Exchange Rates, Unit Labor Costs and Free Trade: The Mexican Experience

By Pablo Ruiz-Nápoles*

This work is intended to show that the Absolute Advantages trade theory and the Unit Labor Costs approach to exchange rates, between Mexico and the United States, are more meaningful to explain Mexican exports pattern than Comparative Costs theory and the Purchasing Power Parity approach. The analysis employed the use of Input-Output and Econometrics techniques and covered the period of neoliberal policies applied in Mexico by the government. One of our main findings is that the ratio of Unit Labor Costs between Mexico and the US is highly correlated in the long run with the Real Exchange Rate, calculated by Mexican monetary authorities. This result is especially important for policy-making in Mexico.

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I. Introduction

This paper is, in a way, a follow up of the original topic developed in my Ph.D. dissertation supervised by Anwar Shaikh (Ruiz-Nápoles 1996), incorporating other issues related, trade theory, exchange rate policy and trade agreements between Mexico and the US.

We intend to prove that Relative Unit Labor Costs and Absolute Advantages are the main determinants of the Mexican exports pattern and dynamics, in actual competition with the United States in the North American market. For which we follow a non-orthodox approach to trade theories, that maybe called Classical as in Shaikh (2016), Tsoulfidis and Tsaliki (2019). We also show that by contrast in the Mexican-US trade case, orthodox free trade policies failed to produce the economic growth goals, aimed at by various Mexican governments in the so called "structural change" neoliberal era (1982-2018). Mainly because they were based on wrong mainstream economics' orthodox ideas.

This article has five sections including this introduction. In the second section we present basic theoretical considerations regarding the neoclassical conceptions of exchange rates, comparative costs, and international trade. In the third section we present the alternative heterodox theory of absolute advantages for trade, and the unit labor costs as best competitiveness indicator, both at national and sector levels. In the fourth section we develop the methodology, which consists of a model, based on Input-Output (I-O) Analysis, designed for the calculation of vertically integrated unit labor costs. In the fifth section we apply the I-O model for the Mexico-US, Unit Labor Costs (ULC) and Relative ULC by sector for various periods between 1971-2021. And in the final sixth section, we draw some conclusions.

II. Neoclasssical Trade Theory and Policy

The Purchasing Power Parity doctrine and the Bertil Ohlin's Comparative Costs theory are the two pillars of the neoclassical theory of international trade on which Trade and Exchange Rate policies are based (van Meerhaeghe 1986).

A. Exchange rate and relative prices: Purchasing Power Parity

In a general equilibrium neoclassical framework, competitiveness between countries is determined by the comparative cost principle; and the real exchange rate is determined by the Purchasing Power Parity

* Professor of Economics, Universidad Nacional Autónoma de México (ruizna@unam.mx)

(PPP) doctrine. Thus, any country would always find at least one industry in which it is competitive. If the exchange rate is managed by authorities or the market to achieve and maintain such competitiveness, foreign trade will tend to be balanced (Friedman 1953). Moreover, the adjusting mechanism is automatic if the exchange rate is flexible and free trade prevails.

According to the PPP doctrine, a currency becomes overvalued when the domestic inflation rate exceeds the rate of inflation in its trading partners, and this is what produces a loss of competitiveness and consequently a trade deficit in the balance of payments. Thus, to correct the deficit, the nominal exchange rate adjusts to the real exchange rate, either directly by the authorities in a fixed exchange rate regime, or through the market mechanism in a flexible exchange rate regime (Krugman 1978; Krueger 1983; Dornbusch 1987, 1988).

If the theory is correct, then in the long run the nominal exchange rate should freely move around the real exchange rate as defined by PPP. Most empirical models have focused on testing to what extent this theory is true; that is, they evaluate the market efficiency in adjusting from one exchange rate level to the other, under assumed free market and competition (Levitch 1985). This study is one of many that have been developed to establish a strong relationship between nominal and real exchanges rates in many different countries.

However, the PPP theory has important flaws. On the one hand, it involves the use of price indexes (Dornbusch 1988); which, while expressing the effects of supply and demand conditions in general, do not necessarily show the degree of competitiveness of the economy, but only the general price level. On the other hand, the evidence has shown that, in some cases, depreciation policies have not significantly corrected current account deficits in most economies. Instead, they have had a strong impact on domestic inflation rates.

Two things must be analyzed in the context of a trade model. First, the source of the change in international trade flows that brings about the trade disequilibrium and second the adjusting mechanism or policy to be adopted consistent with the diagnosis. In this line of thinking two diverse types of causes of external disequilibrium are identified: "changes in the real conditions... such as weather, technical conditions of production, consumer tastes, and in monetary conditions, such as divergent degrees of inflation or deflation in various countries. These changes affect some commodities more than others and so tend to produce changes in the structure of relative prices..." (Friedman 1953, 414). In turn these changes will affect the trade balance of the country in which they take place by changing the supply of and the demand for both exports and imports and, thereby, the foreign exchange's supply and demand.

In dealing with exchange rate policy there are three viable alternative measures for restoring the required equilibrium in the foreign exchange market of the country facing tendencies towards trade imbalances: modification of the exchange rate; direct relative price changes and financing the trade deficit out of reserves or by borrowing abroad. It must be emphasized that whatever the original cause of external disequilibrium, it must be reflected in a change in relative prices, and this is what produces the trade imbalance. It follows that the financing of trade deficits can only be study onn as a temporary, and therefore not as a real, long run adjusting mechanism.

Thus, we are left with only two alternative policy measures to be considered to adjust an external disequilibrium: direct relative price changes or a modification of the exchange rate. In both cases the desired objective is to produce a change in the relative price structure of the country facing the trade imbalance. Friedman (1953, 424) favors a policy of exchange rate variations over relative price changes on the grounds that:

> "changes in internal prices and incomes are undesirable because of rigidities in internal prices especially wages, and the emergence of full employment as a major goal of policy... It is far simpler to allow one price to change, namely the price of foreign exchange, than to rely upon changes in the multitude of prices that together constitute the internal price structure" (Friedman 1953, 424).

Expressing the exchange rate by the number of units of foreign currency in exchange for a unit of domestic currency, the adjusting mechanism works as follows:

> "A rise in the exchange rate produced by a tendency towards a surplus makes foreign goods cheaper in terms of domestic currency, even though their prices are unchanged in terms of

> their own currency, and domestic goods more expensive in terms of foreign currency, even though their prices are unchanged in terms of domestic currency. This tends to increase imports, reduce exports, and so offset the incipient surplus. Conversely, a decline in the exchange rate produced by a tendency toward a deficit makes imports more expensive to home consumers, and exports less expensive to foreigners and so tends to offset the incipient deficit" (Friedman 1953, 417).

To be precise, it is not a rigid exchange rate variation produced occasionally by a government decision but a flexible exchange rate, whose equilibrium level is reached by free market forces, which works as the real adjusting mechanism.

