Vertically Integrated Unit Labour Costs by Sector:
Mexico and USA 1970-2000

Pablo Ruiz-Nápoles

Abstract

Real effective exchange rates have been calculated by relative unit labour costs for many countries in the world economy. In this paper we develop a methodology to estimate vertically integrated unit labour costs by sector, using input-output techniques, for the Mexican and US economies in the period 1970-2000. The results are then compared with the measurement of 'Revealed' Comparative Advantage by sector, of the Mexican economy, in order to establish whether Mexican foreign trade by sector was related to its relative labour costs, during this period. To test this relationship, econometric analysis for panel data is utilized. An important corollary of this study is that the Mexican economy is moving from labour-intensive goods production to non-labour intensive goods production; this may be regarded as a structural change in the foreign trade pattern of the Mexican economy.

JEL Classification

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1. Introduction

The purpose of this paper is to develop and apply a methodology for measuring the unit labour costs by sector in two countries, which are close neighbors and trading partners—Mexico and the United States—for the period 1970-2000. In the second section we present some theoretical considerations regarding labour costs, real exchange rates, competitiveness and international trade. In the third section we develop the methodology, which consists of a model, based on input-output analysis, designed for the calculation of vertically integrated unit labour costs by sector of production. The fourth section is devoted to the application of the model for the Mexico-US case, so that annual relative unit labour costs between these two countries are estimated for the period 1970-2000. In the fifth section the results of the model's estimation are presented and analyzed as determining factors of Mexico's comparative advantages by sector. An analysis of the trade pattern is included in this section. In the final section, some conclusions are drawn about the nature of revealed comparative advantage in Mexico and the predictive power of the Heckscher-Ohlin trade theory.

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2. Purchasing Power Parity and Unit Labour Costs

It is commonly believed that the real exchange rate, as determined by price ratios, i.e. purchasing power parity (PPP), is the best indicator of the relative competitiveness of any country. This theory fits perfectly well with the Heckscher-Ohlin (H-O) theorem for trade patterns and, in fact, assuming no capital movements between trading countries, there would be an exchange rate that keeps the trade balanced in equilibrium, i.e. the *equilibrium exchange rate* (Ohlin, 1933). Together, the H-O theorem and the PPP doctrine are regarded as the pillars of the neoclassical theory of trade on its real side (Krueger, 1983).

If we can estimate the real exchange rate of any given country by the PPP theory, using price indexes for the home country and its trading partners, we can also do it for each and every sector of the home country's economy, as long as they are compared to the same sectors of its trading partners' economies.[1] However, the PPP theory has been seriously challenged over the years. Curiously enough, this doctrine has been criticized not as a theoretical statement, but rather as an empirical proposition.[2]

Alternatively, some authors and international organizations like the OECD and the IMF have been using relative labour costs as a measure of competitiveness, equivalent to real exchange rates (Krugman, 1992; Zanello and Desruelle, 1997). In the case of Mexico and Central America, there have been some studies, carried out mainly by central banks' economists, using or calculating unit labour costs in relation to competitiveness and exchange rates (Gil-Díaz and Carstens, 1996; Graf, 1996; CMC, 2003). In fact, the IMF calls these rates the "Real Effective Exchange Rates."

The unit labour costs approach stems originally from the neoclassical standard tradition (Officer, 1976). These costs are usually estimated only for manufacturing using direct labour employed in production per unit of value added for calculating the local ratio of labour costs. The formulae for relative unit labour 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 over-simplified. In particular, their measure of productivity (labour per unit of output) considers only direct labour, and not vertically integrated labour (see, Zanuello and Desruelle, 1997).

The method of calculation for unit labour costs that we use in this work comes from Ricardo's theory of value and the input-output model of Pasinetti (1977) for vertically integrated labour. Input-output analysis gives us the opportunity of capturing both direct and indirect labour requirements per unit of output.[3]

3. Unit Labour Cost based on Vertically Integrated Labour[4]

3.1 Relative Prices and Vertically Integrated Labour

Pasinetti (1977) interprets Ricardo's labour content equation in a general case by:

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

Where, $\mathbf{v}$ is the vector of *vertically integrated* labour content, or direct and indirect labour requirements; $\mathbf{a}$ is the row vector of direct labour coefficients; and $\mathbf{A}$ is the 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 labour embodied in them; that is, the relative quantities of direct and indirect labour bestowed in their production (Ricardo, 1973: 6-7). In particular, 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 labour content of product i divided by the total labour content of product j, which may be expressed, in matrix notation, as:

$$\frac{p_i}{p_j} \approx \frac{\mathbf{a}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{e}^{(i)}}{\mathbf{a}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{e}^{(j)}} = \frac{\mathbf{ve}^{(i)}}{\mathbf{ve}^{(j)}} , \qquad (2)$$

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

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

$$v_i = \mathbf{ve}^{(i)} = \mathbf{a}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{e}^{(i)} \qquad (3)$$

Now, by introducing wages in equation (3), we are calculating *vertically integrated unit labour costs* (VIULC). So the total labour costs to produce one unit of commodity i is:

$$vu_i = \mathbf{a}\hat{\mathbf{W}}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{e}^{(i)} \qquad (4)$$

where, vu_i is the vertically integrated unit labour costs of commodity i; and $\hat{\mathbf{W}}$ is the diagonal matrix, of the same order as $\mathbf{A}$, with wages in the main diagonal and zeros elsewhere.

Thus, for the whole economy, the VIULC indicator (a scalar) will be:

$$vu = \mathbf{a}\hat{\mathbf{W}}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{d} \qquad (5)$$

Where, vu is the weighted average of vertically integrated unit labour costs (a scalar); and $\mathbf{d}$ is the column vector of each industry's percentage of aggregated final demand (weights).

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

$$R = \frac{vu}{vu^*} \qquad (6)$$

Where, R is the real effective exchange rate; vu is the vertically integrated unit labour costs in the home country; vu^* is the vertically integrated unit labour costs in the foreign country; and vu and vu^* are measured in each country's own currency.

According to Ricardo, labour costs *regulate* prices. But they are costs not prices; that is to say, labour costs act as "centers of gravity" for prices (see Semmler, 1984). In other words, prices and prices' variations, in the short and medium terms, are also influenced by other factors whose importance cannot be overlooked; they include 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, i.e. the price-parity rate. To make the formula operational, the foreign country's VIULC—the denominator in equation (6)—is measured as a weighted average of the home country's trading partners' VIULC.

The relative unit labour 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 very little about the specific advantages in trade a country may have with respect to other countries. There remains a need for estimating relative labour costs by sector in order to find out a country's advantages or disadvantages in trade.

3.2 Sectoral Unit labour Costs

There have been some interesting theoretical approaches applied in the literature for productivity estimation with vertically integrated sectors (Dosi *et al*., 1990; De Juan & Febrero, 2000). But average overall competitiveness says very little about trade advantages. In line with input-output analysis, we can calculate relative VIULC by industry, which will give us a good indicator of the relative sector's competitiveness.[5]

In matrix notation for each country, we have:

$$\mathbf{vu} = \mathbf{a}\hat{\mathbf{W}}(\mathbf{I} - \mathbf{A})^{-1} \tag{7}$$

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

3.3 Revealed Comparative Advantages

Neoclassical trade theory predicts that specialization according to comparative advantages will maximize aggregate consumer welfare, under free competition conditions. Different trade theories discuss the different determinants of comparative advantages, but comparative advantage is typically defined in terms of autarkic price relationships that, in fact, are not observable. The 'revealed' comparative advantage (RCA) measure, pioneered by Balassa (1965, 1977, 1979, 1986), assumes that the true pattern of comparative advantage can be observed from post-trade data. Balassa's RCA index compares the export share of a given sector in a country with the export share of that sector in the world market (Balassa, 1965, 1979). Over the years, there have been some improvements and variations of Balassa's RCA index. Most differences between the various RCA indices are related to the industry classification system utilized in the countries' trade data and the availability of the data for various periods, so as to make valid aggregations and

comparisons (Balassa, 1986; Vollrath, 1991; Yeats, 1992; Li and Bender, 2002, 2003; Lee, 2003).

