Welfare Growth Accounting Revisited

Tarek M. Harchaoui*
Department of Global Economics Management
and
Groningen Growth and Development Centre
University of Groningen

Paul Willemsen
Department of Global Economics Management
University of Groningen

June 2017

Abstract: Welfare gains—defined to include trading gains and multifactor productivity gains—have taken an increased importance in determining nations' prosperity. An important line of research has contended that improvements in trading gains in one period tend to be offset by losses from subsequent deteriorations, leaving productivity gains as virtually the sole major long-term source of increased prosperity. We revisit this consensus view by using a unifying dual framework that offers a symmetric treatment of welfare and multifactor gains all the while adjusting the estimates for two measurement problems that arose with globalization—double counting of exports and offshoring bias. The results, based on a representative set of ten economies over the 1996-2009 period, emphasize the importance of trading gains which now contribute for about 8.1% of welfare gains compared to a dampening effect of -6.8% under the unlikely scenario where these measurement problems do not occur—a hefty 15 percentage point turnaround. This aggregate 8.1% upgrade in the relative importance of trading gains masks a great deal of variation ranging from 4.1% for NAFTA to 35.0% for Europe, compared to 10.4% for emerging nations. To some important extent, our results contribute to nuance the well-established narrative that limits trading gains to a quantitatively small and transitory effect.

JEL Classification Codes: C67, D24, E01, F41 and F62.

* Corresponding author: t.m.harchaoui@rug.nl

I. Introduction

An important question at the crossroads of macroeconomics and international trade is to inquire into the sources of advances in domestic welfare. An established line of thinking, which can be traced back at least to Diewert and Morrison (1986), stresses the "symmetric" interpretation between improvements in the terms of trade and technical change—both of which translate into an increase of net output for a similar set of endowments. Specifically, with productivity gains, an economy raises its domestic income which is regarded as a proxy of domestic welfare. Similarly, favourable terms of trade movements allow a larger quantity of imports to be purchased for a given quantity of exports thus raising the purchasing power of domestic income.

Although, conceptually, productivity gains and favourable terms of trade are at the core of improvements in domestic welfare, much of the literature and policy-making assumed that productivity is "almost everything", leaving virtually no room for terms of trade. For example, Diewert and Lawrence (2006, 49), in their comprehensive study on Australia's welfare gains, conclude "(...) that, taken over long time periods of several decades, changes in the terms of trade have relatively little impact on Australian welfare. Welfare benefits from improvements in the terms of trade in one period tend to be offset by losses from subsequent deteriorations in the terms of trade." Kohli (2014,Table 1, 13) reaches a similar conclusion for a larger sample of economies at a different stage of development.

In this paper, we argue that the unprecedented recent alteration to the pace, shape, and engagement of nations in the global trade flows warrants a fresh look at the relative importance of terms of trade and productivity in welfare gains. The starting point of our argument is that, while these flows have made the world economy much more integrated, they prompted new measurement problems regarded as being important by a recent strand of literature. First, intermediate inputs are the primary vehicle of this global integration. They cross borders several times during the manufacturing process, making conventionally measured exports subject to a double-counting problem. Although this problem has long been recognized by both the economics profession (e.g., Hummels et al. 2001), Koopman et al. (2014) provided the first serious treatment of this pitfall. Their concept of value added of exports developed as part of a unified framework highlights a 43% world average double counting in 2004, ranging from 10.9% for Russia to 63.7% for Singapore. Johnson and Noguera (2012) found that this double counting problem emerged since the 1970s, and worsened after 1990 which marks the development of the second wave of globalization.

Second, doubts also emerged on the reliability of import prices as they do not adequately track the cost-savings that arise from the shift in sourcing to low-cost foreign suppliers—offshoring bias. Ever since the June 2007 Business Week cover story with the somewhat inflammatory title, “The Real Cost of Offshoring” (Mandel 2007), failure to measure price declines associated with offshoring has been the focus of an active line of research which assessed their implications on a variety of flagship economic indicators. Offshoring bias has been found as being important in U.S. manufacturing where the imported share of intermediate inputs from low-wage countries rose from about 17% to 25% over the 1997-2007 period (see Houseman et al. 2011). Compared with prices of intermediate inputs produced in the U.S., quality-adjusted prices are 25.2% and 13.8% lower in developing and intermediate countries, respectively (Houseman et al. 2010). Final consumer spending, an important area of the domestic economy, has not been insulated from those trends either. Reinsdorf and Yuskavage (2016) found evidence of an important upward bias in the import indexes for some types of durable goods, especially computers, and a more modest upward bias in the import indexes for apparel. Both of these studies emphasized that this upward bias led to an overestimation of the productive performance of manufacturing and the entire business sector of the U.S. economy during the decade ending in 2007.

To revisit how much trading gains and multifactor productivity contribute to welfare gains, we extend the framework developed by Diewert and Morrison (1986) and Kohli (2004) in two important dimensions: First, we build a dual framework of the notion of production possibility frontier, an approach that symmetrically treats trading gains and productivity gains as a price-effect. Thus, our approach differs from the one employed by Diewert and Morrison (1986) and Kohli (2004) which offers the disadvantage of blending a price-effect (terms of trade gains) with a real effect (productivity gains)—a combination that does not always lend itself to a straightforward interpretation. Second, we then turn to the question of the accuracy of trading gains and productivity gains, assessing how much they might be impacted by the compelling evidence on double counting of the exports and offshoring bias. While these measurement problems entertain a complex interplay which may lead to small quantitative net changes, we believe that the exercise performed in this paper remains worthwhile for the sake of good measurement.

To take our framework to the data, we turn to the World Input Output Tables (WIOT) and the Socio-Economic Accounts (SEA) with an emphasis on a representative set of ten economies (Canada, China, France, Germany, India, Italy, Mexico, Netherlands, UK, and the U.S.) accounting, on average, for 52.2% of global GDP in current international prices. We first estimate the trading gains/losses (terms of trade and real exchange effect) that these featured economies record out of their trade relations with some of the main trading zones (NAFTA, EU-Core, EU-Periphery, China and India as representatives of emerging nations and the rest of the world) over the 1996-2009 period. We then estimate the multifactor productivity trends of these ten economies to arrive at the welfare growth accounting recorded over the same period. We provide baseline estimates of welfare gains and their allocations in terms of trading gains and multifactor productivity advance which are then contrasted with estimates that are adjusted for double counting and offshoring bias.

With the explicit account of double counting of exports and offshoring bias, our results feature the following findings: First, for the whole set of ten economies over the 1996-2009 period, welfare gains advanced annually at 1.05% compared to 1.13% of the unlikely event where double counting and offshoring bias do not occur (our baseline scenario). This 0.09 percentage point downgrade ranges from a -0.17 percentage point for Europe (roughly the same order of magnitude for emerging nations) to a moderate 0.03 percentage point upgrade for NAFTA. Second, over the same period and for the whole sample of economies, trading gains reported a remarkable turnaround to 0.09% from -0.08% (under the baseline scenario) while multifactor productivity experienced a reversal from 1.21% to 0.96%. This 0.17 percentage point turnaround in the trading gains may appear negligible but, when cumulated over the 1996-2009 period, will add a fairly significant 3.2% to the welfare gains advance. Consequently, trading gains have now contributed to lift welfare gains by 8.1%, a striking difference from the baseline scenario where they dampened them by -6.8%. This 8.1% ranges from 4.1% for NAFTA to 35.0% for Europe while emerging nations reported a 10.4% increase. Third, while productivity performance still remains the main contributor to welfare gains, our work has the dual merit of emphasizing the importance of additional measurement issues than those highlighted by the literature and to offer, along the way, a more nuanced perspective on the quantitative relative importance of trading gains.

While our work draws upon the venerable literature discussed above, it is intimately related to recent efforts of reassessing economic performance indicators in light of the recent change in the structures of international trade prompted by globalization. The closest antecedent to our work is represented by Feenstra et al. (2013) who found a considerable understatement in the decline of import prices that arise from longstanding measurement problems in official statistics—the use of a fixed-base Laspeyres formula combined with the lack of accounting for the variety and the decline in tariffs. The unattended effect of this practice features unmeasured terms of trade gains which translated into an overstatement of the post-1995 productivity surge of the U.S. economy. Our work is also related to Nakamura and Steinsson (2012) who brought to light the presence of a product replacement bias in the U.S. international trade prices. This other form of measurement problem tends to delay price adjustments until the time of introduction of a new model and is found to be responsible for smoothing out import and export price indexes. We extend this literature by placing the emphasis on double counting and offshoring bias while ruling out the possible presence of other longstanding measurement problems which may or may not exacerbate the measurement errors that we uncover in our work.

Our work is also related to more recent developments in the literature of the measurement of welfare. Feenstra et al. (2015) has incorporated trading gains in the measurement of the real GDP level suitable for comparisons across time and countries. While our framework places the emphasis on growth-accounting, we expect that our results could be extended to incorporate level-accounting comparisons, but such an extension is beyond the scope of the present paper. Basu et al. (2016) have shown how, under a broad set of considerations, multifactor productivity and capital stock can be fruitfully used to construct summary statistics on welfare. Their paper represents a welcome generalization to a dynamic setting of some of our results obtained in a static framework, but measurement problems are assumed away (p. 18) while they are at the core of our investigation.

The remainder of the paper is structured as follows. Section II introduces the framework along with its implications. The quantitative analysis, which features the source data, the adjustment undertaken and the analysis of the results, is provided in Section III. Concluding remarks are drawn in Section IV.

II. Framework

1. Basic Setup

Diewert and Morrison (1986) formulated a production theory setting that provided index number estimates of the contribution of terms of trade gains and multifactor productivity gains to welfare gains. Their framework rests on the notion of a production possibility frontier that allows for joint production of the categories of the final demand GDP (consumption, investment, and net exports) from capital and labor services. Kohli (2004) extended this framework to account for the real exchange rate gains, another price-effect which, in combination with the terms of trade gains, forms the notion of trading gains. Though the approach developed by this set of contributions made a significant advance in the way of tracking economic performance in an open macroeconomic setting, the proposed framework offers the disadvantage of blending a price-effect (terms of trade gains) with a real effect (productivity gains)—a combination that does not always lend itself to a straightforward interpretation. We take the counterpoint of this approach by considering a dual approach that has the merit to harmonize the treatment of these two gains as a price-effect.

Consider the technology of a given economy characterized by the following GDP function:

$$G(P_C, P_I, P_G, P_X, P_M, K, L, t) = \max_{\{C_t, I_t, G_t, X_t, M_t\}} \{P_C C + P_I I + P_G G + P_X X - P_M M : (C, I, G, X, M, K, L, t) \in T_t\}. \quad (1)$$