B. Purchasing Power Parity and Comparative Costs

The comparative-costs theory, developed by Ohlin as an interpretation of Ricardo's theory of relative advantages but "independent of the classical labor theory of value" (Ohlin 1935, vii).

As developed in Ohlin's (1935) original work the theorem assumed a Walras-Cassel general-equilibrium model in which the theory of international trade, based on comparative costs, is just a special case of the more general theory of price determination by supply and demand. Foreign (international or inter-regional) trade would be the special case in which there is no mobility of factors of production between regions or countries, whatever the cause (natural, cultural, or political). The crucial effect of factor immobility is the existence and prevalence of factor-price differences between countries (or regions), as opposed to the usually assumed equality of factor prices within an economy.

Following Ohlin, if Walras's general equilibrium conditions and assumptions prevail in any two countries, any existing differences between their respective price systems will be exclusively determined by differences in their corresponding sets of data: (1) factor endowments, (2) technology availability, (3) distribution of factors and factors' incomes, and (4) individuals' preferences.

Assuming, an equal range of technologies available for the two countries, Ohlin stressed the importance of factor endowments and demand conditions to account for relative price differences between them. Since great differences in factor endowments exist between countries, Ohlin noticed that the proportions in which factors occur in each country will be decisive in determining their relative price rentals and, therefore, the relative commodity prices. Thus, other things being equal, the determinants of relative price differences between the two countries are the relative factor endowment differences. If there are price differences between the two countries, no transport costs, and no barriers to free commodity mobility, trade will be established between these countries, based precisely on those price differences.

For measuring relative price differentials between countries, the respective price systems must be compared to each other. The exchange rate of the two currencies allows comparisons to be made between the systems. Consequently, Ohlin (1935, 20) points out:

> "When an exchange rate has been established, prices and costs of production can be compared directly. Goods requiring a large quantity of factors cheaper in A than in B, and only a small quantity of other factors, can be produced at a lower cost in A and will therefore be exported to B. On the other hand, commodities requiring a large quantity of the latter factors and a small quantity of the former can be more cheaply produced in B and will be imported from that region to A. Each region [country] has an advantage in the production of commodities into which enter considerable amounts of factors abundant and cheap in that region [country]."

Ohlin's proposition regarding the main determining causes of comparative advantages was called the "Heckscher-Ohlin theorem" after Eli Heckscher (1919), who had worked previously on the same topic and, as his professor, influenced Ohlin's ideas. In mathematics, a theorem is a statement that has been proven, based on previously established statements, and accepted statements, such as axioms. The proof of a theorem is a logical argument for the theorem statement given, according to the rules of a deductive system, in contrast to the notion of a scientific theory, which is empirical. Therefore, it can be said that the H-O theorem derives its validity from its model (the Heckscher-Ohlin model) and the axioms and assumptions on which the theorem and the model are grounded.

This comprehensive theory of international trade is known as the Hecksher-Ohlin theory of trade (H-O theorem and H-O model) which has been regarded as the modern (as opposed to classical) trade theory in all international economics textbooks for graduate students in most universities (Kindleberger 1973; Markusen et al. 1995; Feenstra 2004; Krugman and Obstfeld 2005).

C. Trade balance and Exchange Rate Policies in the Neoliberal era

The neoclassical theory of trader (H-O comparative costs theory) and the Purchasing Power Partiy of Exchange Rate have inspired all economic policies recommended by the international financial organizations, the IMF, and the World Bank, especially to developing countries' governments for purposes of equilibrium, stabilization, and growth (Sachs 1987; Corden 1993; Ahmed and Sukar 2018).

In contrast, active trade policies (protectionism) and fixed or regulated exchange rates did prevail in most countries in the twentieth century. It was in the late seventies and early eighties of the last century, when neoliberalism started to prevail in economic policy both domestically, by reducing government expenses and regulation, and internationally, by reducing tariffs and eliminating non-tariff barriers to trade in goods and services, and capital flows.

However, neoliberal policies have had mixed economic results. While they have stopped inflation and reduced fiscal deficits, they have not produced economic growth, full employment, and, in some cases, not even balanced trade. This has particularly affected underdeveloped countries, which have suffered from a lack of economic growth, widespread unemployment, growing poverty and social inequality since long before these policies were applied by their governments. Their situation study onms to have worsened rather than improved due to the application of said neoliberal policies in the last forty years.

Paradoxically some neoliberal authors that originally promoted depreciation of the currency and liberalization of trade as the two conditions for trade balance (Dornbusch 1987, 1988; Corden 1977), changed their minds in view of two apparently unexpected effects of a currency depreciation policy: the "exchange rate pass-through into inflation" documented by Goldfajn and Werlag 2000, Campa and Goldberg 2005 and Barhoumi Barhoumi (2009), and the so called "purchasing power puzzle" (Rogoff 1996). Both implying that a nominal depreciation of the currency produces a short run domestic inflation which offsets its desired effect on the trade balance and spins off inflation. So, they changed the policy instrument to correct for trade imbalances from depreciation to local credit restrictions that prevent inflation and limits the demand for imports based on the famous "Monetary approach to the Balance of Payments" (Johnson 1972). In other words it now is an strong recessionary policy that restores equilibrium in all markets in the globalization era Dornbusch (1980); Corden (1989). These policies were to be followed by autonomous monetary authorities as "inflation targeting."

III. Alternative Approach to the Neoclassical Trade Theory

A. Unit Labor Costs

Outside the neoclassical general equilibrium framework, there have been authors, some of which are related to the Ricardo and Marx labor-theory of value tradition, who consider important relative unit labor costs to be either a measure of relative international competitiveness (Capdeville and Alvarez 1981; Dosi, Pavitt and Soete 1990), the main determinant of real exchange rates (Shaikh 1991), or the real exchange rate itself (Aglietta and Oudiz 1984). Empirical tests for different countries' cases using advanced econometrics techniques strongly support that unit labor costs in manufacturing are the main determinant of real exchange rates (Shaikh and Antonopoulos 1998; Boundi-Chraki and Perrotini-Hernández 2021; Poulakis and Tsaliki 2023). In most empirical tests, causality is proved to run from unit labor costs to exchange rates.

Also alternatively, to the PPP approach, some authors, and international organizations, like the IMF itself, have been using relative labor costs as a measure of competitiveness, equivalent to real exchange rates (Zanello and Desruelle 1997). In fact, the IMF calls these rates the "Real Effective Exchange Rates" (International Monetary Fund 1985).

However, this unit labor costs approach stems originally from the neoclassical tradition (Officer 1975, 1980). These costs are usually estimated only for manufacturing using direct labor employed in production per unit of value added for calculating the local ratio of labor costs. The formulas for relative unit labor costs while placing significant emphasis on the importance of a complex series of derived weights required to measure the rest of the world's competitiveness, can be considered oversimplified. Their measure of productivity (labor per unit of output) considers only direct labor (Zanello and Desruelle 1997). A first approximation to Unit Labor Cost (ULC) for any given country is:

$$U = \frac{L}{Q} \cdot \frac{W}{L} \quad (1)$$

where: U = ULC, L = total number of workers per year, W = total wages and salaries paid per year, and Q = Gross Domestic Product per year, all measured in the local currency units.

