The Exchange Rate, Productivty, and the Standard of Living

Robert Lafrance and Lawrence L. Schembri, International Department

- *Canada's standard of living relative to the United States as well as the Canadian-U.S. dollar exchange rate have both declined over the 1990s. This coincident occurrence has led some observers to maintain that these two key economic variables are intimately and causally related. Indeed, they argue that Canada's flexible exchange rate is responsible for the relative fall in the standard of living and that the decline could have been avoided had Canada been on a fixed exchange rate over this period.*

- *This article explores the various channels through which these two variables could be related based on economic theory and empirical evidence. The main channels through which the standard of living and the exchange rate may be related are productivity and the terms of trade. Although this article focuses on the possible links between productivity and the exchange rate, the relationship between the terms of trade and the exchange rate is also examined.*

- *The authors conclude that exogenous forces—notably a decline in the world prices of commodities and weak demand for domestic output—were affecting both Canada's standard of living and the exchange rate and that the flexible exchange rate regime itself did not play an independent role in the relative decline in Canada's standard of living.*

A country's standard of living is usually measured by per capita income or expenditure.[1] The standard of living is determined essentially by three factors: the country's supply of factors of production per capita (e.g., physical and human capital, labour, and, especially in Canada's case, natural resources) and their rate of utilization; the productivity of the employed factors, which reflects the efficiency of the processes used to transform these factors into final output; and the country's terms of trade, which represent the relative value of the country's exports in terms of goods and services that it imports from the rest of the world. (See Box 1 for a discussion on measuring productivity.)

Generally speaking, a country's standard of living will be higher, the greater the size and quality of its supply of productive factors relative to its population, the higher the rates at which these factors are employed, the more productive these factors are in generating output, and the more valuable its domestic exports are in world markets.[2] To explain the decline in Canada's

1. In this article, only the conventional real income- or expenditure-based definition of standard of living is used, instead of broader definitions that would include other economic and non-economic factors (e.g., wealth, pollution, and income inequality). National income is typically measured by GDP (even though GDP is technically a measure of national output). Domestic expenditure is the sum of expenditures on goods and services (including housing) by consumers and governments and by businesses on investment goods (including investment in inventories).

2. For capital, the rate of employment is measured by the utilization rate. For labour, the key measures are the participation rate (the proportion of the eligible population ages 15 to 65 that participates in the labour force) and the employment rate (the proportion of the labour force that is actually employed, i.e., the converse of unemployment rate).

Zahir Antia and Jason Daw provided excellent research assistance.

BOX 1: Measuring Productivity

Statistics on productivity measure how much output can be obtained from a given set of productive inputs (e.g., capital, labour, and intermediate inputs). That is, a production process, a firm, or a country is said to have higher productivity if it can produce more output after allowing for changes in the quantity and quality of its inputs. Productivity statistics are calculated and quoted in different ways. The most important distinction is between labour and total (or multi-) factor productivity (TFP or MFP).

Labour productivity is normally measured as output per worker or output per hour worked (the latter being more useful for comparison because it avoids the issue of the average length of the work week), while TFP measures output per unit of a composite input. The key difference between the two measures is that, ideally, TFP reflects increases in productivity due to enhanced technical efficiency primarily resulting from technological improvements, while labour productivity rises not only with technological progress (i.e., TFP goes up) but also when the supplies of other factors, chiefly capital, increase relative to labour. [1]

Measures of labour productivity, and especially TFP, are difficult to calculate because they require accurate data on the volumes of both outputs and inputs, which are determined as ratios of reported dollar values and appropriate price indexes.[2] These price indexes should be adjusted to reflect quality changes in the outputs and inputs. Making these quality adjustments to input and output price indexes is complicated and is typically not done, or not done well, because of the difficulty and expense. Therefore, TFP generally reflects not only changes in technical efficiency, but also changes in the quality of the inputs, especially capital, because machinery and equipment often embody new technology.

Two final points about productivity measures are noteworthy. First, aggregate productivity statistics are normally quoted for the total business or private sector and for the manufacturing (secondary) sector. The business sector includes the primary and tertiary (service) sectors in addition to manufacturing. Although the service sector represents approximately 60 to 70 per cent of the economy, the output of this sector is notoriously difficult to measure. Consequently, for many international comparisons, labour productivity data from the manufacturing sector are used because they are more widely available and are likely to be more accurate.[3] Second, productivity measures are normally calculated as indexes; hence, they are usually quoted in terms of growth rates. Some limited aggregate data on productivity levels are available, but their accuracy is less certain.

---

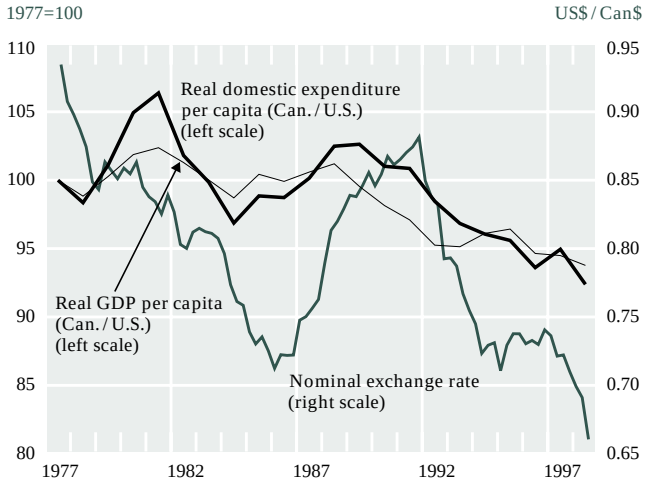
1. Income per capita is more closely related to labour productivity than to TFP.