This technology is subject to the assumption of constant returns to scale, implying that:

$$P_C C + P_I I + P_G G + P_X X - P_M M \equiv P_K K + P_L L. \quad (2)$$

Differentiating (2), with respect to time and dividing by $G(\cdot)$ and rearranging terms yields, the following identity between the primal and dual multifactor productivity formula $\left(\frac{\hat{A}}{A}\right)$:

$$\frac{\hat{A}}{A} = \left(s_C \frac{\hat{C}}{C} + s_I \frac{\hat{I}}{I} + s_G \frac{\hat{G}}{G} + s_X \frac{\hat{X}}{X} - s_M \frac{\widehat{M}}{M}\right) - \left(s_K \frac{\widehat{K}}{K} + s_L \frac{\hat{L}}{L}\right)$$

$$\equiv -\left(s_C \frac{\hat{P}_C}{P_C} + s_I \frac{\hat{P}_I}{P_I} + s_G \frac{\hat{P}_G}{P_G}\right) - \left(s_X \frac{\hat{P}_X}{P_X} - s_M \frac{\hat{P}_M}{P_M}\right) + \left(s_K \frac{\hat{P}_K}{P_K} + s_L \frac{\hat{P}_L}{P_L}\right) \quad (3)$$

with $s_i (i = C, I, G, X, M, K, L)$ representing the share of i in nominal GDP. Under the well-known conditions of constant returns to scale, competitive markets, and instantaneous adjustment of factor inputs, the term $\left(\frac{\hat{A}}{A}\right)$ is interpreted as an indicator of technical change (see Hulten 2001). The term $\left(s_X \frac{\hat{P}_X}{P_X} - s_M \frac{\hat{P}_M}{P_M}\right)$ which represents the trading gains effect along with $\left(\frac{\hat{A}}{A}\right)$ both have the same property— an increase of net-output for a given set of inputs. Diewert and Morisson (1986) dubbed the combination of these two terms as welfare gain. Hence, it makes sense to group these two terms as:

$$\frac{\hat{A}}{A} + \left(s_X \frac{\hat{P}_X}{P_X} - s_M \frac{\hat{P}_M}{P_M}\right) \equiv -\left(s_c \frac{\hat{P}_C}{P_C} + s_I \frac{\hat{P}_I}{P_I} + s_G \frac{\hat{P}_G}{P_G}\right) + \left(s_K \frac{\hat{P}_K}{P_K} + s_L \frac{\hat{P}_L}{P_L}\right)$$
$$= -\frac{\hat{P}_D}{P_D} + \frac{\hat{P}_Z}{P_Z}. \quad (4)$$

with $-\frac{\hat{P}_D}{P_D} \equiv -\left(s_c \frac{\hat{P}_C}{P_C} + s_I \frac{\hat{P}_I}{P_I} + s_G \frac{\hat{P}_G}{P_G}\right)$ and $\frac{\hat{P}_Z}{P_Z} \equiv \left(s_K \frac{\hat{P}_K}{P_K} + s_L \frac{\hat{P}_L}{P_L}\right)$. So, welfare gains represent the decline in the price of gross domestic income not attributable to the combined price change of the inputs. The trading gain term can be re-written as:

$$s_X \frac{\hat{P}_X}{P_X} - s_M \frac{\hat{P}_M}{P_M} \equiv \left(s_c \frac{\hat{P}_C}{P_C} + s_I \frac{\hat{P}_I}{P_I} + s_G \frac{\hat{P}_G}{P_G} + s_X \frac{\hat{P}_X}{P_X} - s_M \frac{\hat{P}_M}{P_M}\right) - \left(s_c \frac{\hat{P}_C}{P_C} + s_I \frac{\hat{P}_I}{P_I} + s_G \frac{\hat{P}_G}{P_G}\right)$$
$$\equiv \frac{\hat{P}_Y}{P_Y} - \frac{\hat{P}_D}{P_D} \quad (5)$$

with $\frac{\hat{P}_Y}{P_Y}$ and $\frac{\hat{P}_D}{P_D}$ representing, respectively, the change in the GDP implicit price index (first term between parentheses on the right-hand side of (5)) and the change in the implicit price index of domestic demand (second term between parentheses on the right-hand side of (5)) defined as:

$$\frac{\hat{P}_D}{P_D} = \omega_c \frac{\hat{P}_C}{P_C} + \omega_I \frac{\hat{P}_I}{P_I} + \omega_G \frac{\hat{P}_G}{P_G} \quad (6.1)$$

and

$$\frac{\hat{P}_Y}{P_Y} = s_D \frac{\hat{P}_D}{P_D} + s_X \frac{\hat{P}_X}{P_X} - s_M \frac{\hat{P}_M}{P_M} \quad (6.2)$$

with $\omega_i (i = C, I, G)$ representing the share of the categories of domestic demand i in the domestic demand $P_D D \equiv P_C C + P_I I + P_G G$. Thus, our framework leads to a straight version of the dual measure of the ratio of real GDI to real GDP discussed in Kohli (2014).

Using (6) and the fact that $s_D + s_X - s_M = 1$, (5) can be rewritten as:

$$s_X \frac{\hat{P}_X}{P_X} - s_M \frac{\hat{P}_M}{P_M} = (1 - s_X + s_M)\frac{\hat{P}_D}{P_D} + s_X \frac{\hat{P}_X}{P_X} - s_M \frac{\hat{P}_M}{P_M} - \frac{\hat{P}_D}{P_D} = -s_X \frac{\hat{P}_D}{P_D} + s_M \frac{\hat{P}_D}{P_D} + s_X \frac{\hat{P}_X}{P_X} - s_M \frac{\hat{P}_M}{P_M} \quad (7)$$

Note that :

$$s_X \frac{\hat{P}_X}{P_X} \equiv \frac{1}{2} s_X \frac{\hat{P}_X}{P_X} + \frac{1}{2} s_X \frac{\hat{P}_X}{P_X} \tag{8.1}$$

and

$$-s_M \frac{\hat{P}_M}{P_M} \equiv -\frac{1}{2} s_M \frac{\hat{P}_M}{P_M} - \frac{1}{2} s_X \frac{\hat{P}_M}{P_M} \tag{8.2}$$

Using (8.1) and (8.2), (7) then becomes:

$$s_X \frac{\hat{P}_X}{P_X} + s_M \frac{\hat{P}_M}{P_M} = -s_X \frac{\hat{P}_D}{P_D} + s_M \frac{\hat{P}_D}{P_D} + \frac{1}{2} s_X \frac{\hat{P}_X}{P_X} + \frac{1}{2} s_X \frac{\hat{P}_X}{P_X} - \frac{1}{2} s_M \frac{\hat{P}_M}{P_M} - \frac{1}{2} s_X \frac{\hat{P}_M}{P_M} \tag{9}$$

Adding $-\frac{1}{2} s_X \frac{\hat{P}_M}{P_M} + \frac{1}{2} s_X \frac{\hat{P}_M}{P_M} - \frac{1}{2} s_M \frac{\hat{P}_X}{P_X} + \frac{1}{2} s_M \frac{\hat{P}_X}{P_X}$ on the right-hand side of (9) leads to the following formula of trading gains:

$$\begin{aligned} s_X \frac{\hat{P}_X}{P_X} + s_M \frac{\hat{P}_M}{P_M} &= \frac{1}{2}(s_X + s_M)\left(\frac{\hat{P}_X}{P_X} - \frac{\hat{P}_M}{P_M}\right) + (s_X - s_M)\left(\frac{1}{2}\frac{\hat{P}_X}{P_X} + \frac{1}{2}\frac{\hat{P}_M}{P_M} - \frac{\hat{P}_D}{P_D}\right) \\ &= \frac{1}{2}(s_X + s_M)\left(\frac{\hat{P}_X}{P_X} - \frac{\hat{P}_M}{P_M}\right) + \frac{1}{2}(s_X - s_M)\left(\frac{\hat{P}_X}{P_X} + \frac{\hat{P}_M}{P_M} - 2\frac{\hat{P}_D}{P_D}\right) \\ &= \underbrace{\frac{1}{2}(s_X + s_M)\left(\frac{\hat{P}_X}{P_X} - \frac{\hat{P}_M}{P_M}\right)}_{\text{Terms of Trade Effect } \left(\frac{\hat{T}}{T}\right)} + \underbrace{\frac{1}{2}(s_X - s_M)\left[\left(\frac{\hat{P}_X}{P_X} - \frac{\hat{P}_D}{P_D}\right) + \left(\frac{\hat{P}_M}{P_M} - \frac{\hat{P}_D}{P_D}\right)\right]}_{\text{Real Exchange Effect } \left(\frac{\hat{E}}{E}\right)} \end{aligned} \tag{10}$$

Expression (10) suggests that trading gains are driven by two sources: the change in the terms of trade times the average share of trade in GDP and the change in the relative price of tradeables weighted by the trade balance. It is identical to the one developed by Kohli (2004) and recently extended by Reinsdorf (2010) to the Fisher index environment. Combining (4) and (10) gives the following expression of welfare gains :

$$\frac{\hat{A}}{A} + \underbrace{\left(\frac{\hat{T}}{T}\right) + \left(\frac{\hat{E}}{E}\right)}_{\text{Trading Gains}} \equiv -\frac{\hat{P}_D}{P_D} + \frac{\hat{P}_Z}{P_Z} \tag{11}$$

Equation (11) rests entirely on the measurement of price-effects. Thus, it differs from previous attempts made by the literature which blends price with volume-effects (see, for example, Fox et al. 2002).

2. Implications

A straight use of official statistics in the empirical implementation of (11) leads to two measurement errors discussed in the outset of the present paper and which we emphasize here as part of the implications of our setup. Official statistics are subject to a dual pitfall. First, export statistics record the gross value of goods at each border crossing rather than the value added content between border crossings. Second, there is compelling evidence of an upward bias in the imports-price index indicating their failure to capture price declines associated with shifts to lower cost foreign suppliers of intermediate inputs. We now move to assess the way (11) needs to be altered to adequately account for these two measurement problems.

Accounting for these two problems leads to a complex set of changes in (11) in which the ultimate effects are difficult to predict on a priori grounds. The changes may work in opposite directions thus leaving the ultimate effects to the empirical results.[1] These two problems directly affect the trading gains components and indirectly affect the other components of (11). Moving away from the conventional measure of exports to value added of exports reduces the value of nominal GDP which leads to the following direct effects: i) a change in the relative importance of exports in nominal GDP and an upgrade in the share of components of domestic absorption (C, I and G) and imports (M); and ii) a change in the aggregate price index of exports whose direction cannot be predicted. The related indirect effect manifests itself through the right-hand side of (11), i.e., a corresponding decline in the value of labour and capital compensation following the decline in nominal GDP for which the relative shares in GDP remain unchained. The respective prices of these two primary factor inputs $\left(\frac{\hat{P}_Z}{P_Z}\right)$ are adjusted accordingly to reflect the decline in their value of compensation. The other effect occurs through $\left(\frac{\hat{P}_D}{P_D}\right)$. Similarly, accounting for offshoring bias leads to a direct effect represented by a decline in the trend of the imports price index $\left(\frac{\hat{P}_M}{P_M}\right)$, hence, on trading gains. Given that multifactor productivity growth is measured as a residual, then the net effect of these changes alters the term $\left(\frac{\hat{A}}{A}\right)$.

In light of these changes, equation (11) is amended in the following way:

$$\left(\frac{\hat{A}}{A}\right)^a + \underbrace{\left(\frac{\hat{T}}{T}\right)^a + \left(\frac{\hat{E}}{E}\right)^a}_{\text{Adjusted Trading Gains}} = -\left(\frac{\hat{P}_D}{P_D}\right)^a + \left(\frac{\hat{P}_Z}{P_Z}\right)^a \tag{12}$$

with

[1] See Houseman et al. (2011, 129) for a similar point of view: "That said, the measurement of GDP is subject to a wide range of problems that can bias the statistics up or down, and many other factors may work in opposite directions, thus leaving open the degree—or even the direction—of the overall bias in the official statistics."

$$\underbrace{\frac{1}{2}(s_{VAX}+s_M^a)\left[\frac{\hat{P}_{VAX}}{P_{VAX}}-\left(\frac{\hat{P}_M}{P_M}\right)^a\right]}_{\text{Adjusted Terms of Trade Effect }\left(\frac{\hat{T}}{T}\right)^a} + \underbrace{\frac{1}{2}(s_{VAX}-s_M)\left[\left(\frac{\hat{P}_{VAX}}{P_{VAX}}-\left(\frac{\hat{P}_D}{P_D}\right)^a\right)+\left[\left(\frac{\hat{P}_M}{P_M}\right)^a-\left(\frac{\hat{P}_D}{P_D}\right)^a\right]\right]}_{\text{Adjusted Real Exchange Effect }\left(\frac{\hat{E}}{E}\right)^a} \tag{13}$$

where a stands for an adjustment of the initial variables and s_{VAX} represents the value added of exports as a share of GDP. Similarly, $\frac{\hat{P}_{VAX}}{P_{VAX}}$ indicates the adjusted export price index now based on value added of exports (VAX) values.

III. Quantitative Analysis

1. The Source Data

The primary source data used in this paper is based by on the World Input Output Database (WIOD) developed and maintained by the Groningen Growth and Development Center (GGDC).[2] This source data comprises four building blocks represented by the World Input-Output Tables (WIOT), the Socio Economic Accounts (SEA), the National Input Output Tables (NIOT), and the Environmental Accounts (EA) (see Timmer et al. 2015). An attractive feature of the WIOD is that it represents a rich dataset with a high degree of integration and consistency with a potential to support a broad-based empirical research effort.

