggests that a total of some 29,000 production workers were employed in Canada in 1998, and just over 141,000 in the U.S. Harbour's estimate for Canada is equivalent to about 70 percent of the Statistics Canada estimate of hourly-paid employment in auto assembly (the difference is due to various factors such as assembly facilities not covered by the Harbour survey, and assembly-related employment in various "off-line" functions excluded from the Harbour survey). But Harbour's estimate of U.S. production employment is equivalent to only 57 percent of the U.S. Bureau of Labor Statistics estimate of total U.S. assembly employment. This difference may in part be due to a narrower definition in the Canadian case of what constitutes an assembly-related production function.

10. These data also cast some doubt on the claim that there is an "affordability problem" which has restrained the level of new vehicle purchases in Canada; with the typical vehicle buyer moving increasingly "up-market" in their purchasing decisions, it is hard to believe that vehicles have truly become less affordable. Indeed, the price data indicate that in real terms the price of a "basic" car has actually declined.

11. Not all North American auto-makers participate in the survey, although coverage is growing. For further details on the Harbour methodology, see *The Harbour Report 1999* (Troy, MI: Harbour and Associates Inc., 1999).

12. The actual measure is hours *paid*, not worked, as explained above.

13. The fact that more labour-intensive trucks account for a smaller share of total assembly in Canada accounts for a small share–about 8 percent–of the combined Canadian advantage.

14. The company which was "hardest hit" by the change in the Harbour methodology was DaimlerChrysler, which was found to utilize more overtime in its assembly operations; it fell in Harbour's productivity rankings as a direct result of the change in methodology. DaimlerChrysler accounts for a larger share of total assembly in Canada than in the U.S., and hence Canada's relative productivity performance is less impressive under Harbour's new approach.

15. As noted above, this intertemporal comparison can only be conducted using the original workers per vehicle methodology.

16. As a rough rule-of-thumb, it is typical that as many as 200 jobs will disappear from a normal-scale assembly plant in the course of each major retooling.

17. This comparison assumes an exchange rate of 70 cents.

18. See Peter Kuhn, "Unions and the economy: what we know; what we should know," *Canadian Journal of Economics* 31(5) 1998, pp. 1033-1056, for a recent discussion of these issues in the Canadian context.

19. The major initiative in this area has been the so-called "SPA" program (Scheduled Personal Absence), under which each worker in the assembly and parts operations of the unionized auto makers now receives two weeks off work per year with full pay, in addition to their regular holidays and vacations. These weeks off are randomly scheduled so that plant operation is not affected, and the companies are required to hire enough additional staff to cover these regular and ongoing SPA absences. The CAW estimates that the SPA program, which was first implemented in 1993, has saved over 2000 jobs in the assembly and parts industry in Canada. Because of the design of this program, the reduction in *annual* hours worked due to the SPA program is not reflected in the data on normal *weekly* hours of work which was illustrated in Figure 4 above.

20. Honda also operates a non-union assembly facility in Canada, but does not yet participate in the Harbour survey.

21. This evidence must be interpreted in the context of the long-troubled labour relations climate at GM in Canada. A powerful indicator of this was provided during the ratification by workers at the Oshawa assembly complex of the 1999 collective bargaining agreement–a contract which included very impressive gains in wages, pensions, time off, and other benefits. Where this agreement was ratified by an average of about 95 percent at other Canadian facilities, it received only 70 percent support in Oshawa, following a long and heated discussion about the contract's failure to address numerous long-standing issues regarding working conditions and work organization at Oshawa. The company, and perhaps also the union, have underestimated the extent of worker anger over the consequences of various GM "lean" production initiatives. The low labour content of GM's Oshawa operations are key to Canada's overall strong productivity performance; moreover, as noted in Table 4, there is evidence that the Oshawa operations may have outsourced more functions which were traditionally supplied in-house. Workplace resentment over the long-term impacts of leaning and outsourcing–reflected in concerns over problems such as workplace stress and repetitive strain injuries–may increasingly pose a constraint on further management efforts to improve productivity through the intensification of work processes. For further details on the attitudes of Canadian auto workers to workplace reorganization, see *Working Conditions Study, Benchmarking Auto Assembly Plants* (Toronto: CAW-Canada, 1996).

22. These three-shift systems in and of themselves may have a small positive impact on labour productivity by reducing unit inputs of fixed labour (such as plant maintenance and supervisory functions). In the Harbour methodology, however, they are seen to result in *lower* (apparent)

productivity, due to Harbour's use of hours paid as a proxy for hours worked. Most importantly, by allowing for a higher utilization of physical plant, these agreements have been influential in leveraging additional investment and output for Canadian-based facilities, with subsequent benefits for overall productivity.