To make this a measurement of ULC a comparable one to other country's ULC, it must be multiplied by the nominal exchange rate of the currencies of the two countries in comparison. The only reason we introduce this elemental formula here is to stress the importance of wages, productivity, and the nominal exchange rate in the determination of Relative Unit Labor Costs between any two countries. But it presents some limitations since it does not consider direct and indirect labor and wages in producing any good. The method of calculation for unit labor costs that we use in this work comes from Ricardo's theory of value and the input-output model of Pasinetti 1997 for vertically integrated labor. Input-Output analysis gives us the opportunity of capturing both direct and indirect labor requirements per unit of output.

B. Absolute Advantages

One non-orthodox alternative to comparative cost theory is the consideration of absolute advantages, based on technology differences, as major determinants of trade flows and competitiveness. According to this approach, known as the technology gap argument, the international competitiveness of a country, or industry, is primarily based on its absolute advantages in terms of product technology and labor productivity (Dosi, Pavitt and Soete 1990; Cimoli 1994).

However, Anwar Shaikh was the first in criticizing the Comparative Costs theory from a non-orthodox perspective, since one of his early works (Shaikh 1980). This critique focused on the Ricardian theory of comparative advantages, from which comparative costs theory originated. Instead, he has favored the Absolute Advantage theory of trade. The whole and thorough analysis is systematically developed in his most recent work (Shaikh 2016, 491-535). This also includes the ULC approach to show relative absolute advantages or disadvantages in international trade, based on what he calls a Smithian decomposition (Shaikh 2016, 513).

For being of especial importance to our study, we stress two of the results of his "classical approach" These are, first that "... industry comparative costs and terms of trade are determined by real wages and relative productivities of regulating capitals...", and second that "... the direction of a nation's trade balance is determined by its absolute cost advantage or disadvantage..." (Shaikh 2016, 521).

IV. Methodology and Scope

For our model we are using yearly economic data and Input-Output matrices provided by official agencies when it is available and by other sources when it is not, they are all referred. Since we are dealing with trade and foreign exchange data between Mexico and the U.S., all economic data are denominated in US dollars at current prices, except when it is otherwise indicated. Labor data in the case of Mexico comes from official agencies, which include informal jobs most of which are registered in the trading sector.

A. An Input-Output Model

Pasinetti's (1977) using Leontief's model, interprets Ricardo's labor content equation in a general case by:

(2) $$\mathbf{v}=\mathbf{a}(\mathbf{I}\text{-}\mathbf{A})^{-1}$$

where: $\mathbf{v}$ is the vector of *vertically integrated* labor content, or direct and indirect labor requirements, $\mathbf{a}$ = row vector of direct labor coefficients, $\mathbf{A}$ = technical coefficients matrix.

For Ricardo, value regulates price; that is, the exchange value of a commodity regulates its relative price. In turn, what regulates the exchange value of commodities is the quantity of labor embodied in them; that is, the relative quantities of direct and indirect labor bestowed in their production (Ricardo, 1973). This approach to the determination of relative prices says that the normal price of a product i in terms of another product j, can be approximated by the total labor content of product i divided by the total labor content of product j, which may be expressed, in matrix notation, as:

(3) $$\frac{p_i}{p_j} \approx \frac{\mathbf{a}(\mathbf{I}\text{-}\mathbf{A})^{-1}\mathbf{e}^{(i)}}{\mathbf{a}(\mathbf{I}\text{-}\mathbf{A})^{-1}\mathbf{e}^{(j)}} = \frac{\mathbf{v}\mathbf{e}^{(i)}}{\mathbf{v}\mathbf{e}^{(j)}}$$

where: $\mathbf{e}^{(j)}$ and $\mathbf{e}^{(j)}$ and are vectors in which the i-th or the j-th element respectively, is equal to one and all other elements are equal to zero.

The total labor content, or vertically integrated labor, necessary to produce one unit of commodity i, is given by:

(4) $$v_i = \mathbf{v}\mathbf{e}^{(i)} = \mathbf{a}(\mathbf{I}\text{-}\mathbf{A})^{-1}\mathbf{e}^{(i)}$$

Now, by introducing wages in equation (4), we are calculating *vertically integrated unit labor costs* (VIULC). So, the total labor costs to produce one unit of commodity i is:

(5) $$vu_i = \mathbf{a}\hat{\mathbf{W}}(\mathbf{I}\text{-}\mathbf{A})^{-1}\mathbf{e}^{(i)}$$

where: vu_i = vertically integrated unit labor costs of commodity i; $\hat{\mathbf{W}}$ is a diagonal matrix of the same order as A with wages in the main diagonal and zeros elsewhere. Thus for the whole economy, the VIULC indicator (a scalar) will be:

(6) $$vu = \mathbf{a}\hat{\mathbf{W}}(\mathbf{I}\text{-}\mathbf{A})^{-1}\mathbf{d}$$

where: vu= weighted average of vertically integrated unit labor costs (a scalar), $\mathbf{d}$ = column vector of each industry's percentage of aggregated final demand (weights).

B. Unit labor costs as real effective exchange rates

The ratio of two countries' ULC can be interpreted as the real effective exchange rate between these two countries' currencies. Consequently, in principle, the real effective exchange rate equation is:

(7) $$RULC = \frac{vu}{vu^*}$$

where: $RULC$ = relative unit labor costs; vu = vertically integrated unit labor costs in the home country, vu^*= vertically integrated unit labor costs in the foreign country; vu and vu^* are measured in each country's own currency.

According to Ricardo, labor costs *regulate* prices. But they are costs not prices; that is to say, labor costs function as "centers of gravity" for prices. In other words, prices, and prices' variations, in the short and medium terms, are also influenced by other factors which importance cannot be overlooked such as, the rate of profit, prices of imported goods, indirect taxes and the cost of fixed capital. Therefore, this *real effective* exchange rate must be distinguished from the market real exchange rate, that is, the price-parity rate.

To make the formula operational, the foreign country's ULC – the denominator in equation (7) – is measured as a weighted average of the home country trading partners' ULC.

Notwithstanding, relative unit labor costs, whichever the technique utilized for their calculation, have proven to be real effective exchange rates that show the overall competitiveness of the economy in most cases. But this says little about the specific advantages in trade a country may have with respect to other countries. There remains a need for estimating relative labor costs by sector to find out a country's advantages or disadvantages in trade.

C. *Sectoral Unit Labor Costs*

There have been interesting theoretical approaches applied in the literature for productivity estimation with vertically integrated sectors (Dosi, Pavitt and Soete 1990; De Juan and Febrero 2000). But average overall competitiveness says little about trade advantages. In the line of input-output analysis, we can calculate relative ULC by industry, which will give us a good indicator of relative sector's competitiveness.