Of its four components, the WIOT and the SEA are directly relevant to the empirical implementation of the framework devised in this paper. The WIOT is considered an extension of the input-output tables from a national to a worldwide setting, featuring the commodity and industry inter-country flows of inputs, income generating output, and final demand categories for the 1995-2011 period in both current U.S. prices and constant (previous year) prices for 40 countries at different stages of development and the rest of the world (ROW) (see Dietzenbacher et al. 2013 for a description). The WIOT, in previous year prices, covers only the 1996-2009 period, a restriction that shapes the time-span retained in this paper. The SEA contains industry data on value added, gross output in both current and constant (national) prices, compensation of capital and labor, and employment series for all of the 40 national economies included in the WIOD. Given the absence of capital stock series from the

[2] Available at http://www.wiod.org/new_site/home.htm

SEA, we resorted to the 8.1 edition of the Penn World Tables (PWT 8.1) which offer these data for the same level of aggregation and the same coverage of countries.[3]

The WIOT is suitable for supporting the implementation of the framework outlined in Section II which employs a dual aggregate production possibility frontier to examine how much of the decline in the prices of the total economy outputs in terms of consumption, investment, and net exports is attributable to changes in the primary input prices and technical change captured by multifactor productivity under the assumption of constant returns to scale, perfect competition, and instantaneous adjustments in factor inputs. Our notion of output covers the whole economy, a measure that is broader than the one recommended by international guidelines on productivity measurement (OECD 2001) which place the emphasis on the market economy. The estimates are first derived at the national level and then aggregated to major trading blocs using nominal GDP in international prices.

Corresponding data for the primary input prices are constructed from the SEA and the PWT 8.1. While these source data offer the great advantage of assembling a consistent set of production accounts for the ten economies considered in this paper, they offer the disadvantage of using the concepts of employment and capital stock which do not account for the compositional shifts from low- to high-marginal productivity forms of inputs. Under these circumstances, these shifts are embedded as part of our measure of multifactor productivity trends. Thus, our coverage of the whole economy combined with concepts of inputs constructed not in accordance with the notion of service flows make our results difficult to reconcile with others produced for some economies covered in our paper.

2. Adjustments to the Source Data

2.1. Country Groupings

In order to facilitate the analysis of our results, the set of 40 economies that are covered as part of the WIOD countries are grouped into six 'meta' groupings: EU-Core (Austria, Belgium, Denmark, Spain, Finland, France, Germany, the United Kingdom, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Sweden), the EU-Periphery (Bulgaria, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Lithuania, Latvia, Malta, Poland, Romania, Slovakia, and Slovenia), NAFTA (Canada, Mexico, and the United States); China and India representing the major emerging economies and others which not only include WIOD's rest of the world (ROW) but also the remainder of the 40

[3] Available at http://www.rug.nl/research/ggdc/data/pwt/pwt-8.1

countries for which WIOD offers separate data, i.e., Australia, Brazil, Indonesia, Japan, South Korea, Russia, Turkey, and Taiwan. While the majority of these groupings correspond to the existing main trading blocs, the one made of the remaining WIOD 40 countries is less than ideal as it lumps together a large variety of countries at different stages of development offering a wide-range of economic structures. However, we believe that it offers a convenient way to display the results.

We place the emphasis on ten economies deemed to be representative of the global economy and provide a higher level of resolution in their trading gains and multifactor productivity gains by tracking their trade flows with the six 'meta' groupings identified above. These ten economies are: Canada, China, France, Germany, Italy, India, Mexico, Netherlands, UK, and the U.S.

2.2. Substantive Adjustments

Double counting

Koopman et al. (2014) were amongst the first to identify the problem of double counting of exports that arose as part of the development of the global value chain and offered a solution that decomposes gross exports into value added exports and double-counted components. Recently, Los et al. (2016) exploited the so-called 'hypothetical extraction' technique to offer an elegant simplification to this decomposition which we use in the present paper. The novelty of this technique warrants a brief outline of its conceptual underpinnings.

This technique structures the world economy along the input-output framework and computes the value added of exports of a given economy, s ,as the difference between its actual GDP and its hypothetical GDP where the trade linkages are 'extracted'. Formally, if we assume that the world input-output tables track the transactions between a given economy, s, and the rest of the world, r, then the global final demand $\mathbf{Y}$ is defined as:

$$\mathbf{Y} = \begin{bmatrix} \mathbf{y}_{ss} & \mathbf{y}_{sr} \\ \mathbf{y}_{rs} & \mathbf{y}_{rr} \end{bmatrix}$$

where the vectors $\mathbf{y}_{ss}$ and $\mathbf{y}_{sr}$ represent the deliveries from industries in country s to final demand categories in s and in r. Similarly, the global matrix $\mathbf{A}$ of input coefficients a_{ij}, which track the intensity with which intermediate inputs delivered by industry i are used by industry j is defined as:

$$\mathbf{A} = \begin{bmatrix} \mathbf{A}_{ss} & \mathbf{A}_{sr} \\ \mathbf{A}_{rs} & \mathbf{A}_{rr} \end{bmatrix}$$

where $\mathbf{A}_{ss}$ and $\mathbf{A}_{sr}$ represent the deliveries of intermediate inputs from industries of country s to local industries and their counterpart in country r, respectively. The hypothetical versions of the matrices $\mathbf{Y}$ and $\mathbf{A}$, noted as $\mathbf{Y}^*$ and $\mathbf{A}^*$, are defined as:

$$\mathbf{Y}^* = \begin{bmatrix} \mathbf{y}_{ss} & \mathbf{0} \\ \mathbf{y}_{rs} & \mathbf{y}_{rr} \end{bmatrix} \text{ and } \mathbf{A}^* = \begin{bmatrix} \mathbf{A}_{ss} & \mathbf{0} \\ \mathbf{A}_{rs} & \mathbf{A}_{rr} \end{bmatrix}$$

where the trade flows between country s and the rest of the world r have been cancelled out.

In accordance with the well-established practice that goes all the way back to Leontief (1949), the corresponding estimates of GDP under both actual and hypothetical configurations are, respectively:

$$GDP_s = \mathbf{v}_s(\mathbf{I} - \mathbf{A})^{-1}\mathbf{Y}\boldsymbol{i}$$

and

$$GDP_s = \mathbf{v}_s(\mathbf{I} - \mathbf{A}^*)^{-1}\mathbf{Y}^*\boldsymbol{i}$$

The value added of exports is then calculated as:

$$VAX_s = GDP_s - GDP_s^* \tag{14}$$

Offshoring bias

The practice of matched model indexes used to track price changes is well-established across the whole spectrum of official statistics' price programs including the imports-exports price index. The rapid turnover of commodities makes it difficult to track the price of the same commodity over the previous and the current period. The matched model method meant to address this problem links incoming items into the index calculation using the so-called link-to-show no change, a procedure that makes an implicit quality adjustment procedure. For many decades, while the matched model method was thought adequate to track pure price changes (quality is held constant), it became increasingly clear that considerable quality changes were missed as true changes in quality-adjusted prices that occur at the time that item replacements are dismissed from the estimate of the rate of price change.

Recent research (see Houseman et al. (2011) and the references therein) finds that deployment of production from the U.S. to low-wage economies substantially reduced prices paid by U.S. manufacturers for intermediate inputs, a result that points to potentially serious mismeasurement problems on key economic indicators such as economic growth and productivity performance. At the same time, this line of research has emphasized the need to depart from the matched model import price index which fails to account for the entry of lower-priced items from new producers in low cost offshore locations—offshoring bias. In the absence of an alternate import price index which eliminates this bias, Diewert and Nakamura (2009) devised the following correction for the upward bias B in the official import price index:

$$B = (1 + i) \cdot \mu \cdot d, \tag{15}$$

where $(1 + i)$ represents the price movement of the official intermediate input price index which corresponds to the variable $\frac{\hat{P}_M}{P_M}$ used throughout our accounting framework; μ represents the import share captured by low-cost suppliers as a share of total imports, and d gives the so-called percentage cost advantage of purchasing the input from a low-cost supplier over a high-cost supplier. With the estimate of B, the import price index is adjusted as follows:

$$\left(\frac{\hat{P}_M}{P_M}\right)^a = \frac{\hat{P}_M}{P_M} - B. \tag{16}$$

Quantitative Impact

We begin the analysis of the substantive adjustments to the data with the extent of double counting for our selected set of ten economies for the 1996-2009 period. We have considered this whole period without any split in sub-periods as it represents the full business cycle prior to the Great Recession. The results reported in Figure 1, based on (14), suggest that the order of magnitude of double-counting is large with a median for the ten economies that increased from 23.9% in 1996 to of 28.7% in 2009. This suggests that the global supply chain and its related multiple border crossings of intermediates at different stages of processing have gained traction over this period. The range around this median is large, averaging 28.0 percentage points over the 1996-2009 period. The U.S. defines the lower bound which averages 11.9% while the upper bound is represented by the Netherlands with an average close to 40.0%, an indication that the severity of double counting varies with the size of the economy which, in turn, shapes trade intensity. These results are broadly consistent with those reported by Johnson (2014, Table 1, Columns 1 and 2) based on the WIOD for 2008 though with a slightly different time period. Interestingly, double accounting steadily increased after 2002, a timing that coincided with the admission of China to the World Trade Organization in late 2001.

[Insert Figure 1 Here]

On a cross-country basis, the variation in the order-of-magnitude of double counting and its evolution over time is nothing short of remarkable (Figure 2). Though countries like the Netherlands, Mexico, Canada, France, and the UK report a sizable order-of-magnitude in double counting as early as 1996, this pattern has evolved differently by 2009. Canada and, to a lesser extent, the UK were the only countries that experienced a decline in the order-of-magnitude of double counting owing possibly to the shift of these two economies away from manufacturing towards natural resources and financial services, respectively. Nonetheless, their size of double counting remains, in 2009, close to the median of our sample. In contrast, all other countries have seen their double counting worsening off, albeit with considerable variation regardless of the stage of the development of the economy. With 13.2 percentage points, India reported the largest increase followed far behind by Germany (+7.4 percentage points) while China remains a distant third (+5.2 percentage points) close to Italy and France (+4.8 and +4.1 percentage points, respectively).

[Insert Figure 2 Here]

The main take-away point out of this exercise is that double counting in exports matter in a meaningful way with an order of magnitude that is generally large and increasing over time. The same holds true for offshoring bias, though the impact of each of these measurement issues on each of the economies of our sample varies considerably. Our investigation of offshoring bias begins with the analysis of the relative importance of the geographical origin of the imports of the selected set of ten economies. This information is important given that the offshoring bias arises from the assumption that advanced countries shift towards low-cost suppliers for the sourcing of intermediate inputs.

Table 1, which reports the shift in sourcing in the manufacturing sector for our set of economies over the 1996-2009 period, highlights three main results. First, the relative decline of the main trading bloc in the geographical origin of the imports of intermediates by developed nations. For example, back in 1996, 2/3 of Canadian imports originated from NAFTA compared to roughly 50% in 2009. The same holds true for our sample of EU members for which the EU-Core still accounts for nearly half of their imports in 2009, though down from 60% in 1996. Second, the falling behind of NAFTA and the EU as the two main global trading zones in the source of imports for NAFTA between 1996 and 2009 primarily benefited China. For the EU, much of the decline in the EU-Core as a source of imports benefited China and the EU-Periphery almost equally. There is, however, considerable variations across countries. For example, the relative importance of imports from China has considerably advanced for the U.S. and Mexico with a little higher than 11 percentage points for both and less so for Canada which reported a more modest +7.5 percentage points. The advance of China in the imports of the EU-Core has been more modest with a high of 5.7 percentage points for Germany and a low of 3.7 percentage points for Italy. Third, in addition to developed nations, developing nations have not been immune from the shift towards China's supply of their imports. For example, the increase of India's imports from China is 13.3 percentage points slightly higher than that of Mexico. In contrast, this shift in the sourcing of imports has been has been a one-way street for China whose relative importance of imports from India advanced rapidly though with a level that remains extremely low in 2009.

[Insert Table 1 Here]

Now that we have established the presence of compelling evidence in favor of a shift in the sourcing of imports from suppliers in developed economies to their competitors located in low-wage economies, we need to discuss the way in which we arrive at the offshoring bias defined in (15). The absence of customized estimates requires a multi-pronged approach that combines adjustments to the data along with some simplifying assumptions commonly used in the literature. Since offshoring bias arises primarily from the manufacturing sector and involves low-wage economies, the variable μ in (15) needs to be altered in a way that captures the size of manufacturing goods imported from the low-wage country i in the total imports of economy j ($j = 1, \ldots, 10$), i.e. $\mu_{ij}^{M,T}$. This is accomplished using the following equation $\mu_{ij}^{M,T} = \mu_{ij}^{M} \cdot \mu_{ij}^{T}$ with μ_{ij}^{M} representing the size of manufacturing goods imported by country j from i in the overall imports of j from i while μ_{ij}^{T} refers to the imports from country i as a share of total imports of country j. The imports of manufactured goods from the low-wage country i contain both intermediates and final goods. The latter component is included following Kohli (2004, 88) who considers that even final demand imports are often subject to further adjustments or transportation before they can be truly considered final demand. A part of these imports accrue to the manufacturing sector (μ_{ij}^{M}) while the remainder ends up in the rest of the economy (μ_{ij}^{-M}) in accordance with the identity $\mu_{ij}^{M} + \mu_{ij}^{-M} = 1$.