2. There is a large body of literature on the appropriate measurement of TFP. See Diewert and Nakamura (2000) and Gullickson (1995) for more details. This debate has spawned the computation of alternative measures of TFP. These different measures, along with the difficulty of calculating TFP, have contributed to the recent debate concerning Canada's productivity performance in the 1990s.

3. Since services are generally non-traded, manufacturing productivity statistics may be more useful for gauging the competitiveness of domestic traded goods.

Chart 1

The Nominal Exchange Rate and Relative Standards of Living in Canada and the United States



standard of living relative to the United States in the past decade (Chart 1), most observers point to three probable causes: a relative fall in Canada's labour force participation rate, a decrease in relative labour productivity, and a worsening of Canada's terms of trade.[3,4] The purpose of this article is to show how trends in relative productivity and the evolution of Canada's terms of trade have affected both our relative standard of living and the exchange rate.

The Exchange Rate and Relative Productivity Growth

In general, movements in a country's exchange rate or in its productivity performance relative to other countries represent the aggregate outcomes of a myriad of private domestic and foreign actions together with government policies.[5] Because both the exchange rate and relative productivity depend on a large set of underlying factors, it is highly unlikely that a simple causal relationship between the two variables exists and can be detected easily from the data. Nonetheless, three propositions (illustrated in Chart 2), that support a causal relationship, merit closer examination.[6]

> *The Balassa-Samuelson hypothesis*: In the long run, differences in labour productivity growth in the traded-goods sector due to different rates of technological progress cause movements in the bilateral real exchange rate (defined as the nominal exchange rate deflated by comparable national price indexes, such as the consumer price index).[7]
>
> *The "exchange-rate-sheltering" hypothesis*: A depreciating real exchange rate reduces growth in domestic productivity because it shelters domestic firms from foreign competition, thus reducing their incentive to make productivity-enhancing investments.
>
> *The "factor-cost" hypothesis*: Movements in the real exchange rate will affect the absolute and relative cost of new capital and labour, influencing both total factor productivity (TFP) and labour productivity.[8]

3. Using the methodology of Freedman (1977) and Stuber (1983), a useful, albeit approximate, breakdown of the factors contributing to the relative decline in Canada's standard of living can be obtained. Over the period, 1988–98, domestic expenditure per capita in the United States grew by 2.03 per cent per annum and in Canada by 0.60 per cent. Of this 1.43 per cent difference, 0.86 per cent was due to lower labour productivity growth in the Canadian business sector measured on an output-per-hour basis, 0.49 per cent to the fall in the Canadian labour force participation rate, 0.17 per cent to a decline in the employment rate in Canada, and 0.15 per cent to a worsening of Canada's terms of trade. The residual is due to other factors that primarily worked in Canada's favour: for example, a relative increase in hours per worker and greater labour force growth. Fortin (1999) obtains a similar breakdown but argues that the dominant factor in the 1990s was the decline in the employment rate in Canada relative to the United States.

4. The relative decline in the labour force participation rate in Canada is discussed in Kuszczak and Dion (1997) and Ip (1998). See also Fortin (1999).

5. The nominal exchange rate is visible and easy to measure. However, it is the real exchange rate that is important in economic decisions because it represents the relative price of domestic and foreign goods. Therefore, our analysis involves the real exchange rate (unless otherwise stated).

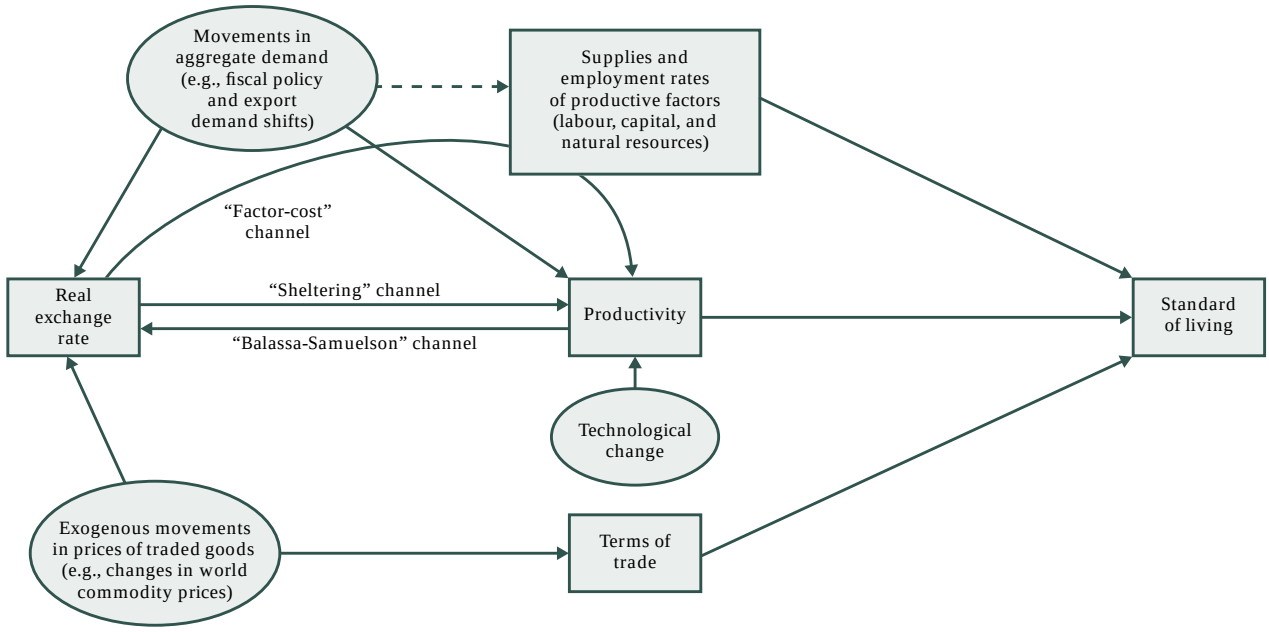
6. Another hypothesis, not pursued in this article, is that productivity and the real exchange rate can be linked on the supply side of the economy. A country experiencing strong productivity growth (a positive supply shock) may need to sell some of the additional output abroad. To increase foreign sales, part of the productivity gains would be passed on to foreign consumers through lower prices. In effect, this would amount to a real depreciation of the currency (which could also be achieved with an equivalent nominal depreciation, assuming that domestic prices were unchanged).