In matrix notation for each country, we have:

$$\mathbf{vu} = \mathbf{a}\hat{\mathbf{W}}(\mathbf{I} - \mathbf{A})^{-1} \tag{8}$$

where: **vu** = row vector with real VILUC for each industry. Each element in vector **vu** corresponds to vu_i, where the subscript i denotes a particular industry, $i = 1, 2, 3 \ldots\ n$, where n the number of industries included in the matrix **A**.

V. The Mexican-US case

A. *Neoliberal Policies in Mexico*

In the middle of the recession that resulted from the 1982 foreign exchange crisis, the Mexican government started a trade liberalization process in 1983, which was accelerated in 1989. After forty years of being a highly closed economy, the Mexican economy was rapidly opened from a set of free market policies. As a corollary of such a policy Mexico joined the North American Free Trade Agreement (NAFTA). One of the main reasons that justified the abandoning of protectionism was that it was producing a bias against exports (Lustig 1992).

Viewed as a complement to any adjusting program, this type of policies was recommended to developing countries as a new strategy for recovery and growth based on exports. This new strategy should include: "1) trade liberalization. . . ; 2) real exchange rate depreciation. . . ; 3) privatization of state-owned firms and 4) a general reduction of all forms of state intervention, both in capital markets and in factor markets, as well as in taxation and government expenditure. This liberalization package [was] promoted by the US government. . . by the IMF and the World Bank" (Sachs 1987).

The same type of reforms was also applied in Latin American countries in the eighties and the nineties, under the assumption that mere deregulation constituted the "structural change" needed to correct a distorted economy and increase the level of employment and wages (Weller 2001). The set of policies were in line with the "Washington Consensus" (Moreno-Brid, Pérez Caldentey and Ruiz-Nápoles 2004).

In the case of Mexico, the whole neoliberal package was fully adopted by the administration starting in 1989. The general idea, which aimed these policies, was to induce growth by means of increasing manufacturing exports. At the same time exports as an increasing source of foreign exchange, were supposed to eliminate the external restriction for growth, typical of an underdeveloped country.

After forty years of being a highly closed economy, there was an opening of the Mexican economy as result of free market policies. The process, which was gradual in the beginning, accelerated in the mid 80's when Mexico joined GATT, and it peaked when Mexico joined the NAFTA in 1994.

This change in development strategy in favor of trade liberalization and state downsizing was the most significant event in Mexico's economic history in the last five decades. It is also recognized that NAFTA was a main cause of the spike in exports and foreign direct investment (FDI) that has taken place in Mexico.

Analysts have interpreted NAFTA's role in Mexico as a corollary of the Washington Consensus' set of liberalization, deregulation, and privatization measures that the Mexican Government adopted (Blecker 2006). Other authors sustain that NAFTA was more based on the notion of preferential trade, than on the free-trade one (Ruiz-Nápoles 2007*a*).

Table 1—Mexico Main Economic Indicators: Average annual rate of growth

	1970-1981	1982-1993	1994-2005	2006-2012
GDP in constant Pesos	6.9	1.6	2.9	2.5
Population	2.6	2.6	1.4	1.3
GDP real per capita	4.1	-0.9	1.5	1.3
Exports (US Dlls)	29.1	4.1	9.8	9.3
Oil Exports	103.5	-1.6	15.8	10.8
Manufacturing Exports	22.5	17.4	13.2	9.0
Gross Fixed Investment	9.3	0.2	4.6	3.6
Consumer Prices	17.8	59.3	13.6	4.2
Exchange Rate (Mex/US)	7.1	58.5	12.9	3.0
Real Exchange Rate Index*	1.3	2.1	1.3	1.9

Note: *1970-1993 were estimated by Mex/US Prices
Source: Instituto Nacional de Estadistica y Geografia and Banco de México

As shown in Table 1, the free trade period 1982-1993, that is when the liberalization policy entered in operation in Mexico, GDP did not grow, GDP per capita declined, exports increased little, there was no investment, inflation and devaluation increased most. In the following two periods when NAFTA was in force, the situation improved but it was never equal as in the pre-free trade protectionist final period 1970-1981.

In the evaluation of these various periods in Table 1 it must be noted that the Mexican economy was in an ascending phase of a Kondratiev cycle between 1940 and 1981, and in a descending phase in the period 1982-2006 (Erquizio 2007, 239); short cycles were nor shown very clearly except for crises induced by fiscal and monetary astringent policies or foreign exchange crisis produced by capital flights and speculation (Heath 2011; Cordero, Torres and Sánchez 2015; Calderón and Hernández 2017).

B. Factor Endowments and the Heckscher-Ohlin theorem in Mexico

In this new trade and investment relationship, it has been assumed that Mexico's relative advantage in the North American trading area was in having abundant and, consequently, cheap labor, so the opening of Mexico's and US's markets to firms of both countries, would help to define their trade pattern according roughly to the H-O theorem, with Mexico exporting labor-intensive goods and importing capital-intensive goods. An in fact in 1980 and 1990 Mexico had more labor than capital, while in the US it was the opposite.

We assess the hypothesis that, if Mexican foreign trade follows a H-O determined pattern and given that Mexico has an abundance in labor with respect to capital, relative to its closest trade partner and competitor –so that wages are persistently lower in Mexico than in the US– the Mexican net exporting sectors must be more labor-intensive.

We followed step by step what Leontief did for the US economy in his famous study Leontief (1953), in this case for the Mexican economy in the years 1980, 1990. The results in Table 3 show that, in 1980 when the Mexican economy was highly protected exported more labor-intensive goods, and in 1990 when there was free-trade, exports were capital-intensive and imports labor-intensive (Ruiz-Nápoles 2019). Labor being measured in number of workers and capital stock in US constant Dollars.

We could not claim in this case that Mexican capital was more productive than US capital, in anyone of the years analyzed, as Leontief did for the US labor. So, this is not a paradox but a plain contradiction of the H-O theorem's prediction. A recent analysis realized by Paraskevopoulos et al. (2016) comes to a similar conclusion.

Table 2—Absolute and Relative Factor Endowments in Mexico and the U.S.

Year	Labor Force (000s)	Capital Stock* (Millions $)	L/C
		Mexico	
1980	22,066	1,378,344	16
1990	28,558	1,979,691	14.4
		United States	
1980	106,974	21,011,698	5.1
1990	125,857	26,453,210	4.8

Note: *Capital Stock at constant PPPs (in millions of US Dlls)
Source: Instituto Nacional de Estadística y Geografía México; U.S. Bureau of Labor Statistics and Penn World Table, version 9.0 Feenstra, Inklaar and Timmer (2015).