The final piece of the jigsaw required to calculate the order-of-magnitude of offshoring bias is represented by the cost-advantage d offered by foreign input producers relative to the domestic ones which we borrow from the estimates constructed by Houseman et al. (2010) for the U.S. Their estimate of the cost-advantage is constructed from a set of microdata prices based on a set of 344 narrowly-defined manufactured commodities classified into developing, intermediate, and advanced economies over the 1997-2007 period. The approach proceeds with the estimate of the price change when a given firm switches providers to a new source country after an account of the item specification. These estimates are then further refined to account for quality change so the term d tracks a pure change in the cost-advantage. Their result suggests that, on average, the quality-adjusted adjusted cost advantage accompanying a shift from a high-cost supplier to an intermediate-cost supplier was 13.8%. Similarly, the cost–advantage resulting from a shift from high-cost to a low-cost supplier is estimated to be 25.2%.[4]

While these estimates have been carefully constructed and constitute a serious advance in our understanding of the extent of mismeasurement that arises from offshoring, their emphasis is on the U.S. economy which make them possibly less ideal to other major developed economies considered in our representative set of economies. For this reason, we place some bounds around these estimates to ascertain the extent to which they may impact trading gains and productivity performance. Using this set of estimates, we constructed the extent of offshoring bias experienced by the sample of economies covered by our sample. The results reported in Figure 3 suggest a 1/5 percentage point upward bias at the aggregate level ranging from almost half of percentage point for Germany, the country that possesses the largest relative importance of manufacturing, and virtually a neutral effect for the UK, possibly a result of the swift deindustrialization in this last country (see Nickell et al. 2008).

[Insert Figure 3 Here]

3. Trading Gains and Productivity under Alternate Configurations

We have now reached the stage where we can assess the impacts of double counting in the value of exports and offshoring bias on welfare gains that originate from trading

[4] All South American countries and the EU-periphery are allocated to the intermediate country group whereas the developing country group consists of China, Indonesia, India, Taiwan and the Rest of the World.

gains and multifactor productivity performance. The first stage in the analysis is to obtain the estimates of the two components without any adjustment in the data. The results, which we refer to as baseline estimates, are entertained here as a benchmark.

3.1. Baseline Estimates

Tables 2a, 2b, and 2c offer a double-entry structure where rows report the ten sets of economies and their groupings as well as a set of trading blocs in columns (i.e., NAFTA, EU split between the core and the periphery and China and India as the two representative emerging economies, and the rest of the world (ROW)). These tables provide baseline and adjusted estimates displayed in Panels A-C for terms of trade, real exchange rate, and their sum as trading gains, respectively. The figures reported in the table represent average annual growth rates in percentages over the 1996-2009 period. The display side-by-side of the baseline and the adjusted estimates are meant to facilitate comparisons.

We begin with the baseline estimates. Consider the results reported in Table 2a which focus on NAFTA and its three constituent countries. The analysis of the results is best illustrated through the consideration of a specific example. For instance, Canada reported a -0.35% deterioration in its terms of trade over the 1996-2009 period, of which more than half stems from its trading relations with NAFTA (-0.19 percentage point). This stands in a sharp contrast with Mexico which reports a 0.26 percentage point of its 0.51% advance in its terms of trade from within NAFTA alone. The results for the real exchange rate, however, are of a considerably smaller order-of-magnitude with a similar pattern as those for the terms of trade. The 0.05% decline reported by Canada is primarily driven from trade within NAFTA (-0.09 percentage point) mitigated by trade with other regions around the world (+0.04 percentage point). With a modest -0.10% overall change in the trading gains, compared to those of its trading partner, the results for the U.S. are consistent with the notion that international trade matters less for a large economy like the U.S. which also happens to shape those of NAFTA.

[Insert Table 2a Here]

Europe as whole also reports a moderate terms of trade loss and in the same order of magnitude as that of the U.S. (see Table 2b). Within Europe, however, there is considerable variation with the UK and, to a lesser extent, Italy reporting positive growth in the terms of trade while the Netherlands, Germany, and France report one-third of a percentage point deterioration. The story remains virtually intact with the consideration of trading gains, an indication that the real exchange rate remains negligible. Another regularity that emerges from these figures is that trading gains (losses) are primarily driven from trade relations within these nations' own trading zone. The median reported by developed countries is slightly more than 50% which contrasts markedly with the U.S. where NAFTA generates a modest 28% of the trading losses leaving a hefty 47% to the ROW.

[Insert Table 2b Here]

The patterns of emerging nations' trading gains are strikingly different from those of their developed counterparts (see Table 2c). While trends in terms of trade are large and generally systematically negative for developed nations and driving much of the movement of trading gains, the story is opposite for emerging nations which all offer positive terms of trade trends though with a lower order of magnitude than real exchange rates which present a negative trend. What sets China and India apart from Mexico, though, is that their real exchange rate is considerably larger, dwarfing the terms of trade effect along the way.

[Insert Table 2c Here]

We now complement these estimates of trading gains with multifactor productivity trends for this sample of economies over the same period. The results reported in Table 3, Panel A, reiterate some well-established facts such as the 1.21% aggregate multifactor productivity advance which dwarfs the 0.08% decline in the trading gains thus entirely lifting the 1.13% welfare gains. Productivity trends report a great deal of variation across our sample set of economies with the results broadly consistent with the economic growth experienced in the 20th century which features success, failure, and catch-up (see Craft and O'Rourke 2013). First, the U.S. reports a 1.37% advance, the most rapid pace amongst developed nations, though lagging considerably behind China and, to a lesser extent, India which report a performance in line with the convergence theory. Second, Europe lags considerably behind the U.S. after a long and steady period of convergence that halted in 1995 (Gordon 2004) with some economies, like Italy, reporting a substantial productivity deterioration with the Netherlands outperforming the remainder of the continent. Both Canada and Mexico report an unenviable productivity performance during a period where the full benefit of being part of a free trade zone should have come into play. Canada's lackluster performance still remains a real puzzle while Mexico's dwindling multifactor productivity is attributed, according to Hanson (2011), to the fact that economic reforms did not go far enough, and this economy has been competing unsuccessfully with China for the same markets.

For the majority of the economies, their trading losses dampened productivity performance trends which, nonetheless, remains large enough to shape welfare gains. The exception to this general pattern is Canada where welfare losses result from trading losses that dwarf productivity performance. At the other end of the spectrum, the UK reports the second most rapid welfare gains after the U.S. amongst Western economies due to significant trading gains yet smaller than productivity gains.

[Insert Table 3 Here]

3.2. Adjusted Estimates of Welfare Gains and their Underlying Components

We now present how much double counting of exports and offshoring bias impact the estimates of welfare gains and their underlying components. While our primary interest is to assess the quantitative impact of these measurement issues on the relative contributions of trading gains and multifactor productivity in welfare gains, we begin with a simple exercise that asks which of these two measurement issues matter the most for trading gains and productivity. An important aspect of this question is to shed light on the primary source of the bias and whether there are any identifiable regularities on a cross-country basis. The results reported in Table 4 suggest that, at the aggregate level, offshoring bias is found to be primarily responsible for the alteration of the results of trading gains and multifactor productivity gains, accounting for 3/4 and 4/5, respectively. While, for the majority of countries, offshoring bias is the primary source in the change of trading gains estimates, there is no clearly discernible pattern in the revision of the productivity estimates. For example, in the latter case, for some countries like the U.S., the Netherlands and, to a lesser extent, the UK, offshoring bias is the primary source of the changes in the estimates. For others like Germany and France, both offshoring bias and double counting of exports are virtually equally responsible. In contrast, Canada stands out as an outlier with double counting generating almost 3/4 in the revisions of both trading gains and productivity advances. This relative importance of offshoring bias in the changes of the order magnitude size of the revision of trading gains and productivity performance also remains robust under alternate estimates of offshoring bias (see Appendix 1).

[Insert Table 4 Here]

We now move to the core aspect of our quantitative analysis which consists of comparing the estimates on welfare gains and their sources with and without adjustments for the joint effect of double counting and offshoring bias. The combined effect of this adjustment, reported in Table 3, Panel C, leads to a 0.16 percentage point upgrade in the aggregate trading gains (+0.09 compared to a -0.08 percentage point for the baseline estimates) while multifactor productivity reports a -0.25 percentage point downgrade (+0.96% compared to 1.21% prior to the adjustment). As revealed by Figure 4, this pattern is systematic across the three blocs of economies that are considered: a downgrade of multifactor productivity performance accompanied with an upgrade of trading gains. The net effects of these revisions is a -0.09 percentage point decline in the welfare gains for the set of ten economies with emerging nations reporting the largest decline (-0.20 percentage point) followed closely by Europe (-0.17 percentage point) while NAFTA reports a marginal upgrade (+0.03 percentage point).

[Insert Figure 4 Here]

On a cross-country basis, except for the Netherlands and India, trading gains have improved systematically with the largest increase occurring in Mexico (+0.81 percentage point), China (+0.45 percentage point), Canada (+0.31 p.p.), and France (0.26 p.p.) (see Table 3). While terms of trade remain the primary components in the trading gains, the real exchange effect gained a significant turnaround, particularly in Mexico and, to a lesser extent, in Canada and France (see Tables 2). In contrast, the majority of economies experienced a deterioration in the productivity performance with the largest deterioration happening in Mexico (-0.83 p.p.), Germany (-0.73 p.p.), and China (-0.62 p.p.) while the U.S. reported much a more moderate downgrade. Canada remains the exception with an increase in productivity possibly due to the small impact of offshoring bias compared to other countries (see Table 4). The net effect is a systematic downgrade in welfare for all countries with the exception of Canada which reported almost half a percentage point upgrade (+0.44), much larger than that of the UK (+0.07 p.p.), though the sources behind this upgrade are different between the two economies. For Canada, it is the combined effect in the turnarounds of both trading gains and productivity while the estimates remained moderately unaffected for the UK.

The results reported for the U.S. are broadly consistent with the one reached by Feenstra et al. (2013) who identified mismeasurement in import prices as being responsible for the gaining importance of trading gains at the expense of the productivity surge in the post-1995 period. Our results suggest a 0.02 percentage point upgrade in the trading gains outweighed by the order-of-magnitude decline in multifactor productivity, leaving welfare gains unchanged. We can view our work as extending their results in three important directions. First, we consider a set of different measurement issues from the ones they have considered. Second, we assess the impact on welfare gains and on a wide range of other countries. Third, we consider the contribution of trading gains and multifactor productivity gains on welfare.

All things considered, the adjusted estimates trading gains for all countries account for 8.1% of welfare gains leaving the remaining 91.9% to multifactor productivity gains (Figure 5). This represents a sharp contrast to the baseline estimates where trading gains dampened welfare gains by -6.8%. This aggregate 8.1% ranges from 4.1% for NAFTA to 16.2% for Europe while emerging nations report a 10.4%, a hefty turnaround compared to the base line scenario—+ 11.9 percentage points for NAFTA, 35 percentage points for Europe, and 14.4 percentage points for emerging nations. While multifactor productivity gains remain the main story behind welfare gains, the adjusted estimates nuance the traditional narrative by highlighting that trading gains are not negligible, and they lifted welfare gains.

[Insert Figure 5 Here]

IV. Concluding Remarks

A well-established line of research in international trade and macroeconomics contends that welfare gains are primarily driven by multifactor productivity gains, leaving virtually no room for trading gains over the long-run. We revisit this literature along two dimensions. First, we propose a dual approach that makes it possible to unify the interpretation of trading gains and productivity gains. While the existing literature mixes the price effect with a volume effect, our framework offers the advantage of treating both of them as a price effect. Second, while we take this framework to the data, we address the issue of double counting of exports and offshoring bias, both of which have been the focus of recent strands of literature that emphasizes the impact of globalization on the reliability of flagship economic indicators.

