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1. Introduction

Empirical studies of the employment-real wage relationship have occupied economists' attention for a long period of time, although they have failed to determine the exact nature of this relationship. Economic theory has neither been able to settle this dispute, since classical and keynesian models result in a negative association between these two variables, while disequilibrium analysis predicts the opposite relationship.

Working with different time periods, sectors, levels of aggregation, data frequency and countries have produced conflicting evidence in this respect. Early studies such as Dunlop (1938) discovered a positive relationship between real and nominal wages, thus seeming to reflect a positive association of real wages and employment, for the period 1860-1937 in Great Britain. A similar pattern was found by Tarshis (1939) in U.S. monthly data from 1932 to 1938, although in a poscript to his 1939 article he reports a "rather high negative association"[1] between man-hours and real hourly wages. Recent studies by Neftci (1978) and Sargent (1978) have used a richer dynamic structure to find a predominantly negative influence of real wages on employment. Sargent's dynamic, rational-expectations model has inspired subsequent work in the subject such as Meese (1980), Coyle (1984) and Burda (1984); all these studies work with U.S. post-

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[1]Tarshis (1939), p. 154.

war manufacturing data at different levels of aggregation.

Among the few cross-country analyses of the employment-real wage relationship we find Geary and Kennan (1982) and Sachs (1982, 1983). The former two authors study evidence from 12 industrialized countries for different postwar sample periods, which they find supporting the conclusion of independence between these two variables over the business cycle. However, Sachs reconstructs their data and uses different indices and tests to recover, in general, the negative association of employment and real wages.

This paper studies the above mentioned relationship in the tradeable sector for a group of 12 developing countries. A complete analysis of tradeables should ideally include agriculture, manufacturing and mining. However, data availability forced us to concentrate only in the latter two. The model used is a simplified version of Sargent (1978) in which, given our representation of the wage process, only the contemporaneous wage enters in the employment equation, and it does so with a negative reduced form coefficient. One might wonder to which extent is this theoretical prediction correct, since it comes from intertemporal optimizing, rational entrepreneurs which are price takers both in goods and input markets. In particular, the structuralist tradition would argue that this is hardly a correct representation of developing countries' reality where, just to start with, there is much less responsiveness to price incentives.[2]

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[2]The structuralist school has traditionally argued that this lack of responsiveness is mainly a feature of the agricultural sector (see Larraín (1982)) although some related work (i.e. Krugman and Taylor

Another issue which can be analyzed with the resulting evidence is whether the manufacturing and mining sectors show a different pattern of behavior. A priori, our model might be expected to perform worse in mining, on the grounds that the firms in this sector tend to have a greater proportion of public ownership than in manufacturing for developing countries. A more heavily state-owned mining sector may behave less in a profit-maximizing way, the argument follows, and thus wages should be less significant in explaining employment.

The results obtained show some support for this latter idea but not for the structuralist view. In fact, 9 out of the 12 countries present a negative contemporaneous association between real wages and employment for the manufacturing sector, 7 of them significant. In a suggestive coincidence with Krueger's (1978) study, those countries which present the wrong sign of the wage coefficient according to the model were precisely those more heavily reliant on quantitative -as opposed to price- restrictions to trade (India and Turkey) or those which experienced repeated attempts of liberalization, none of which endured (Chile). Krueger's study is the only comprehensive comparative analysis of trade regimes covering 7 out of the 12 countries considered here, with a similar -but shorter- sample period than ours. In the mining sector (reduced to 9 countries

(1978)) extends this characteristic to the whole tradeable sector. For a formal treatment of structuralism see Taylor (1982).

because of data availability problems) 6 out of 9 cases reflect a negative real wage effect on employment, but this influence is significant in only 3 of them. Furthermore, adjustment costs in labor appear to have a more important role in manufacturing than in mining.

Theory also predicts that if real wages are highly autocorrelated employment will strongly respond to the current wage because a wage change will then be considered as permanent by agents. When real wages are not highly autocorrelated, on the other hand, firms will not find optimal to adjust significantly their use of labor services when the wage changes, assuming the existence of increasing marginal adjustment costs in labor hiring and firing. Even if a formal test of this prediction is not possible, a simple correlation test shows the expected relationship between wage and labor adjustment in both manufacturing and mining; however, the significance of the estimated correlations is questioned under certain assumptions.

As an extension of the model, the influence of world demand on employment is analyzed. The results show a generally weak effect of this variable in manufacturing and a totally insignificant effect of it in mining for the individual countries. As an implication, the small country model seems an adequate representation for most of the cases.

The paper is organized as follows. Section 2 presents the model and discusses the implications derived from its underlying assumptions. Section 3 briefly analyzes the countries and the data, while section 4 focuses on estimation strategies and presents the results. An extension of the model to include the world demand variable is pursued in section 5 and, finally, section 6 states the conclusions and policy implications.

2. The Model.

In what follows we develop a simplified version of Sargent (1978), where labor demand is the result of intertemporal optimization by firms. It should be kept in mind from the outset, as Sargent states it, that "...rational expectations, optimizing agent models will not be able to save us entirely from the ad-hoc assumptions and interpretations made in applied work."[3]

Since our aim is empirical application it is better to work in discrete time. Other authors like Morrison (1983) develop a continuous model and when it comes to econometric work they take the discrete time equivalent of the resulting equations. This is a very questionable procedure, and particularly so when the periods are a year long.

However, even in the discrete time version we have to assume away some important problems, like aggregation from the firm level to the industry level. In addition, we will assume that the technology describing the production process is quadratic, with labor as the only variable input. The presence of uncertainty is reflected in a multiplicative random shock affecting the marginal productivity of labor. There also exist adjustment costs for labor which are associated with hiring and firing.

