

Catalogue no. 11F0027M — No. 068  
ISSN 1703-0404  
ISBN 978-1-100-18330-5

## Research Paper

Economic Analysis (EA) Research Paper Series

# Measurement of Real Income in the System of National Accounts: An Application to North American Economies

by Ryan Macdonald

Economic Analysis Division  
18-F, R.H. Coats Building, 100 Tunney's Pasture Driveway  
Telephone: 1-800-263-1136



Statistics  
Canada

Statistique  
Canada

Canada

# Measurement of Real Income in the System of National Accounts: An Application to North American Economies

by  
Ryan Macdonald

**11F0027M No. 068**  
**ISSN 1703-0404**  
**ISBN 978-1-100-18330-5**

Statistics Canada  
Economic Analysis Division  
18-F, R.H. Coats Building, 100 Tunney's Pasture Driveway  
Statistics Canada, Ottawa K1A 0T6

**How to obtain more information:**  
National inquiries line: 1-800-263-1136  
E-Mail inquiries: [infostats@statcan.gc.ca](mailto:infostats@statcan.gc.ca)

**July 2011**

The paper was prepared for the "Measuring Progress and Social Welfare" seminar held on November 4 and 5, 2009, at the Centro de Investigación y Docencia Económicas (CIDE) in Mexico City, Mexico.

Published by authority of the Minister responsible for Statistics Canada

© Minister of Industry, 2011

All rights reserved. The content of this electronic publication may be reproduced, in whole or in part, and by any means, without further permission from Statistics Canada, subject to the following conditions: that it be done solely for the purposes of private study, research, criticism, review or newspaper summary, and/or for non-commercial purposes; and that Statistics Canada be fully acknowledged as follows: Source (or "Adapted from", if appropriate): Statistics Canada, year of publication, name of product, catalogue number, volume and issue numbers, reference period and page(s). Otherwise, no part of this publication may be reproduced, stored in a retrieval system or transmitted in any form, by any means—electronic, mechanical or photocopy—or for any purposes without prior written permission of Licensing Services, Information Management Division, Statistics Canada, Ottawa, Ontario, Canada K1A 0T6.

**La version française de cette publication est disponible (n° 11F0027M au catalogue, n° 068).**

## **Note of appreciation**

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, and Canada's businesses, governments, and other institutions. Accurate and timely statistical information could not be produced without the continued cooperation and goodwill of these partners.

## **Standards of service to the public**

Statistics Canada is committed to serving its clients in a prompt, reliable, and courteous manner. To this end, the Agency has developed standards of service which its employees observe in serving its clients. To obtain a copy of these service standards, please contact Statistics Canada, toll-free, at 1-800-263-1136. The service standards are also published on [www.statcan.gc.ca](http://www.statcan.gc.ca). Under "Our agency": click on "About us > The agency" and select "Providing services to Canadians."

## Economic Analysis Research Paper Series

The Economic Analysis Research Paper Series provides for the circulation of research conducted by the staff of National Accounts and Analytical Studies, visiting fellows, and academic associates. The Economic Analysis Research Paper Series is meant to stimulate discussion on a range of topics, including the impact of the New Economy, productivity issues, firm profitability, technology usage, the effect of financing on firm growth, depreciation functions, the use of satellite accounts, savings rates, leasing, firm dynamics, hedonic estimations, diversification patterns, investment patterns, differences in the performance of small and large firms and of domestic and multinational firms, and purchasing power parity estimates. Readers of the series are encouraged to contact the authors with comments and suggestions.

The primary distribution medium for the papers is the Internet. These papers can be accessed for free at [www.statcan.gc.ca](http://www.statcan.gc.ca).

All papers in the Economic Analysis Research Paper Series go through institutional and peer review, in order to ensure that they conform to Statistics Canada's mandate as a government statistical agency and adhere to generally accepted standards of good professional practice.

The papers in the series often include results derived from multivariate analysis or other statistical techniques. It should be recognized that the results of these analyses are subject to uncertainty in the reported estimates.

The level of uncertainty will depend on several factors: the nature of the functional form used in the multivariate analysis; the type of econometric technique employed; the appropriateness of the statistical assumptions embedded in the model or technique; the comprehensiveness of the variables included in the analysis; and the accuracy of the data that are utilized. The peer group review process is meant to ensure that the papers in the series have followed accepted standards, in order to minimize problems in each of these areas.

Publications Review Committee  
Analysis Branch, Statistics Canada  
18th Floor, R.H. Coats Building  
Ottawa, Ontario K1A 0T6

### Symbols

The following standard symbols are used in Statistics Canada publications:

- . not available for any reference period
- .. not available for a specific reference period
- ... not applicable
- 0 true zero or a value rounded to 0 (zero)
- 0<sup>s</sup> value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- <sup>p</sup> preliminary
- <sup>r</sup> revised
- x suppressed to meet the confidentiality requirements of the [Statistics Act](#)
- <sup>E</sup> use with caution
- F too unreliable to be published
- \* significantly different from reference category ( $p < 0.05$ )

# Table of contents

<b>Abstract</b> .....	<b>5</b>
<b>Executive summary</b> .....	<b>6</b>
<b>1 Introduction</b> .....	<b>7</b>
<b>2 Real income in the System of National Accounts</b> .....	<b>8</b>
2.1 Nominal income concepts .....	8
2.2 Income concepts .....	9
2.3 Income calculations.....	11
2.3.1 Nominal income aggregates.....	12
2.3.2 Real income aggregates .....	12
<b>3 Real income versus real GDP</b> .....	<b>14</b>
3.1 Real income and real GDP .....	15
3.2 Real income and economic aggregates .....	17
3.3 Economic performance in Mexico and Canada relative to the United States .....	18
<b>4 Conclusion</b> .....	<b>20</b>
<b>References</b> .....	<b>21</b>

## Abstract

This paper makes use of both output and income statistics derived from the System of National Accounts to examine performance in the three North American countries. In doing so, the paper follows recommendations contained in the *System of National Accounts 1993* (SNA 1993) for calculating aggregate real income statistics such as gross national income (GNI) and gross national disposable income (GNDI) rather than aggregate real gross domestic product (GDP), in order to demonstrate the utility of alternate measures for analyzing aggregate economic performance and the standard of living. To move from estimates of GDP to estimates of GNI and GNDI, adjustments are made for changes in relative prices, referred to as a “trading gain” (the combined effect of changes to the terms of trade and changes in the ratio of traded goods prices to non-traded goods prices), and for current account entries other than the trade balance.

The paper compares real output and income measures for Mexico, the United States, and Canada. Differences between the GDP and GNDI estimates illustrate the extent to which non-production factors, such as relative price changes, can influence the economic performance of a nation, either as compared to that of other nations or in terms of a nation’s ability to purchase the goods and services its citizens consume. They also illustrate the benefit of using more than one measure when comparing economic performance across countries.