We apply this framework to a representative set of ten economies accounting for 51% of global nominal GDP in PPPs over the 1996-2009 period. This new framework was taken to the data under two different scenarios. First, the baseline scenario which assumes that neither offshoring bias nor double counting exists and, second, the adjusted model that acknowledges the presence of these biases and explicitly accounts for them accordingly. Not only do our findings suggest the presence of double counting in exports across all observed countries, they also report its increasing impact over time. In addition, we find that a substantial shift in import sourcing took place over the 1996-2009 time period, suggesting the presence of an upward offshoring bias.

An analysis of the relative impacts of these biases on total estimated change in multifactor productivity gain and trading gains leads to two observations. First, the mismeasurement in officially reported statistics due to the offshoring bias is larger than the bias resulting from double counting. Second, a comparison between the baseline and the adjusted estimates suggests a larger contribution of trading gains, accounting for 8.1% of welfare gains. While multifactor productivity gains still account for the majority of growth in domestic welfare, the contribution of trading gains experienced a remarkable turnaround from a -0.08 to a 0.09 percentage point at the expense of productivity which has been downgraded from 1.21 to 0.96, leading to a slight decline in welfare gains from 1.13% top 1.05.

References

Basu, S., Pascali, L., Schiantarelli F. and Serven, L. 2016. Productivity and the Welfare of Nations. Revision of NBER Working Paper 17971 (2014). http://fmwww.bc.edu/EC-P/wp793.pdf

Crafts, N. and O'Rourke, K.H. 2013. Twentieth Century Growth, Oxford University Economic and Social History Series 117, Economics Group, Nuffield College, University of Oxford. http://www.economics.ox.ac.uk/materials/papers/12884/Crafts%20O%27Rourke%20117.pdf

Dietzenbacher, E., Los, B., Stehrer, R., Timmer, M.P. and de Vries, G.J. 2013. The Construction of World Input-Output Tables in the WIOD Project. Economics Systems Research, 25(1): pp. 71-98.

Diewert, W. E., and C.J. Morrison. 1986. Adjusting Outputs and Productivity Indexes for Changes in the Terms of Trade. Economic Journal 96 (383): 659–79.

Diewert, W. Erwin, and Alice O. Nakamura. 2009. Bias in the Import Price Index Due to Outsourcing: Can It Be Measured? Paper presented at the conference "Measurement Issues Arising From the Growth of Globalization," Washington, DC, November 6–7.

Diewert, W.E. and Lawrence, D. 2006. Measuring the Contributions of Productivity and Terms of Trade to Australia's Economic Welfare, Report by Meyrick and Associates to the Productivity Commission, Canberra.

Feenstra, R.C., Inklaar R. and Timmer M.P. 2015. The Next Generation of the Penn World Table. American Economic Review, 105(10): 3150-82.

Feenstra, R.C., Mandel, B.R., Reinsdorf, M.B. and Slaughter, M.J. 2013. Effects of Terms of Trade Gains and Tariff Changes on the Measurement of US Productivity Growth. American Economic Journal: Economic Policy, 5(1): 59-93.

Fox, K. J., Kohli, U. and Warren Jr., R. S. 2002. Accounting for Growth and Output Gaps: Evidence from New Zealand. Economic Record, 78: 312–326.

Gordon, R.G. 2004. Why was Europe Left at the Station When America's Productivity Locomotive Departed? In Gregory M., Salverda, W., and Schettkat, R. eds.: Services and Employment: Explaining the U.S.-European Gap. Princeton and Oxford: Princeton University Press, 2007, pp. 176-97.

Hanson, G.H. 2010. Why Isn't Mexico Rich? Journal of Economic Literature, 48(4): 987-1004.

Houseman, S., Kurz, C.J., Lengermann, P. and Mandel, B.R. 2010. Offshoring Bias in U.S. Manufacturing: Implication for Productivity and Value Added. Board of Governors of the Federal Reserve System, International Finance Discussion Papers, number 1007. https://www.federalreserve.gov/pubs/ifdp/2010/1007/ifdp1007.pdf

Houseman, S., Kurz C., Lengermann P., and Mandel B. 2011. Offshoring Bias in U.S. Manufacturing. Journal of Economic Perspectives 25 (2): 111–32.

Hulten, C. R. 2001. Total Factor Productivity: A Short Biography, In Hulten C.R., Dean E.R. and Harper M.J. (editors): New Developments in Productivity Analysis, 1-54: University of Chicago Press. Chicago.in ‘New Developments in Productivity Analysis’, University of Chicago Press.

Hummels, D., Ishii, J. and Yi, K.-M. 2001. The Nature and Growth of Vertical Specialization in World Trade. Journal of International Economics, Vol.54, pp. 75-96.

Johnson, R.C. 2014. Five Facts about Value-Added Exports and Implications for Macroeconomics and Trade Research. Journal of Economic Perspectives, 28(2): pp. 119-42.

Johnson, R.C. and Noguera, G. 2012. Accounting for Intermediates: Production Sharing and Trade in Value Added. Journal of International Economics, 86(2), pp. 224-236.

Kohli, U. 2014. Who Gains Most from Trade? Paper presented at the EMG Workshop at the University of New South Wales, Sydney, Australia, December 5. https://www.business.unsw.edu.au/research-site/centreforappliedeconomicresearch-site/Documents/EMG14_UKohli_Who_Gains_Most_from_Trade.pdf

Kohli, U. 2004. Real GDP, Real Domestic Income, and Terms-of-Trade Changes. Journal of International Economics, 62(1), 83-106.

Koopman, R., Wang, Z. and Wei, S.J. 2014. Tracing Value-Added and Double Counting in Gross Exports. American Economic Review, 104(2): pp. 459-494.

Leontief, W. 1949. Structural Matrices of National Economies. Econometrica, 17, pp.273–82.

Los, B., Timmer, M.P. and de Vries, G.J. 2016. Tracing Value-Added and Double Counting in Gross Exports: Comment. American Economic Review,106(4): pp. 432-454.

Mandel, M. 2007. The Real Costs of Offshoring. Business Week, June 18. http://www.bloomberg.com/news/articles/2007-06-17/the-real-cost-of-offshoring

Nakamura, E., and Steinsson, J.. 2012. Lost in Transit: Product Replacement Bias and Pricing to Market. American Economic Review 102 (7): 3277–3316.

Nickell, S., Redding, S. and Swaffield, J. 2008. The Uneven Pace of Deindustrialisation in the OECD. World Economy, 31: 1154–1184.

OECD, Measuring Productivity, OECD, Paris, 2001.

Reinsdorf, M.B. 2010. Terms of Trade Effects: Theory and Measurement. Review of Income and Wealth, 56: S177–S205.

Reinsdorf, M. and Yuskavage, R. 2016. Offshoring, Sourcing Substitution Bias, and the Measurement of Growth in U.S. Gross Domestic Product and Productivity. Review of Income and Wealth. http://onlinelibrary.wiley.com/doi/10.1111/roiw.12263/epdf

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J. 2015. An Illustrated User Guide to the World Input–Output Database: The Case of Global Automotive Production. Review of International Economics, 23: pp. 575–605.

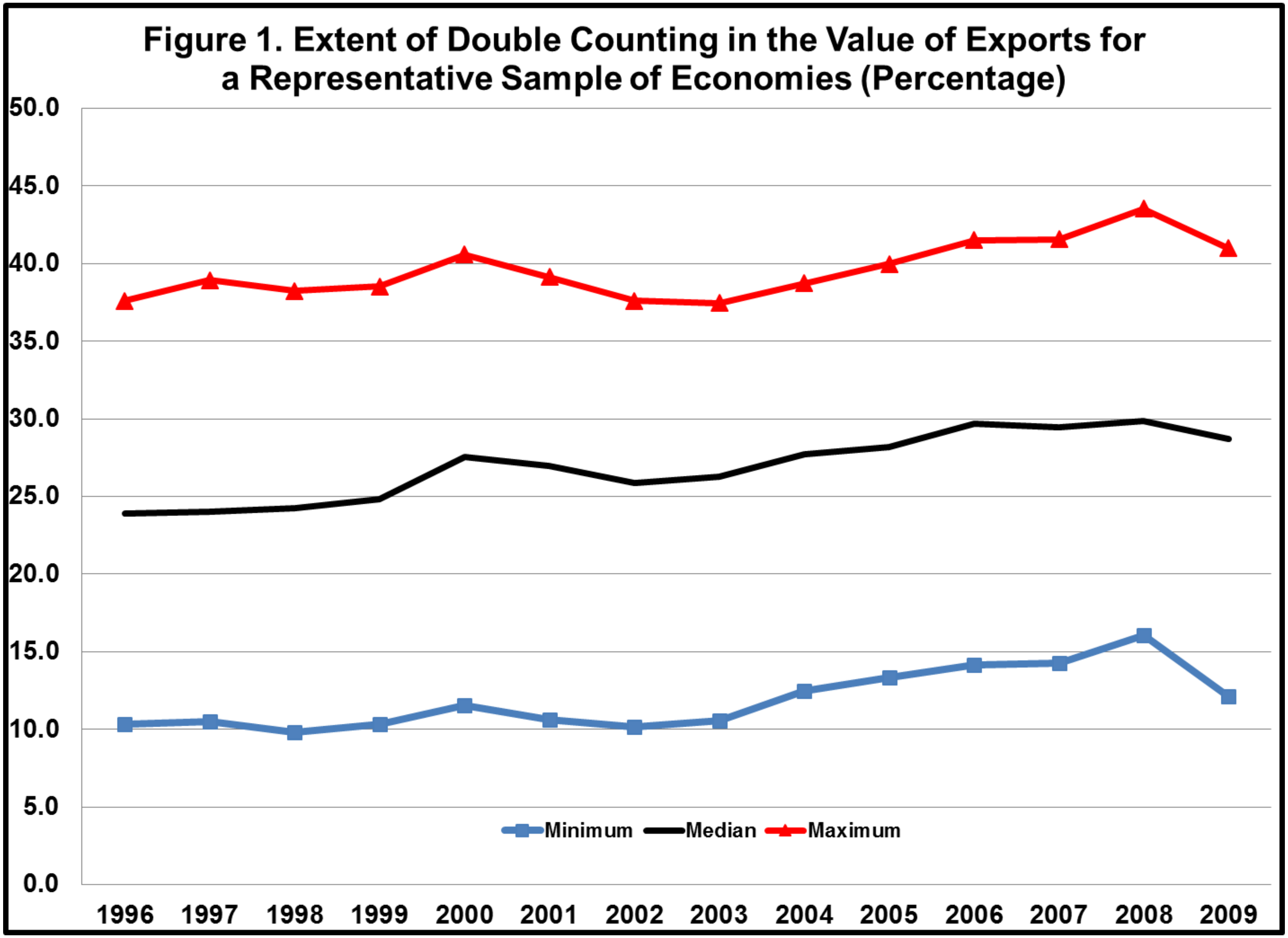


Figure 1. Extent of Double Counting in the Value of Exports for a Representative Sample of Economies (Percentage)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Minimum
Median
Maximum