Thus, our representative firm will maximize at time t the expected present value of future profits (V_t)

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[3]Sargent (1978), p. 1025.

$$(1)\ V_t = E_t \sum_{j=0}^{\infty} b^j\{x_{t+j}-(d/2)(n_{t+j}-n_{t+j-1})^2-w_{t+j}n_{t+j}\}$$

subject to

$$(2)\ x_{t+j}=(f_0+a_{t+j})n_{t+j}-(f_1/2)n_{t+j}^2$$

where (all the variables with time subscripts)

E_t=expectation conditional on information available at time t

a=random shock to the marginal productivity of labor

x=volume of production

b=1/(1+r)=the discount factor, assumed given and constant

d=the adjustment cost parameter

w=real wage

f_0, f_1=constants

Some additional comments on the above formulation are required:

(i) Adjustment costs are assumed to be convex. Only in this case will a desired increase in the amount of labor services be spread over time. If, on the other hand, adjustment costs were linear, labor services would be adjusted in one period.[4]

(ii) The problem has been expressed in real terms, everything being measured in units of output. In our context this implies that the real

[4]Nickel (1984) provides a good discussion of adjustment costs for labor.

wage summarizes all the relevant information about prices to the firm.

Thus, it is necessary to define the real wage. Since we are dealing with labor demand the correct measure is the product wage, that is, the wage in terms of the price of output. This stands in contrast to Sargent (1978), who uses the CPI to deflate nominal wages, but agrees with the spirit of Geary and Kennan (1982) and Sachs (1982), although we end up using a different measure. Further details on this issue are discussed in the next section.

(iii) The model is formally stated as a partial equilibrium one. Nonetheless, our implicit division of the economy in two sectors (tradeables and nontradeables), which defines our product wage to be measured in terms of tradeables, captures some flavor of a general equilibrium analysis. In a two-sector model with labor as the only input, although in a static context, Dornbusch (1974) showed the equivalency of analyzing things in terms of relative prices (P_N/P_T) or in terms of the product wage (W/P_T).

To solve the model we replace equation (2) in (1) to obtain the expression to maximize,

$$(3)\ V_t = E_t \sum_{j=0}^{\infty} b^j \{(f_0+a_{t+j})n_{t+j}-(f_1/2)(n_{t+j}^2)-(d/2)(n_{t+j}-n_{t+j-1})^2-w_{t+j}n_{t+j}\}$$

which gives rise to the set of first order conditions

$$(4)\quad f_0+a_{t+j}-f_1n_{t+j}-d(n_{t+j}-n_{t+j-1})+dbE_{t+j}(n_{t+j+1}-n_{t+j})-w_{t+j} = 0 \qquad (j=0,1,\ldots)$$

The solution for the maximization of (3) is given by the set of Euler equations in (4) which state that the marginal productivity of labor has to be equated in every period to the additional adjustment costs provoked by an extra unit of labor and the real wage payed for it. Two boundary conditions are further required: an initial predetermined level of labor services, and the transversality condition written below

$$(5)\quad \lim_{T\to\infty} E_t b^T\{f_0+a_{t+T}-f_1n_{t+T}-d(n_{t+T}-n_{t+T-1})-w_{t+T}\}=0$$

Equation (5) is essentially a requirement for the present value of the firm to be defined in the finite and positive range. For (5) to be met we need that the series $\{w_{t+j}\}$ and $\{a_{t+j}\}$ be of exponential order smaller than 1/b, which we will assume.

Now, (4) is a second order differential equation in employment and it may be rewritten as

$$E_{t+j}n_{t+j+1}\{1-(1+1/b+f_1/bd)L+L^2/b\}=(1/bd)(w_{t+j}-f_0-a_{t+j})$$

where L is the lag operator.

The term in brackets in the latter expression may be factorized as

$$\{1-(1+1/b+f_1/bd)L+L^2/b\}=(1-\lambda_1L)(1-\lambda_2L)$$

As long as $f_1>0$ it may be shown that $\lambda_1<1$ and $\lambda_2>(1/b)>1$, where λ_1 is the smaller root above.[5] To satisfy the transversality condition the unstable root must be used to solve forward, so that the optimum solution for employment at time t is given by

$$(6)\ n_t = \lambda_1 n_{t-1} - (\lambda_1/d) \sum_{j=0}^{\infty} (1/\lambda_2)^j E_t(w_{t+j} - f_0 - a_{t+j})$$

In order to make (6) operational for empirical implementation it is necessary to specify a process for both wages and the productivity shock. We assume w_t to be a first order autorregressive process of the form

$$(7)\ w_t = c_0 + c_1 w_{t-1} + e_t$$

The specification of equation (7) is clearly arbitrary, since other variables such as the unemployment rate can be expected to have an effect on wages besides from the lagged value of wages itself. Even if we acknowledge this limitation there are two main reasons to choose a simple form as (7):

(i) The lack of a comprehensive and coherent set of data on other variables for some of the countries in the sample.

(ii) More importantly, even if data could be found, a more complex

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[5]See Sargent (1979), p. 197.

form for (7) enormously complicates the solution of the expectational component of equation (6).

Thus, (7) is principally chosen for practical reasons. This is a clear trade-off, since in order to have employment as an intertemporal optimizing solution we have to give up a better choice for wages. Other possible avenue which has not been pursued here is to work with a more complex equation of wage determination and drop the optimal dynamic framework for employment. This is just one more illustration of the fact that rational expectations models can not escape from the ad-hoc assumptions made in empirical work.