7. The original references are Balassa (1964) and Samuelson (1964). For a recent literature review, see Froot and Rogoff (1995) and Asea and Corden (1994). Note that factors other than differences in technological progress may cause different rates of labour productivity growth in the traded-goods sector. For example, shifts in government and private demand for non-traded goods would affect the allocation of labour, thus influencing labour productivity. De Gregorio, Giovannini, and Krueger (1994) find evidence consistent with these effects in European data.

8. Relative and absolute movements in factor cost influence decisions about the acquisition of capital and also optimal factor ratios. Total factor productivity and labour productivity are affected because new capital typically embodies recent technological improvements, and labour productivity depends on the amount of capital and other factors per worker.

Chart 2

The Relationship Between the Real Exchange Rate and the Standard of Living



The Balassa-Samuelson Hypothesis

The Balassa (1964) and Samuelson (1964) model demonstrates that different rates of technological progress and labour productivity growth in the traded-goods sector (growth rates of productivity in non-traded goods are assumed to be smaller and more similar across countries) would cause a movement in the measured real exchange rate between two countries. The source of this movement is a divergence in national price levels.

The basic intuition for this result is as follows. Suppose that there is technological progress in the home country's traded-goods sector, while there is no change in the foreign country, and labour is the only factor of production. This technological improvement would raise the marginal product of labour and the nominal (and real) wage in the home country's traded-goods sector. If labour is mobile between sectors, then the non-traded sector's nominal wage would have to rise to retain its labour force, and its prices would increase if labour productivity in this sector remained relatively unchanged. Hence, countries experiencing higher rates of productivity growth in traded goods would also experience a relative increase in their national price level and an appreciation of their measured real exchange rate. (See Box 2 for an example.)

Although the simple logic of the Balassa-Samuelson hypothesis is compelling, the empirical evidence is mixed. Cross-country studies have clearly documented that countries with high (low) per capita incomes have high (low) national price levels based on a comparable set of traded and nontraded goods.[9] Samuelson (1994) argues that the best explanation of this observation is the Balassa-Samuelson hypothesis: relatively rich (poor) countries have relatively high (low) levels of technical efficiency and labour productivity in the production of manufactured (traded) goods.[10] Time-series evidence, however, is less compelling. A number of recent cross-country studies on

9. See Summers and Heston (1991). The difference in national price levels is most pronounced when countries with large income differences are compared; it is harder to detect when national incomes are similar.

10. Samuelson (1994) attributes most of the credit for the Balassa-Samuelson hypothesis to Harrod (1957), whose work he was unaware of when he wrote his 1964 article, and to Balassa (1964).

BOX 2: The Balassa-Samuelson Hypothesis

If S is the nominal exchange rate expressed as the price of foreign exchange, and P and P^* are domestic and foreign national price levels expressed in local currency (they represent price indexes for comparable national consumer or producer commodity baskets), then the real exchange rate is defined by:

$$R = \frac{SP^*}{P}. \qquad (1)$$

To illustrate the Balassa-Samuelson hypothesis, transform equation (1) with all variables expressed as a percentage rate of change:

$$\hat{R} = \hat{S} + \hat{P}^* - \hat{P}. \qquad (2)$$

The national inflation rates, $\hat{P}$ and $\hat{P}^*$, can be expressed as weighted averages of the inflation rates for traded and non-traded goods:

$$\hat{P} = a_T\hat{P}_T + a_N\hat{P}_N \qquad (3)$$

and

$$\hat{P}^* = a_T\hat{P}_T^* + a_N\hat{P}_N^*, \qquad (4)$$

where a_T and a_N are the shares of traded and non-traded goods in the national commodity baskets.[1]

Substituting equations (3) and (4) into equation (2) gives:

$$\hat{R} = \hat{S} + (a_T\hat{P}_T^* + a_N\hat{P}_N^*) - (a_T\hat{P}_T + a_N\hat{P}_N) \qquad (5)$$

and if we assume that arbitrage will ensure that traded goods sell for the same price across markets, this implies that $\hat{S} = \hat{P}_T - \hat{P}_T^*$, then equation (5) can be rewritten as:

$$\hat{R} = a_N[(\hat{P}_T - \hat{P}_N) - (\hat{P}_T^* - \hat{P}_N^*)]. \qquad (6)$$