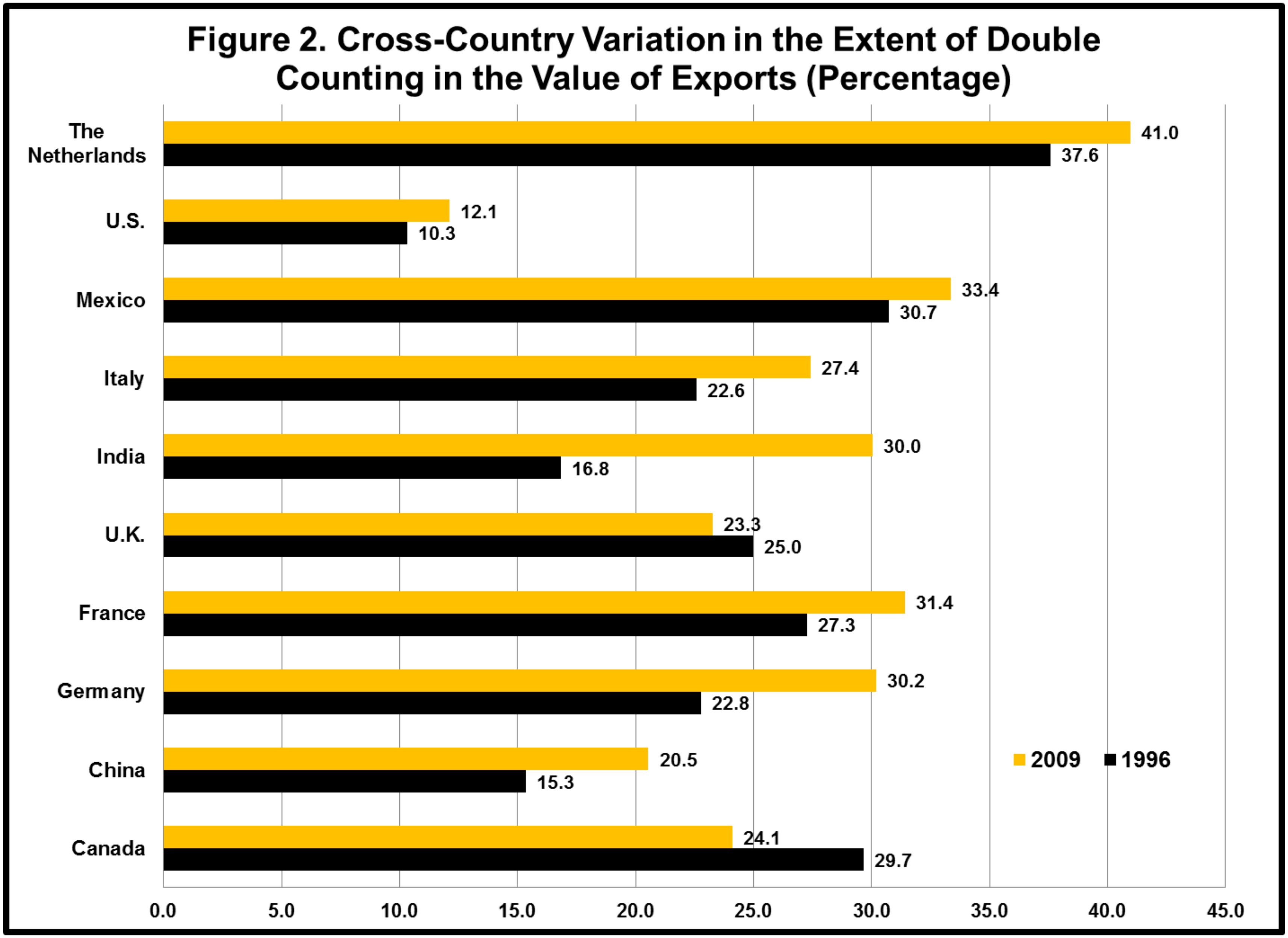


Figure 2. Cross-Country Variation in the Extent of Double Counting in the Value of Exports (Percentage)
The Netherlands
U.S.
Mexico
Italy
India
U.K.
France
Germany
China
Canada
41.0
37.6
12.1
10.3
33.4
30.7
27.4
22.6
30.0
16.8
23.3
25.0
31.4
27.3
30.2
22.8
20.5
15.3
24.1
29.7
2009
1996
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

Table 1. Shift in Imports Sourcing (Percentage)

	Year	NAFTA	EU-Core	EU-Periphery	China	India	Rest of the World	Total
Canada	1996	63.0	16.3	0.5	2.9	0.5	16.9	100.0
	2009	49.9	17.0	1.1	10.4	2.1	19.6	100.0
Mexico	1996	71.9	12.8	0.2	0.7	0.2	14.1	100.0
	2009	51.0	14.2	0.7	12.2	0.5	21.4	100.0
U.S.	1996	24.9	25.7	0.7	4.8	1.1	42.9	100.0
	2009	21.4	20.5	0.8	16.3	3.6	37.3	100.0
Nafta	1996	31.6	23.9	0.6	4.3	1.0	38.6	100.0
	2009	26.3	19.7	0.8	15.5	3.2	34.5	100.0
France	1996	11.2	65.7	1.9	1.4	0.4	19.4	100.0
	2009	8.1	55.3	5.3	6.0	0.8	24.4	100.0
Germany	1996	8.8	57.1	6.7	1.9	0.8	24.6	100.0
	2009	7.4	46.2	12.5	7.6	1.5	24.8	100.0
Italy	1996	8.4	60.3	3.7	1.4	1.2	25.1	100.0
	2009	4.9	48.0	7.4	5.1	0.9	33.8	100.0
Netherlands	1996	10.3	57.9	2.0	2.6	1.0	26.2	100.0
	2009	10.1	50.3	4.1	6.6	2.2	26.8	100.0
UK	1996	12.9	58.5	1.6	2.2	0.9	24.0	100.0
	2009	13.7	48.9	5.3	6.5	2.1	23.5	100.0
Europe	1996	10.2	59.9	3.7	1.8	0.8	23.6	100.0
	2009	8.6	49.4	7.7	6.4	1.4	26.3	100.0
China	1996	11.6	19.4	0.3	0.0	0.6	68.2	100.0
	2009	12.0	17.9	0.8	0.0	1.0	68.2	100.0
India	1996	9.5	33.9	0.9	3.8	0.0	51.9	100.0
	2009	10.7	13.2	0.6	17.1	0.0	58.4	100.0
Asia Emerging Nations	1996	10.8	25.0	0.5	1.5	0.4	61.9	100.0
	2009	11.6	16.5	0.8	5.2	0.7	65.3	100.0

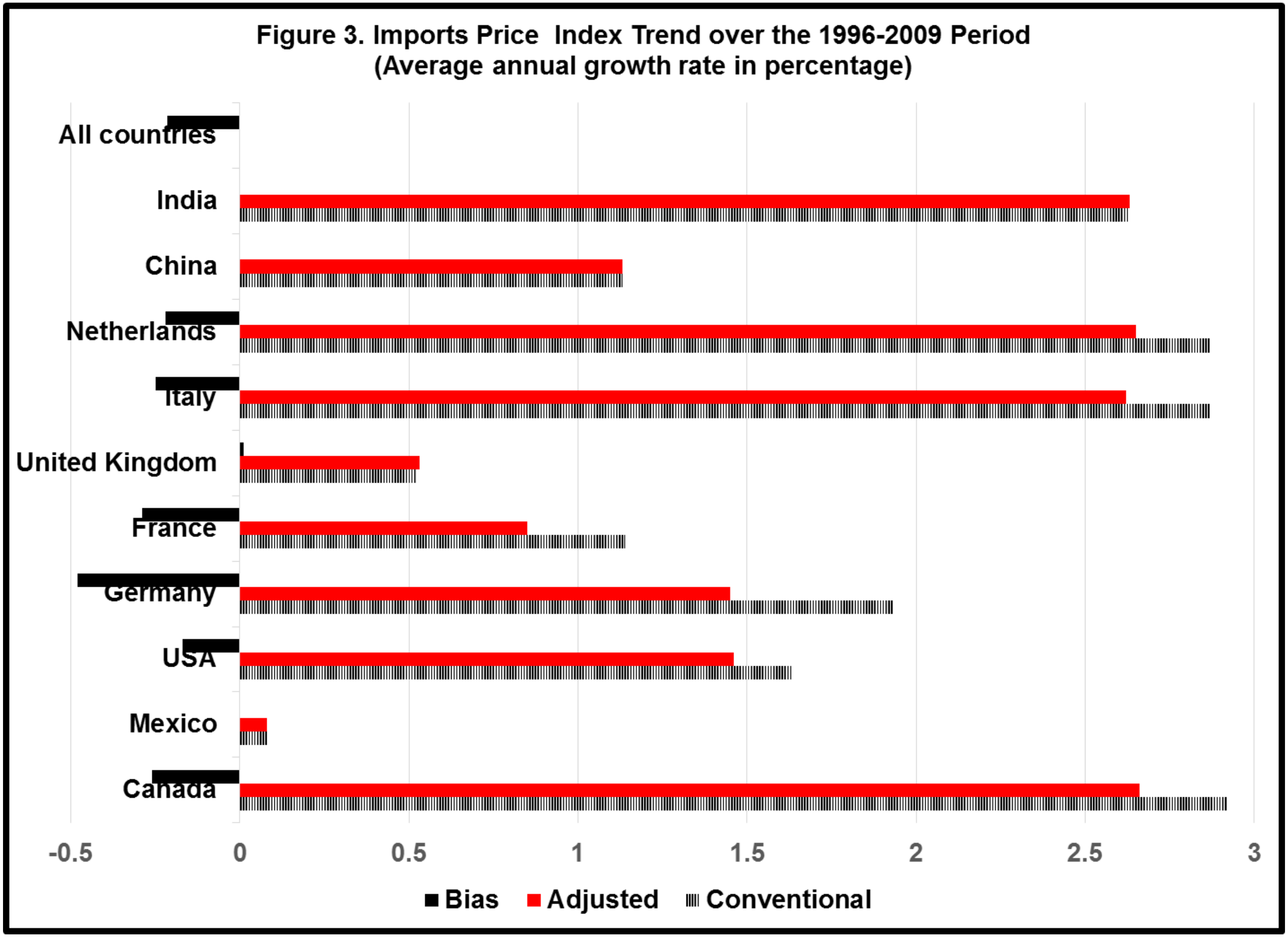


Figure 3. Imports Price Index Trend over the 1996-2009 Period
(Average annual growth rate in percentage)
All countries
India
China
Netherlands
Italy
United Kingdom
France
Germany
USA
Mexico
Canada
-0.5
0
0.5
1
1.5
2
2.5
3
Bias
Adjusted
Conventional

Table 2a. Trading Gains and Their Sources of Origin over the 1996-2009 period (Percentage point)

	Baseline Estimates								Adjusted Estimates						
	NAFTA	**EU-Core**	**EU-Periphery**	**China**	**India**	**ROW**	**Total**		**NAFTA**	**EU-Core**	**EU-Periphery**	**China**	**India**	**ROW**	**Total**
	A. Terms of Trade (1)														
Canada	-0.19	-0.05	0.00	-0.03	-0.01	-0.06	-0.35		-0.07	-0.03	0.00	-0.03	-0.01	-0.03	-0.17
Mexico	0.26	0.07	0.00	0.01	0.00	0.16	0.51		0.62	0.10	0.00	0.02	0.00	0.22	0.97
U.S.	-0.02	-0.02	0.00	0.00	0.00	-0.04	-0.09		-0.02	-0.02	0.00	0.00	0.00	-0.04	-0.08
NAFTA	-0.01	-0.01	0.00	0.00	0.00	-0.02	-0.05		0.03	-0.01	0.00	0.00	0.00	-0.02	0.01
	B. Real Exchange Effect (2)														
Canada	-0.09	0.01	0.00	0.01	0.00	0.01	-0.05		0.01	0.02	0.00	0.02	0.00	0.02	0.08
Mexico	-0.09	0.03	0.00	0.02	0.00	-0.01	-0.05		0.22	0.04	0.00	0.01	0.00	0.01	0.29
U.S.	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01		0.00	0.01	0.00	0.00	0.00	-0.01	0.00
NAFTA	-0.02	0.01	0.00	0.00	0.00	-0.01	-0.02		0.02	0.02	0.00	0.00	0.00	-0.01	0.03
	C. Trading Gains (1)+(2)														
Canada	-0.28	-0.04	0.00	-0.02	0.00	-0.05	-0.40		-0.06	-0.01	0.00	-0.01	-0.01	-0.01	-0.09
Mexico	0.17	0.10	0.00	0.03	0.00	0.15	0.46		0.85	0.14	0.00	0.04	0.00	0.23	1.27
U.S.	-0.02	-0.02	0.00	0.00	0.00	-0.05	-0.10		-0.02	-0.01	0.00	0.00	0.00	-0.05	-0.08
NAFTA	-0.03	-0.01	0.00	0.00	0.00	-0.03	-0.07		0.05	0.01	0.00	0.00	0.00	-0.02	0.04

Table 2b. Trading Gains and Their Sources of Origin over the 1996-2009 period (Percentage point)