Under the above conditions equation (6) gets finally reduced to

(8) $n_t=\{(\lambda_1/d(1-k))(f_0-c_0k/(1-c_1k))\}+\lambda_1 n_{t-1}-(\lambda_1/d(1-c_1k))w_t+\eta_t$

where $k=(1/\lambda_2)=b\lambda_1$ and $\eta_t=(\lambda_1/d)a_t$

The system to estimate is composed of equations (7) and (8). However, both the employment and wage series will be demeaned and detrended before estimation; the model will thus be fitted to the residuals of a regression of the corresponding variables on a constant, a time trend and a time-squared term. This is a standard procedure to account for the absence of capital and productivity measures in the model.[6] Consequently, constants may be dropped from (7) and (8) to get

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[6]Sachs (1982), Sargent (1978).

(9) $w_t=c_1w_{t-1}+e_t$

(10) $n_t=\lambda_1n_{t-1}-(\lambda_1/d(1-c_1k))w_t+\eta_t$

We notice from the outset that the system in its current form does not allow us to identify the structural parameters of the model (c_1,λ_1,d and k); c_1 and λ_1 are appropriately recovered from the above equations but it is not possible to use c_1 and λ_1 to identify d and k. We will proceed with the standard assumption of assuming a given real rate of discount, which will be set at 5%. This immediately fixes the value of k in terms of λ_1 ($k=0.95\lambda_1$) and allows d to be identified, as may be verified from the factorization prior to equation (6). Equation (10) can now be expressed as

(10') $n_t=\lambda_1n_{t-1}-(\lambda_1/d(1-0.95\lambda_1c_1))w_t+\eta_t$

Equations (9) and (10') contain the two main points on which the analysis will focus:

(i) The model predicts a negative coefficient of the contemporaneous wage in the employment equation, as should be expected since (10') is really the labor demand of expected-profit-maximizing firms. This prediction can simply be tested by estimating the reduced form of the model.

(ii) A second prediction of the theory stems from the cross-equation restriction between (9) and (10'), which is a simple and intuitive one. The presence of c_1 in equation (10') implies that the higher the autorregressive coefficient in the wage equation, the higher the contemporaneous wage coefficient in the employment equation, ceteris paribus. That is, if the real wage is highly autocorrelated, then employment will strongly respond to the current wage because a wage change will be considered more as a permanent change by agents. In other words, the existence of increasing marginal costs of hiring and firing labor tells rational, farsighted entrepreneurs not to adjust employment significantly when a wage change is regarded as transitory.

A formal test of the latter hypothesis would require the presence of overidentifying restrictions in (9) and (10'). However, the system becomes just identified when the cross-equation restrictions are imposed. This implies that we will be able to recover the structural parameters we are interested in, but it will not be possible to formally test the hypothesis in question using the data on a country by country basis. An alternative test based on cross-country data is discussed and performed in section 4.

3. Countries, data and further discussion.

Our aim is to do an international comparative study of the employment-real wage relationship for a group of developing countries. With respect to their choice, the attention was directed principally at Asia and Latin America, to countries of average to large size with a sizable foreign trade sector. The threshold level of GDP was put in U.S.$10 billion. Beyond these considerations, the final group of countries was mainly determined by data availability, which was an important constraint for this study.

The 12 countries analyzed are: Chile, Colombia, Ecuador, Mexico and Venezuela in Latin America, Hong-Kong, India, Israel and Korea in Asia, and Turkey in Europe. All of them presented data for the manufacturing sector, but Mexico, Venezuela and Hong-Kong failed to do so for mining. The target sample period was 1955-82 for all them, but very few countries had data for all these years; this forced us to work with a different period for each country, that is, the available years between 1955 and 1982.

In order to get a general comparative idea about these countries Table 1 shows data on GDP, GDP per-capita and exports for the years 1960, 1970 and 1980. Regarding the latest GDP figures, economies range from Singapore's $11 billion to Mexico's $186 billion; with respect to GDP per-capita India is at the lower end of the scale with $241 while Israel is on top with $5431. If the ranking is done according to exports, it is quite astonishing to see that Singapore

TABLE 1

GDP, GDP per capita and total exports. Selected years.*

	GDP			GDP per capita			Exports		
Country	1960	1970	1980	1960	1970	1980	1960	1970	1980
Chile	2261	8081	28081	294	862	2530	488	1249	4671
Colombia	3893	7103	33508	253	346	1237	465	736	3945
Ecuador	943	1674	11368	216	281	1361	146	221	2481
Hong-Kong	1065	3170	21618	348	801	4264	689	2514	19720
India	31590	56684	159831	74	100	241	1332	2026	8536
Israel	1986	5603	21019	939	1886	5431	217	779	5530
Korea	3767	8588	58246	153	266	1528	33	835	17505
Mexico	12041	35552	186331	334	701	2591	765	1403	15570
Philippines	6729	6999	35487	245	190	733	624	1041	5741
Singapore	706	1896	10982	432	916	4595	1136	1554	19735
Turkey	5678	12796	56886	207	362	1266	321	588	2910
Venezuela	7633	11624	60021	1043	1131	4315	2305	2623	19221
World							118300	286800	1878700

* All figures in U.S.$ millions, except for GDP per capita, expressed in U.S.$.

Sources: U.N., Yearbook of National Account Statistics (1981)
I.M.F., Yearbook of International Financial Statistics (1984)

ranks in first place with almost $20 billion, or approximately twice her GDP. A high ratio of exports to GDP is a common characteristic of Singapore, Hong-Kong and Korea, members of the so-called "gang of four", although more impressively so in the first two (which are largely entreport economies). In addition, around 90% of their exports are manufacturing goods.