Because the Balassa-Samuelson model assumes that labour is the only factor of production and that each good requires a fixed amount of labour, the price of each good is the product of the wage rate (assumed to be the same in every sector) and the unit labour requirement:

$$P_i = \frac{W}{x_i}; \qquad i = T, N, \qquad (7)$$

where x_i is the inverse of the unit labour requirement or the average product of labour, and W is the nominal wage measured in local currency. Labour is assumed to be mobile internally but not across countries. Thus, wages are equalized across sectors only in a given country. Expressing equation (7) in terms of percentage rates of change and using equation (6) gives:

$$\hat{R} = a_N[(\hat{x}_T^* - \hat{x}_T) - (\hat{x}_N^* - \hat{x}_N)]. \qquad (8)$$

Equation (8) is the core of the Balassa-Samuelson hypothesis. Ignoring productivity growth differences in the non-traded sector, it implies that real exchange rate movements are a function of the relative importance of the non-traded sector, a_N, and the difference in productivity growth in the traded-goods sector. If there were no non-traded goods, $a_N = 0$, the result would disappear. However, the model predicts that relatively higher labour productivity growth in the domestic traded (chiefly, manufacturing) sector would cause the real exchange rate to appreciate.

1. For convenience, the shares a_T and a_N are assumed to be the same in both countries.

OECD countries, reviewed in detail by Froot and Rogoff (1995), find evidence consistent with the hypothesis that technological progress (measured by TFP growth) in traded goods causes the relative price of non-traded to traded goods to rise and the real exchange rate to appreciate, although the evidence for the link to the real exchange rate is weaker. Studies of individual countries find that Japan's experience seems to provide the strongest evidence consistent with the Balassa-Samuelson hypothesis.[11]

For Canada, the evidence is only mildly supportive. Over the 1979–96 period, labour productivity and TFP growth rates in manufacturing in Canada have, on average, been below those of the United States.[12] Therefore, the Balassa-Samuelson hypothesis would predict that this differential should eventually cause the Canadian real exchange rate to depreciate, which it did over the 1981–98 period. However, it seems to have depreciated by much more than the theory would predict, indicating that other factors were at work.[13] Indeed, much of the real depreciation over this period is explained by weaker non-energy commodity prices (Murray and Antia 1999).[14] Moreover, Djoudad and Tessier (1999) find that relative growth rates in productivity are not statistically significant in explaining recent changes in Canada's real exchange rate.

The Balassa-Samuelson model provides a causal link between differing productivity growth rates and movements in the real exchange rate. However, some observers argue that the Canada-U.S. deficit in labour productivity growth in manufacturing also underlies the recent depreciation of the *nominal* exchange rate. To understand the implications of this argument, it helps to recognize that the change in the nominal exchange rate can be broken down into movements in the real exchange rate and movements in the domestic-foreign inflation rate differential.

As shown in Box 2, the Balassa-Samuelson model predicts that the real exchange rate will be affected, in the long run, by a domestic-foreign differential in productivity in the traded-goods sector. The domestic inflation rate, however, is ultimately under the control of the domestic monetary authorities. Hence, productivity and the nominal exchange rate are linked only through the real exchange rate. Therefore, assuming that the real exchange rate is unchanged, any depreciation of the nominal exchange rate must ultimately be due to monetary policy that is too expansionary.

The Exchange-Rate-Sheltering Hypothesis

Proponents of this hypothesis argue that a depreciating real exchange rate protects Canadian firms from external competitive pressure, much like a tariff, and thus dulls their incentive to make productivity-enhancing investments, even though these investments could be profitable.[15] Managers are assumed to be "satisficing" (i.e., seeking a quiet life) rather than constantly seeking to maximize profits. A recent study (McCallum 1999) finds a statistically significant positive correlation between the differential in Canada-U.S. labour productivity growth in manufacturing and past movements in the bilateral real exchange rate.[16] (See Chart 3.)

The exchange-rate-sheltering hypothesis raises several difficult questions. Why are Canadian firms not interested in increasing profits? Increasing productivity generally lowers costs and, all else being equal, raises profits. Clearly, if managers are less concerned with profits and pay attention to productivity only when the survival of the firm is threatened, then a depreciated exchange rate may give them a feeling of protection from external forces. But why would shareholders tolerate managers who exhibit "satisficing" behaviour that is clearly not in their interest, and why would another investor / manager group not take over the firm and increase its value by making productivity-enhancing investments? For these interventions

11. For example, both Hsieh (1982) and Marston (1987) find strong empirical evidence linking high rates of technological progress in the traded-goods sector in Japan to its appreciating exchange rate over the periods 1954–76 and 1973–83.

12. Labour productivity growth rates in Canada and the United States in the manufacturing sector (in per cent) were for 1979–88: 1.71 and 3.47 and for 1988–96: 2.06 and 2.27. For TFP, the growth rates in per cent were for 1979–88: 0.60 and 1.55 and for 1988–96: 0.54 and 1.00.

13. Consistent with the proposition that the real value of the Canadian dollar is lower than that predicted by the Balassa-Samuelson hypothesis is the observation that the purchasing-power-parity (PPP) rate for Canada relative to the United States was 0.82 in 1996 (OECD 1998), while the exchange rate was 0.73.

14. McCallum (1998) also claims to have found evidence that the large increase in total Canadian government debt over this period was an important factor in the real depreciation.