Table 3—Domestic Capital and Labour Requirements of Mexican Exports and Competitive Import Replacements 1980 and 1990 (per Million USD)

	1980		1990	
	Exports	Imports	Exports	Imports
Capital (Millions USD)	16.6	47.6	55.6	65.7
Labour (workers per year)	347.6	727.9	668.3	1,218
Capital/Labor (USD)	47,893	65,339	83,217	53,944
Labour/Capital (number of workers)	20.9	15.3	12.0	18.5

Source: Ruiz-Nápoles Ruiz-Nápoles (2019)

C. Nominal and Real Exchange Rates Mexican Peso vs. USD

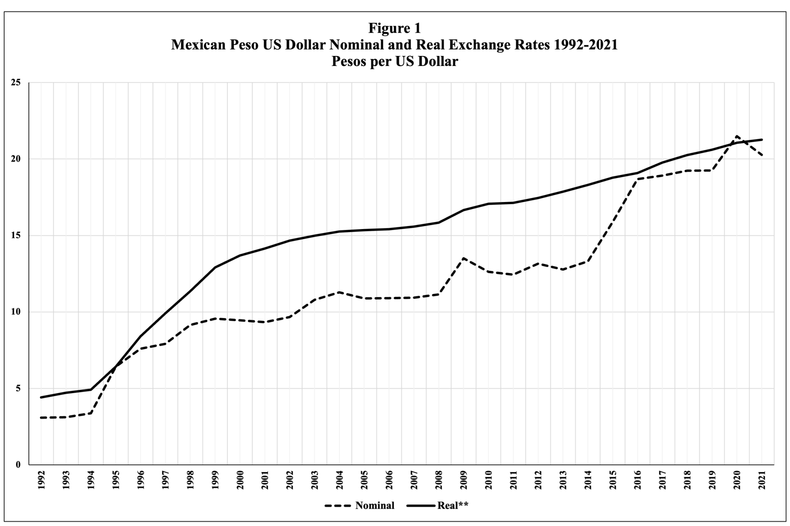


Figure 1
Mexican Peso US Dollar Nominal and Real Exchange Rates 1992-2021
Pesos per US Dollar

Source: Banco de México

The first and important result shown in the Figure 1 (and Table A1 in Appendix) is that the Real Exchange Rate of the Mexican Peso to the USD estimated by the central bank according to the PPP theory is permanently above the level of the nominal exchange rate determined by the foreign exchange market in the period 1992-2021, with few exceptions (dirty interventions by the central bank). It was in 1995 that the Mexican monetary authorities established a flexible exchange rate, but the automatic adjustment between these two rates has never occurred.

D. A RULC Input-Output Model for Mexico

For this model we used I-O data for both Mexico and the US from OECD. We start out by recalling equations (4) to (7) above, in this case applied to each country's data:

$$vu_{ht} = \mathbf{a_{ht}}\mathbf{\hat{W}_{ht}}(\mathbf{I} - \mathbf{A_{ht}})^{\mathbf{-1}}\mathbf{d_{ht}} \tag{9}$$

$$vu_{jt} = \mathbf{a_{jt}}\mathbf{\hat{W}_{jt}}(\mathbf{I} - \mathbf{A_{jt}})^{\mathbf{-1}}\mathbf{d_{jt}} \tag{10}$$

$$\mathbf{a} = (a_1, a_2, ..., a_n) \tag{11}$$

$$a_i = l_i/y_i \tag{12}$$

The Relative Unit Labor Cost Ratio (real effective exchange rate) of country h is:

$$RULC_{(h/j)t} = \frac{vu_{ht}}{\Sigma_j vu_{jt}}, j \neq h \tag{13}$$

where: vu_{ht} = weighted total of vertically integrated unit labor costs of country h, in time t; $\mathbf{a_h}$ = vector of labor coefficients in country h; $\mathbf{\hat{W}_{ht}}$ = diagonal matrix of wages per unit of labor of country h; $\mathbf{A_h}$= technical coefficient matrix of country h; $\mathbf{d_{ht}}$ = column vector of percentages of gross domestic product per industry in country h; l_i = labor units used in industry i per unit of time; y_i = output of industry i per unit of time; vu_j = total vertically integrated unit labor costs of country j; $\mathbf{a_j}$ = vector of labor coefficients in country j; $\mathbf{\hat{W}_{jt}}$ = diagonal matrix of wages per unit of labor in country j; $\mathbf{A_j}$ = technical coefficient matrix of country j; $\mathbf{d_{jt}}$ = column vector of percentages of gross domestic product per industry in country j; $R_{(k/j)t}$ = real effective exchange rate in terms of ULC between h and j countries in time t; subscripts, h stands for home country and j for its trading partner country (j = 1,2,3,. . . ,m; j≠h).

For the application of equations (9), (10), (13) to any comparison between countries, the denominator in (13) must be a weighted average of the home country (h) trading partners, i.e., of all j, labor costs and weights being denominated in the same currency. Similarly, we recall equation (8) above to define:

$$\mathbf{vu_j} = \mathbf{a_j}\mathbf{\hat{W}_j}(\mathbf{I} - \mathbf{A_j})^{\mathbf{-1}} \tag{14}$$

where: $\mathbf{vu_j}$ = row vector of ULC for each industry in each country, and $\mathbf{\hat{W}_j}$ is a diagonal matrix of wages of each country, $\mathbf{A_j}$ is the technical coefficients matrix of each country, the subscript j denotes any country (including home country, h = j).

Each element in vector $\mathbf{vu_j}$ corresponds to $\mathbf{vu_i^j}$ vui j, where the subscript i denotes a particular industry, i = 1, 2, 3, . . . , 45, being n=45 the number of industries included in matrix $\mathbf{A_j}$ and the superscript j denotes de country (including home country, h = j).

Consequently, we define relative vertically integrated unit labor costs (RULC) MEX-US as:

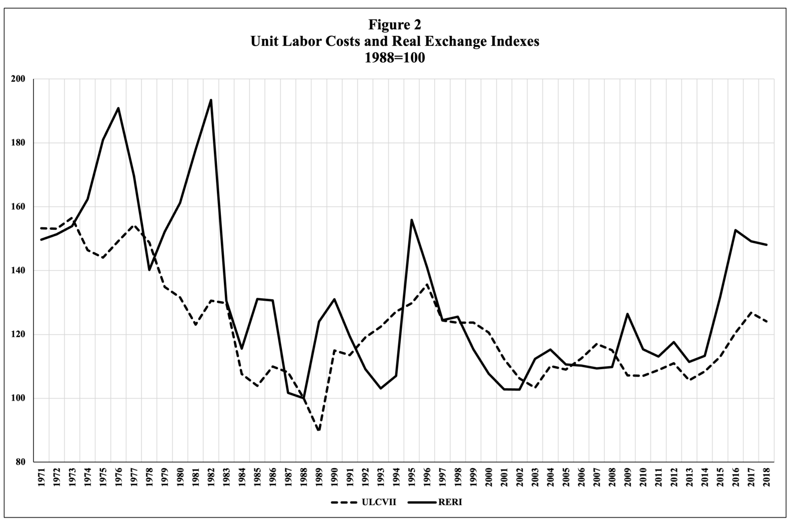
$$\mathbf{rulc}_t = \frac{vu_{it}^{mx}}{vu_{it}^{us}} \tag{15}$$

where: $\mathbf{rulc}_t$ is a vector of relative vertically integrated unit labor costs in time t, vu_{it}^{mx} reflects the vertically integrated unit labor costs of industry i in time t in Mexico, measured in Mexican Pesos; and vu_{it}^{us} is the vertically integrated unit labor costs of industry i, in time t, in the US, measured in US Dollars; $t = 2000 - 2014$.