All the nominal wage data were taken from the Yearbook of Labour Statistics[7] of the International Labor Office. It very usually happens in empirical work that a compromise has to be made between what are the best theoretical measures for a variable and what is actually available; this study is not an exception to the rule. Thus, in dealing with labor demand the wage measure should reflect the incremental cost to the firm of hiring additional units of labor services, rather than workers' earnings. Unfortunately, only the latter measure was available for our sample period and this is the one we used. This would not be a serious problem if the proportion of total cost to earnings per unit of labor services were roughly constant through time. Sachs (1982) has presented evidence that this proportion has in fact been rising over time for industrialized economies. Although a similar trend may be suspected for our group of countries we do not have consistent evidence to support it. Another issue with respect to the wage data relates to the unit of time for which labor

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[7]Except for manufacturing employment in Mexico, taken from the Yearbook of Industrial Statistics, United Nations.

cost is measured. Ideally it should be a per-hour figure since the optimum measure of employment, as discussed hereafter, is total number of hours worked, but only in very few cases was this available. Table 2 describes the data in detail.

With respect to the employment data, the theoretically correct measure is total hours of labor services employed rather than the total number of workers, as Sachs (1982) has clearly emphasized. "It is recognized that when a rise in real wages results in a fall in employment this may be manifested in a decline in hours per employee, or in the number of employees, or both."[8] Nonetheless, hours of work were only available for less than half of the countries during the sample period, and so we had to go through with the "second best" measure of number of employees.

In spite of its limitations, these data seem to be the most coherent and standarized figures available for this group of developing countries. In addition, particular care was taken towards the consistency of the data for each sector; if employment is made dependent on the real wage in a regression, the two variables should come from the same population. Geary and Kennan (1982) were either less careful or more constrained by data availability in this respect; in Austria, Belgium, Denmark and Holland employment and wages were not measured for the same group of industries.

[8]Sachs (1982), p.2.

TABLE 2

Employment and wage data.

Country	Manufacturing		Mining	
	Employment	Wages	Employment	Wages
Chile	wage earners	monthly erngs. includes pmts. in kind		monthly erngs. includes pmts. in kind
Colombia		hourly erngs.	7 main cities	hourly erngs. oil extraction
Ecuador		hourly erngs.		hourly erngs.
Hong-Kong	all persons engaged	daily erngs.		
India	employees and working owners	monthly erngs.	employees and working owners	weekly erngs. coal mining
Israel	employees incl. mining and quarrying	daily erngs. prior to 1975, excl. pmts. in kind	employees	monthly erngs. prior to 1975, excl. pmts. in kind
Korea	wage earners and salaried employees	monthly erngs. incl. pmts. in kind and family allowance	wage earners and salaried employees	monthly erngs. incl. pmts. in kind and family allowance
Mexico	employees	hourly erngs.		
Philippines	employees	monthly erngs.	employees	monthly erngs.
Singapore	wage earners and salaried employees	hourly erngs.	wage earners and salaried employees	hourly erngs.
Turkey	employees	daily erngs.	registered employees	daily erngs.
Venezuela	employees	monthly erngs.		

Having the nominal wage data carries us only half the way through; we need a series of product wages. The ideal index to use for this purpose is a sectoral wholesale price index for manufacturing and mining, which unfortunately we have not found available. Three other indexes can also be used, all of them being second best measures for different reasons:

(a) The general wholesale price index (WPI), which has the problem of including other traded goods that we are not interested in, as well as nontradeables. Also the WPI tends to be heavily weighted towards primary and intermediate commodities.

(b) The value-added sectoral GDP deflator (GDF in short) has the disadvantage of the difficulty of correctly measuring value-added by sector. The accuracy of this index seems particularly questionable in developing countries.

(c) Since manufacturing and mining are both tradeable sectors, another possible choice is a relevant foreign price for each sector, adequately adjusted by the nominal exchange rate. The weakness of this measure is that it does not capture the effects of trade policy on internal prices, as will be discussed in detail later.

Data availability has to be also taken into account. If the WPI is used we would have to drop from our study 4 countries in manufacturing and 3 in mining because either the sample period is drastically reduced , or because WPI is simply not available. GDF, on the other hand, makes us drop for the same reason 3 countries in manufacturing and 2 in mining; it is available in the rest of the cases only from 1960. This latter issue forces us to drop about 20% of the observations for most of the remaining countries, a significant cost in light of our already reduced sample. The exchange rate based measure has the advantage in this respect of not being a limitation in terms of availability.

In any case, regressions were also run using the WPI and GDF measures, when available for similar periods as the third index. Except for one case, discussed in detail later on, no significant improvement appeared on the results. In addition, those countries which did not conform to the model under the exchange-rate-based measure also failed to do so with the other indexes.

In light of the above discussion we will relate the internal price of manufacturing and mining goods to the world price through a type of purchasing parity rule. Thus, we may write

(11) $P_{ma}=P_{ma}^{*}E \quad ; \quad P_{mi}=P_{mi}^{*}E$

where the subscripts ma and mi stand for manufacturing and mining, P for price, E for the nominal exchange rate and * denotes a world variable. Product wages (w) are then defined as

(12) $w_{ma}=W_{ma}/P_{ma}^{*}E \quad ; \quad w_{mi}=W_{mi}/P_{mi}^{*}E$

where W is the nominal wage.

Even if the nominal exchange rate is common for manufacturing and mining in a given country, the relevant world price variable will differ across the two sectors. Several other considerations affect the construction of (11) and (12).

(i) Manufacturing: This sector produces two broad types of goods, exportables and import substitutes, which in our work have been implicitly treated as a composite commodity. This is, of course, a simplification since there is no presumption that the relative price between these two groups of goods has been maintained constant during the period of analysis. In particular, trade policy has not been considered in this measure of product wages not because the author considers it unimportant, but because its appropriate inclusion would require a comprehensive work such as the National Bureau of Economic Research's project headed by Bhagwati and Krueger, which is totally beyond our scope. Nonetheless, we will relate our conclusions to theirs.