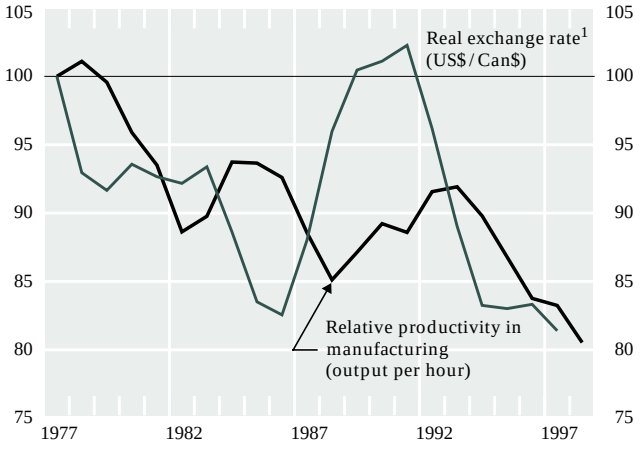
15. Proponents of this argument also maintain that the depreciation in the real exchange rate could have been avoided had the nominal rate been fixed.

16. Although it is possible to find a statistical correlation between the real bilateral exchange rate and productivity growth in manufacturing in Canada relative to the United States (which suggests the latter can be used to predict the former), the relationship breaks down when other variables are considered. Dupuis and Tessier (1999), for example, found that including variables that would be suggested by theory, such as real wage differentials or relative employment levels, eliminated the perceived statistical link between current productivity movements and past changes in the real exchange rate.

Chart 3

The Real Exchange Rate and Relative Labour Productivity in Manufacturing in Canada and the United States

1977=100



1. Real exchange rate calculated using GDP deflators

not to occur, information and transactions costs must be high, implying that capital markets are inefficient. Finally, why is the domestic business environment not sufficiently competitive to encourage such investments, or why is it that only foreign competition matters? Obviously, for this hypothesis to be true, managers and shareholders would have to be inattentive to the value of the firm, and capital and product markets would have to be imperfect and uncompetitive. While information and transactions costs may explain some deviations from optimal behaviour in the short run, it is unlikely that they could persist for a sufficiently long period of time to explain Canada's relatively poor productivity performance in manufacturing.[17]

It is also important to stress that the exchange rate and the rate of productivity growth depend on a large number of underlying factors, some of which can influence both the exchange rate and productivity simultaneously. Chief among these are cyclical movements in aggregate demand and changes in fiscal policy, especially in Canada in the 1990s. As the economy moves through a business cycle, aggregate demand fluctuates. Consequently, during an expansion, productivity rises because aggregate demand is relatively high and domestic factors of production, chiefly capital and labour, are fully utilized. Conversely, when aggregate demand and output are relatively low, productivity declines because the quantities of labour and capital are not adjusted immediately when demand falls since there are costs to releasing and rehiring them. As a result, measures of productivity are generally pro-cyclical.

The exchange rate and the rate of productivity growth depend on a large number of underlying factors, some of which can influence both the exchange rate and productivity simultaneously.

The real exchange rate would also have a pro-cyclical pattern if aggregate demand shocks predominate, because it adjusts to equilibrate not only the trade balance but also aggregate demand and supply. Hence, an increase in the demand for domestically produced goods and services would lead to a real appreciation, all else unchanged.[18] Movements in export demand or fiscal policy, which affect the demand for domestic output, could generate similar positive correlations in productivity and the real exchange rate. For example, the 1990s witnessed a sizable fiscal retrenchment in Canada by all levels of government as taxes were increased and expenditure levels were reduced as a percentage of GDP (Chart 4). As aggregate demand and productivity growth were relatively weak until recently, it is not surprising that the real exchange rate depreciated over most of this period.[19]

17. Much of the difference in manufacturing productivity growth rates in Canada and the United States over the last 10 years is due to differences in two specific industries: industrial machinery and equipment and electrical equipment (Sharpe 1999 and Statistics Canada 1999a). Thus, if the exchange-rate-sheltering hypothesis were true, it is not obvious why it would pertain only to these industries and not to the rest of the manufacturing sector.

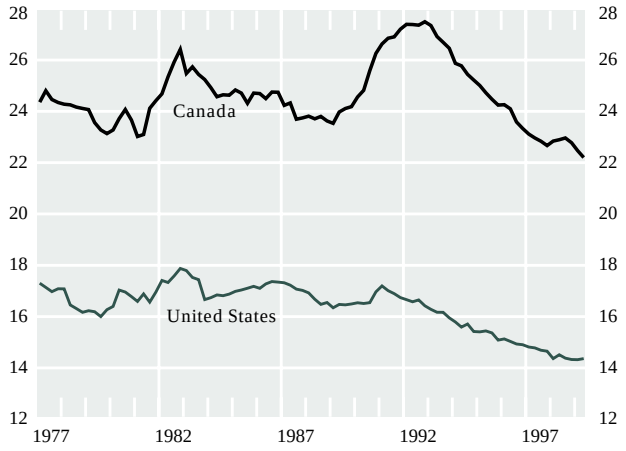
18. Laidler (1999) makes similar arguments.

19. Under a flexible exchange rate, monetary policy aimed at stabilizing output and prices could also produce a positive correlation between the real exchange rate and productivity in the short run. Monetary policy is normally tightened as the economy moves through an expansion, raising interest rates and causing the nominal and real exchange rates to appreciate in the short run. The opposite would be true in a recession. The shift in the monetary policy stance of the Bank of Canada during the 1990s, from tight to neutral, contributed to the depreciation of the exchange rate, in nominal and real terms, over this period. In the long run, however, monetary policy will affect only the nominal, not the real, exchange rate.