For the purposes of our study, we consider Vollrath's (1991) RCA measure that is calculated for various countries by Li and Bender (2003). Thus, we have the equation:

$$RCA_i = \frac{\left\{\dfrac{X_{ij}}{(\sum\limits_{i} X_{ij}) - X_{ij}}\right\}}{\left\{\dfrac{\left((\sum\limits_{j} X_{ij}) - X_{ij}\right)}{\left[(\sum\limits_{j}\sum\limits_{i} X_{ij}) - (\sum\limits_{j} X_{ij})\right] - \left[(\sum\limits_{i} X_{ij}) - X_{ij}\right]}\right\}} \qquad (8)$$

Where, RCA_i is the relative comparative advantage of the i sector; X_{ij} is the exports of sector i by country j; $\sum\limits_{i} X_{ij}$ is the total exports of country j; $\sum\limits_{j} X_{ij}$ is the world exports of sector i; and $\sum\limits_{j}\sum\limits_{i} X_{ij}$ is the total world exports.

4. A Model of Relative VIULC Mexico-USA and Mexico's RCA

Prior to NAFTA, Mexico and the US have had a very strong and enduring economic relationship, given the long border they share, and the prevailing close connection between Mexican and US firms and banks. However, there has been an important shift in Mexico-US trade and investment flows with the opening of the Mexican economy since the mid-eighties, the change in Mexico's regulation regarding foreign direct investment in the early nineties and, more recently, with the North American Free Trade Agreement (NAFTA), which was implemented in 1994 (see, Moreno-Brid *et al.*, 2005).

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* labour; so the opening of Mexico's and US's markets to firms of both countries would help to define their trade pattern roughly according to the H-O theorem, with Mexico exporting labour-intensive goods and importing capital-intensive goods.[6] However, it must be recognized that besides relative factor endowments (*i.e.*, H-O theorem) there are other forces that influence the determination of trade patterns between nations.[7]

Thus, by applying this unit labour cost model to the Mexico and US economies, and calculating RCA measures of Mexico's trade flows, we wish to find out in which sectors Mexico has labour-cost advantages, whether these advantages have changed over time, and whether they show a direct influence on Mexico's trade pattern and trade balance.

We test the hypothesis that, if Mexican foreign trade follows a H-O determined pattern and given that Mexico has an abundance in labour 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 labour-intensive and show lower VIULC relative to the corresponding sectors in the United States. The market that would reveal these differences is not, however, just the NAFTA market but the world market for tradable goods.

4.1 The VIULC MEX-US Equations

We start out by recalling equations (3) to (6) above, in this case applied to each country's data:

$$vu_{ht} = \mathbf{a}_{ht}\ \hat{\mathbf{W}}_{ht}\ (\mathbf{I} - \mathbf{A}_{ht})^{-1}\ \mathbf{d}_{ht} \tag{9}$$

$$vu_{jt} = \mathbf{a}_{jt}\ \hat{\mathbf{W}}_{jt}\ (\mathbf{I} - \mathbf{A}_{jt})^{-1}\ \mathbf{d}_{jt} \tag{10}$$

$$\mathbf{a} = (a_1, a_2, \ldots, a_n)$$

$$a_i = l_i\ /\ y_i$$

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

$$R_{(h/j)t} = \frac{vu_{ht}}{\sum_j vu_{jt}} \qquad j \neq h \tag{11}$$

Where, vu_{ht} is the weighted total of vertically integrated unit labour costs of country h, in time t; $\mathbf{a}_h$ is the vector of labour coefficients in country h; $\hat{\mathbf{W}}_{ht}$ is the diagonal matrix of wages per unit of labour of country h; $\mathbf{A}_h$ is the technical coefficient matrix of country h; $\mathbf{d}_{ht}$ is the column vector of percentages of gross domestic product per industry in country h; l_i is the labour units used in industry i per unit of time; y_i is the output of industry i per unit of time; vu_j is the total vertically integrated unit labour costs of country j; $\mathbf{a}_j$ is the vector of labour coefficients in country j; $\hat{\mathbf{W}}_{jt}$ the diagonal matrix of wages per unit of labour in country j; $\mathbf{A}_j$ is the technical coefficient matrix of country j; $\mathbf{d}_{jt}$ is the column vector of percentages of gross domestic product per industry in country j; $R_{(k/j)t}$ is the real effective exchange rate in terms of VIULC between h and j countries in time t; and subscripts, h stands for home country and j for its trading partner country ($j = 1,2,3,\ldots,m; j \neq h$).

For the application of equations (9) – (11) to any particular comparison between countries, the denominator in (11) must be a weighted average of the home country's (h) trading partners, *i.e.* of all j, labour costs and weights being denominated in the same currency.

Similarly, we recall equation (7) above to define:

$$\mathbf{vu}_j = \mathbf{a}_j\ \hat{\mathbf{W}}_j\ (\mathbf{I} - \mathbf{A}_j)^{-1} \tag{12}$$

where, $\mathbf{vu}_j$ is the row vector of VIULC for each industry in each country; $\hat{\mathbf{W}}_j$ is the diagonal matrix of wages of each country; $\mathbf{A}_j$ is the

technical coefficients matrix of each country; and the subscript j denotes any country (including home country, $h = j$).

Each element in vector $\mathbf{vu}_j$ corresponds to $vu_i{}^j$, where the subscript i denotes a particular industry, $i = 1, 2, 3, \ldots, n$, n being 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 labour costs (RULC) MEX-US as:

$$\mathbf{rulc}_t = \frac{vu_{it}^{mx}}{vu_{it}^{us}} \qquad\qquad (13)$$

Where, $\mathbf{rulc}_t$ is the vector of relative vertically integrated unit labour costs in time t; $vu_{it}{}^{mx}$ is the vertically integrated unit labour costs of industry i in time t in Mexico, measured in constant Mexican Pesos; and $vu_{it}{}^{us}$ is the vertically integrated unit labour costs of industry i, in time t, in the US, measured in constant US Dollars; and $t = (1970,\ldots, 2000)$.

Equation (13) is similar to equation (11) adapted to the Mexico-USA case under the assumption that Mexico, the home country in the numerator, is a small economy whose foreign trade is highly concentrated in the US market, which is the foreign country in the denominator.[8]

We estimated the system defined in equations (9) to (13), with data taken from Mexican and US official sources, for the period 1970-2000. The period of analysis was determined mainly by the availability of the data, especially with regard to input-output matrices for Mexico.[9] In order to make the labour, wages, input-output, gross domestic product and trade data compatible for both countries, in terms of industry classification, we had to do some aggregation of industries ending up with information for 36 industries, fully comparable between the two countries, 25 out of which were identified as traded goods industries, and just 24 registered exports in at least one year of the period 1970-2000.

4.2 The RCA Equation

Another problem related to data restricted our analysis: the system of classification and aggregation of world trade data by sector was not compatible with the one we used for Mexico. In estimating equation (8), instead of world exports, we considered US imports whose classification is fully compatible with Mexican data, but only from the year 1989 onwards. This reduced our panel by 19 years of annual estimates.