**Keywords:** aggregate income, terms of trade, real income, balance of payments

## Executive summary

This paper makes use of both output and income statistics derived from the System of National Accounts to examine performance in the three North American countries. In doing so, the paper follows recommendations contained in the *System of National Accounts 1993* (SNA 1993) for calculating aggregate real income statistics such as gross national income (GNI) and gross national disposable income (GNDI) rather than aggregate real gross domestic product (GDP), in order to demonstrate the utility of alternate measures for analyzing aggregate economic performance and the standard of living.

The paper uses Organization for Economic Co-operation and Development (OECD) data to compare commonly employed metrics like labour productivity and real GDP per capita with real income measures that some may argue are more closely associated with well-being. Specifically, the SNA 1993 metrics of real gross domestic income (GDI) per capita, real GNI per capita, and real GNDI per capita are examined. The real income metrics include adjustments for relative prices of traded goods and current account transactions outside of the trade balance. The latter are income flows for primary incomes associated with production across jurisdictional boundaries and for international income transfers.

The comparison of the real income metrics with more traditionally examined real GDP per capita and/or labour productivity shows that conclusions about the relative performance of these three North American economies are sensitive to the measures adopted:

- Economic downturns and recoveries can be more pronounced than real GDP metrics imply. For example, in Mexico, the 1984 balance-of-payments crisis led to an average annual reduction of real GDP per capita of 1.3% between 1981 and 1986. Real GNDI per capita, which incorporates terms-of-trade changes and income flows in the balance of payments, declined at an average annual rate of 2.9%, a rate more than twice that for real GDP per capita. During the subsequent recovery in Mexico, between 1987 and 1990, real GDP per capita grew at an average annual rate of 0.4%, while real GNDI per capita grew at 1.3%.
- Perceptions about the progress of nations can be affected by the metric employed. After 2000, Canada's labour productivity growth lagged that of the United States, while real GDP per capita progressed at about the same rate in the two countries. On the basis of GNDI per capita, Canadian real income grew significantly faster than real income in the United States over this period.

# 1 Introduction

The *Report by the Commission on the Measurement of Economic Performance and Social Progress* (Stiglitz-Sen-Fitoussi report) (2009) highlights the difficulties that statistical systems face when producing measures of economic activity. As the report emphasizes, there is no one-size-fits-all measure that can be employed for examining all the facets of society that interest social scientists and policy makers. Nor is it straightforward to aggregate diverse statistics on, for example, market activity, non-market activity, health status, and education outcomes into a single, easily interpreted aggregate variable.

The current measurement system embodied in the *System of National Accounts 1993* (SNA 1993) (Inter-Secretariat Working Group on National Accounts 1993) is geared to measuring market-based transactions. With the exception of a few sectors (notably owner-occupied dwellings), measures of gross output, intermediate inputs, and, therefore, gross domestic product (GDP), are based on statistical surveys, administrative sources, and censuses. Basing the measurement system on verifiable data reduces the extent to which estimates of economic aggregates can be arbitrarily adjusted by statistical agencies and produces measures of economic activity that correspond closely to the variables that decision makers in central banks and finance departments need. As the Stiglitz-Sen-Fitoussi report (2009) argues, however, the measures of GDP necessary for fiscal and monetary policy will not necessarily correspond to the experiences of individual citizens.

Nevertheless, basing measurement on market-based activity does not diminish the usefulness of the SNA 1993 for analyzing the progress of nations. The SNA outlines a complex set of interactions that go beyond GDP and encompass savings and investment activities, wealth accumulation, and the balance of payments. The Stiglitz-Sen-Fitoussi report (2009) can make it seem that entire new measurement systems are necessary, while the reality is that many of the recommendations about economic data contained in the Stiglitz-Sen-Fitoussi report can be met, or the first steps can be taken, with data already collected for the purposes of measuring national income in the SNA framework. Measures of household wealth accumulation and of gross and net saving and methods to include terms-of-trade adjustments are all present. However, these metrics are not as widely known or discussed as GDP.

The aim of this paper is to demonstrate how using the recommendations contained in the SNA 1993 for transforming GDP measures to GNDI measures by including a terms-of-trade adjustment and income flows in the current account can both enhance our understanding about how economies progress and increase the utility of the data collected for measuring GDP. The current measurement system can be used to produce measures of real income that come closer to the notion of welfare in that they correspond to changes in the utility or well-being of a representative agent rather than to changes in an economy's production function. While these real income measures do not address the distribution of income, they can provide important information on aggregate economic performance beyond production-based GDP measures. Moreover, because the SNA 1993 recommends that real income adjustments be derived from estimates used to calculate current production-based measures, they can be readily produced from existing data. The remainder of this paper outlines the recommendations set out in SNA 1993 and then follows those recommendations by making use of publically available data from the Organization for Economic Co-operation and Development (OECD).

The paper is organized into two distinct sections. The first half of the analysis discusses how to move through the SNA 1993 in order to arrive at differing measures of income. It follows the recommendations set out in Part XVI, Section K ("Measures of real income for the total economy"), paragraphs 16.148 to 16.161, pertaining to relative price and current account adjustments. The adjustments performed are the addition of a trading gain to capture the

influence of the terms of trade and adjustments for net current account flows other than the trade balance.

The second half of the analysis is divided into three parts.

The first part examines the extent to which growth in real GDP per capita differs from the growth in aggregate measures of real per capita income in each of the three national economies under study. The paper demonstrates that changes in per capita income yield a stronger impression of economic performance in Canada and Mexico than do changes in per capita GDP. There is little difference between these measures of economic performance in the United States.

The second part examines the extent to which the growth in real GDP per capita and the growth in real income per capita are correlated with changes in final domestic demand—a basic measure of the expenditures on goods and services in each of the national economies. The paper finds that, for both Canada and Mexico, changes in real per capita income more closely mirror changes in final domestic demand than do changes in per capita GDP. This suggests that trading gains and balance of payments income flows are important for understanding changes in domestic expenditures in small, trade-oriented economies.

Finally, the third part evaluates the implications of using real income measures when making cross-national comparisons of economic performance. Estimates of real per capita income growth for recent years suggest that the economic performance of Canada and Mexico vis-à-vis the U.S. economy has been stronger than suggested by changes in GDP per capita.

## 2 Real income in the System of National Accounts

The SNA 1993 contains a series of recommendations for moving from a production-based measure of real income to a purchasing-power-based measure of real income. There are two main adjustments that are required to do so. The first pertains to nominal income adjustments for international income flows captured by the current account of the balance of payments; the second relates to the deflation method for measuring real income.

### 2.1 Nominal income concepts

GDP is a measure of production that captures an economy's ability to generate income through the production process that transforms inputs into outputs. In a balanced system of national accounts based on a set of input-output tables, this nominal income can be calculated in three ways, and the interconnected approaches form the foundation for SNA real income measurement.

The starting point for measuring GDP is the input-output system that lies at the core of the SNA 1993. In the input-output system, GDP is a measure of value derived by subtracting intermediate inputs from gross output:

$$GDP = \sum_J p_j v_j - \sum_I p_i u_i$$

where  $v_j$  and  $p_j$  are the volumes and prices, respectively, for the  $J$  commodities produced, and  $u_i$  and  $p_i$  are the quantities and prices, respectively, of the  $I$  intermediate inputs purchased by firms.