Chart 4

Expenditures by All Levels of Government in Canada and the United States

% of GDP



In summary, there are strong theoretical reasons to believe that the observed correlation between movements in relative labour productivity and the real exchange rate does not reflect causality between these variables but is the result of shifts in aggregate demand that have affected them simultaneously. Thus, there is little compelling evidence to support the argument that the flexible nominal exchange rate, which has depreciated over the 1990s, sheltered domestic industry from foreign competition. Indeed, the real exchange rate depreciation that did occur was driven by underlying fundamentals and would have occurred even if the exchange rate had been fixed.

The Factor-Cost Hypothesis

Exchange rate movements affect the absolute and relative costs of capital, labour, and other factors of production, thereby altering the accumulation of different forms of capital and relative factor use. Total factor productivity would be influenced because new physical capital (chiefly, machinery and equipment) typically embodies new technology, while investments in research and development are reflected in the stock of accumulated knowledge. Labour productivity would be affected not only by the possible impact of the exchange rate on the acquisition and use of new technology, but also by a possible shift in the allocation of capital and other factors per worker. In general, labour productivity is positively related to the ratio of capital (and other factors) per worker.

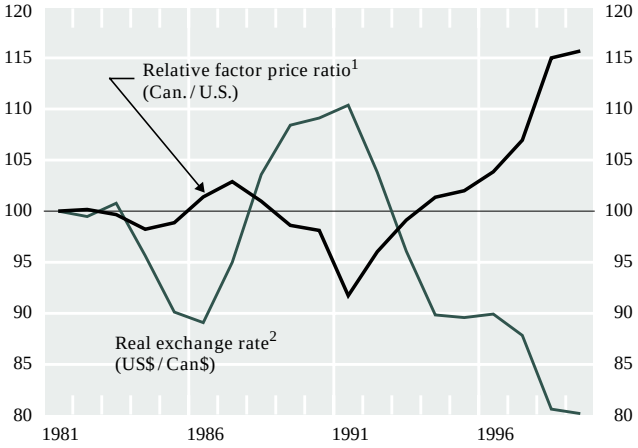
In Canada, there are essentially two main channels through which movements in the exchange rate can affect the relative cost of capital. The first channel is the impact of the exchange rate on the cost of foreign goods, because approximately 70 per cent of Canada's installed machinery and equipment is imported (Statistics Canada 1999b). Thus, a depreciation of the real exchange rate, for example, would raise the cost of imported machinery and equipment in real terms but also relative to labour, plant, and other Canadian-sourced factors of production. This is illustrated in Chart 5, which compares the evolution of the real bilateral exchange rate with an index of relative factor prices. The black line represents the ratio of a price index for machinery and equipment to an index of wages in Canada relative to the United States. A rise in the index means that the price of capital goods, relative to labour, is increasing at a faster pace in Canada than in the United States. One factor that would have contributed to this development in the 1990s is the real depreciation of the Canadian dollar.

In addition, Chart 6 shows that a large gap has developed over the 1990s between Canadian and U.S. levels of investment in machinery and equipment. This gap undoubtedly explains a significant proportion of the difference in Canadian and U.S. growth rates of TFP and labour productivity in manufacturing over this period.

Chart 5

Relative Factor Prices and the Real Exchange Rate

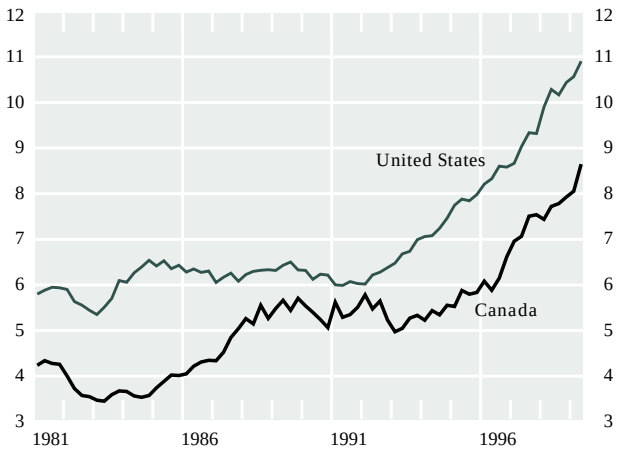
1981=100



1. The factor price ratio is the machinery and equipment chained GDP price index / the all-sector wage and salary index.
2. Real exchange rate calculated using GDP deflators

Chart 6

Investment in Machinery and Equipment in Canada and the United States (1992 dollars)



The second possible channel through which the exchange rate can affect the cost of physical, human, and research and development capital is through the impact of exchange rate uncertainty on the interest rate risk premium. A more uncertain exchange rate could increase the risk premium. This would raise domestic interest rates and thus discourage investments on which returns are paid in the future.

There are essentially two main channels through which movements in the exchange rate can affect the relative cost of capital.

Although this channel is superficially appealing, it is important to recognize that exchange rate uncertainty is often the result of uncertainty in the underlying fundamentals, typically fiscal and monetary policy, rather than uncertainty intrinsic to the flexible exchange rate regime. Uncertainty in the underlying fundamentals would itself cause the interest rate risk premium to increase.[20] In addition, evidence suggests that any risk premium stemming from an uncertain flexible rate is likely to be small, especially if monetary policy has a well-defined and credible inflation target. In these circumstances, the impact on investment, which empirically is not very sensitive to the interest rate, is likely to be small.