One peculiarity of the RCA formula is that it considers only the home country's exports (not imports) and, at the level of aggregation we use, the RCA indicator shows advantages which are different from zero for all 24 exporting goods industries. The reason is that while it would be impossible that each and every industry of the Mexican economy could be a net exporter, it is none-the-less true that today's trade is mostly intra-industry rather than inter-industry; so there are exports and imports in each industry. It does not mean that the RCA indicator is useless; quite the contrary, it shows this new feature of the trade flows between nations and the data estimated reveals where the relative advantages lie for the Mexican economy in the US market. But this means that we should also take into account, as an indicator for relative advantages, the real trade balance. The real trade balance has the advantage of being

available for the whole period of analysis, i.e. 1970-2000. Mexico's trade balance by sector was calculated according to the equation:

$$RTB_{it} = X_{it} - M_{it} \qquad (14)$$

Where, RTB_{it} is the real trade balance of sector i in time t; X_{it} is the real exports of sector i in time t; M_{it} is the real imports of sector i in time t; $i = (1,....,25)$ traded goods sectors; and t = 1970 to 2000. It follows that overall trade balance equation is:

$$\sum_i RTB_{it} = \sum_i X_{it} - \sum_i M_{it} \qquad (15)$$

5. Results of Model Estimation

5.1 Relative Vertically Integrated Unit Labour Costs by Sector MEX-US

The results of equations (12) and (13) are the estimated relative vertically integrated unit labour costs for Mexico-US for the period 1970-2000, which are presented in tables 1.1, 1.2 and 1.3 by groups of industries: primary traded goods and two groups of manufacturing traded goods industries (so divided for convenience of presentation).

Table 1.1					
Relative Unit Labour Cost Mex/US					
Traded Primary Goods					
Year	Agriculture live-stock, forestry and fishing	Metal mining	Coal mining	Oil and gas extraction	Nonmetallic minerals, except fuels
1970	0.9791	0.4537	0.8890	2.8992	0.9393
1971	0.9870	0.4564	1.0024	2.6335	0.9646
1972	1.0777	0.5118	1.0283	2.7932	1.0999
1973	1.0784	0.7486	1.1878	2.3611	1.1977
1974	0.9886	0.6756	1.5003	1.4390	1.2017
1975	0.8920	0.6827	1.5137	1.3890	1.0851
1976	0.8810	0.7729	1.4816	1.7621	1.2070
1977	0.8589	0.6499	1.2939	1.1584	1.2505

1978	0.8562	0.7008	1.3969	1.0093	1.1707
1979	0.8556	0.5845	1.4470	0.9414	1.1593
1980	0.8160	0.4641	1.3531	0.4208	1.1430
1981	0.8463	0.6616	1.5776	0.5530	1.1989
1982	0.7513	0.4591	1.7333	0.3979	1.0832
1983	0.6728	0.4854	1.1114	0.2422	0.9571
1984	0.6211	0.5573	0.8863	0.2463	0.7909
1985	0.5255	0.8051	0.9238	0.4019	0.6270
1986	0.5384	0.5908	1.2058	0.4035	0.5744
1987	0.5159	0.5239	1.1446	0.3058	0.6058
1988	0.4943	0.4299	0.7152	0.5575	0.5411
1989	0.5020	0.3960	0.7234	0.7201	0.4798
1990	0.4363	0.3259	0.6097	0.5050	0.4489
1991	0.4320	0.3863	0.7102	0.7138	0.4060
1992	0.4677	0.4218	0.7402	0.5964	0.3890
1993	0.4808	0.8374	0.8403	0.6313	0.4602
1994	0.4933	0.8009	0.9501	0.5733	0.4551
1995	0.4166	0.4878	0.6419	0.5053	0.4491
1996	0.3599	0.2797	0.4962	0.5154	0.4806
1997	0.3450	0.3027	0.5354	0.4907	0.4985
1998	0.3410	0.3042	0.5389	0.4333	0.4652
1999	0.3400	0.3418	0.5586	0.3921	0.4717
2000	0.3403	0.3946	0.5645	0.5374	0.4656

Source: Estimated by the model with data from INEGI for Mexico and BEA for US.

Table 1.2
Relative Unit Labour Cost Mex/US
Traded Manufactured Goods I

Year	Food and kindred products	Tobacco products	Textile mill products	Apparel and other textile products	Lumber and wood products	Furniture and fixtures	Paper and allied products	Printing and publishing	Chemicals and allied products	Petroleum and coal products
1970	0.7755	0.4591	0.6746	0.2520	0.6691	0.4992	0.5804	0.6260	0.6458	0.7050
1971	0.7259	0.4087	0.7076	0.2366	0.6631	0.5012	0.6094	0.6203	0.6463	0.6382
1972	0.7596	0.3999	0.6807	0.2470	0.7380	0.5265	0.6301	0.6481	0.6730	0.6635
1973	0.7232	0.4896	0.6244	0.4829	0.7270	0.5315	0.6130	0.6249	0.7027	1.5287
1974	0.7156	0.4760	0.6447	0.5038	0.7238	0.5315	0.5711	0.6040	0.7230	1.0482
1975	0.6868	0.4800	0.6694	0.5688	0.6459	0.5644	0.6041	0.6314	0.6859	0.9460
1976	0.7301	0.4081	0.6920	0.5929	0.7229	0.6122	0.6116	0.6822	0.7398	1.1775
1977	0.6822	0.3896	0.6263	0.5765	0.7313	0.5925	0.6032	0.6950	0.6810	0.8820
1978	0.6191	0.3682	0.5618	0.5075	0.7209	0.5497	0.5302	0.6463	0.6348	0.7935
1979	0.6386	0.3471	0.5289	0.4710	0.6332	0.4941	0.4997	0.5931	0.6090	0.8773
1980	0.5801	0.4831	0.4593	0.4251	0.5449	0.4739	0.4629	0.5495	0.5833	0.6111
1981	0.6149	0.4432	0.4725	0.4418	0.5666	0.4686	0.4709	0.5243	0.6052	0.6360
1982	0.5713	0.4843	0.4753	0.4762	0.5669	0.4403	0.4640	0.4943	0.5446	0.5486
1983	0.4904	0.3734	0.3875	0.3898	0.4998	0.3711	0.3490	0.4246	0.4438	0.3975
1984	0.4515	0.3397	0.3624	0.3684	0.4201	0.3447	0.3414	0.3576	0.4355	0.3771
1985	0.4131	0.4045	0.4371	0.3935	0.3898	0.2908	0.3364	0.3540	0.4916	0.6818
1986	0.4070	0.4445	0.4273	0.3887	0.4160	0.2991	0.3302	0.3387	0.4611	0.7023
1987	0.3846	0.4005	0.3795	0.3549	0.4109	0.2839	0.2826	0.3189	0.4093	0.5885
1988	0.3479	0.4423	0.3738	0.3001	0.3300	0.2271	0.2732	0.2893	0.3964	0.6095
1989	0.4258	0.5244	0.4697	0.4512	0.3982	0.3514	0.4067	0.4832	0.5001	0.8799
1990	0.4125	0.5036	0.4674	0.4173	0.3989	0.3674	0.4000	0.3706	0.4598	0.7029
1991	0.4398	0.5209	0.5285	0.4405	0.4522	0.3968	0.4249	0.3967	0.4957	0.7830
1992	0.4753	0.5610	0.6205	0.4986	0.5192	0.4389	0.4811	0.4433	0.5194	0.7314
1993	0.4803	0.6805	0.5926	0.3805	0.4329	0.3229	0.4027	0.3936	0.5429	0.6387
1994	0.4877	0.6886	0.5816	0.3846	0.4519	0.3281	0.4100	0.3926	0.5471	0.5984
1995	0.3899	0.4970	0.4374	0.2975	0.3841	0.2751	0.3444	0.4475	0.4103	0.4803

1996	0.3237	0.5694	0.4367	0.3334	0.3925	0.3562	0.3557	0.5200	0.3766	0.4968
1997	0.3298	0.7106	0.4467	0.3521	0.3936	0.3655	0.3670	0.5085	0.3973	0.5355
1998	0.3427	0.7999	0.4858	0.3676	0.4009	0.3755	0.3822	0.5166	0.4123	0.5432
1999	0.3497	0.8176	0.5137	0.3966	0.4078	0.3930	0.3938	0.5284	0.4076	0.5195
2000	0.3496	0.8795	0.5495	0.4111	0.3970	0.3940	0.4124	0.5476	0.4075	0.6528

Source: Estimated by the model with data from INEGI for Mexico and BEA, DOC, US, for the US.

