Converging on the Canada-US Productivity Paradox

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1 Introduction

The growth of labor productivity (GLP) and the growth of total factor productivity (GTFP) are two widely used candidates to measure improvement in living standards. The use of the two productivity concepts to compare the relative evolution in Canada and the US produces divergent results. From the TFP growth point of view, Canada has outperformed the US since the early 1980s, whereas from a labor productivity (LP) growth point of view, the US economy has outperformed its northern neighbor. This is the Canada-US productivity paradox.

In this paper, we make use of the underlying theoretical framework for the calculation of TFP growth to establish a theoretical relationship regarding the relative evolution of TFP growth and LP growth. In the dynamic relationship between the two productivity measures, the neo-classical concept of convergence plays a key role. We will show that in the US, the relative evolution of GLP and GTFP is consistent with its underlying theoretical framework. In Canada however, using the last estimates of TFP growth released by Statistics Canada, the evolution of GTFP is inconsistent with the evolution of GLP and the underlying neo-classical growth accounting framework since the early 1980s. The analysis suggests that Statistics Canada is systematically overestimating TFP growth for the period starting in 1980. This statistical problem is likely to follow from a systematic underestimation of the growth of the capital stock in Canada.

We conclude by arguing that it is preferable to focus on labor productivity concept rather than on the TFP one to compare the relative evolution of productivity between Canada and the US. Labor productivity is much more straightforward to measure than TFP and is then a more reliable concept, given the inconsistency of TFP measurement in Canada. From a policy point of view, the analysis suggests that, contrary to the TFP growth measure released by Statistics Canada, the US economy has outperformed systematically the Canadian economy since the early 1980s in terms of productivity growth. If nothing changes in the future, there is no reason to think that this trend will be reversed. Furthermore, the analysis suggests that Statistics Canada should thoroughly revise its growth accounting methodology for the estimation of TFP growth.

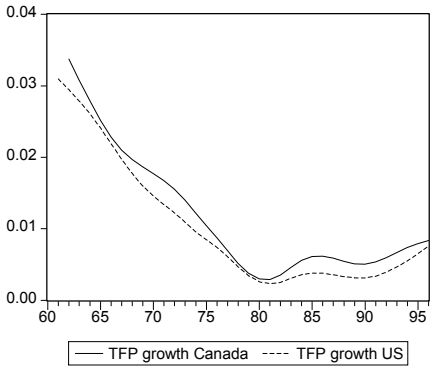
II The Productivity Paradox

We use the latest (September 1999) estimates of GLP and TFP growth produced in Canada by Statistics Canada and in the US by XXXXXXXXXXXX We are using yearly data computed for the period 1961-1996. Instead of focusing on sub-period for comparing the relative evolution of GLP and GTFP in Canada and the US, we use a

time series approach to eliminate the problem of the arbitrary dates for the period of comparison. Both GLP and GTFP series are affected by important stochastic shocks. In order to focus on the medium and the long-run relationships, the analysis concentrates on the trend estimates of both GLP and GTFP. We use the Hodrick-Prescott Filter's (HP filter) with a smoothing parameter of 100 to estimate the trend from actual GLP and GTFP growth data. GLP and GTFP were initially computed from the indexes series of LP and TFP using the logarithmic growth rate (GLP(1)=log(LP(1)/LP(0)).

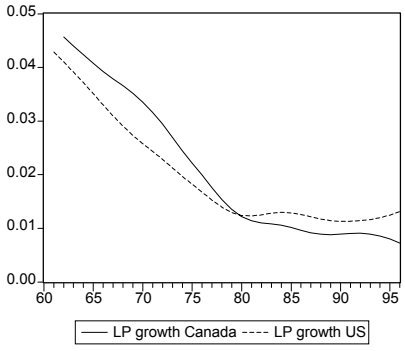
The productivity paradox is illustrated in Figures 1 and 2 with comparison of the trend growth rates of TFP (Figure 1) and LP (Figure 2) in both Canada and the US.

Figure 1: Trend in TFP Growth, Canada and the US



The gradual showdown in TFP growth from the 1960s and the 1970s to the 1980s is strikingly illustrated in Figure 1 in both countries. What is more interesting however for the point of view of this comment is the level relationship between the TFP growth trend in the two countries. The TFP growth trend is always higher in Canada than in the US. Since 1908, Canada has continued to outperform the US with a mean TFP growth rate (for the original growth rate data) of 0.47% in Canada against 0.29% in the US. According to this estimated of productivity growth, Canada does not have a (relative) productivity problem comparing with the US.