	Baseline Estimates							Adjusted Estimates						
	NAFTA	**EU-Core**	**EU-Periphery**	**China**	**India**	**ROW**	**Total**	**NAFTA**	**EU-Core**	**EU-Periphery**	**China**	**India**	**ROW**	**Total**
	A. Terms of Trade (1)													
Germany	-0.03	-0.14	-0.03	-0.01	0.00	-0.08	-0.30	-0.02	-0.11	-0.02	-0.01	0.00	-0.06	-0.22
France	-0.03	-0.15	-0.01	-0.01	0.00	-0.07	-0.27	-0.02	-0.09	-0.01	0.00	0.00	-0.04	-0.16
United Kingdom	0.08	0.22	0.01	0.01	0.00	0.10	0.43	0.09	0.25	0.01	0.01	0.00	0.10	0.46
Italy	0.01	0.04	0.01	0.00	0.00	0.03	0.09	0.01	0.07	0.01	0.01	0.00	0.05	0.15
Netherlands	-0.03	-0.22	-0.02	-0.02	0.00	-0.08	-0.36	-0.04	-0.30	-0.02	-0.02	-0.01	-0.12	-0.52
Europe	0.00	-0.08	-0.01	-0.01	0.00	-0.03	-0.13	0.00	-0.06	-0.01	0.00	0.00	-0.03	-0.11
	B. Real Exchange Effect (2)													
Germany	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01
France	-0.01	0.02	0.00	0.00	0.00	-0.02	-0.01	0.00	0.10	0.00	0.01	0.00	0.02	0.14
United Kingdom	-0.02	0.02	0.00	0.00	0.00	-0.02	-0.02	-0.01	0.04	0.00	0.00	0.00	0.00	0.03
Italy	-0.01	0.00	-0.01	0.00	0.00	-0.02	-0.03	-0.01	0.03	0.00	0.00	0.00	0.00	0.01
Netherlands	0.00	0.02	0.00	0.00	0.00	-0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.03
Europe	-0.01	0.02	0.00	0.00	0.00	-0.01	-0.01	0.00	0.04	0.00	0.00	0.00	0.01	0.05
	C. Trading Gains (1)+(2)													
Germany	-0.03	-0.14	-0.03	-0.01	0.00	-0.08	-0.30	-0.02	-0.11	-0.02	-0.01	0.00	-0.07	-0.23
France	-0.04	-0.13	-0.02	0.00	0.00	-0.09	-0.29	-0.01	0.01	-0.01	0.01	0.00	-0.02	-0.03
United Kingdom	0.06	0.25	0.01	0.01	0.00	0.08	0.41	0.08	0.29	0.01	0.01	0.00	0.10	0.49
Italy	0.00	0.05	0.00	0.00	0.00	0.01	0.06	0.01	0.10	0.01	0.01	0.00	0.04	0.17
Netherlands	-0.03	-0.20	-0.01	-0.02	-0.01	-0.09	-0.35	-0.03	-0.29	-0.02	-0.02	-0.01	-0.11	-0.48
Europe	-0.01	-0.06	-0.01	-0.01	0.00	-0.05	-0.14	0.00	-0.02	-0.01	0.00	0.00	-0.02	-0.05

Table 2c. Trading Gains and Their Sources of Origin over the 1996-2009 period (Percentage point)

	Baseline Estimates								Adjusted Estimates						
	NAFTA	EU-Core	EU-Periphery	China	India	ROW	Total		NAFTA	EU-Core	EU-Periphery	China	India	ROW	Total
	A. Terms of Trade (1)														
China	0.00	-0.01	-0.01	-	-0.01	0.17	0.14		0.05	0.04	0.00	-	0.00	0.29	0.38
India	0.05	0.01	0.00	0.03	-	-0.04	0.05		0.04	0.01	0.00	0.03	-	-0.05	0.03
Emerging Nations	0.01	0.00	0.00	0.01	-0.01	0.10	0.11		0.05	0.03	0.00	0.01	0.00	0.18	0.26
	B. Real Exchange Effect (2)														
China	-0.24	-0.05	-0.01	-	-0.01	0.04	-0.26		-0.14	-0.02	0.00	-	-0.01	0.13	-0.05
India	-0.04	-0.01	0.00	0.00	-	-0.03	-0.08		-0.02	0.00	0.00	0.00	-	-0.04	-0.06
Emerging Nations	-0.17	-0.03	-0.01	0.00	-0.01	0.02	-0.20		-0.10	-0.01	0.00	0.00	-0.01	0.07	-0.05
	C. Trading Gains (1)+(2)														
China	-0.24	-0.05	-0.02	-	-0.02	0.21	-0.12		-0.09	0.02	-0.01	-	-0.01	0.42	0.33
India	0.00	0.01	0.00	0.03	-	-0.07	-0.03		0.01	0.01	0.00	0.03	-	-0.09	-0.04
Emerging Nations	-0.16	-0.03	-0.01	0.01	-0.01	0.12	-0.09		-0.06	0.02	0.00	0.01	-0.01	0.25	0.21

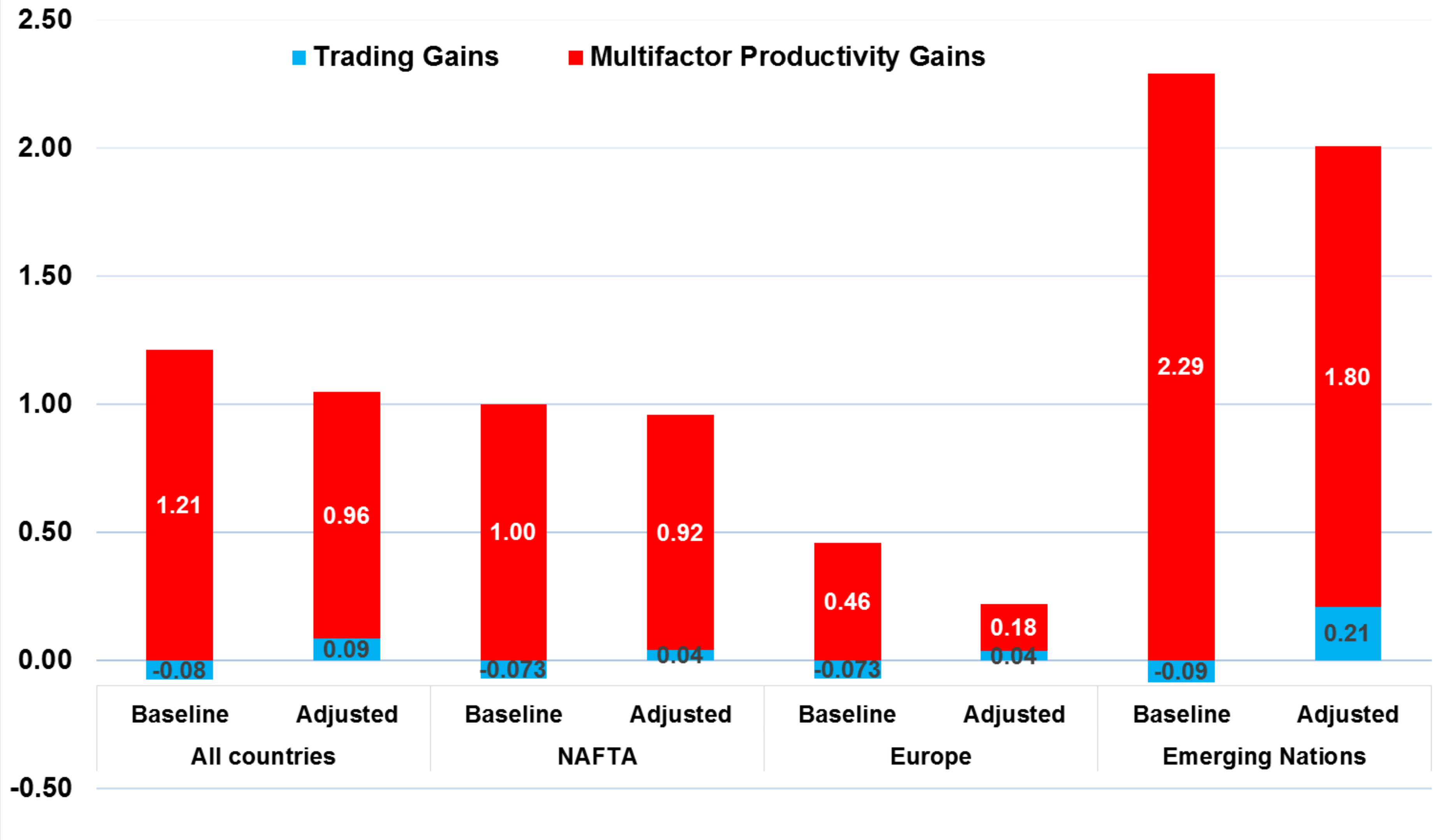
Table 3. Welfare Gains and Their Sources over the 1995-2009 (Percentage)

	Non-Adjusted (A)			Adjusted (B)			Changes (B)-(A)		
	Trading Gains (1)	**Multifactor Productivity Gains (2)**	**Welfare Gains (1)+(2)**	**Trading Gains (1)**	**Multifactor Productivity Gains (2)**	**Welfare Gains (1)+(2)**	**Trading Gains (1)**	**Multifactor Productivity Gains (2)**	**Welfare Gains (1)+(2)**
Canada	-0.40	0.35	-0.06	-0.09	0.48	0.39	0.31	0.13	0.44
Mexico	0.46	-2.02	-1.56	1.27	-2.84	-1.57	0.81	-0.83	-0.02
U.S.	-0.10	1.37	1.27	-0.08	1.35	1.27	0.02	-0.02	0.00
NAFTA	-0.07	1.00	0.93	0.04	0.92	0.96	0.11	-0.08	0.03
Germany	-0.30	0.64	0.34	-0.23	0.10	-0.13	0.07	-0.54	-0.47
France	-0.29	0.66	0.37	-0.03	0.35	0.32	0.26	-0.31	-0.05
United Kingdom	0.41	0.77	1.18	0.49	0.76	1.25	0.08	-0.01	0.07
Italy	0.06	-0.54	-0.48	0.17	-0.72	-0.55	0.12	-0.18	-0.06
Netherlands	-0.35	0.95	0.60	-0.48	0.82	0.34	-0.13	-0.13	-0.26
Europe	-0.07	0.46	0.39	0.04	0.18	0.22	0.11	-0.28	-0.17
China	-0.12	2.65	2.53	0.33	2.03	2.36	0.45	-0.62	-0.17
India	-0.03	1.58	1.55	-0.04	1.34	1.31	-0.01	-0.24	-0.25
Emerging Nations	-0.09	2.29	2.20	0.21	1.80	2.01	0.30	-0.49	-0.20
			0.00						
All countries	-0.08	1.21	1.13	0.09	0.96	1.05	0.16	-0.25	-0.09

Table 4. Contribution of Each Measurement Problem to Components of Welfare Gains, 1996-2009 (Percentage)

	Trading Gains		**Multifactor Productivity**	
	Double Counting	**Offshoring Bias**	**Double Counting**	**Offshoring Bias**
Canada	73.0	27.0	73.0	27.0
USA	27.0	73.0	0.0	100.0
Germany	11.0	89.0	54.0	46.0
France	17.0	83.0	51.0	49.0
United Kingdom	18.0	82.0	9.0	91.0
Italy	6.0	94.0	28.0	72.0
Netherlands	18.0	82.0	0.0	100.0
All countries	**23.8**	**76.2**	**17.3**	**82.7**

Figure 4. Welfare Gains and Its Sources Under Alternate Measurement Scenarios, 1996-2009 (Average Annual Growth Rate in Percentage)