The relevant world price of manufactures is taken as a geometric average of an export price and a price of import substitutes. Since at this level of aggregation there are no readily available measures of prices we will use unit value indexes[9] and so we define

(13) $P_{ma}^{*}=(UMAXD)^{0.5}(UMAXI)^{0.5}$

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[9]A unit value index is a less desirable measure than a price index because it weights the prices of the individual goods by quantity volumes rather than by money values.

where UMAXD=unit value of manufacturing exports from developing
countries to the total world

UMAXI=unit value of manufacturing exports from industrialized
countries to developing countries

The weights for both exportables and import substitutes have been assumed as 0.5 for all countries, in the face of the impossibility of determining the appropriate weights for each of the 12 countries. Further, the use of UMAXI assumes that most of the import substitution in developing countries occurs toward products coming from industrialized countries.

(ii) Mining: Aggregation problems in this sector are less serious since mining activity, especially in LDC's, tends to be concentrated on a few commodities, one of which typically plays a strong dominant role. In the case of India the data referred to coal mining and thus the average wholesale price of coal[10] was used as P_{mi}^*. Colombia's figures were for petroleum extraction, leading us to use the price index of mineral exports (whose main component is crude petroleum) from developing countries.[11] Unfortunately, the rest of the countries do not provide information about the types of products comprised in their data and thus we have to study each case on an individual basis. The source used for this investigation was the United Nations Yearbook

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[10]Source: Commodity Yearbook.
[11]Source: U.N. Statistical Yearbook.

of International Trade Statistics.

In Chile and Philippines the most important mining commodity is copper and thus the choice was the export price index of non-ferrous base metals (NFBM) from developing countries.[12] Ecuador is a heavy exporter of oil but the employment data does not seem to be from oil extraction since the number of employees reported has declined by approximately two thirds between the oil price shock (1973) and 1981.[13] Israel's biggest export is processed diamonds (32% of total exports in 1980) but its primary material is to an overwhelming extent imported (13% of imports in 1980); it does not appear to exist another prominent mining activity. The other countries have a tiny extractive sector and no commodity seems to be dominant on it.

The two broad choices for P_{mi}^* in the mining sector of developing countries are a price index of mineral exports and the NFBM index. Since Israel, Korea, Singapore and Turkey are heavily dependent on oil imports (the main component of the former index) and given the situation for Ecuador, we finally decided to use the NFBM index for all them. All of these countries except Ecuador show exports of some significance in non-ferrous base metals (especially Singapore).

Finally, the resulting data on product wages and the employment figures were converted to an index with base 100 in 1970.

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[12]Source: U.N. Statistical Yearbook.

[13]Moreover, when an index comprising oil was used to deflate wages, the results of the employment regression worsen considerably, tending to confirm this argument.

4. Estimation techniques and results.

Our first step will be to estimate the reduced form of equations (9) and (10') which are reproduced below, the latter one in a slightly modified version. We recall that the model will be fitted to data which are deviations from means and trends.

(9) $w_t=c_1w_{t-1}+e_t$

(11) $n_t=\beta_1n_{t-1}+\beta_2w_t+\eta_t$

An obvious alternative is to estimate (9) and (11) separately by ordinary least squares (OLS). Nonetheless, since equation (11) has been obtained by making use of (9), another possible choice is seemingly unrelated regression (SUR). This technique, originally suggested by Zellner (1962), provides more efficient estimates whenever exists some correlation between the disturbances of a group of equations. In other words, SUR operates under the assumption -just as OLS- that the error terms within each equation are identically and independently distributed, but allows -unlike OLS- the disturbances to be contemporaneously correlated across equations.

However, the application of SUR by itself to (9) and (11) is based on the belief that the error terms of both equations are correlated. If this is the case SUR will provide inconsistent estimates of the parameters of the model because one of the right hand side variables in (11), w_t, will be correlated to the disturbance of that equation, as can be readily verified.

One further and related issue arises because (11) has been derived as a labor demand schedule, and thus the danger appears that wages may have been determined endogenously by the interaction of supply and demand in the labor market. In this case we would have the classical simultaneous equation problem, which bias the estimates of the coefficients.

Two types of arguments can be raised at a conceptual level against the existence of simultaneous equation bias in the model:

(i) The relevant variable for labor supply is the real wage, measured in terms of a basket of goods that includes tradeables as well as nontradeables. However, the variable being used here is the product wage, the one relevant for labor demand decisions. This point is even stronger for mining, which has a negligible weight in the consumption basket (except when oil is included).

(ii) Unemployment is usually high in developing countries, where figures in many cases climb to the two-digit level. In such a scenario, labor supply will be a fairly flat curve over the relevant range and our data can be safely taken as points along a labor demand schedule; no identification problem arises. This argument, however, neither applies equally to all countries in our group, nor homogeneously through time for a given country. On the one hand, economies like Hong-Kong, Korea and Singapore had average unemployment levels below 5% during the seventies, even though substantially higher levels during the sixties. On the other extreme, Chile had an average unemployment rate of 10.38%, and Colombia was close to 10%, during the seventies.

Both conceptual arguments, however, do not settle the issue. We will thus estimate the model jointly with the SUR method but at the same time using instrumental variables to avoid the potential problems of simultaneity. This amounts to a three-stage least squares procedure.[14] The usual problem in these situations is finding a variable which is highly correlated with the current wage, but uncorrelated with the disturbance term. A standard candidate would be the lagged wage, which receives additional support from equation (9), and this is the one selected.