Gross output in the input-output system is equal to the final value of all goods and services sold on markets by firms. The production processes that firms employ use capital and labour to transform intermediate inputs into outputs. When intermediate inputs used in production are netted off of gross output, the remaining balance is the income that accrues to capital and labour—the inputs to which the SNA 1993 refers as “the primary factors of production.” As a result, value added is equal to the income that accrues to capital and labour in each period, which gives rise to the income approach to GDP measurement:

$$GDP = \sum_M w_m l_m + \sum_N r_n k_n$$

where  $l_m$  and  $k_n$  are the labour and capital inputs, respectively, and  $w_m$  and  $r_n$  are their corresponding prices.

The SNA 1993 also uses a set of matrices in its input-output system that corresponds to a set of final expenditures by agents within an economy. This is the approach to estimating GDP most familiar to users of National Accounts data. The final expenditure categories measure the value of expenditures made on final goods and services by domestic and foreign agents less imports:

$$GDP = \sum p_q^c c_q + \sum p_r^i i_r + \sum p_s^g g_s + \sum p_t^x x_t - \sum p_u^m m_u$$

Where  $\sum p_q^c c_q$  denotes final expenditures on the set of consumption commodities  $q$ ,  $\sum p_r^i i_r$  denotes final expenditures on the set of investment commodities  $r$ ,  $\sum p_s^g g_s$  represents final expenditures on the set of government goods and services  $s$ , and  $\sum p_t^x x_t$  and  $\sum p_u^m m_u$  correspond to the values of all exports  $t$  and imports  $u$ , respectively.

The equality between measures of GDP illustrates two key features of the SNA measurement system. The first is that income in the system is a measure of value added. It is not a measure of output, but a measure of production. The second is that income is equal to the final value of sales ( $C+I+G+X$ ) less purchases ( $M$ ) so that the expenditures on final goods and services in an economy are equal to the income that an economy produces. A recognition of the relationship between expenditures, income, and value added provides the basis for real income measurement in the SNA. The SNA sets forth a series of recommendations for adjusting GDP for current account entries in the balance of payments and for the use of different deflation methods that produce real income measures other than real GDP.

## 2.2 Income concepts

The most commonly published and discussed real income measure is real GDP. Real GDP is a measure of the real income that an economy generates through production in terms of the goods and services produced. This is the appropriate metric when examining production-related phenomena like productivity growth, capacity utilization, and business cycles.

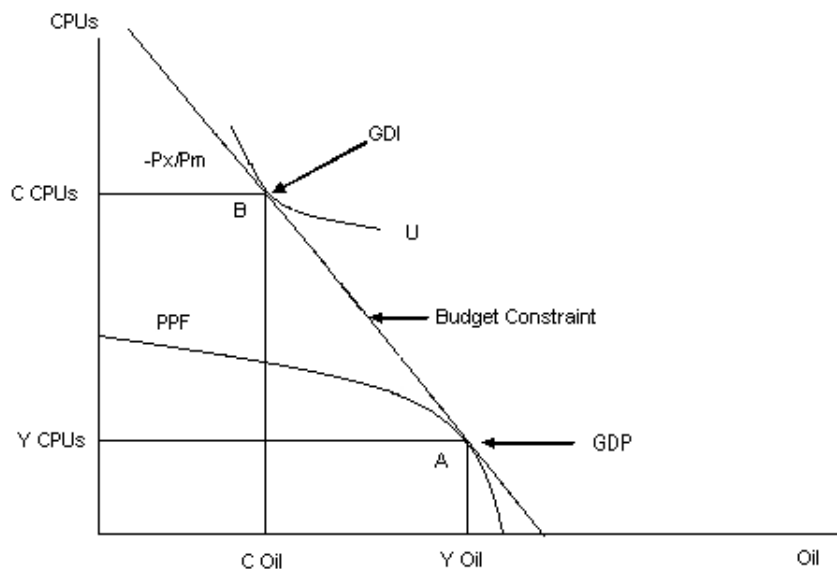
In order to move to real income measures that are more closely associated with well-being, it is necessary to: make adjustments to the indices used to create volume measures; and to add in international income transfers. These changes affect the underlying income concept (production or purchasing power) and the position of an economy’s budget constraint.

The SNA 1993 refers to real “gross domestic income” (GDI) as a measure of real income that is “derive[d] from domestic production [but] depends also on the rate at which exports may be traded against imports from the rest of the world” (paragraph 16.152). Real GDI is a measure of

the goods and services available to an economy for consumption and investment. It can be interpreted as a measure of the purchasing power of real GDP. Moving from real GDP to real GDI is equivalent to changing the focus of real income measurement from a point on an economy's production possibilities frontier to a point on an economy's utility curve (Figure 1).

**Figure 1**

**Gross domestic product (GDP) versus gross domestic income (GDI)**



Note: Graphical representation of the solution to the Consumer's Utility Maximization Problem assuming the income the consumer has for purchasing goods is derived from the society's production function. The maximum income generated by the society given export prices ( $P_x$ ) and import prices ( $P_m$ ) occurs where the relative price of exports to imports (the terms of trade) is tangent to the society's production possibilities frontier.

Measures of real GDP capture the real income that is earned through production while measures of real GDI capture what income can purchase. The GDP deflator, therefore, accounts for all prices while the GDI deflator uses only prices for consumption and investment by public- and private-sector agents. As a result, in an economy where export and import prices progress at different rates, changes in real GDP and in real GDI do not have to occur at the same rate.

GDP and GDI measure income flows produced by factors of production that reside within a country's borders. However, not all income accruing to a country is the result of activity within its borders; nor is all income retained within a country. When, for example, a firm's foreign direct investments earn profits that are repatriated, a country's income may rise while its production may not. Similarly, when residents of an economy send money to relatives in their home country, or when governments provide foreign aid, the income transferred abroad can increase or decrease an economy's consumption possibilities.