Table 1.3									
Relative Unit Labour Cost Mex/US									
Traded Manufactured Goods II									
Year	Rubber and misc. plastics products	Leather and leather products	Stone, clay, and glass products	Primary metal industries	Fabricated metal products	Industrial machinery and equipment	Electronic and other electric equipment	Motor vehicles and equipment	Other transportation equipment	Miscellaneous manufacturing industries
1970	0.6971	0.4318	0.6957	0.5673	0.5986	0.7504	0.5332	0.4401	0.5190	0.2528
1971	0.7464	0.4220	0.7363	0.6090	0.6413	0.7782	0.6047	0.5322	0.5439	0.2540
1972	0.7908	0.4009	0.7469	0.6164	0.6320	0.7765	0.6052	0.4788	0.5549	0.2603
1973	0.8406	0.6196	0.7659	0.6251	0.8099	0.8623	0.6116	0.5195	0.5469	0.2207
1974	0.8354	0.6395	0.7519	0.6159	0.7833	0.8360	0.5929	0.5170	0.5527	0.2231
1975	0.8290	0.6543	0.7421	0.6369	0.8073	0.8718	0.6969	0.5884	0.6518	0.2601
1976	0.8834	0.7465	0.8042	0.4976	0.7917	0.9162	0.6957	0.7183	0.6240	0.2670
1977	0.8608	0.7065	0.7775	0.6473	0.8096	0.8925	0.7410	0.6095	0.6676	0.2553
1978	0.7115	0.6246	0.7292	0.6230	0.7014	0.7728	0.6497	0.4826	0.6879	0.2356
1979	0.6563	0.6441	0.6974	0.5682	0.6555	0.6968	0.6045	0.4539	0.6759	0.2056
1980	0.5644	0.6332	0.6187	0.4939	0.5640	0.6382	0.5553	0.4170	1.0173	0.1777
1981	0.6094	0.6816	0.6097	0.5572	0.5728	0.6379	0.5891	0.4333	1.0179	0.1917
1982	0.5889	0.5942	0.5975	0.5374	0.5551	0.6098	0.5831	0.4370	1.0928	0.1736
1983	0.4701	0.4999	0.5077	0.4722	0.4530	0.5061	0.4736	0.4070	0.9680	0.1338
1984	0.4387	0.4648	0.4766	0.4021	0.4053	0.4708	0.4599	0.3304	1.0013	0.1286
1985	0.4204	0.4575	0.4262	0.4399	0.3843	0.4434	0.4819	0.2883	0.7673	0.1263
1986	0.4204	0.4411	0.4216	0.3943	0.3767	0.4531	0.4662	0.3373	0.8447	0.1293

Year										
1987	0.3777	0.3984	0.3838	0.3532	0.3284	0.3961	0.4187	0.2961	0.8401	0.3450
1988	0.3564	0.3580	0.3640	0.3262	0.2947	0.3261	0.4152	0.2585	0.7413	0.2514
1989	0.4565	0.4179	0.4645	0.4202	0.4134	0.4753	0.9568	0.4210	0.7668	0.3573
1990	0.4777	0.4138	0.4505	0.3794	0.4068	0.4475	0.9487	0.4227	0.6966	0.3951
1991	0.5364	0.4236	0.4501	0.3963	0.4456	0.4732	1.0351	0.3897	0.7757	0.4176
1992	0.6229	0.5125	0.4628	0.4259	0.5206	0.5500	1.1042	0.4623	0.7685	0.4816
1993	0.5945	0.4405	0.4404	0.4109	0.4707	0.4915	0.4059	0.3692	0.6191	0.3650
1994	0.5946	0.4160	0.4435	0.4049	0.4717	0.4832	0.3771	0.3636	0.6228	0.3468
1995	0.4481	0.2818	0.4208	0.2976	0.3580	0.3684	0.2402	0.2492	0.3210	0.2772
1996	0.4522	0.2878	0.3828	0.2407	0.3553	0.3828	0.3015	0.2662	0.4121	0.3176
1997	0.4621	0.2953	0.3878	0.2518	0.3592	0.3531	0.3017	0.2838	0.4429	0.3490
1998	0.4770	0.2953	0.3903	0.2603	0.3727	0.3157	0.2767	0.2893	0.4287	0.3457
1999	0.5040	0.3029	0.3966	0.2657	0.3846	0.3183	0.2663	0.3015	0.3724	0.3596
2000	0.4955	0.3285	0.3815	0.2640	0.3969	0.3173	0.2452	0.2935	0.3922	0.3705
Source: Estimated by the model with data from INEGI for Mexico and BEA, DOC, US, for the US.										

It is observable that the great majority of industries show levels below 1, which means that, in general, unit labour costs are lower in Mexico than in the USA. This is not particularly surprising, given the asymmetries in industrial structures and the wage differentials between these two countries. However, even in those industries in which labour costs were higher in Mexico than in the US, relative ULC in all industries show a clear tendency to decline over time.

5.2 Mexico's RCA and VIULC by Sector

We calculated RCA by industry from Vollrath's equation (8) for the period 1989-2000, which are shown in table 2.1, ranking these coefficients for three selected years, 1989, 1994 and 2000.

Table 2.1												
Mexico's Revealed Comparative Advantages												
Vollrath's modified coefficient												
Industry	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Agriculture, livestock, forestry and fishing	1.47	2.26	2.43	2.34	2.85	2.46	2.32	1.65	1.57	1.82	1.97	2.03