The results for the manufacturing sector are presented in Table 3. It is possible to observe that 9 out of the 12 countries present a negative coefficient in the employment equation, significant in 7 of the cases.[15] We notice that for Philipines the exchange-rate deflated product wage produced an insignificant coefficient; then, the wholesale price index was tried as a deflator and this is the result reported. In fact, the WPI was tried as an alternative to (P_{ma}*E) for all the countries; only in Philippines did an improvement occurred. In Israel the coefficient, although negative, is quite small and

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[14]Zellner and Theil (1962).

[15]Six of them significant at the 95% level and one (Venezuela) at the 90% level.

TABLE 3

Manufacturing results: three stage least squares.

Country	Sample	wage equation (9)		employment equation (11)			
		w_{t-1}	D-H	n_{t-1}	w_t	D-H	w_{1r}
Chile	61-77	0.4086 (1.8265)	0.7556	0.4495 (2.9428)	0.1303 (2.7831)	-0.0450	0.2367
Colombia	57-80	0.8023 (6.5641)	3.1042	0.7451 (6.6241)	-0.0694 (2.3122)	0.1177	-0.2723
Ecuador	58-80	0.4346 (2.1920)	3.2773	0.6640 (5.0653)	-0.2639 (2.2756)	-0.3981	-0.7854
Hong-Kong	65-80	0.6820 (3.4450)	2.7369	0.3912 (1.8052)	-0.4501 (2.4591)	1.6785	-0.7395
India	57-80	0.5948 (3.6718)	2.5676	0.6323 (5.7261)	0.1356 (3.6766)	1.8509	0.3668
Israel	56-79	0.3792 (1.9787)	1.2774	0.5514 (2.4448)	-0.0832 (0.2876)	1.1671*	-0.1855
Korea	64-80	0.5239 (2.4537)	3.9194	0.5400 (1.4590)	-1.2420 (2.1714)	1.3355*	-2.7000
Mexico	56-80	0.8329 (7.3101)	-0.6496	0.3203 (1.9662)	-0.8939 (3.9207)	1.3613	-1.3151
Philippines	56-80	0.7580 (5.8449)	1.6614	0.8138 (7.5413)	-0.1639 (2.5516)	0.7869	-0.8802
Singapore	56-79	0.5707 (3.3617)	0.6066	0.6362 (4.3971)	-0.4108 (0.9978)	2.4757	-1.1291
Turkey	56-79	0.6064 (3.7466)	2.3561	0.6913 (3.9802)	0.0449 (0.5167)	1.5740	0.1454
Venezuela	65-78	0.5594 (2.6265)	1.2196	0.7718 (5.6789)	-0.4013 (1.9091)	1.3115	-1.7585

Notes: (i) Coefficients are reported with t-tests in parentheses.
(ii) D-H is the Durbin-H statistic. A star over a number implies that D-H was imaginary and Durbin-Watson is reported.
(iii) Mexico's figures shown are estimated by OLS since the standard errors and the coefficients were in the tens of thousand for 3SLS.
(iv) The column below w_{1r} reports the long run elasticity of employment witn respect to wages, evaluated in 1970.

insignificant. This may be due to the fact that Israel is the only country whose manufacturing data included mining and quarrying. Since the calculation of the product wage in this sector involved the use of a manufacturing price index, our measure has additional noise due to this factor. The wage coefficient in Singapore, even if negative and among the higher in the group, is not significant. The other 3 countries (Chile, India and Turkey) present a positive wage coefficient, contrary to the model's prediction (and significant for two of them). It will be sustained that it was precisely the neglect of trade policy which is the principal reason for this result.

The problem with trade policy arises because tariffs are not the single and nor even the most important restriction to trade. Developing countries have been extremely prolific in implementing all sorts of quantitative restrictions (quotas, previous deposits for imports, lists of prohibited imports, etc) which are very hard to quantify. All these policies have a direct impact on the internal price of tradeable goods that is not captured by our exchange rate based measure. Thus, the model should be expected to perform less well in countries which were more heavily reliant on quantitative -as opposed to price- restrictions, and/or those on which trade policy has fluctuated widely over time. The only comprehensive comparative study of trade regimes covering 7 out of these 12 countries for a considerable fraction of our sample period provides substantial support to the previous argument. Indeed, Krueger's (1978) summary of the individual country studies asserts that the combined experience of the 10 countries analyzed falls roughly into three cathegories:

(i) Those starting initially from a quantitatively-restricted scenario, which moved over time towards greater reliance on price measures. It included Colombia, Israel and South Korea. The Philippines also belonged to this group, although to a lesser extent because of a resumption of quantitative restrictions in the late sixties.

(ii) Countries which repeatedly attempted trade liberalization, coming back to protectionism every time (Chile and Ghana).

(iii) Economies heavily reliant on quantitative restrictions, with only infrequent, short-lived liberalization episodes (Egypt, India and Turkey).

The pattern outlined in this classification is entirely consistent with our results for the common countries. The Philippines did not conform to the model under the exchange rate deflated wage but did so under the WPI measure, which has a better chance of capturing trade policy changes. Chile cycled back and forth between liberalization and protectionism, thus provoking substantial changes in the internal terms of trade between exportables and import substitutes; this is not captured by our product wage measure and apparently defeats our aggregation attempt. India and Turkey, appart from sporadic liberalization efforts were heavily reliant on non-price policy measures.

It is nonetheless true that our coefficients capture only the average influence of the product wage on employment during the sample period. Ideally, one would like to compare the behavior of the model in different sub-periods, somehow corresponding to those identified in the Krueger study. The availability of very limited annual data does not allow us to attempt this task.