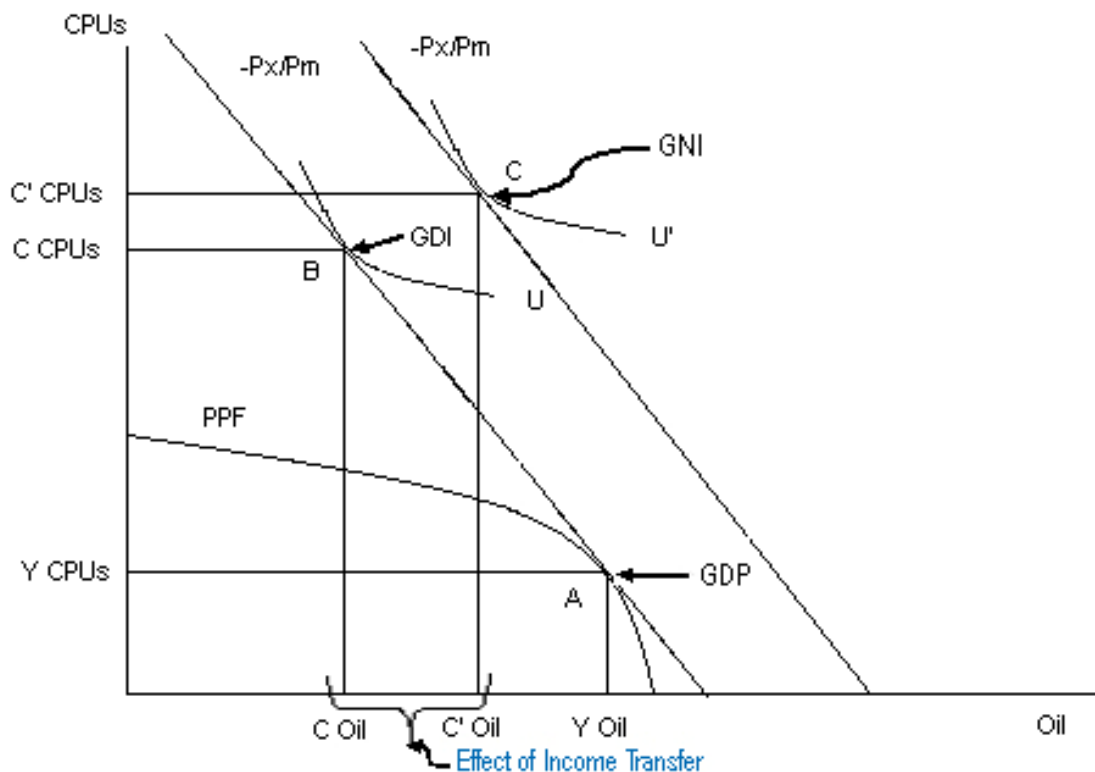
By adding net primary income flows to estimates of domestic income, the SNA 1993 arrives at an income concept referred to as "gross national income" (GNI).<sup>1</sup> Net primary income flows are measured as payments for the use of domestic labour and capital abroad less payments to foreigners for the use of their labour and capital in domestic production. The net primary income flows are referred to as "net income from abroad" (NIFA).

1. GNI was formerly referred to as "gross national product," or GNP.

Similarly, an adjustment can be made for net current transfers, such as remittances or foreign aid. When NIFA and net current transfers are incorporated into aggregate income measurement, an income concept referred to as “gross national disposable income” (GNDI) is generated. In each case, a GDI deflator can be applied to the income flows in order to generate a volume measure.

These adjustments affect the economy's budget constraint, raising or lowering it relative to the income produced through domestic production (Figure 2). The income transfers represent international claims on goods and services and lead to changes in income measures where the current account of the balance of payments, not just the trade balance, is incorporated into income measurement.

**Figure 2**  
**Effect of a positive net transfer**



Note: Graphical representation of the solution to the Consumer's Utility Maximization Problem assuming the income the consumer has to purchase goods is derived from the society's production function plus an international transfer of income. The maximum income generated by the society given export prices ( $P_x$ ) and import prices ( $P_m$ ) occurs where the price of exports relative to the price of imports (the terms of trade) is tangent to the society's production possibilities frontier. The effect of income flows to and from abroad are then added to produced income in order to determine the level of income available to the representative consumer.

### 2.3 Income calculations

Real income index calculations in this paper are based on an assumed equality between income-based estimates of GDP and final-expenditure-based estimates. The discussion of income estimation begins by examining different ways of adjusting a society's budget constraint to form different nominal estimates of aggregate income. A discussion of how nominal measures are deflated to produce real aggregate income estimates is then provided.

### 2.3.1 Nominal income aggregates

The starting point for index number derivations based on GDP is a set of inputs and outputs from the production processes that can be divided into domestic outputs, exported outputs, and imported inputs:  $N = N_D + N_X + N_M$  (see for example Diewert and Morrison 1986 or Fox, Kohli, and Warren 2002). If one assumes that these netputs can be represented by a netput vector,  $\underline{y} \equiv (\underline{y}_D, \underline{y}_X, \underline{y}_M)'$  with a corresponding price vector  $\underline{p} \equiv (\underline{p}_D, \underline{p}_X, \underline{p}_M)'$   $> 0$ , then it is possible to calculate GDP as their sum:

$$GDP = \underline{y} \cdot \underline{p} \quad (1)$$

The corresponding calculation from the input-output system for capital and labour incomes delineates a vector of primary inputs (labour and capital)  $\underline{v} \equiv (v_1, \dots, v_M)'$   $\geq 0$  with price vector  $\underline{w} \equiv (w_1, \dots, w_M)'$   $> 0$ . As with GDP, by summing across the primary inputs, an estimate of aggregate income is obtained:

$$\underline{v} \cdot \underline{w} = Q \quad (2)$$

The SNA 1993 equates the income and expenditure estimates of GDP (aggregate income) so that, by assuming that  $\underline{y}$  and  $\underline{p}$  can be represented by indices, it is possible to write the relationship between nominal GDP and nominal income as:

$$GDP = y_{GDP} \times p_{GDP} = Q \quad (3)$$

The equality between nominal income and the sum of domestic expenditures plus exports less imports means that, in nominal dollars, the estimates of GDP and of GDI are equal. To move to GNI and GNDI in open economies, net adjustments for international transfers must be made. If one assumes that the primary factor income transfers and current transfers can be decomposed into price and volume movements, it is theoretically possible to form commodity ( $\underline{b} \equiv (b_1, \dots, b_B)'$ ) and price ( $\underline{r} \equiv (r_1, \dots, r_B)'$   $> 0$ ) vectors similar to those for labour and capital. By adjusting nominal income for NIFA and net current transfers, measures of nominal GNI and GNDI can be calculated as:

$$GNI = Q + NIFA \quad (4)$$

$$GNDI = Q + NIFA + NCT \quad (5)$$

### 2.3.2 Real income aggregates

The choice of a deflator used to generate a volume from a nominal income measure will depend on the purpose of the analysis, whether it is to track changes in the production capacity or a broader concept of society's welfare related to its absorption capability.

If the desire is a real production-based measure for examining something like productivity, then deflation should account for all prices so that the resulting real measure is associated with the process of transforming inputs into outputs. This approach yields the commonly used real GDP measure:

$$real\ GDP = y_{GDP} = \frac{Q}{P_{GDP}} \quad (6)$$

Measures of real GDP can then be used to measure productivity with respect to progress in the efficiency of production. Productivity growth is typically viewed as the primary source of real income growth in market economies, and a commonly examined measure of productivity is labour productivity that measures real GDP per hour worked:

$$Labour\ Productivity = \frac{y_{GDP}}{h} \quad (7)$$

Moving from production-based measures of real income to a welfare-based measure requires the use of an alternative deflator in order to produce real income estimates measured in terms of what can be purchased with income. Here, a deflator based on final domestic expenditures (FDE) is employed. This choice is espoused by the SNA 1993 because it represents the broadest index of goods and services consumed by domestic agents of an economy.