Equation (15) is like equation (15) adapted to the Mexico-USA case under the assumption that Mexico, the home country in the numerator, is a relatively small economy whose foreign trade is highly concentrated in the US market, which is the foreign country in the denominator.

We estimated the system defined in equations (9) to (13), with data taken from OECD and Mexican and US official agencies, for the period 2000-2014. The period of analysis was determined by the availability of the data. To make compatible the labor, wages, input-output, product, and trade data for both countries, in terms of industry classification, we have used the forty-five sectors industry classification of the OECD for the period 2000-2014.

E. Relative Unit Labor Costs and Exchange Rate Mex/US



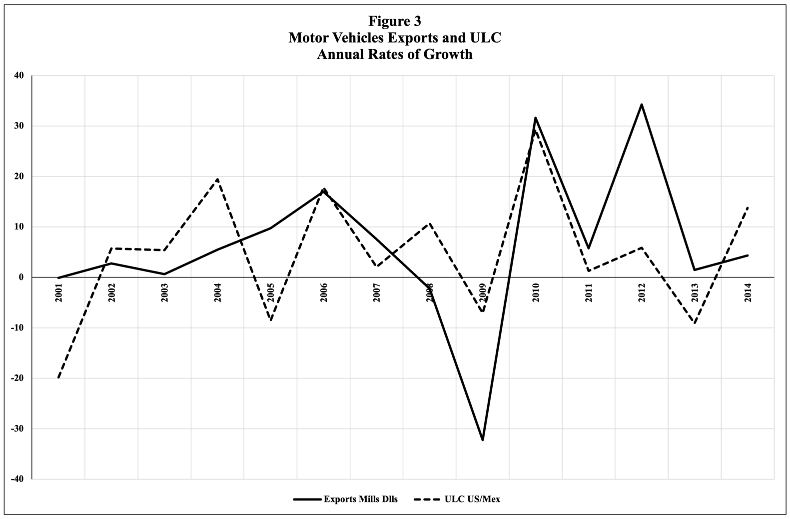
Source: Input-Output Tables and data from OECD; Exchange Rates from Banco de México

In Figure 2 (and Table A2 in Appendix) the results of the Relative Unit Labor Costs estimated by equation (13) and the Real Exchange Rate Index, derived from central bank statistics, indicate that the two series moved close to each other from 1970 to 2018.

F. Sectoral Unit Labor Costs

Now we estimate equation (15) for each industry of both economies in our I-O classification but concentrating in fact in those industries that are main exporting sectors for the Mexican economy over the period 2000-2014 shown in Table A4, included in the Appendix. As shown in the table they were only eight sectors or industries that concentrate between 70.1 and 77.2 per cent of total Mexican Exports in the period under consideration. In Table A5 of the Appendix it is shown that all the RULC values for all the eight sectors in the period 2000-2014 are below 1, which means that the Mexican ULC were never higher than the ULC in the US in any sector in any year.

We selected one important Exporting sector of the Mexican economy during this period to show how important ULC are in determining the exports movement on time. We have in Figure 3 (and



Source: Data from the I-O model and WIOD Release 16

Table 4—Value Added distribution in the United States and Mexico (2014)

	United States		Mexico	
	Million USD	% Share	Millions USD	% Share
Value Added Total	17,348,070	100	1,227,752	100
Labor Compensation	9,771,295	56.3	404,887	33
Capital Compensation	7,576,775	43.7	822,864	67
Valued Added in Motor vehicles	140.240	100	36,570	100
Labor Compensation	65,207	46.5	6.406	17.5
Capital Compensation	75,033	53.5	30,165	82.5

Source: WIOD Release 2016

Table A3 in Appendix) the variations of both variables for the Motor Vehicles industry. In this case, we are considering RULC US/Mex showing that Mexican Exports increase or decline as RULC US/Mex increase or decline.

Also, we present in Table 4 the Value-Added distribution at national level for the US and México in 2014 and for the selected exporting sector of the Mexican economy, the Motor Vehicles industry. Showing that in that year, capital compensation was higher than labor compensations in that industry, both than the average and with respect to the US' same industry.

VI. Conclusions

From the above analysis we derive the following conclusions: First, in the case of the Mexican economy the nominal exchange rate (Mexican Pesos to USD), under a flexible regime never matched the real exchange rate estimated by the central bank according to the PPP theory, which has been always above the nominal rate. Instead, the real exchange rate in the long run is highly correlated to relative ULC between Mexico and the US, as shown in the corresponding Tables, Figures, and Econometric tests. Second, the Heckscher-Ohlin Theorem does not apply in the case of the Mexican Economy, under conditions of free trade. It means that Mexico exports more capital-intensive goods and imports more labor-intensive goods despite having relative abundance of labor factor endowment as compared to the US.

Third, the Mexican main exports pattern and dynamics is highly determined by Relative Unit Labor Costs Mexico-US as predicted by Shaikh's classical theory of international trade (Shaikh 2016, 521). Also, the main exporting industry is highly integrated to the USA but having the same technology the wage gap in this industry between Mexico and the USA is translated in higher profits for Mexican established plants from USA origin.

These results have important implications for policy-making in Mexico, since it becomes clear that ULC is a better indicator for competitiveness both in general and by industry than the usual revealed relative advantages based on orthodox theories Ruiz-Nápoles (2007*b*).

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APPENDIX

A. Tables

Table A1—Exchange Rate of the Mexican Peso to the USD (Mexican Peso per USD*)

Year	Nominal	Real**	Year	Nominal	Real**
1992	3.09	4.42	2007	10.93	15.58
1993	3.12	4.71	2008	11.15	15.83
1994	3.38	4.91	2009	13.51	16.66
1995	6.42	6.42	2010	12.63	17.07
1996	7.60	8.40	2011	12.44	17.14
1997	7.92	9.92	2012	13.16	17.45
1998	9.15	11.36	2013	12.77	17.87
1999	9.56	12.91	2014	13.31	18.31
2000	9.46	13.69	2015	15.87	18.79
2001	9.34	14.16	2016	18.69	19.08
2002	9.67	14.66	2017	18.92	19.77
2003	10.80	14.98	2018	19.24	20.25
2004	11.29	15.26	2019	19.26	20.61
2005	10.89	15.35	2020	21.49	21.06
2006	10.90	15.41	2021	20.28	21.27

Note: *Annual Averages **Calculated with the Real Exchange Rate Index
Source: Banco de México