The autocorrelation measure used is the Durbin H statistic, since the Durbin-Watson test is biased toward 2 when lagged dependent variables appear in the right hand side. Six out of the 12 countries present signs of first order autocorrelation in the error term for the wage equation (Colombia, Ecuador, Hong-Kong, India, Korea and Turkey). It is important to notice that the Durbin H statistic is strongly influenced by the standard error of the estimated coefficient for the lagged dependent variable, and the estimation by instrumental variables increases that standard error. As an exercise, the model was estimated by SUR (running the risk of inconsistency) to find that autocorrelation is significantly reduced and disappears in three of the six cases. Another issue regarding this statistic is that it is asymptotically distributed as normal; given the size of our sample, the Durbin H test can only be regarded as an approximation. The employment equation performs much better on this respect since only 2 of the 12 countries (Israel and Singapore) show signs of potential autocorrelation.

The size of the wage effect on employment can also be analyzed from these results. Since the model has not been estimated in logarithms, elasticities vary through the sample. We recall that both the product wage and employment were converted to an index with base equal to 100 in 1970. Thus, the wage coefficient in equation (11) can be directly interpreted as the (short run) elasticity of employment with respect to wages evaluated in 1970. Because the option of evaluation is essentially arbitrary, further analysis will be based for simplicity on this measure.

If we focus on the cases where the sign of the elasticity is correct according to the model, the employment response to a 10% decrease in the product wage ranges from a 0.69% increase in Colombia to a 12.42% gain in Korea, revealing a large cross-country variability. Other countries where the response is relatively high are Mexico (8.94%), Hong-Kong (4.5%), Singapore (4.11%) and Venezuela (4.01%). These are, however, short run effects. Our model also allows us to calculate the long term elasticity of employment with respect to wages by subsequent substitution of lagged employment levels in equation (11). The resulting values for this variable are also reported in Table 3, on the column under w_{1r}. A 10% reduction in the product wage provokes long run employment gains of 27% in Korea, 17.59% in Venezuela 13.15% in Mexico and 11.29% in Singapore. At the other end of the spectrum we find more modest gains in Colombia (2.72%) and Israel (1.86%).[16]

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[16] Any conclusion for Singapore and Israel is highly tentative, since in both countries the wage coefficients were not significant and both present signs of potential autocorrelation in the employment

It is apparent that the short and long term rankings do not coincide. In some countries the short run gain is relatively modest when compared to the long run outcome, most notably in Philippines and Venezuela. In others, like Hong-Kong and Mexico, most of the employment effect is felt in the short run. These differences are due to the fact that the effects of lagged wages on current employment depends on the persistence in the latter series, which varies across countries.

Turning now to the mining results in Table 4, we observe a very similar sign pattern as in manufacturing,[17] since 6 out of the 9 countries show negative wage coefficients in the employment regression. This correspondence is, however, not exact since now India performs according to the model while Korea does not. Nonetheless, it is at least suggestive that Chile and Turkey belong once again to the group with the wrong sign in the wage coefficient, which is though insignificant for all the members of the group.

However, even if the sign pattern generally agrees with the predictions of the model in 6 countries, only 3 of them have also significant wage coefficients. A rough evaluation of the model according to this will allocate a 33.3% (3/9) "success" rate in mining, compared to a 58.3% (7/12) rate in manufacturing. This can be

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equation.

[17]Data availability problems forced us to drop Hong-Kong, Mexico and Venezuela.

TABLE 4

Mining results: three stage least squares.

Country	Sample	wage equation (9)		employment equation (11)			
		w_{t-1}	D-H	n_{t-1}	w_t	D-H	w_{1r}
Chile	61-77	0.3891 (1.7479)	0.7526	0.5066 (1.6673)	0.1316 (0.8795)	1.4858*	0.2667
Colombia	57-78	0.8320 (6.9550)	2.4805	0.3083 (1.5294)	-0.5177 (3.2059)	1.4391	-0.7484
Ecuador	58-81	0.4399 (1.7227)	1.5004*	0.5578 (3.5016)	-0.3100 (1.0016)	1.6731	-0.7010
India	56-81	0.6781 (5.3528)	-0.8800	0.8955 (13.8359)	-0.1891 (3.5074)	1.3310	-1.8096
Israel	59-78	0.5030 (2.7184)	0.5122	0.4458 (3.2471)	-0.1734 (2.9516)	2.2131	-0.3129
Korea	64-81	0.5597 (3.3392)	1.8882	0.7209 (4.4204)	0.1165 (0.7960)	1.7000	0.4174
Philippines	57-75	0.3501 (1.8735)	1.6749	0.7287 (4.5082)	-0.0888 (1.6093)	0.4978	-0.3273
Singapore	59-79	0.3734 (2.0098)	1.0077	0.2276 (0.9915)	-1.0229 (1.2415)	2.2327*	-1.3243
Turkey	57-79	0.2914 (1.6654)	3.0243	-0.0809 (0.2826)	0.0371 (0.1348)	1.8848	0.0401

Notes: Id. as (i), (ii) and (iv) in Table 3.

interpreted as evidence in favor of the argument of weaker profit maximizing behavior in the mining sector as compared to manufacturing.

Looking at the wage equation, autocorrelation is suggested only in the wage equation for Colombia and Turkey, whereas just Israel shows mild signs of this phenomenon in the employment regression. Overall, first-order serial correlation in the residuals is weaker in this sector as compared to manufacturing, most notably in the wage equation. A plausible explanation for this behavior is that aggregation attempts are less successful in manufacturing than in mining, as has been argued before.