When the FDE deflator is applied to nominal GDP, the result is real GDI:

$$real\ GDI = y_{GDP} \frac{P_{GDP}}{P_{fde}} = \frac{Q}{P_{fde}} \quad (8)$$

Real GDI reflects movements in production and movements in relative prices of traded goods and services. The relative price ratio  $\frac{P_{GDP}}{P_{fde}}$  is referred to as a “trading gain” and represents the gain or loss that an open economy receives when relative prices change.

Using the FDE deflator results in a difference between the GDP and GDI deflators that arises from their respective treatments of exports and imports.<sup>2</sup> The GDP deflator applies separate export and import deflators; this produces an implicit net export deflator. The GDI deflator applies the same price index to imports and exports; in effect, it deflates net exports directly.

Reinsdorf (2008) illustrates that using an FDE deflator for net exports leads to a homothetic adjustment of the trading gain across consumption and investment categories. As a result, the trading gain is distributed across expenditures proportional to existing expenditure patterns. Using the FDE deflator also leads to a result where the trading gain is composed of two relative price changes (Kohli 2006a). The first is the terms of trade, which represent differential movements in export prices and import prices. The second is the relative price of traded goods to non-traded goods. Of the two, the terms of trade are the more important relative price for real income growth in that their contribution to real income changes is larger than the contribution from the relative price of traded goods to non-traded goods (Macdonald 2010). Importantly, the FDE deflator allows for a broader set of relative price changes than do other deflator options

---

2. In the literature surrounding the SNA, the trading gain is derived by deflating net exports directly rather than by using an implicit price deflator. The SNA presents several options for deflating net exports, including import prices, export prices, an average of import and export prices, and a final domestic expenditure price index. For discussions regarding alternative methods, see Geary 1961, Stuvell 1959, Denison 1981, Silver and Mahadavy 1989, Nicholson 1960, Courbis 1969, Kurabayashi 1971, Kohli 2006a, 2006b, and SNA 1993. Currently, the Bureau of Economic Analysis in the United States calculates a command-basis GDP that is equivalent to the real GDI discussed in the SNA using an import price deflator.

discussed in the SNA 1993 (Macdonald 2007). In fact, it can be shown that the other deflator options are constrained versions of the FDE-based trading gain.

The SNA 1993 measurement of real income applies the FDE deflator to other net income measures in the current account. Because these are income flows without discernable commodities, the SNA 1993 recommends using this broadly based price index. For each of the nominal income aggregates in equations (4) and (5), the final domestic expenditure deflator is used to produce a corresponding real income estimate. If an additive index is employed, the real income estimates may be written as:

$$real\ GNI = y_{GDP} \frac{P_{GDP}}{P_{fde}} + nifa = \frac{Q}{P_{fde}} + \frac{NIFA}{P_{fde}} \quad (9)$$

$$real\ GNDI = y_{GDP} \frac{P_{GDP}}{P_{fde}} + nifa + nct = \frac{Q}{P_{fde}} + \frac{NIFA}{P_{fde}} + \frac{NCT}{P_{fde}} \quad (10)$$

### 3 Real income versus real GDP

Real GDP, and measures such as labour productivity derived from it, have been used as a metric for assessing economic performance (see, for example, Hulten 2001 or Rodgers 2003). However, movements in relative prices and changes in the current account can also have noteworthy effects on economies. This section illustrates several features of the differences between real income and real GDP and between real income and labour productivity.

Throughout the discussion, references to real income refer to real GNDI. The other measures of real income (real GDI, real GNI) are presented for completeness. All calculations employ Törnqvist indexes (Törnqvist 1936), which are additive in their log-differences. The data used for making current account adjustments were available only in net form; this makes index number disaggregations problematic because the balances can range from positive to negative. Ideally, outflows and inflows should be examined separately in order to understand how differences between the flows affect the balance. The contribution to growth calculations presented below use the difference between real income growth rate estimates to calculate the contribution to growth of a particular real income source. For example, the contribution to growth from the trading gain is calculated as the difference between real GDI growth and real GDP growth. This method is less than ideal as it illustrates only whether net income from abroad added to, or subtracted from, real income growth but does not provide a more insightful understanding of the reasons for the difference in the balance. Nevertheless, for the purposes of demonstrating what can be done with currently collected National Accounts data, this method is sufficient.

The tabulations in this section are presented in the following sequence. In the first set of tabulations, the growth in real GDP per capita is compared to different measures of the growth in real per capita income in each of the three national economies. In recent years, changes in real income per capita in Canada and Mexico have outpaced the growth in real GDP per capita in these countries. Sources of real income growth are then examined—highlighting the relative contribution of trading gains to real income growth in Canada and Mexico in different periods.

The second set of tabulations focuses on the relationship between changes in real income and real final domestic demand—an aggregate measure of the volume of domestic expenditures on consumption and investment commodities. For Canada and Mexico, changes in real income are

more closely associated with movements in real final domestic demand than are changes in real GDP.

The final set of tabulations compare the results for Canada and Mexico to those for the United States—to obtain relative measures of the growth in real GDP per capita, real income per capita, and labour productivity. For both Canada and Mexico, overall impressions of economic performance depend upon the aggregate measure that is used to compare growth in these countries relative to the U.S. economy.

### 3.1 Real income and real GDP

Movements in real income and in real GDP can diverge (Table 1). For the North American economies, real GDP and real income tend to move in the same direction because changes in production are the primary source of real income growth. However, changes in relative prices and changes in current account activity can also be important in assessing a country's economic performance.

**Table 1**  
**Growth by real income measure versus labour productivity growth**

Growth in economic performance measures	1971 to 1980	1981 to 1986	1987 to 1990	1990 to 1992	1993 to 2000	2001 to 2007
	percent					
<b>Mexico</b>						
Real gross domestic product per capita	3.3	-1.3	0.4	3.2	1.8	1.9
Real gross domestic income per capita	3.7	-2.6	0.7	3.8	1.9	2.3
Real gross national income per capita	3.6	-3.0	1.3	4.1	1.9	2.4
Real gross national disposable income per capita	3.6	-2.9	1.3	4.0	1.9	2.5
Labour productivity	...	...	...	...	0.1	1.5
<b>United States</b>						
Real gross domestic product per capita	2.2	2.3	2.6	0.4	2.6	1.6
Real gross domestic income per capita	1.8	2.5	2.5	0.4	2.7	1.5
Real gross national income per capita	1.9	2.4	2.5	0.4	2.7	1.6
Real gross national disposable income per capita	1.9	2.4	2.6	0.3	2.7	1.6
Labour productivity	1.6	1.7	0.8	2.0	1.5	2.0
<b>Canada</b>						
Real gross domestic product per capita	2.6	1.6	2.4	-1.7	2.8	1.9
Real gross domestic income per capita	2.8	1.1	3.0	-2.2	2.9	2.6
Real gross national income per capita	2.7	1.0	3.0	-2.2	3.1	2.9
Real gross national disposable income per capita	2.7	1.0	3.0	-2.2	3.1	2.9
Labour productivity	1.8	1.3	0.7	1.0	1.9	1.2

In Mexico, real income grew faster than real GDP from 1971 to 1980. During this period, the trading gain added to real income growth, while NIFA detracted from real income growth (Table 2). The peso devaluations and the recession of the early 1980s led to a reduction in real GDP and in real income. The average annual decline for real GDP was 1.3% between 1981 and 1986. The average annual decline in real GNDI was more than twice as large. Currency devaluations in 1982 reduced real income growth through the trading gain by an annual average of 1.4 percentage points per year, while NIFA was associated with a further reduction of 0.4 percentage points of real income growth. Net current transfers are the only component of real income that contributed positively to real income growth during this period, adding an annual average of 0.2 percentage points to growth.