Figure 2: Trend in Labor Productivity Growth, Canada and the US



The picture changes if we look at the trend in labor productivity growth in Figure 2. The showdown in productivity growth in both countries emerges again as a striking fact but the Canadian economy outperforms the US economy only during the period prior to 1980. After that, the US economy systematically outperforms the Canadian economy with a mean growth rate (for the original growth data) of 1,23% against only 0.95% in Canada.

Which picture of productivity growth should we believe? In order to answer this question, we set up in the following section a framework to evaluate the internal consistency of the relative evolution of TFP growth and LP growth in an economy.

III Convergence, TFP Growth, and Labor Productivity Growth

In the long run, or in steady state, neo-classical growth theory could account for growing standards of living only if technology is allowed to grow over time (Solow, 1956). This well-known result follows from the law of decreasing returns to capital accumulation. The contribution of capital accumulation to economic growth is limited to

the convergence process toward steady-state. From this framework, it is possible to derive a formal relationship between the two concepts of productivity growth: LP growth and TFP growth. The theoretical analysis is legitimate since growth accountings are usually based on neo-classical growth assumptions: constant return to scale, and decreasing return to reproducible capital.

To fix the ideas, consider the following concave neo-classical production function with constant return to scale:

$$Y(t) = F(K(t), A(t)L(t)).$$

In this notation, output *(Y)* is a function (*F*) of the capital stock *K*, labor (*L),* labor-augmenting technological progress *A* (growing at the exogenous rate *g*), and time (*t*). Following Romer (1996, p. 26), it could be demonstrated that the growth-accounting framework compatible with this general neo-classical production framework is:

$$GLP(t) = \alpha(t)(Gk(t)) + GTFP(t). \quad (1)$$

Here, α(t) is the elasticity of output with respect to capital and *Gk(t)* is the (percentage) change in the Capital /labor ratio *K(t)/L(t)*. The parameter α(t) is measured by the share of profits in national income. In Canada, as in many countries, the share of profits (used by Statistics Canada for the measure of TFP growth) oscillates around a relatively constant trend. Between 1961 and 1996, it oscillates between a maximum of 0.39 and a minimum of 0.31 with a mean value of 0.36. For the computing of TFP growth in Canada, the growth of labor productivity is measure in hour terms. The growth of total factor productivity (*GTFP)* is measured residually from this accounting framework after having estimated the growth in the capital stock.

The convergence concept allows to decompose the evolution of the Capital / Labor ratio into a transitory and a permanent components. The following identity illustrates this point:

$$Gk(t) \equiv (Gk(t) - g) + g. \quad (2)$$

Here, the growth rate of technological progress *g* is the long run or steady state growth rate of the *k(t)*. Then (*Gk(t)-g*) is the transitory contribution of the convergence process to the growth of the capital labor ratio. When *k* is below its steady-state level, *Gk(t)* exceeds g and the capital labor ratio (and labor productivity) is growing at a faster rate than technological progress.

Using equations (1) and (2), we could establish the following relationship between *GLP*, *GTFP*, and the convergence contribution to the growth of labor productivity *CONV* defined as α(t)(*Gk(t)-g)*:

$$GLP(t) - GTFP(t) = CONV(t) + \alpha(t)g. \quad (3)$$

With α(t) relatively constant as it is in Canada and a constant positive growth of technological progress, the difference between the growth of labor productivity and TFP growth is equal to a positive constant α*g* and to a transitory component that could be positive or negative whether the economy converges from below or from above its long-run steady state. The vast literature on convergence suggests that in post WWII period, developed countries are converging from below to their long-run steady state. In this case, the *CONV(t)* factor is positive and gradually fading out as the economy

approaches its long-run equilibrium.