Metal mining	9.04	8.14	0.88	1.15	1.28	1.37	1.43	1.04	1.44	1.41	1.78	1.72
Coal mining	1.48	1.74	0.91	1.08	0.45	0.36	0.37	0.35	0.36	0.46	0.47	0.33
Oil and gas extraction	5.87	5.08	4.19	4.55	3.47	3.37	2.64	2.98	2.46	2.05	2.29	2.24
Nonmetallic minerals, except fuels	8.65	7.25	8.02	5.99	3.46	3.78	3.85	3.15	2.81	3.14	3.13	2.91
Food and kindred products	2.72	1.58	1.85	1.57	1.88	2.19	2.57	2.22	2.36	2.26	2.12	2.26
Tobacco products	6.69	4.25	5.79	2.33	2.26	12.76	11.28	8.33	3.97	5.03	5.78	4.83
Textile mill products	1.65	1.16	1.15	1.08	1.09	1.41	2.20	1.96	1.92	1.86	1.82	1.81
Apparel and other textile products	0.17	0.16	0.15	0.15	0.16	0.19	0.28	0.36	0.44	0.50	0.53	0.53
Lumber and wood products	0.05	0.04	0.13	0.14	0.10	0.07	0.08	0.08	0.08	0.07	0.06	0.05
Furniture and fixtures	0.69	0.49	0.49	0.58	0.63	0.52	0.43	0.54	0.61	0.49	0.40	0.31
Paper and allied products	0.37	0.22	0.22	0.23	0.16	0.20	0.30	0.24	0.29	0.35	0.34	0.31
Printing and publishing	0.43	0.41	0.83	0.71	0.77	0.68	0.66	0.54	0.62	0.63	0.54	0.54
Chemicals and allied products	1.74	1.65	1.73	1.72	1.58	1.58	1.59	1.14	1.06	1.03	0.92	0.94
Petroleum and coal products	0.65	1.03	0.95	1.05	1.29	0.98	1.00	0.60	0.62	0.66	0.73	0.57
Rubber and misc. plastics products	0.19	0.11	0.21	0.18	0.22	0.27	0.31	0.32	0.35	0.37	0.40	0.37
Leather and leather products	0.28	0.25	0.28	0.37	0.34	0.28	0.35	0.40	0.49	0.44	0.44	0.45
Stone, clay, and glass products	1.96	1.56	1.67	1.76	1.91	1.68	1.48	1.50	1.47	1.47	1.40	1.33
Primary metal industries	0.89	0.88	1.24	1.22	1.38	1.16	1.71	1.29	1.30	1.04	0.86	0.79
Fabricated metal products	0.57	0.51	0.78	0.77	0.80	0.88	1.19	0.94	1.01	0.94	0.70	0.64
Industrial machinery and equipment	0.36	0.35	0.33	0.33	0.32	0.34	0.33	0.32	0.41	0.49	0.48	0.46
Electronic and other electric equipment	0.18	0.20	0.33	0.33	0.47	0.54	0.40	0.52	0.63	0.67	0.65	0.54
Motor vehicles and equipment	0.82	0.97	1.16	1.33	1.51	1.65	1.89	2.22	2.05	2.25	2.14	2.43
Miscellaneous manufacturing industries	0.23	0.29	0.27	0.25	0.28	0.29	0.28	0.28	0.30	0.33	0.32	0.29

Source: Elaborated with data from Instituto Nacional de Estadística, Geografía e Informática, INEGI, México and Bureau of Economic Analysis, DOC, US.

The ranking is shown in table 2.2. The industries are divided into two groups: those with a coefficient above one in any one of the three selected years and those with all coefficients below one. The first group consists of eleven industries which are known for being dynamic exporters especially after trade opening. In some cases the advantages these industries show, arise from relative abundance of natural resources like oil, mining, agricultural products, livestock, fishing, stone, clay and glass products. Others fit into what is known as light manufacturing, food and kindred products, chemicals and textiles. The most relevant as heavy manufacturing is the *Motor vehicles and equipment* industry.

Table 2.2			
Mexico's RCA for Selected Years			
Ordered by highest to lowest coefficient in 2000			
Industry	**1989**	**1994**	**2000**
Tobacco products	6.69	12.76	4.83
Nonmetallic minerals, except fuels	8.65	3.78	2.91
Motor vehicles and equipment	0.82	1.65	2.43
Food and kindred products	2.72	2.19	2.26
Oil and gas extraction	5.87	3.37	2.24
Agriculture, livestock, forestry and fishing	1.47	2.46	2.03
Textile mill products	1.65	1.41	1.81
Metal mining	9.04	1.37	1.72
Stone, clay, and glass products	1.96	1.68	1.33
Chemicals and allied products	1.74	1.58	0.94
Primary metal industries	0.89	1.16	0.79
Fabricated metal products	0.57	0.88	0.64
Petroleum and coal products	0.65	0.98	0.57
Printing and publishing	0.43	0.68	0.54
Electronic and other electric equipment	0.18	0.54	0.54

Apparel and other textile products	0.17	0.19	0.53
Industrial machinery and equipment	0.36	0.34	0.46
Leather and leather products	0.28	0.28	0.45
Rubber and misc. plastics products	0.19	0.27	0.37
Coal mining	1.48	0.36	0.33
Paper and allied products	0.37	0.20	0.31
Furniture and fixtures	0.69	0.52	0.31
Miscellaneous manufacturing industries	0.23	0.29	0.29
Lumber and wood products	0.05	0.07	0.05
Source: Elaborated with data from INEGI, México and BEA, DOC, US.			

We then compared RCA estimates with the corresponding relative VIULC Mex/US values from 1989 to 2000. The results in table 3 show a correlation coefficient between 0.4 and 0.7 for nine of all the exporting goods industries, most with the right sign.

Table 3		
Correlation between RCA and Rel. VIULC		
Industry	Correlation	Beta
	Coefficient	value
Motor vehicles and equipment	0.74620	-6.61881
Electronic and other electric equipment	0.68571	-0.39203
Stone, clay, and glass products	0.66572	4.92468
Lumber and wood products	0.61012	0.61567
Industrial machinery and equipment	0.59373	-0.61931
Chemicals and allied products	0.58460	4.17109
Oil and gas extraction	0.50897	8.74495
Textile mill products	0.47552	-4.25650

Leather and leather products	0.40249	-0.66427
Agriculture, livestock, forestry and fishing	0.22903	3.08347
Nonmetallic minerals, except fuels	0.22461	-33.36739
Food and kindred products	0.17227	-2.41618
Apparel and other textile products	0.16158	-1.17387
Printing and publishing	0.12590	-0.71490
Miscellaneous manufacturing industries	0.11943	-0.18778
Fabricated metal products	0.11550	-1.23107
Rubber and misc. plastics products	0.11042	-0.49662
Paper and allied products	0.07953	-0.52544
Metal mining	0.03759	-2.94448
Tobacco products	0.03404	-4.43896
Petroleum and coal products	0.02730	0.31022
Coal mining	0.01352	0.41475
Furniture and fixtures	0.01241	-0.27697
Primary metal industries	0.00030	0.06021
Source: Estimated by OLS with data from INEGI and BEA, DOC, US.		

These results indicate that for nine of the twenty-four exporting industries in Mexico, relative unit labour costs affected their competitive position in the US market in the period 1989-2000. The industry that was most highly correlated with labour costs is *Motor vehicles and equipment* which, besides *Oil extraction*, has been the most successful exporter, especially after the trade opening. Another interesting result is that all of these nine industries are manufactures, both heavy and light.

5.3 Mexico's Trade Balance and Relative VIULC

The result of estimating equations (9) to (11)[10] is the overall ratio of VIULC Mex/US. This ratio is shown in table 4 together with Mexico's overall Trade Balance at constant prices, estimated by equation (15).

Table 4		
Mexico´s Trade Balance and Relative ULC		
Year	Mexico's Trade	Rel. VIULC
	Balance in Mill.	Ratio
	of const. Pesos	Mex/US
1970	-82,989.2	0.5629
1971	-76,216.6	0.5660
1972	-82,918.5	0.5873
1973	-125,011.9	0.6161
1974	-166,580.3	0.5914
1975	-139,675.9	0.6020
1976	-99,508.9	0.6373
1977	-52,656.8	0.6026
1978	-25,724.9	0.5545
1979	-81,058.7	0.5335
1980	-118,359.0	0.5071
1981	-129,993.0	0.5316
1982	183,202.0	0.5053
1983	360,745.0	0.4279
1984	362,746.0	0.3924
1985	294,652.0	0.3805
1986	330,090.0	0.3781
1987	363,738.0	0.3808
1988	281,896.0	0.3526
1989	195,014.0	0.4397
1990	123,449.6	0.4045
1991	67,854.2	0.4281

1992	-90,147.1	0.4697
1993	-53,203.2	0.4430
1994	-158,780.4	0.4446
1995	378,327.3	0.3589
1996	363,866.0	0.3342
1997	261,657.5	0.3414
1998	126,709.8	0.3405
1999	33,636.2	0.3451
2000	-120,512.1	0.3404
Source: Calculated with data from INEGI, Mex		
and BEA, DOC, US.		