Table A2—Unit Labor Costs and Real Exchange Rate Mex/US (Indexed 1988=100)

Year	ULCI	RERI	Year	ULCI	RERI
1971	153.22	149.64	1995	129.75	155.86
1972	153.12	151.34	1996	135.58	141.01
1973	156.52	153.89	1997	124.36	124.44
1974	146.41	162.36	1998	123.66	125.54
1975	144.03	180.95	1999	123.69	115.37
1976	149.23	190.90	2000	120.58	107.66
1977	154.24	169.68	2001	112.28	102.82
1978	148.77	140.19	2002	106.24	102.75
1979	134.87	152.14	2003	103.28	112.32
1980	131.59	161.16	2004	110.09	115.27
1981	123.04	177.92	2005	109.02	110.63
1982	130.54	193.40	2006	112.46	110.26
1983	129.77	130.49	2007	116.98	109.34
1984	107.58	115.52	2008	115.08	109.78
1985	103.89	131.09	2009	107.14	126.39
1986	109.91	130.65	2010	107.03	115.33
1987	108.13	101.71	2011	108.85	113.07
1988	100.00	100.00	2012	110.94	117.56
1989	89.46	123.99	2013	105.60	111.43
1990	114.94	131.04	2014	108.38	113.27
1991	113.55	119.41	2015	113.03	131.65
1992	119.03	109.16	2016	120.51	152.67
1993	122.44	103.06	2017	126.77	149.17
1994	127.13	107.05	2018	124.05	148.08

Note: ULCI= Unit Labor Costs Index, RERI = Real Exchange Rate Index
Source: Input-Output Tables and data from OECD; Exchange Rates from Banco de México

Table A3—Motor Vehicles Exports and RULC (Annual Rates of Growth)

Year	Exports (Millions USD)	RULC (US/Mexico)
2001	-0.1	-19.8
2002	2.8	5.7
2003	0.7	5.4
2004	5.5	19.5
2005	9.8	-8.5
2006	17.0	17.8
2007	7.6	2.1
2008	-2.2	10.7
2009	-32.2	-7.1
2010	31.6	29.3
2011	5.8	1.3
2012	34.3	5.9
2013	1.5	-9.1
2014	4.4	13.7

Source: Data from the I-O model and WIOD Release 16

TABLE A4—MEXICAN MAIN EXPORTING SECTORS 2000-2014 (MILLIONS OF US DOLLARS)

Year	Mining & Quarrying	Food, Bever. & Tobacco	Basic Metals	Metal Products	Computer & Electronics	Electrical Equipment	Machinery & Equipment	Motor Vehicles	Subtotal	Total Exports	%
2000	15,809	3,345	3,208	4,174	40,120	13,614	3,622	34,393	118,286	168,631	70.1
2001	12,507	3,469	2,669	4,821	40,674	11,397	3,454	34,355	113,346	160,298	70.7
2002	14,286	3,718	3,023	5,131	39,403	11,032	3,801	35,313	115,706	162,448	71.2
2003	18,447	3,914	3,431	4,298	38,692	12,287	4,359	35,544	120,973	165,872	72.9
2004	23,544	4,493	4,966	5,312	45,068	13,780	6,065	37,502	140,731	188,698	74.6
2005	30,942	5,444	6,008	6,505	47,586	15,404	7,853	41,159	160,902	214,892	74.9
2006	37,620	6,612	8,245	7,289	56,969	18,699	10,222	48,158	193,815	251,147	77.2
2007	42,876	7,458	10,135	8,303	56,795	20,452	12,577	51,811	210,407	273,232	77
2008	46,594	8,317	11,555	8,112	61,588	22,549	15,026	50,666	224,407	291,646	76.9
2009	29,616	8,735	9,436	6,500	54,060	17,730	12,484	34,342	172,903	228,431	75.7
2010	43,768	10,297	13,885	7,489	60,195	23,090	19,504	45,209	223,437	291,360	76.7
2011	63,754	13,092	19,392	8,977	59,045	23,443	22,351	47,814	257,868	338,923	76.1
2012	58,896	12,209	16,938	9,715	60,044	23,829	23,450	64,207	269,290	348,179	77.3
2013	54,941	14,101	14,430	10,370	61,705	24,448	23,565	65,150	268,711	358,019	75.1
2014	49,433	15,177	13,625	11,328	61,781	25,855	22,960	67,985	268,144	363,783	73.7

Source: World Input-Output Data Base WIOD Release 2016

Table A5—Unit Labor Costs by Sector 2000-2014 (ULC Mex/US ratio in current US dollars)

Year	Mining & Quarrying	Food, Bev. & Tobacco	Basic Metals	Metal Products	Computers & Electronics	Electrical Equipment	Machinery & Equipment	Motor Vehicles
2000	0.0963	0.1236	0.0964	0.1643	0.1909	0.2727	0.3254	0.1400
2001	0.1374	0.1352	0.1189	0.1798	0.1900	0.2917	0.3332	0.1746
2002	0.1426	0.1456	0.1198	0.1950	0.1770	0.2833	0.3437	0.1652
2003	0.1056	0.1453	0.1215	0.1931	0.2096	0.2441	0.3718	0.1567
2004	0.0797	0.1416	0.0761	0.1710	0.1750	0.2210	0.3347	0.1312
2005	0.0579	0.1448	0.0775	0.1597	0.1720	0.2317	0.4055	0.1434
2006	0,0577	0.1550	0.0623	0.1528	0.1600	0.2602	0,3811	0,1217
2007	0.0558	0.1356	0.0582	0.1465	0.1563	0.1992	0.3739	0.1193
2008	0.0472	0.1278	0.0554	0.1302	0.1478	0.2135	0.4094	0.1077
2009	0.0935	0.1394	0.0791	0.1195	0.1238	0.1792	0.4095	0.1159
2010	0.0627	0.1212	0.0600	0.1194	0.1162	0.1407	0.3291	0.0897
2011	0.0594	0.1054	0.0502	0.1158	0.1036	0.1477	0.3165	0.0885
2012	0.0707	0.1013	0.0544	0.1032	0.1191	0.1521	0.2980	0.0836
2013	0.0900	0.0976	0.0614	0.1185	0.2233	0.1856	0.3490	0.0920
2014	0.0956	0.0903	0.0595	0.1132	0.2033	0.1903	0.3268	0.0809

Source: Elaborated with data estimated by the I-O model with data from OECD

B. Econometric Tests

We estimated a cointegration test, based on the series of the Relative Unit Labor Cost (RCLUVI) between Mexico and the United States estimated by the model and the Real Exchange Rate (TCR) obtained from official agencies, 1989-2018, both measured in index numbers base 2010 = 100.

In this econometric exercise, we have taken the variables in absolute levels (not differences). The first step is to determine the optimal number of lags, which is important in this test. Since we have a sample of only 30 observations, we consider just one lag for the dependent variable TCR which is TCR(-1)[1] so as to maintain consistency and keep up with the tests' requirements.