23. Since most Canadian-made vehicles are exported, it is the overall North American market trend which is most important to production and capacity utilization in Canada. Nevertheless, it is interesting to note that the Canadian new vehicle market experienced a greater increase in offshore penetration during the latter 1990s than any other major developed country–at the very point in time when Canadian auto trade policies were being challenged at the WTO as being "unfair."

Table 1

Auto Assembly and Parts, Real GDP per Hour Worked

Canada vs. U.S., 1986 to 1998, $1992

	Canada ($Cdn per hour)	**U.S. ($US per hour)**	**Canadian Advantage @ 75¢ US**	**Canadian Advantage @ 85¢ US**
1986	$31.75	$40.81	-41.7%	-33.9%
1991	$34.66	$29.70	-12.5%	-0.8%
1998	$49.72	$37.00	+0.8%	+14.2%
Growth, 86-98	+56.6%	-9.3%		

Source: Author's calculations from real GDP and employment data published by Statistics Canada (Canada), Bureau of Economic Analysis, and Bureau of Labor Statistics (U.S.).

Table 2

Physical Labour Productivity Level Comparisons

North America, 1998, Harbour Data

	Car Productivity	Truck Productivity	Truck Output Share	Average Productivity
Hours per Vehicle Methodology				
Canada	23.36	29.34	42%	25.87
U.S.	26.84	28.27	52%	27.58
Mexico	40.72	45.90	46%	43.08
Canada-U.S. "Advantage"	+13%	-4%		+6%
Workers per Vehicle Methodology				
Canada	2.65	3.07	42%	2.85
U.S.	2.95	3.17	52%	3.06
Mexico	4.10	4.51	46%	4.28
Canada-U.S. "Advantage"	+10%	+3%		+7%

Source: Author's calculations from data published in *The Harbour Report 1999* (Troy, MI: Harbour and Associates Inc., 1999).

Table 3

Growth of Physical Labour Productivity

North America, 1992 to 1998, Harbour Data, Workers per Vehicle

	1992 Level	Growth, 1992 to 1998	1998 Level
Cars			
Canada	3.61	+26.5%	2.65
U.S.	3.82	+22.7%	2.95
Mexico	5.35	+23.3%	4.10
Canada-U.S. "Advantage"	+5.5%		+10.2%
Trucks			
Canada	3.77	+18.4%	3.07
U.S.	3.78	+16.1%	3.17
Mexico	n/a	n/a	4.51
Canada-U.S. "Advantage"	+0.3%		+3.2%
Total Light Vehicles			
Canada	3.69	+22.7%	2.85
U.S.	3.81	+19.7%	3.06
Mexico	5.35	+19.9%	4.28
Canada-U.S. "Advantage"	+3.1%		+6.9%

Source: Author's calculations from data published in *The Harbour Report 1999* (Troy, MI: Harbour and Associates Inc., 1999).

Table 4

In-Plant Sourcing Decisions

Canada vs. U.S., 1998, Harbour Data

	GM Sierra/Silverado Pickup Truck			Ford F-Series Pickup Truck				DC Minivan	
	Oshawa	*Ft. Wayne*	*Pontiac East*	*Ontario*	*Kansas City*	*Ken-tucky*	*Norfolk*	*Wind-sor*	*St. Louis*
Bumper Assembly									
Closure Panel Assy.									
Door Handle Assy.									
Door Trim Assy.									
Front Diff. Assy.									
Front Hub Assy.									
Fuel Tank Assy.									
Head Liner Assy.									
HVAC Assy.									
I/P Assy.									
Wheels/Tire Assy.									
Productivity	**24.98**	**27.05**	**31.33**	**25.28**	**22.63**	**25.36**	**24.02**	**30.07**	**34.21**

Source: *The Harbour Report 1999* (Troy, MI: Harbour and Associates Inc., 1999). The author is indebted to David Robertson for suggesting this comparison.

Table 5

Labour Productivity by Company

Canada vs. U.S., 1998, Harbour Data, Hours per Vehicle

	Canada	U.S.	Canada-U.S. "Advantage"
General Motors	22.60	32.58	+30.4%
Daimler-Chrysler	30.93	32.90	+6.0%
Ford	23.61	23.92	+1.3%
Toyota	21.72	21.07	-3.1%

Source: Author's calculations from data published in *The Harbour Report 1999* (Troy, MI: Harbour and Associates Inc., 1999).