We observed the relationship between the two variables and specified a semilogarithmic equation for OLS estimation with a lagged term and a dummy variable with unit values from 1994 onwards, assuming that previous unit labour costs values affected present real trade balance and that there was a structural change (upward shift) in this relationship since NAFTA started to operate in 1994.

$$RTB_t = \infty + \beta_1 \, LRULC_t + \beta_2 \, LRULC_{t-1} + D + \mu \qquad\qquad (16)$$

Where, *RTB* is Mexico's Real Trade Balance; *LRULC* is the relative unit labour costs US/Mex in logarithms; *D* is the dummy variable equal to 0 from 1970 to 1993, and equal to 1 from 1994 to 2000.

The OLS estimation results in table 5.1 show a Regression coefficient above 0.6 with a significant Beta coefficient for *LRULC* and with the correct (negative) sign. The usual tests were applied to the equation which results are shown in table 5.2.

Table 5.1				
Modelling *RTB* by OLS, sample (1970-2000)				
Variable	Coefficient	Std. Error	t-value	t-prob
Constant	-562.068	102.188	-5.50033	0.0000
RULC	-1,397.007	303.157	-4.60819	0.0001
RULC (-1)	549.744	294.893	1.86421	0.0736

Dummy	-206.747	67.581	-3.05921	0.0051
R² = 0.651630; Standard Error of reg.= 123.4048; Durbin Watson = 1.197					
Dependent variable RTB = Real Trade Balance of Mexico; Independent variable					
RULC = Relative Unit Labor Costs Mex/US; Dummy variable = 1, 1994 to 2000.					

Table 5.2			
Equation tests results			
Test for		Statistic	P value
Error Autocorrelation	LM(2)	2.5078	0.1026
Serial Correlation	ARCH(1)	0.0519	0.8213
Normality	Jarque-Bera	1.0037	0.6053
Heterocedastic errors	White	0.9616	0.4605
Linearity	Ramsey RESET(1)	1.3804	0.2511
Unit Root Test for resid.	t-ADF(1) (1%= -2.6)	-4.8502	0.0012
Stability	CUSUM	CUSUM Q	Passed

5.4 Mexico's Trade Balance and VIULC by Sector

As a second, and decisive, testing of the influence of unit labour costs on the trade balance, we considered a panel data model for the determination of Mexico's sectoral trade balance by sectoral unit labour costs. In this case we used the trade balance by sector data instead of RCA estimates, as explained variables, due to the limitations mentioned above. The trade balance by sector (shown in tables 6.1 and 6.2) clearly indicates in what industries a country has advantages and in what it has disadvantages in actual trade. Some of the changes in a sector's trade balance are to be attributed to demand variations, determined by income changes. But the important influence—we hypothesized—were labour costs, relative to its corresponding sector in the trading partner and competitor, in this case the US, Mexico being the home country. We also wished to know whether there was any influence of trade opening in the trade balance; so we included a dummy variable with a value of 1 from 1992 on.

Table 6.1

Mexico's Trade Balance by Industry 1970-1985

Thousands of 1980 Pesos

Industry	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Agriculture, livestock, forestry and fishing	9,224	10,477	9,677	4,563	-5,575	-7,210	957	-3,714	-1,876	-5,290	-29,732	-35,823	-9,323	-27,601	-22,841	-18,165
Metal mining	4,742	1,610	4,201	2,587	6,637	4,950	4,636	4,239	3,111	3,073	4,400	9,142	8,852	9,813	10,536	10,077
Coal mining	-1,294	-1,188	-1,366	-1,504	-1,635	-1,388	-377	-316	-936	-1,313	-1,582	-1,140	-1,139	-247	-416	-1,106
Oil and gas extraction	1,936	1,025	481	224	1,311	25,496	29,217	49,944	88,851	128,027	216,993	282,308	384,512	395,144	391,021	367,586
Nonmetallic minerals, except fuels	1,747	2,480	2,181	1,572	2,536	1,483	1,976	2,020	2,144	2,548	2,995	1,798	896	2,853	2,350	2,029
Food and kindred products	24,244	25,639	26,110	25,831	19,388	17,720	15,339	15,715	19,453	18,902	-3,271	-5,323	5,595	9,766	16,988	20,155
Tobacco products	495	504	685	834	1,176	783	789	819	1,168	977	1,117	963	862	517	611	426
Textile mill products	9,759	8,526	10,964	11,327	9,801	9,096	9,125	7,939	10,145	10,315	7,048	7,768	6,484	6,591	10,098	6,401
Apparel and other textile products	-2,552	-3,039	-3,368	-3,212	165	-820	-1,491	-849	-1,362	-2,782	-3,408	-5,141	-2,539	653	1,029	526
Lumber and wood products	-1,375	-1,106	-1,211	-1,051	-1,448	-1,920	-1,461	-1,323	-1,234	-1,568	-1,805	-1,991	-1,102	-220	-707	-795
Furniture and fixtures	-2	625	791	1,128	1,457	696	940	1,173	1,248	867	465	654	792	3,102	4,060	2,885
Paper and allied products	-6,585	-5,269	-4,276	-7,953	-9,274	-7,921	-7,408	-8,304	-6,006	-7,832	-12,872	-11,623	-7,410	-4,960	-5,278	-5,881
Printing and publishing	-275	-717	-1,602	-915	-446	-135	-213	215	-66	-311	-675	-2,384	-1,749	539	-500	-567
Chemicals and allied products	-23,358	-22,811	-25,022	-27,876	-42,651	-29,058	-23,116	-27,543	-25,279	-29,481	-40,382	-40,770	-25,022	-9,819	-9,326	-22,755
Petroleum and coal products	-9,163	16,757	-22,053	-35,993	-29,183	-11,986	-13,795	-5,669	-7,239	-6,284	2,549	5,273	-4,749	10,116	23,563	18,013
Rubber and misc. plastics products	-975	-965	-1,076	-1,277	-1,709	-2,111	-2,195	-1,160	-1,792	-3,103	-5,075	-5,921	-3,156	-1,570	-1,842	-3,176
Leather and leather products	-1,775	-962	-479	-208	109	121	58	615	922	734	473	36	198	646	861	733
Stone, clay, and glass products	-320	-165	336	402	872	-516	1,597	3,306	3,042	-85	-1,431	-2,700	-168	5,049	6,702	6,505
Primary metal industries	-2,412	2,296	2,384	-6,443	-9,505	-12,823	-7,383	-5,428	-24,769	-30,191	-47,680	-57,527	-24,126	-243	-7,445	-15,932
Fabricated metal products	-5,999	-6,904	-7,210	-7,522	-8,892	-9,093	-6,606	-4,810	-6,508	-10,727	-13,456	-18,487	-9,880	-1,489	-4,759	-6,448
Industrial machinery and equipment	-34,224	-32,542	-35,636	-37,743	-42,314	-51,186	-50,053	-33,092	-42,937	-74,944	-101,627	-125,269	-69,771	-23,334	-32,986	-43,291
Electronic and other electric equipment	-11,466	-9,842	-10,400	-9,440	-7,919	-6,248	-6,805	-6,903	-6,438	-13,658	-15,696	-20,375	-13,169	-4,071	-7,989	-12,049
Motor vehicles and equipment	-18,557	-18,694	-16,898	-18,623	-35,785	-40,139	-33,037	-28,342	-19,373	-35,784	-42,837	-57,654	-22,943	2,747	4,413	4,634
Other transportation equipment	-9,431	-3,587	-4,707	-7,434	-6,923	-11,563	-6,353	-7,500	-5,102	-10,976	-17,429	-24,398	-15,051	-9,502	-10,507	-6,374