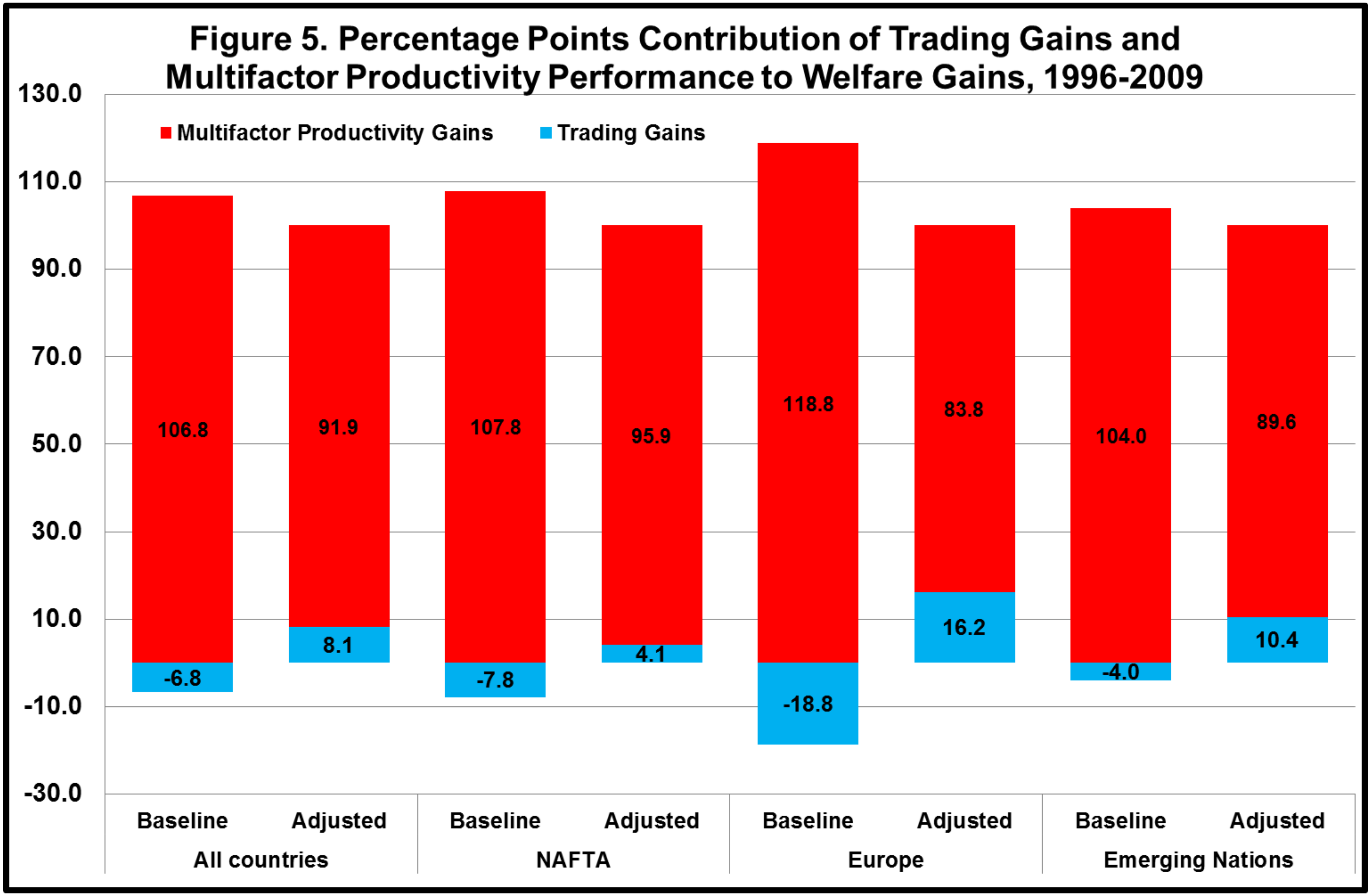


Figure 5. Percentage Points Contribution of Trading Gains and Multifactor Productivity Performance to Welfare Gains, 1996-2009
130.0
110.0
90.0
70.0
50.0
30.0
10.0
-10.0
-30.0
Multifactor Productivity Gains
Trading Gains
106.8
-6.8
91.9
8.1
107.8
-7.8
95.9
4.1
118.8
-18.8
83.8
16.2
104.0
-4.0
89.6
10.4
Baseline
Adjusted
All countries
Baseline
Adjusted
NAFTA
Baseline
Adjusted
Europe
Baseline
Adjusted
Emerging Nations

Appendix

Table A-2a. Trading Gains and Their Sources of Origin over the 1996-2009 period (Percentage point)

	Adjusted Estimates -5%							Adjusted Estimates +5%							
	NAFTA	**EU-Core**	**EU-Periphery**	**China**	**India**	**ROW**	**Total**		**NAFTA**	**EU-Core**	**EU-Periphery**	**China**	**India**	**ROW**	**Total**
	A. Terms of Trade (1)														
Canada	-0.06	-0.03	0.00	-0.03	-0.01	-0.03	-0.15		-0.08	-0.03	0.00	-0.03	-0.01	-0.03	-0.19
Mexico	0.62	0.10	0.00	0.02	0.00	0.22	0.97		0.62	0.10	0.00	0.02	0.00	0.22	0.97
U.S.	-0.02	-0.02	0.00	0.00	0.00	-0.04	-0.08		-0.02	-0.02	0.00	0.00	0.00	-0.04	-0.09
NAFTA	0.03	-0.01	0.00	0.00	0.00	-0.02	0.00		0.03	-0.01	0.00	0.00	0.00	-0.02	0.01
	B. Real Exchange Effect (2)														
Canada	0.01	0.02	0.00	0.02	0.00	0.02	0.08		0.01	0.02	0.00	0.02	0.00	0.02	0.08
Mexico	0.22	0.04	0.00	0.01	0.00	0.01	0.29		0.22	0.04	0.00	0.01	0.00	0.01	0.29
U.S.	0.00	0.01	0.00	0.00	0.00	-0.01	0.00		0.00	0.00	0.00	0.00	0.00	-0.01	0.00
NAFTA	0.02	0.01	0.00	0.00	0.00	-0.01	0.03		0.02	0.01	0.00	0.00	0.00	-0.01	0.02
	C. Trading Gains (1)+(2)														
Canada	-0.05	0.00	0.00	-0.01	0.00	0.00	-0.07		-0.07	-0.01	0.00	-0.01	0.00	-0.01	-0.11
Mexico	0.85	0.14	0.00	0.04	0.00	0.23	1.27		0.85	0.14	0.00	0.04	0.00	0.23	1.27
U.S.	-0.02	-0.01	0.00	0.00	0.00	-0.04	-0.08		-0.02	-0.02	0.00	0.00	0.00	-0.05	-0.09
NAFTA	0.05	0.00	0.00	0.00	0.00	-0.01	0.05		0.05	-0.01	0.00	0.00	0.00	-0.02	0.03

Table A-2b. Trading Gains and Their Sources of Origin over the 1996-2009 period (Percentage point)

	Adjusted Estimates -5%								Adjusted Estimates +5%						
	NAFTA	EU-Core	EU-Periphery	China	India	ROW	Total		NAFTA	EU-Core	EU-Periphery	China	India	ROW	Total
	A. Terms of Trade (1)														
Germany	-0.02	-0.09	-0.02	0.00	0.00	-0.05	-0.18		-0.03	-0.13	-0.02	-0.01	0.00	-0.07	-0.26
France	-0.01	-0.09	-0.01	0.00	0.00	-0.04	-0.15		-0.02	-0.10	-0.01	0.00	0.00	-0.04	-0.18
United Kingdom	0.09	0.25	0.01	0.01	0.00	0.10	0.46		0.09	0.25	0.01	0.01	0.00	0.10	0.46
Italy	0.01	0.08	0.01	0.01	0.00	0.05	0.17		0.01	0.07	0.01	0.00	0.00	0.04	0.14
Netherlands	-0.04	-0.29	-0.02	-0.02	-0.01	-0.11	-0.49		-0.04	-0.32	-0.02	-0.02	-0.01	-0.13	-0.55
Europe	0.01	0.01	-0.01	0.00	0.00	0.00	0.01		0.01	-0.01	-0.01	0.00	0.00	-0.01	-0.02
	B. Real Exchange Effect (2)														
Germany	0.00	0.00	0.00	0.00	0.00	-0.01	0.00		0.00	0.00	0.00	0.00	0.00	-0.01	-0.01
France	0.00	0.11	0.00	0.01	0.00	0.02	0.14		0.00	0.10	0.00	0.01	0.00	0.02	0.13
United Kingdom	-0.01	0.04	0.00	0.00	0.00	0.00	0.03		-0.01	0.04	0.00	0.00	0.00	0.00	0.03
Italy	-0.01	0.03	0.00	0.00	0.00	0.00	0.02		-0.01	0.03	0.00	0.00	0.00	-0.01	0.01
Netherlands	0.01	0.01	0.00	0.00	0.00	0.01	0.04		0.01	0.01	0.00	0.00	0.00	0.01	0.03
Europe	0.00	0.04	0.00	0.00	0.00	0.00	0.04		0.00	0.04	0.00	0.00	0.00	0.00	0.04
	C. Trading Gains (1)+(2)														
Germany	-0.02	-0.09	-0.01	0.00	0.00	-0.06	-0.18		-0.03	-0.13	-0.02	-0.01	0.00	-0.08	-0.27
France	-0.01	0.02	0.00	0.01	0.00	-0.02	-0.01		-0.01	0.00	-0.01	0.00	0.00	-0.03	-0.04
United Kingdom	0.08	0.29	0.01	0.01	0.00	0.10	0.49		0.08	0.29	0.01	0.01	0.00	0.10	0.49
Italy	0.01	0.11	0.01	0.01	0.00	0.05	0.18		0.00	0.09	0.00	0.00	0.00	0.04	0.15
Netherlands	-0.03	-0.28	-0.02	-0.02	-0.01	-0.10	-0.45		-0.03	-0.31	-0.02	-0.02	-0.01	-0.12	-0.52
Europe	0.01	0.04	0.00	0.00	0.00	0.00	0.06		0.00	0.02	-0.01	0.00	0.00	-0.01	0.01

Table A-2c. Trading Gains and Their Sources of Origin over the 1996-2009 period (Percentage point)

	Adjusted Estimates -5%							Adjusted Estimates +5%						
	NAFTA	**EU-Core**	**EU-Periphery**	**China**	**India**	**ROW**	**Total**	**NAFTA**	**EU-Core**	**EU-Periphery**	**China**	**India**	**ROW**	**Total**
	A. Terms of Trade (1)													
China	0.05	0.04	0.00	-	0.00	0.29	0.38	0.05	0.04	0.00	-	0.00	0.29	0.38
India	0.04	0.01	0.00	0.03	0.00	-0.05	0.03	0.04	0.01	0.00	0.03	-	-0.05	0.03
Emerging Nations	0.05	0.03	0.00	0.01	0.00	0.18	0.26	0.05	0.03	0.00	0.01	0.00	0.18	0.26
	B. Real Exchange Effect (2)													
China	-0.14	-0.02	0.00	0.00	-0.01	0.13	-0.05	-0.14	-0.02	0.00	-	-0.01	0.13	-0.05
India	-0.02	0.00	0.00	0.00	0.00	-0.04	-0.06	-0.02	0.00	0.00	0.00	-	-0.04	-0.06
Emerging Nations	-0.10	-0.01	0.00	0.00	-0.01	0.07	-0.05	-0.10	-0.01	0.00	0.00	-0.01	0.07	-0.05
	C. Trading Gains (1)+(2)													
China	-0.09	0.02	-0.01	0.00	-0.01	0.42	0.33	-0.09	0.02	-0.01	-	-0.01	0.42	0.33
India	0.01	0.01	0.00	0.03	0.00	-0.09	-0.04	0.01	0.01	0.00	0.03	-	-0.09	-0.04
Emerging Nations	-0.06	0.02	-0.01	0.01	-0.01	0.25	0.21	-0.06	0.02	0.00	0.01	-0.01	0.25	0.21

Table 3A. Welfare Gains and Their Sources over the 1995-2009 (Percentage)

	Non-Adjusted (-5%)				Adjusted (+5%)		
	Trading Gains (1)	**Multifactor Productivity Gains (2)**	**Welfare Gains (1)+(2)**		**Trading Gains (1)**	**Multifactor Productivity Gains (2)**	**Welfare Gains (1)+(2)**
Canada	-0.07	0.46	0.39		-0.11	0.50	0.39
Mexico	1.27	-2.84	-1.58		1.27	-2.84	-1.58
U.S.	-0.08	1.34	1.26		-0.09	1.35	1.26
NAFTA	0.04	0.91	0.95		0.03	0.92	0.95
Germany	-0.18	0.06	-0.12		-0.27	0.15	-0.12
France	-0.01	0.34	0.33		-0.04	0.37	0.33
United Kingdom	0.49	0.76	1.25		0.49	0.76	1.25
Italy	0.18	-0.73	-0.55		0.15	-0.70	-0.55
Netherlands	-0.45	0.79	0.34		-0.52	0.86	0.34
Europe	0.06	0.17	0.22		0.01	0.21	0.22
China	0.33	2.03	2.36		0.33	2.03	2.36
India	-0.04	1.34	1.30		-0.04	1.34	1.31
Emerging Nations	0.21	1.80	2.01		0.21	1.80	2.01