On steady state, recall that the *CONV* factor equals zero and that *g* equals *GLP*. Consequently, the long-run relationship between labor productivity growth and TFP growth is simply:

$$GLP = \frac{GTFP}{1-\alpha} \quad (4)$$

Figure 3: Convergence and the Theoretical Path for GLP-GTFP
(from an initial situation below steady-state)

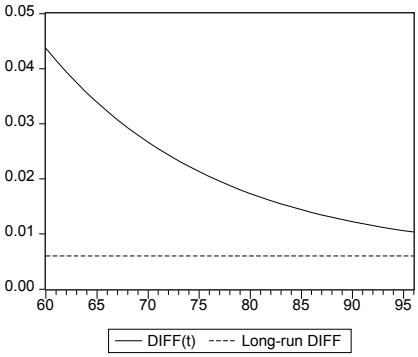
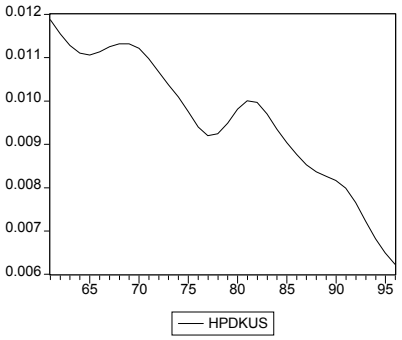


Figure 3 illustrates the theoretical evolution of the difference between the growth of labor productivity and the TFP (*GLP(t)-GTFP(t)*) from an initial situation where the economy converges to its steady state from below.

Initially, the growth of labor productivity exceeds TFP growth by a large amount since the Capital / Labor ratio is growing rapidly in the convergence process. TFP growth accounting assimilates a larger par of the growth in labor productivity in this case to the growth of the capital input. However, as the economy approaches its steady state, the difference between the two productivity indexes approaches its long-run value.

Figure 4: Trend in the Difference Between GLP and GTFP in the US

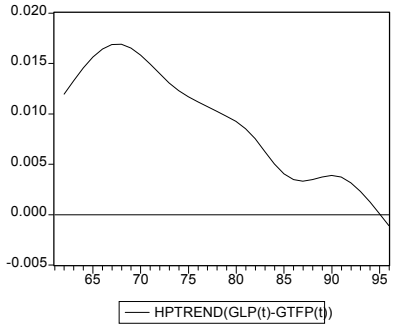


IV What the Data Show

We have used again the HP filter with a smoothing parameter of 100 to estimate the trend in the difference between GLP and GTFP in both countries. The idea of the exercise is to verify if the evolution of GLP and GTFP is consistent with the theoretical framework.

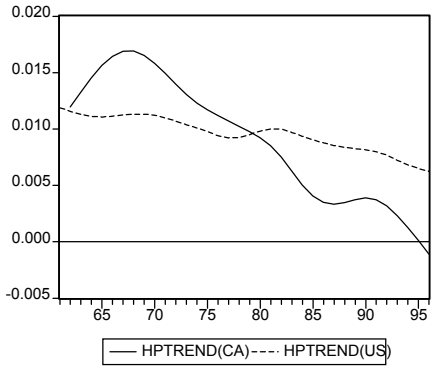
The trend in the difference between the growth of labor productivity and the growth of TFP in the US is illustrated in Figure 4. The difference between the two productivity indexes shows a clear tendency to decline since the early 1960s indicating that the US economy is converging from below to its long-run steady state growth path. By the end of the period, the difference between the two productivity indexes is 0.6%. If the growth rate technological progress is 1.2% and the α parameter is around 1/3, the long-run difference between GLP and GTFP should be around 0.4%. Base on this back of the envelope calculation, the US economy appears to be still below, but very close to, its long-run steady state by the end of the period.

Figure 5: Trend in the Difference Between GLP and GTFP in Canada



The trend in the difference between LP growth and TFP growth in Canada is illustrated in Figure 5. As it is the case for the US, the difference shows a clear tendency to decrease since the 1960s. This indicates that Canada is converging to its long-run steady state growth path from below. However, a striking point emerges from a close analysis of the graph. By the end of the period, the trend in the difference fells to zero and is even negative. This uncharacteristic fall in the difference between GLP and GTFP is not due to the detrending procedure chose. Between 1983 and 1996, the raw data indicate that TFP growth has exceeded LP growth in eight out of 14 years! Remember that TFP growth should be a fraction in the neighborhood of 2/3 of LP growth. On average, since 1983, the difference between GLP and GTFP in Canada is virtually zero (0.09%).