A real exchange rate movement in a small open economy represents a change in the relative price of traded and non-traded goods. Such a relative price change can affect the allocation of factors of production across the two sectors and thus affect labour productivity. To illustrate this point, assume that there are only two factors of production, capital and labour, and that there is always full employment of both factors. If the capital/labour ratios in the two sectors are fixed and equal, then a reallocation of capital and labour as a result of a real exchange rate movement will not alter labour productivity. Now suppose that traded goods are relatively capital-intensive and that the real exchange rate depreciates. This relative price change will cause the traded-goods sector to expand and the non-traded-goods sector to contract. This reallocation of resources will cause capital/labour ratios, labour productivity levels, and real wages to fall in both sectors as labour and capital move from the relatively labour-rich and capital-poor non-traded-goods sector into the relatively labour-poor and capital-rich traded-goods sector.[21] Suppose that this experiment is repeated, but now there is unemployed labour. Once again, capital/labour ratios and labour productivity will decline in both sectors as unemployed labour is absorbed into the workforce; the real exchange rate depreciation effectively reduces the real wage and expands employment.

In summary, by affecting the absolute and relative costs of capital, labour, and other factors of production, exchange rate movements can influence productivity. In the 1990s, the real exchange rate depreciation most likely contributed to lower relative TFP and labour productivity growth by increasing the cost of imported machinery and equipment and by lowering the relative cost of labour, thus encouraging firms to substitute labour for capital in the production process. It is important to reiterate, however, that this real depreciation was driven by fundamental factors and would have occurred irrespective of the exchange rate regime in place.

20. Clinton (1998) shows that the interest rate risk premium in Canada fell over the course of the 1990s as the inflation rate declined and fiscal deficits were eliminated.

21. This is simply an example of the well-known Stolper-Samuelson theorem.

The Exchange Rate and the Terms of Trade

An important channel through which the standard of living and the exchange rate may be related is the terms of trade. The terms of trade are defined as the relative price of a country's exports and imports. Because they are largely determined in world markets for a small economy like Canada's, shifts in the terms of trade will generally affect both the standard of living and the exchange rate. For example, a worsening of Canada's terms of trade (perhaps because of a decline in the world price of certain commodities that Canada produces) will cause the exchange rate to depreciate and our standard of living to fall. The exchange rate will depreciate because there is a reduction in the relative demand for these Canadian-produced goods so that the equilibrium real exchange rate must depreciate in order to restore demand for Canadian goods.[22] With a flexible exchange rate, this adjustment will take place primarily through a nominal depreciation as opposed to a decline in the Canadian-dollar price of Canadian goods as would occur, albeit more slowly, under a fixed exchange rate. In this case, Canada's standard of living would fall because the purchasing power of domestically produced goods in world markets has been reduced. In other words, a given level of exports will purchase a smaller amount of imports for domestic residents to consume.

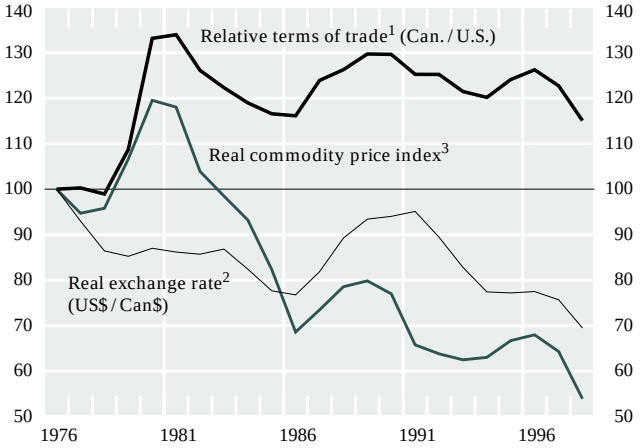
An important channel through which the standard of living and the exchange rate may be related is the terms of trade.

While the decline in commodity prices over the last decade has contributed to the deterioration in Canada's relative terms of trade, falling computer prices on the import side (as well as other factors) have partially offset this negative effect (Chart 7). On the whole, Canada's terms of trade, relative to those of the United States, have declined by about 12 per cent from the recent peak reached in 1988. As noted earlier, this fall has contributed to a decline in Canada's relative standard of living. It is, however, important to recognize that the exchange rate depreciation and the relative fall in the standard of living that took place over the 1990s were not directly linked but resulted, in part, from the worsening in the relative terms of trade.

Chart 7

Commodity Prices and Terms of Trade

1976=100



1. Relative terms of trade are expressed as the price of exports / price of imports, Canada / U.S.
2. Real exchange rate calculated using GDP deflators
3. Bank of Canada commodity price index, deflated using the U.S. GDP deflator

* * *

Canada's flexible exchange rate regime played little, if any, role in the relative decline in Canada's standard of living over the last decade. Virtually all of the real depreciation that occurred over this period would have happened even if the nominal exchange rate had been fixed. In fact, the depreciation was an equilibrium adjustment to exogenous shifts in real fundamentals, chiefly lower demand for Canadian output and weaker world prices for commodities. Moreover, much of the decline in the relative standard of living was due to reduced labour force participation and lower employment rates, which were not directly related to the real depreciation—indeed they were dampened by the depreciation. The other major sources of the relative decline in standard of living—relatively low labour productivity growth and a decline in the terms of trade—were caused mainly by the same exogenous forces that generated the depreciation of the real exchange rate. Thus, it is unlikely that the flexible nominal exchange rate exerted a significant independent influence on Canada's standard of living.