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Miscellaneous manufacturing industries	-5,372	-4,849	-5,425	-6,287	-6,776	-5,905	-3,850	-3,691	-4,892	-12,171	-15,441	-21,409	-13,692	-3,735	-4,890	-8,779
Total Traded Goods Industries	-82,989	-76,217	-82,919	-125,012	-166,580	-139,676	-99,509	-52,657	-25,725	-81,059	118,359	129,993	183,202	360,745	362,746	294,652

Source: Instituto Nacional de Geografía, Estadística e Informática, INEGI, México

Table 6.2

Mexico's Trade Balance by Industry 1986-2000

Thousands of 1980 Pesos

Industry	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Agriculture, livestock, forestry and fishing	620	-3,194	-12,252	-13,565	-14,241	-15,734	-34,219	-25,008	-41,838	-12,268	-44,147	-41,900	-54,477	-61,740	-58,002
Metal mining	10,871	8,895	8,550	6,013	8,086	-1,485	-2,488	-1,339	68	-2,387	-3,701	-5,155	-4,052	-5,625	-3,106
Coal mining	-438	-363	-800	-1,283	-879	-937	-1,473	-1,775	-2,092	-2,359	-2,576	-3,649	-3,379	-2,693	-3,378
Oil and gas extraction	331,782	343,283	335,905	326,791	325,056	349,019	345,297	344,959	340,369	349,194	412,517	452,207	447,064	407,586	420,823
Nonmetallic minerals, except fuels	1,722	1,194	1,578	1,239	259	461	1,385	644	33	1,532	204	232	-468	337	337
Food and kindred products	27,333	35,642	21,935	12,828	-17,701	-10,991	-23,880	-21,053	-29,595	19,022	22,865	11,600	2,593	570	-11,663
Tobacco products	526	268	473	526	472	792	621	1,007	928	1,619	2,088	2,070	2,270	2,363	2,395
Textile mill products	8,078	10,397	8,073	5,513	1,434	776	-1,541	-3,255	-1,069	15,328	11,286	8,963	5,554	4,491	2,058
Apparel and other textile products	2,388	3,953	7,218	2,715	-825	-4,863	-14,476	-14,374	-9,980	17,597	28,714	32,191	37,058	44,456	49,753
Lumber and wood products	-568	-279	-529	-549	-1,226	-905	-1,703	-1,820	-1,736	1,752	2,226	2,285	599	-327	-3,004
Furniture and fixtures	5,090	6,515	12,921	13,969	11,172	9,358	10,045	9,955	8,210	11,978	20,745	25,313	23,758	23,259	19,241
Paper and allied products	-4,668	-6,430	-8,437	-10,453	-12,549	-15,011	-19,241	-21,637	-28,402	-18,886	-16,785	-19,829	-20,118	-21,864	-26,143
Printing and publishing	-1,344	-5	-61	-1,714	-3,043	-4,022	-6,163	-7,763	-10,902	-4,604	-3,714	-3,804	-4,827	-5,682	-6,373
Chemicals and allied products	-7,500	-2,593	-7,822	-11,979	-1,182	-4,317	-6,927	-17,971	-25,536	32,893	918	-23,677	-36,194	-46,485	-55,460
Petroleum and coal products	11,790	2,369	145	-12,283	-8,317	-17,117	-25,987	-19,674	-24,031	-10,782	-25,818	-49,581	-54,940	-60,389	-98,198
Rubber and misc. plastics products	-3,380	-1,087	-1,164	-1,906	-4,713	-10,400	-13,083	-14,661	-18,465	-9,864	-14,717	-17,902	-19,371	-17,891	-23,076
Leather and leather products	1,278	3,027	4,195	2,282	2,982	2,227	1,077	708	-370	7,117	9,550	10,754	7,876	8,061	7,842
Stone, clay, and glass products	8,345	9,858	11,195	6,600	3,676	437	-2,112	-3,071	-4,414	5,322	5,863	3,842	1,283	2,143	890
Primary metal industries	-2,698	2,921	-1,483	131	-1,053	-652	-10,289	5,802	-557	52,086	34,762	22,821	-3,449	-10,999	-26,419

Fabricated metal products	-3,755	-2,271	-5,033	-10,579	-13,805	-16,560	-23,095	-21,377	-28,115	-7,199	-12,426	-18,064	-31,060	-45,752	-52,164
Industrial machinery and equipment	-34,158	-27,838	-44,147	-50,575	-63,918	-72,206	-104,754	-97,102	-109,700	-34,926	-56,098	-61,776	-90,367	-104,792	-129,389
Electronic and other electric equipment	-11,683	-7,715	-20,560	-24,502	-27,586	-34,781	-43,254	-39,377	-45,846	-19,179	-33,692	-51,971	-65,344	-74,268	-102,827
Other transportation equipment	-7,069	-6,212	-9,306	-4,266	-10,503	-12,792	-16,917	-12,782	-20,406	-9,645	-1,645	-8,283	-7,321	3,734	-7,916
Motor vehicles and equipment	2,307	-806	-11,041	-29,183	-36,599	-53,245	-68,968	-65,719	-73,324	11,684	51,398	29,756	31,946	41,033	35,079
Miscellaneous manufacturing industries	-4,779	-5,791	-7,657	-10,756	-11,547	-19,197	-27,998	-26,521	-32,011	-16,695	-23,949	-34,785	-37,920	-45,892	-51,814
Total Traded Goods Industries	**330,090**	**363,738**	**281,896**	**195,014**	**123,450**	**67,854**	**-90,147**	**-53,203**	**158,780**	**378,327**	**363,866**	**261,657**	**126,710**	**33,636**	**-120,512**
Source: Instituto Nacional de Geografía, Estadística e Informática, INEGI, México															

The equation was specified accordingly as:

$$RTBM_{it} = \alpha + \beta_1 LGDPM_{it} + \beta_3 RULC_{it} + \beta_4 D_{it} + \mu_{it} \qquad (17)$$

Where, *RTBM* is the Real Trade Balance of Mexico; *LGDPM* is the Gross Domestic Product of Mexico; *RULC* is the relative vertically integrated unit labour costs Mex/US; these three explaining variables are expressed in logarithms. *D* is the dummy variable with values equal to 0 from 1970 to 1991 and equal to 1 from 1992 to 2000; t = 1970 to 2000; and *i* = (1,…, 25) industries.

According to the Hausman, and Breusch and Pagan tests (see table 7), it is appropriate to estimate the coefficients of the previous model by making use of the Random Effects model. The results of the estimation are also reported in table 7. They indicate that the relative vertically integrated unit labour costs is significant and with the correct sign. There is also a significant Dummy Shift variable which takes a zero value before 1992 and one value from 1992 to 2000. The inclusion of such Dummy variable indicates the presence of structural change starting from 1992. The R square coefficient is about 0.35 which is the standard in Panel Data Regressions.

Table 7				
Random Effects Estimates (GLS) for Trade Balance				
	Constant	RULC	L(GDPM)	Dummy

			-		-
Coefficient		86,194.2	-100,890.9	-0.000587	-5,699.1
Std. Error		13,775.6	5,674.7	-0.000117	3,117.1
R²		0.3754			
Tests			Chi-square	P-value	
Hausman			23.02	0.0000	
Breusch and Pagan			4,432.67	0.0000	
Dependent Variable = Real Trade Balance of Mexico 1970-2000 annual data by sector					
Regressions also include: Relative Vertically Integrated Unit Labour Costs (RULC);					
Gross Domestic Product of Mexico (GDPM) and a Dummy variable with values equal					
to 0 from 1970 to 1991 and 1 from 1992 to 2000.					

The final estimated equation is:

$$RTBM = 262,369.9 - 11,761.1 * LGDPM - 97,698.3 * RULC + 6,394.3 * D \qquad (18)$$

where all variables have the same meaning as in (16) except that the GDP is measured in logarithms.