Figure 6: Trend in the Difference between GLP and GTFP in Canada and the US



In Figure 6, we put the two trends in the difference between the productivity indexes for Canada and the US. Compare with the US, the difference in the productivity indexes converged much faster. We can compute the implicit convergence speed at the macroeconomic level from the evolution of the difference between the two productivity indexes. Assuming that the long-run difference is 0.4, the US economy takes 30 years half of the gap between this level and its initial difference between the two indexes. That implies a convergence rate of roughly 2.3% per year. This number is quite compatible with the numerous recent studies following Barro and Sala-i-Martin (1995) which, for various sets of countries and regions within developed countries, including US States, have found a convergence rate around 2%. With the same calculation, we found that the convergence speed in Canada since 1968 is around 7%. This number appears much too high. While the difference between the two productivity indexes appears to be converging at an expected rate toward a realistic long-run equilibrium in the US, in Canada, the difference between the two indexes is rather sinking below the water line! How could the facts be explained?

V From a Productivity Paradox to a Statistical Puzzle?

Compared with LP growth, TFP growth in Canada appears to present a pathological behavior. This point is illustrated in another way in Figure 7 and 8 where the HP trends of LG and TFP growth are depicted for each separated countries. In the US, TFP growth remains during all the sample a fraction of LP growth. This is the normal behavior. In Canada however, since the early 1980s, TFP growth is upward sloping while LP growth is relatively constant. The gap between the two lines disappears gradually as the analysis of the preceding section has shown.

Figure 7: Trend in LP and TFP Growth, US

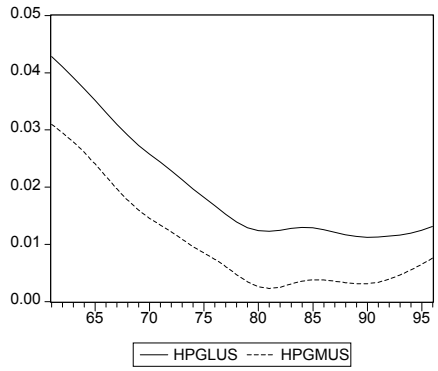
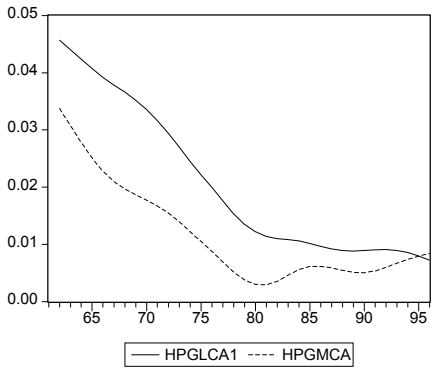


Figure 8: Trend in LP and TFP Growth, Canada



Given the relative constancy of the profit share in Canada, the relative behavior of the two productivity indexes could not be explained by the neo-classical growth model, the underlying theoretical framework used in growth accounting for estimating TFP growth. On theoretical ground, it is possible to have a TFP growth measure exceeding LP growth during a transition to a steady-state from above. In this case, the Capital / Labor ratio would be growing temporarily at a smaller rate than in the long run. However, in this case, LP growth would be decreasing which is not the case in Canada as illustrated in Figure 8.

Our analysis suggests that Statistics Canada might encounter problems in estimating TFP growth in Canada. Compared with LP growth, TFP growth in Canada appears to be systematically overestimated. We think the problem has to deal with the estimation of TFP growth rather than with the estimation of LP growth since, from a statistical point of view, LP growth is a more straightforward measure of productivity than TFP growth. TFP growth is derived residually from statistical measures of LP growth, the profit share, and the growth of the capital stock. In Canada, the LP growth measure used for the estimation of TFP growth is based on a Fisher index in order to account partially for the change in the quality of the labor force. The 'official' measure of LP growth, the one we have used in this analysis, is based on a Laspeyres index. We have done the same analysis with the Fisher's measure of LP and reached the same conclusion. TFP growth appears to be overestimated. Since the problem is not related to the change in the composition of the labor force, it has to be related to the measure of the capital stock.

A look at equation 1 indicates that TFP growth would be overestimated if the growth of the capital stock is underestimated.

VI Conclusion

The usefulness of the convergence concept.

Given the inconsistency in the relationship between LP growth and TFP growth measures in Canada, it is better to look at LP growth in Canada, especially if we want to compare with the US. LP growth is a more straightforward measure of productivity.

Accounting for the change in labor quality does not change the results of the analysis. (US versus Canada)

Consequently, we have a productivity problem in Canada and the Productivity Paradox is likely to be only a statistical pitfall.

Statistics Canada should revise its measure of the growth in the capital stock in order to produce an estimate of TFP growth consistent with LP growth.