22. Amano and van Norden (1993) and Lafrance and van Norden (1995) find a robust relationship between commodity prices, which are a significant component of Canada's terms of trade, and the Canada-U.S. real exchange rate.

Literature Cited

Amano, R. and S. van Norden. 1993. "A forecasting equation for the Canada-U.S. dollar exchange rate." In *The Exchange Rate and the Economy.* Proceedings of a conference held at the Bank of Canada, 22–23 June, 1992, 207–65. Ottawa: Bank of Canada.

Asea, P.K. and W. M. Corden. 1994. "The Balassa-Samuelson Model: An Overview." *Review of International Economics* 2: 191–200.

Balassa, B. 1964. "The Purchasing Power Parity Doctrine: A Reappraisal." *Journal of Political Economy* 72 (December): 584–96.

Canada. Statistics Canada. 1999a. *The Daily,* 23 March, p. 4.

———. 1999b. *The Input-Output Structure of the Canadian Economy, 1993–1995.* Catalogue No. 15–201 (March).

Clinton, K. 1998. "Canada-U.S. long-term interest differentials in the 1990s." *Bank of Canada Review* (Spring): 17–38.

De Gregorio, J., A. Giovannini, and T. Krueger. 1994 ."The Behavior of Nontradable Goods Prices in Europe: Evidence and Interpretation." *Review of International Economics* 2: 284–305.

Diewert, W.E. and A. Nakamura. 2000. "Survey on empirical methods of productivity measurement and analysis." In *Handbook of Econometrics*, Vol. 5, edited by J. Heckman and E. Leamer. Amsterdam: North-Holland (forthcoming).

Djoudad, R. and D. Tessier. 1999. "Quelques résultats empiriques relatifs à l'évolution du taux de change Canada/États-Unis." Paper presented at the Canadian Economics Association meetings, Toronto, 28–30 May.

Dupuis, D. and D. Tessier. 1999. "Analyse empirique du lien entre la productivité et le taux de change." Paper presented at l'Association canadienne de science économique meetings, Hull, Quebec 12–13 May.

Fortin, P. 1999. *The Canadian Standard of Living: Is There a Way Up?* Benefactors Lecture, C.D. Howe Institute. Montreal.

Freedman, C. 1977. "Recent growth in productivity, real expenditure per capita, and real income per capita: Accounting for the differences." *Bank of Canada Review* (August): 3–15.

Froot, K. and K. Rogoff. 1995. "Perspectives on PPP and Long-Run Real Exchange Rates." In *Handbook of International Economics*, Vol. 3, 1647–88, edited by G. Grossman and K. Rogoff. Amsterdam: North-Holland.

Gullickson, W. 1995. "Measurement of productivity growth in U.S. manufacturing."*Monthly Labor Review* 118 (July): 13–28. Washington, D.C.: U.S. Department of Labor.

Harrod, R.F. 1957. *International Economics*. Revised edition. Chicago: The University of Chicago Press.

Hsieh, D. 1982. "The Determination of the Real Exchange Rate: The Productivity Approach." *Journal of International Economics* 12: 355–62.

Ip, I. 1998. "Labour force participation in Canada: Trends and shifts." *Bank of Canada Review* (Summer): 29–52.

Kuszczak, J. and R. Dion. 1997–1998 . "Potential output growth: Some long-term projections." *Bank of Canada Review* (Winter): 43–59.

Lafrance, R. and S. van Norden. 1995. "Exchange rate fundamentals and the Canadian dollar." *Bank of Canada Review* (Spring): 17–33.

Laidler, D. 1999. "The Exchange Rate Regime and Canada's Monetary Order." Bank of Canada Working Paper No. 99-7.

Marston, R. 1987. "Real Exchange Rates and Productivity Growth in the United States and Japan." In *Real-Financial Linkages Among Open Economies*, 71–96, edited by S. Arndt and J.D. Richardson. Cambridge, MA: MIT Press.

McCallum, J. 1998. "Government debt and the Canadian dollar." *Current Analysis*. Toronto: Royal Bank of Canada (September).

———. 1999. "Seven issues in the choice of an exchange rate regime for Canada." *Current Analysis*. Toronto: Royal Bank of Canada (February).

Murray, J. and Z. Antia. 1999. "Fundamental determinants of the Canadian dollar." International Department, Bank of Canada. Paper presented at the Canadian Economics Association meetings, Toronto, 28–30 May.

OECD. 1998. *National Accounts, Main Aggregates,* Volume 1 (1960–1996). Paris: OECD.

Samuelson, P. 1964. "Theoretical Notes on Trade Problems." *Review of Economics and Statistics* 46: 145–54.

———. 1994."Facets of Balassa-Samuelson Thirty Years Later." *Review of International Economic*s 2: 201–26.

Sharpe, A. 1999. *New Estimates of Manufacturing Productivity Growth for Canada and the United States.* Ottawa: Centre for the Study of Living Standards. <URL: http://www.csls.ca/reports.html>

Stuber, G. 1983. "Recent growth in productivity, real expenditure per capita, and real income per capita: Accounting for the differences—An update." *Bank of Canada Review* (July): 3–12.

Summers, R. and A. Heston. 1991. "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950–1988." *Quarterly Journal of Economics* 106: 327–68.