5.5 Mexico's Trade Specialization Trend

From the results of our model, it seems clear that for the 25 tradable goods industries of the Mexican economy considered, either in the aggregate or as a group, the trade balance in real terms is highly correlated with relative unit labour costs. It is important to note, however, that at this level of aggregation even the trade balance says very little about the specialization pattern followed by the Mexican economy in international trade. In other words, to complete the analysis we need to know for certain, whether the Mexican economy followed the prediction of the H-O theorem, in the sense that the trade specialization under free trade goes towards the relatively abundant factor of production which, in the case of the Mexican economy is labour.[11] Using the data for Mexico in real terms for 72 sectors, for the period 1970-2000, we estimated a number of indicators to reveal the trade and production pattern of the Mexican economy between labour-intensive and input-intensive goods industries.[12] The results appear in table 8 for the selected years of 1970, 1980, 1990 and 2000.

Table 8								
Production, Exports and Imports of Tradable Goods industries								
Constant 1980 pesos								
Tradable goods industries (61)	**1970**	**%**	**1980**	**%**	**1990**	**%**	**2000**	**%**
Employed workers (thousands)	6,498.7		8,565.4		10,288.5		11,441.6	
GDP Millions of 1980 Pesos	925.5		1,630.7		1,991.0		2,812.8	
Exports in Millions of 1980 pesos	90.1		347.5		708.7		1,637.1	
Imports CIF in Millions of 1980 pesos	173.3		445.9		584.6		1,791.9	
Workers per 1 Million 1980 pesos	7,022		5,253		5,167		4,068	
GDP per worker (1980 pesos)	142.41		190.38		193.53		245.84	
Labor-intensive goods industries	48	78.7	38	62.3	38	62.3	31	50.8
Employed workers (thousands)	6,297.0	96.9	7,872.6	91.9	9,262.4	90.0	10,269.6	89.8
GDP Millions of 1980 Pesos	797.4	86.2	1,133.5	69.5	1,226.9	61.6	1,476.6	52.5
Exports in Millions of 1980 pesos	77.4	85.9	74.1	21.3	221.9	31.3	616.4	37.7
Imports CIF in Millions of 1980 pesos	142.0	81.9	300.5	65.9	418.0	71.5	1,143.5	63.8
Workers per 1 Million 1980 pesos	7,897		6,945		7,549		6,955	
GDP per worker (1980 pesos)	126.63		143.98		132.46		143.79	
Inputs-intensive goods industries	13	21.3	23	37.7	23	37.7	30	49.2
Employed workers (thousands)	201.7	3.1	692.7	8.1	1,026.0	10.0	1,171.9	10.2
GDP Millions of 1980 Pesos	128.1	13.8	497.2	30.5	764.1	38.4	1,336.2	47.5
Exports in Millions of 1980 pesos	12.7	14.1	273.3	78.7	486.8	68.7	1,020.7	62.3
Imports CIF in Millions of 1980 pesos	31.3	18.1	155.4	34.1	166.6	28.5	648.4	36.2
Workers per 1 Million 1980 pesos	1,574		1,393		1,343		877	
GDP per worker (1980 pesos)	635.16		717.72		744.74		1,140.13	
Source: Own elaboration with data from *Sistema de Cuentas Nacionales*, Instituto Nacional de								
Estadística, Geografía e Informática, INEGI, México								

The data show that the number of tradable goods industries has remained the same over the whole period of study, but the distribution between labour-intensive goods and input-intensive goods has changed substantially both in number and in the level of production, exports and imports. The first group of industries (labour-intensive goods) has diminished in number from 48 in 1970 to 31 in 2000, has decreased its share in the tradable goods' GDP from 78.7 per cent in 1970 to 50.8 in 2000, and its share of exports from 85.9 per cent in 1970 to 37.7 in 2000, even though, this same group kept the majority of employed workers (90 per cent in average).

The opposite is true for the input-intensive goods group which, by 2000 produced 47.5 per cent of tradable goods' GDP, and exported 62.3 per cent of the total, but absorbs only 10 per cent of the work force.

In the year 1990 when Mexico had already liberalized its trade, the exports of the labour-intensive goods industries were 31.3 per cent, and 68.7 per cent for input-intensive goods, while imports were 71.5 per cent of labour-intensive goods and 28.5 per cent of input-intensive goods. GDP per worker—a gross measure of productivity—was five times higher in the input-intensive goods industries than in labour-intensive goods industries in 1970, and increased sevenfold by 2000. In terms of the real trade balance, from 1980 to 2000, the input-intensive goods industries had a positive balance while the labour-intensive goods industries had a negative one.

Thus, according to the data, the Mexican economy has been moving from labour-intensive activities to non-labour intensive activities, and it is in these latter activities where comparative advantages are actually *revealed*. These two results are in plain contradiction to what neoclassical trade theory *predicts* for a country like Mexico under free trade conditions, with a primary trading partner such as the US, if we assume that Mexico is labour abundant relative to the US and Canada.

6. Conclusions

After the estimation of relative vertically integrated unit labour costs by sector between Mexico and the US for a thirty-year period, in which Mexico's trade changed dramatically, we can draw some basic conclusions. First, vertically integrated unit labour costs are a good measure of competitiveness as shown in all tests for Mexico. Second, intra-industry trade is gaining greater importance over time than inter-industry trade in the case of Mexico. Third, Mexico's revealed comparative advantages with the US are mostly based on natural resources according to Vollrath's equation, while relative labour costs are very important for manufacturing net exports. Finally, Mexico's exports are moving from labour-intensive goods to input-intensive goods production despite the relative low wages and abundance of labour that prevail in the country. Thus, while Mexico's trade opening heralds a structural change in the econometric sense of an upper level for the exports trend, the exports structure has been changing all along independently of trade liberalization.

Notes

Errors, if any, are the sole responsibility of the author.

[1] Hiroshi and Li (2001) estimated PPP by sector for China relative to Japan, using Input-Output techniques.

[2] See Ruiz-Nápoles (2004) for a detailed comment on the PPP literature.

[3] Still, previous calculations for the Mexican economy show a strong correlation between direct labour costs per unit of output and vertically integrated unit labour costs over a long period (see, Ruiz-Nápoles, 1996: 120-121).

[4] The author is grateful to Christian Lager for clarifications in some of the equations in this section, in a previous version of this paper.

[5] We are using, indistinctly, sector or industry as synonymous.

[6] This factor endowment assumption inspired Mexico's in-bond plants programme in 1965.

[7] New Trade theories stress the importance of plants' location, product cycle, imperfect competition, and technical gap between nations, as determining factors (see, Markusen *et al.*, 1995; Dosi *et al.*, 1990).

[8] Otherwise, we would have to include a weighted average of h country's trading partners in the denominator. See equation (11).

[9] The last officially calculated input-output matrix for Mexico is that of 1980. The others we used, i.e 1990, 1993 and 1996, are all estimates realized by a private consulting agency CIESA. That for 2003 has been calculated from actual data by the government statistical agency INEGI; the data has not been released yet.

[10] Equation (11) was modified for estimation so as to include in the denominator only US values, under the assumption that most of Mexico's trade is carried out with the US.

[11] The usual and simplified version of H-O theorem considers only two sectors in each economy, labour-intensive goods and capital (or land)-intensive goods. The use of relative abundance refers to the rate of labour to capital being higher or lower in the home country than the trading partner's, in this case being Mexico and the US respectively.

[12] Due to the lack of reliable information regarding capital stocks in the various industries for the periods of study, we defined as input-intensive those industries that have less than two thousand workers per one million constant pesos of output, the weighted average for tradable goods being between four and seven thousand in the four years considered; the rest is defined as labour-intensive industries.

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