The Auto Regressive Distributed Lag (ARDL) methodology used in this document to demonstrate the existence of a long-term association between $LTCR$ and $LRCLUVI$, does not consider relevant to know the degree of integration of the series (Pesaran, Shin and Smith 2001, 289-290). Nonetheless, we performed Unit Root tests on the variables involved to increase robustness in the election of one of five cases. According to Phillips–Perron and Dickey– Fuller tests in levels and, the $LTCR$ is unit root and $LRCLUVI$ is stationary or unit root.

B.1. Estimating the ARDL Model

To begin with we proceeded according to Engle-Granger's methodology. We estimated an ARDL (1,0) model with constant and without trend (case 3). Since TCR is I(1) its linear relationship with RCLUVI might result in a formal long run trend. The model estimated under the above conditions yields in good fit, that is, an R^2 estimate of 0.53 (study on Table B1).

Table B1—Auto Regressive Distributed Lag Model ARDL

Dependent Variable: TCR
Selected Model: ARDL(1, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
TCR(-1)	0.448128	0.164617	2.722244	0.0114
RCLUVI	1.032568	0.381869	2.703986	0.0119
C	-51.8363	35.45607	-1.461987	0.1557
R-squared	0.52835	Mean dependent var		104.3851
Adjusted R-squared	0.492069	S.D. dependent var		13.50612
S.E. of regression	9.625707	Akaike info criterion		7.464449
Sum squared resid	2.409.01	Schwarz criterion		7.605893
Log likelihood	-105.23	Hannan-Quinn criter.		7.508748
F-statistic	14.56	Durbin-Watson stat		1.700429
Prob(F-statistic)	0.000057			

Note: *p-values and any subsequent tests do not account for model selection.

However, the model was subject to the correct specification tests, to demonstrate that the model residuals were consistent with fundamental econometric assumptions of normality. The heteroscedasticity test shows that the estimators are consistent in terms of their residuals. The autocorrelation test shows that the errors in the model are uncorrelated. The normality test in the residues is for showing they are distributed based on parameters of statistical normality. For this model, the residuals are normally distributed, but they present some heteroscedasticity problems since we decided not to sacrifice observations. And the stability test was estimated to determining if there are changes in the specified model, and we found a possible structural change in 1998.

B.2. Long Run Formal Relationship

The estimations shown in Table B2 indicate that the best estimated model using *EViews* 10 is ARDL (1,0). This model presents the statistical significance of regressors individually and jointly considered.

[1]The decision to use just one lag for the dependent variable TCR (-1), was based upon evaluating various models. As least lags are used the consistency and statistical robustness increases.

The long run relationship test is evaluated at 95% significance with a inferior limit I(0) = 4.94 and superior limit I(1) = 5.73. The F statistic = 6.34 shows the existence of a long run relationship between TCR and RCLUVI from 1989 to 2018. This result is strengthened by the t statistic = –3.35 which is above the inferior I(0) = –2.86 and the superior I(1) = –3.22 limits at 95% per cent level of significance.

Table B2—Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-51.8363	35.45607	-1.461987	0.1557
TCR(-1)*	-0.551872	0.164617	-3.352455	0.0025
RCLUVI**	1.032568	0.381869	2.703986	0.0119
* p-value incompatible with t-Bounds distribution.				
** Variable interpreted as Z = Z(-1) + D(Z).				
Levels Equation				
Case 3: Unrestricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RCLUVI	1.871029	0.638999	2.928061	0.007
EC = TCR - (1.8710*RCLUVI)				
F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic:	n =1000
F-statistic	6.343756	10%	4.04	4.78
k	1	5%	4.94	5.73
		2.5%	5.77	6.68
		1%	6.84	7.84
Actual Sample Size	29		Finite Sample	n=35
		10%	4.225	5.05
		5%	5.29	6.175
		1%	7.87	8.96
			Finite Sample	n =30
		10%	4.29	5.08
		5%	5.395	6.35
		1%	8.17	9.285
t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-3.352455	10%	-2.57	-2.91
		5%	-2.86	-3.22
		2.5%	-3.13	-3.5
		1%	-3.43	-3.82

B.3. Error Correction

Finally, the model ARDL (1,0) was estimated, adjusted to the error correction model in order to correct for the disturbances which might show up in the long run relationship equilibrium.

Table B3 shows the short run adjustment coefficient CointEq (-1) = –0.55 which is statistically significant both individually and jointly with the constant. The coefficient indicates specifically that short run adjustment correction is 55% in one year, adjustment ending in two years.

In addition the *EViews* 10 program allows us to evaluate the long run relationship of the model ARDL (1,0) adjusted for correction. The result shows that in effect the adjusted model is congruent with a formal long run relationship at 95% level of significance, given that the F Statistic = 6.34 goes above both limits inferior I(0) = 4.94 and superior I(1) = 5.73 y is reinforced by t statistic = – 3.63 above inferior limit I(0) = –2.86 and superior limit I(1) = –3.22.

B.4. Summary

In order to demonstrate that there is a long run relationship between the Real Exchange Rate (TCR) and the Relative Unit Labor Costs Vertically Integrated (RCLUVI), i.e., these two variables show a common trend over time –from 1989 to 2018–, we started with the time series methodology of Engle-Granger 1987 and Pesaran, Shin and Smith (2001). The results of this test show that both

Table B3—ECM Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-51.8363	14.58498	-3.554087	0.0015
CointEq(-1)*	-0.551872	0.152039	-3.629806	0.0012
R-squared	0.327949	Mean dependent var		0.72013
Adjusted R-squared	0.303058	S.D. dependent var		11.31460
S.E. of regression	9.445771	Akaike info criterion		7.39548
Sum squared resid	2409.01	Schwarz criterion		7.48978
Log likelihood	-105.2345	Hannan-Quinn criter.		7.42502
F-statistic	13.17549	Durbin-Watson stat		1.70043
Prob(F-statistic)	0.001168			
* p-value incompatible with t-Bounds distribution.				
F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	6.343756	10%	4.04	4.78
k	1	5%	4.94	5.73
		2.5%	5.77	6.68
		1%	6.84	7.84
t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-3.629806	10%	-2.57	-2.91
		5%	-2.86	-3.22
		2.5%	-3.13	-3.5
		1%	-3.43	-3.82

variables TCR and RCLUVI are I(1) using augmented Dickey-Fuller. However, when Phillip-Perron test is applied RCLUVI is I(0). Even tough we notice this inconsistency we proceeded to evaluate the residuals in the model, resulting in that the residuals are stationary, which means that there is a long run relationship between the two variables.

To reinforce this preliminary result, we applied the Pesaran , Shin and Smith (2001) methodology estimating the ARDL (1,0) model. The results show that there is a formal long run relationship between TCR and RCLUVI from 1989 to 2018. This relationship allows to correct for short run disturbances by means of an adjustment coefficient of 55% in one year, ending in the next year.