**Table 2**  
**Contributions to real gross national disposable income growth**

	1971 to 1980	1981 to 1986	1987 to 1990	1990 to 1992	1993 to 2000	2001 to 2007
	percent					
<b>Mexico</b>						
Real gross domestic product	3.3	-1.3	0.4	3.2	1.8	1.9
Trading gain	0.4	-1.4	0.3	0.6	0.1	0.3
Net income from abroad	-0.2	-0.4	0.6	0.4	0.0	0.1
Net current transfers	0.0	0.2	0.0	-0.1	0.0	0.1
<b>United States</b>						
Real gross domestic product	2.2	2.3	2.6	0.4	2.6	1.6
Trading gain	-0.4	0.2	-0.1	0.0	0.1	-0.1
Net income from abroad	0.1	-0.1	0.0	0.0	0.0	0.1
Net current transfers	0.0	0.0	0.0	0.0	0.0	0.0
<b>Canada</b>						
Real gross domestic product	2.6	1.6	2.4	-1.7	2.8	1.9
Trading gain	0.3	-0.5	0.6	-0.5	0.2	0.7
Net income from abroad	-0.1	-0.1	0.0	-0.1	0.1	0.3
Net current transfers	0.0	0.0	0.0	0.0	0.0	0.0

While examining real GNDI makes the downturn of the early 1980s look more pronounced in Mexico than real GDP implies, it also makes the subsequent recovery in that country look stronger. Between 1987 and 1990, real GDP in Mexico progressed at an average annual rate of 0.4%. During this period, the trading gain added 0.3 percentage points to average annual growth, while NIFA added 0.6 percentage points. As a result, real GNDI income increased at an average annual rate of 1.3% versus 0.4% for real GDP.

Similarly, in Canada, the 1990–1991 downturn appears deeper and the recovery appears stronger when real income rather than real GDP, is examined. This illustrates that movements in relative prices and international income flows can reinforce the business cycle. The result suggests that the effects of business cycles on domestic agents can be stronger than real GDP implies.

It is interesting to note the extent to which gains in real income have outpaced those in real GDP in both Canada and Mexico in recent years. From 2001 to 2007, the average annual growth rate in Canada's real GDI per capita and real GNI per capita stood at 2.6% and 2.9%, respectively; by comparison, real GDP per capita increased, on average, by 1.9%. Similarly, in Mexico, average annual growth in real GDI per capita and real GNI per capita was 2.3% and 2.4%, respectively, compared to a 1.9% average annual increase in real GDP. Trading gains in both countries have added to income growth in the post-2000 period.

In contrast with Canada and Mexico, there are limited differences in the United States between the growth of these real income measures and the growth of real GDP during this recent period. From 2001 to 2007, the average annual growth in GDI per capita in the United States was 1.5%, while real GNDI per capita increased, on average, by 1.6%. The average growth in real GDP per capita during this period also stood at 1.6%.



## 3.2 Real income and economic aggregates

Moving from real GDP to real GNDI improves researchers' and policy makers' ability to understand movements in economic aggregates. Chart 1 and Chart 2 illustrate the relationship between real GDP, real GNDI, and real final domestic demand (FDD). Real FDD is a measure of the volume of purchases made by domestic agents on consumption and investment commodities. In Mexico and Canada, movements in real FDD are more closely associated with movements in real GNDI than with movements in real GDP.

For the restructuring of the 1980s and the downturn of the mid-1990s in Mexico, movements in real FDD correlate closely with movements in real GNDI. Real GDP did not change sufficiently to explain why consumption and investment activity declined as sharply as they did. Nor does real GDP growth after 1994 have sufficient strength to explain the recovery in real FDD.

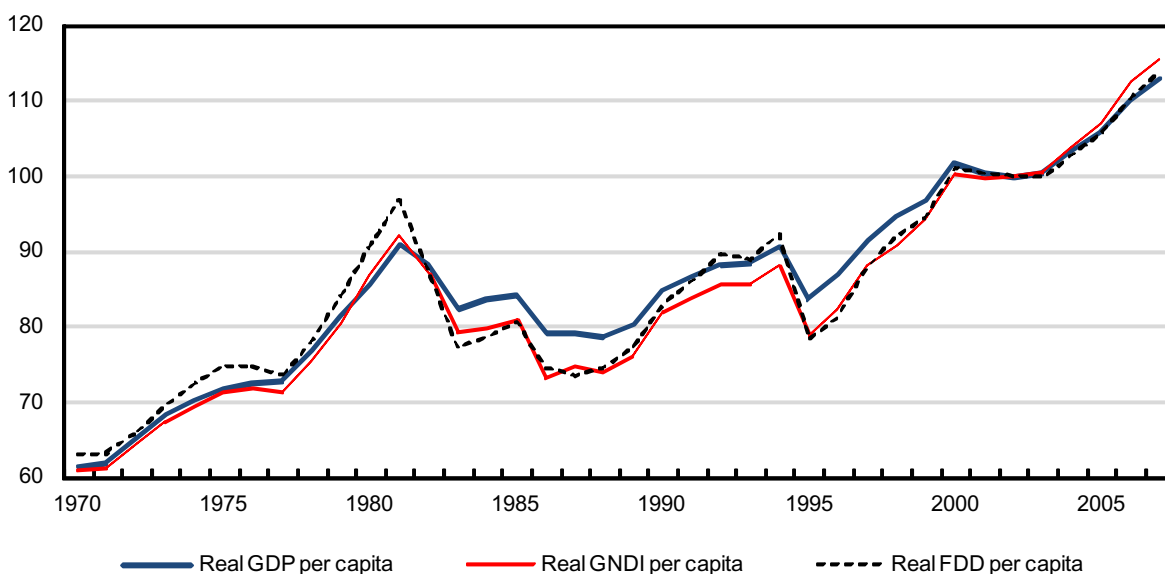
In Canada, resource prices are an important source of national real income (Macdonald 2007). In fact, after production (real GDP), terms-of-trade changes stemming from resource price movements are the most important source of real income growth for Canada. Consequently, during the 1973 and 1979 oil shocks and the 2001-to-2007 period of rising resource prices, real income and real FDD outpaced real GDP by a noticeable margin.

Comparing real GDP with other real income measures and with economic aggregates such as real FDD underscores some of the desire of Stiglitz, Sen, and Fitoussi (2009) to look at features of economies that extend beyond production metrics. With respect to Mexico and Canada, understanding why consumption and investment can progress more rapidly or more slowly than GDP, sometimes for up to five years at a time, is facilitated by incorporating additional features of the economic system into the analysis.

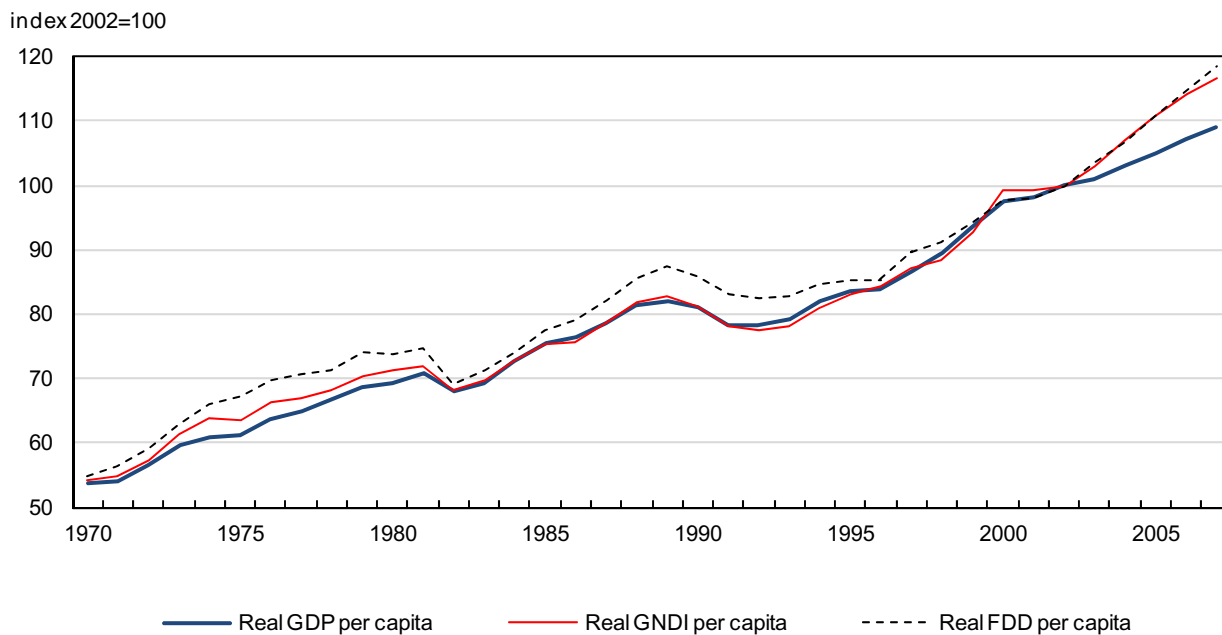
**Chart 1**

### **Mexico — Final domestic demand (FDD) versus gross domestic product (GDP) and gross national disposable income (GNDI)**

index 2002=100



**Chart 2**  
**Canada — Final domestic demand (FDD) versus gross domestic product (GDP)**  
**and gross national disposable income (GNDI)**



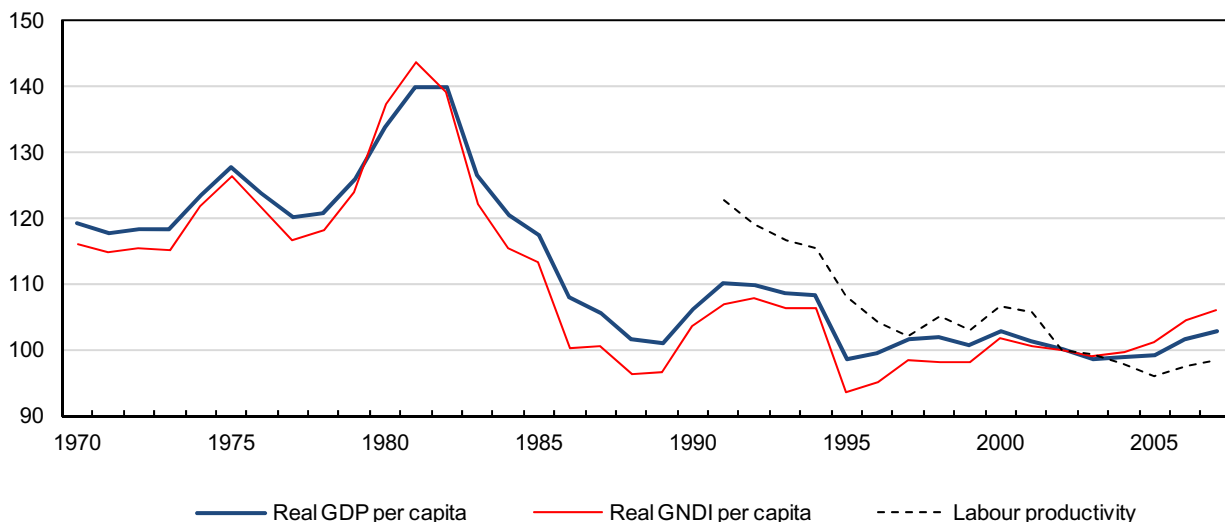
### 3.3 Economic performance in Mexico and Canada relative to the United States

The choice of metric used for international comparisons can affect perceptions of a country's relative economic performance. This point is explicitly discussed in the Stiglitz-Sen-Fitoussi report (2009). Measures of real GDP per capita or measures of labour productivity are often used to make international comparisons. These measures reflect movements related to production that may not be ideal for examining the international performance of all nations. As discussed above, relative prices and current account activity also play an important role in economic performance, particularly for many small open economies.

In Mexico and Canada, for example, perceptions of relative economic performance are affected by the choice of measure used. Chart 3 and Chart 4 plot indexes of labour productivity, real GDP per capita, and real GNDI per capita for Mexico and Canada relative to the United States.

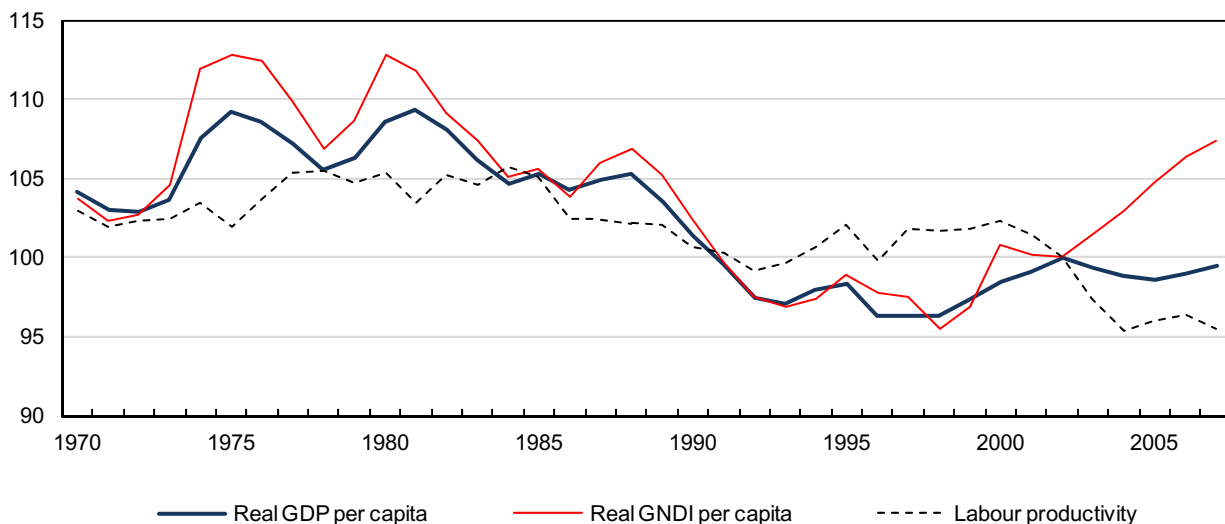
**Chart 3**  
**Mexico relative to the United States — Index of real gross domestic product (GDP), labour productivity, and real gross national disposable income (GNDI)**

index 2002 = 100



**Chart 4**  
**Canada relative to the United States — Index of real gross domestic product (GDP), labour productivity, and real gross national disposable income (GNDI)**

index 2002 = 100



In Mexico, indexes of real GDP per capita and real GNDI per capita relative to the United States tend to move similarly from year to year, but have diverged occasionally. Between 1970 and the early 1980s, relative real GNDI per capita outpaced relative real GDP per capita. The opposite occurred between the early 1980s and the mid-1990s. After 1995, relative real GNDI per capita once again outpaced relative real GDP per capita.

A similar result emerges for Canada relative to the United States, where real GNDI per capita and real GDP per capita diverge. This type of relationship occurred between the 1970s and late 1990s. After the late 1990s, however, real GNDI per capita began increasing in Canada relative to the United States. At the same time, relative real GDP per capita was fairly stable. By 2007, real GNDI per capita in Canada had grown significantly relative to real GDP per capita.

## 4 Conclusion

The Stiglitz-Sen-Fitoussi report (2009) has re-introduced debates about what metrics should be examined and what information should be collected in evaluating the performance of national economies. In doing so, the report has been interpreted by some as calling the current measurement system into question, even though some of the features of the economic system that the report advocates are already contained in the SNA 1993.

In this paper, the SNA 1993 recommendations on how to calculate measures of real income are used to illustrate that the SNA can be used to meet some of the demands of the Stiglitz-Sen-Fitoussi report for a broader set of measures than just GDP. The real income measures employ real GDP as a starting point and then adjust for relative price effects (primarily from the terms of trade) and non-trade balance entries in the current account of the balance of payments.

Real GNI and GNDI can move quite differently than GDP over time, and can track movements in final domestic demand more closely than does real GDP. More importantly, it sometimes generates a different picture of cross-country performance for Canada and Mexico relative to the United States.

The Stiglitz-Sen-Fitoussi report (2009) provides a beneficial step forward in discussions about what should be measured, how it should be measured, and what should be the focus of analysis. The report underscores that there is no one-size-fits-all economic metric.

## References

- Courbis, R.W. 1969. "Comptabilité nationale à prix constants et à productivité constante." *Review of Income and Wealth*. Vol. 15. No. 1. p 33–76.
- Denison, E.F. 1981. "International transactions in measures of the nation's production." *Survey of Current Business*. Vol. 61. No. 5. p. 17–28.
- Diewert, W.E., and C.J. Morrison. 1986. "Adjusting output and productivity indexes for changes in the terms of trade." *The Economic Journal*. Vol. 96. No. 383. p. 659–679.
- Fox, K.J., U. Kohli and R.S. Warren, Jr. 2002. "Accounting for growth and output gaps: Evidence from New Zealand." *The Economic Record*. Vol. 78. No. 242. p. 312–326.
- Geary, R.C. 1961. "Problems in the deflation of national accounts: Introduction." *Review of Income and Wealth*. Vol. 9. No. 1. p. 3–8.
- Hulten, C.R. 2001. "Total factor productivity: A short biography." *New Developments in Productivity Analysis*. C.R. Hulten, E.R. Dean, and M.J. Harper (eds.). Chicago. University of Chicago Press. p. 1–54.
- Inter-Secretariat Working Group on National Accounts (Commission of the European Communities, International Monetary Fund, Organization for Economic Co-operation and Development, United Nations and World Bank). 1993. *System of National Accounts 1993*. Brussels. <http://unstats.un.org/unsd/nationalaccount/docs/1993sna.pdf> (accessed June 1, 2011).
- Kohli, U. 2006a. "Real GDP, real GDI, and trading gains: Canada, 1981-2005." *International Productivity Monitor*. Vol. 13. Fall. p. 46–56.
- Kohli, U. 2006b. *Terms-of-Trade Changes, Real GDP and Real Value Added in the Open Economy: Reassessing Hong Kong's Growth Performance*. Hong Kong Institute for Monetary Research. Working Paper No. 052006.
- Kurabayashi, Y. 1971. "The impact of changes in terms of trade on a system of national accounts: An attempted synthesis." *Review of Income and Wealth*. Vol. 17. No. 3. p. 285–297.
- Macdonald, R. 2007. *Canadian and U.S. Real Income Growth Pre and Post 2000: A Reversal of Fortunes*. Statistics Canada catalogue no. 11F0027M. Ottawa. Economic Analysis (EA) Research Paper Series. No. 48.
- Macdonald, R. 2010. "Real gross domestic income, relative prices and economic performance across the OECD." *Review of Income and Wealth*. Vol. 56. No. 3. p. 498–518.
- Nicholson, J.L. 1960. "The effects of international trade on the measurement of real national income." *The Economic Journal*. Vol. 70. No. 279. p. 608–612.
- Reinsdorf, M. 2008. "Measuring the Effects of Changes in the Terms of Trade on Incomes, Exports and Prices." *Bureau of Economic Analysis Advisory Committee*. Washington, D.C. November 7.  
[http://www.bea.gov/about/pdf/Nov2008AdvisoryCommittee\\_Reinsdorf.pdf](http://www.bea.gov/about/pdf/Nov2008AdvisoryCommittee_Reinsdorf.pdf) (accessed June 2, 2011).

Rodgers, M. 2003. "A survey of economic growth." *Economic Record*. Vol. 79. No. 244. p. 112–135.

Silver, M., and K. Mahadavy. 1989. "The measurement of a nation's terms of trade effect and real national disposable income within a national accounting framework." *Journal of the Royal Statistical Society. Series A*. Vol. 152. No. 1. p. 87–107.

Stiglitz, J.E., A. Sen, and J.-P. Fitoussi. 2009. *Report by the Commission on the Measurement of Economic Performance and Social Progress*. Paris, France. Commission on the Measurement of Economic Performance and Social Progress. <http://www.stiglitz-sen-fitoussi.fr/en/index.htm> (accessed June 17, 2011).

Stuvel, G. 1959. "A new approach to measurement of terms-of-trade effects." *Review of Economics & Statistics*. Vol. 38. No. 3. p. 294–307.

Törnqvist, L. 1936. "The Bank of Finland's consumption price index." *Bank of Finland Monthly Bulletin*. No. 10. p. 1–8.