Once again, the short run employment response to changes in the product wage can be analyzed from the wage coefficients in the employment equation, adequately interpreted as elasticities evaluated in 1970. A 10% reduction in the product wage provokes an employment gain ranging from 0.88% in Philippines to 5.18% in Colombia and 10.23% in Singapore. The long run response is now headed by India (18.1%), Singapore (13.24%) and Colombia (7.48%), with Philippines (3.27%) and Israel (3.13%) on the lower end. Once more, both rankings differ since some countries, like Singapore, enjoy most of the gain in the short run while others, most notably India, have a substantial lagged effect of the product wage on employment.[18]

[18]The conclusions for Ecuador, Philippines and Singapore are tentative due to the lack of significance of the wage coefficient on their employment equation.

It is important to emphasize, keeping in mind the seminal contribution of Lucas (1976), that our analysis has been based on reduced form coefficients which are stable through time only if the relevant structural parameters of the model are also stable. In particular, for the wage coefficient to be stable it is necessary that the adjustment cost parameter (d), the real discount rate (b) and the autorregressive wage coefficient be either stable or move in a compensated way, as is evident from equation (8).

Looking now at the structural coefficients in equation (10) we have already pointed out that the higher the autorregressive term in the wage equation, the higher the contemporaneous wage coefficient in the employment equation should be, ceteris paribus. To test this hypothesis formally it is necessary to have at least one overidentifying restriction. However, the model is just identified for each country when the cross-equation restrictions are imposed, preventing us from carrying out the formal test.

An alternative testing method, although clearly a second best, would be to constrain the adjustment cost parameter (d) to be the same across countries but let the other parameters differ, in addition to the cross-equation restriction within each country. This would be the constrained model, which is to be tested against the totally unconstrained linear model in a nested way. This involves a test of two joint hypothesis: the presumed relation between the autorregressive wage coefficient and the contemporaneous wage coefficient in the employment regression, and the coincidence of d across countries. In any case, this test will imply joint estimation of the model for the whole group of countries, which constrains to use a common sample period: 1965-77 in manufacturing and 1964-75 in mining, leaving us with too few observations to extract meaningful conclusions.

A third and last alternative is the simple test of computing the straight correlation statistic between the two coefficients we are interested in for each sector, across countries. If correlation turns out to be positive, then our structural model receives some support. Nonetheless, this is inconclusive evidence since the two reduced form coefficients are not uniquely related. If we look at equations (9), (10) and (11), it may turn out that c_1 is high while β_2 is low not because the model is not correct, but because, say, d is high. Conversely, it may happen that both coefficients are high, but β_2 has been "helped" by a low d. With this caveat in mind we go ahead to perform this test.

The calculated correlation statistic between c_1 and β_2 is of 0.2040 for the manufacturing sector, showing the expected sign according to the hypothesis implied by the model that a high autorregressive wage coefficient should go together with a high wage coefficient in the employment equation. On intuitive grounds, if the product wage change is interpreted as permanent, employment should strongly react to the current wage.

It remains to be asked if this positive correlation coefficient is significant. If we are willig to assume that the two sets of estimated coefficients come from a normal bivariate population, then we can define a variable z such that[19]

$$z = (1/2)\ln\{(1+\rho)/(1-\rho)\}$$

where ln is the natural logarithm and ρ is the sample correlation coefficient.

Now, z is asymptotically normally distributed and its variance is given by

$$Var(z) = 1/(n-3)$$

with n being the number of observations.

The value of z for manufacturing is 0.2069 and its standard error is 0.3333 leading us to conclude that the correlation coefficient is not signifficant.

The mining sector also presents a positive correlation statistic of 0.1543. With this z takes the value of 0.1555 and its standar error is 0.4082, thus implying that the estimated coefficient is insignificant.

In summary, both manufacturing and mining show the expected sign in the correlation statistic. However, under the assumption of joint normal distribution these coefficients turn out to be statistically insignificant. It is important to notice that the test which has

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[19]See Brunk (1975), p. 225.

been performed is at best an approximation because its properties are asymptotic and our sample size is very saml1 (12 observations in manufacturing and 9 in mining). Moreover, a small number of observations inevitably pushes the test towards insignificance because the variance of the variable z increases as n decreases.

Even if we have been unable to run the formal test of our hypothesis, we can impose the cross-equation restriction to identify the structural parameters of the model c_1, λ_1 and d. Identification in this case is possible because we have assumed a discount parameter b of 0.95, thus implying a real discount rate of approximately 5%. With b and the estimate of λ_1 it is immediate to obtain a value for λ_2, from equation (8). The estimation is carried out as usual in a seemingly unrelated, instrumental variables framework, which amounts to non-linear three-stage least squares.

Looking first at manufacturing, the estimates presented in Table 5 support stability of the model for all the countries considered; this is implied by values of λ_1 and λ_2 that are both smaller than one in absolute value. Nonetheless, this estimate is not significant for Korea and Mexico. The parameter of adjustment costs in labor -d- is positive and significant for Colombia, Ecuador, Hong-Kong, Korea, Philippines and Venezuela. Chile, India and Turkey show a negative d estimate because they had the wrong sign of the wage coefficient, according to the model, in the employment regression.

In mining, stability is everywhere present and the coeffi-

TABLE 5

Estimates of the structural parameters:

manufacturing and mining

Country	manufacturing			mining		
	c_1	λ_1	d	c_1	λ_1	d
Chile	0.4086 (1.8265)	0.4495 (2.9248)	-2.8483 (2.4693)	0.3891 (1.7479)	0.5066 (1.6673)	-3.1289 (1.3220)
Colombia	0.8023 (6.5641)	0.7451 (6.6241)	4.6400 (2.2851)	0.8320 (6.9550)	0.3083 (1.5294)	0.4504 (1.4518)
Ecuador	0.4395 (2.1920)	0.6640 (5.0653)	1.8186 (2.5693)	0.4399 (1.7227)	0.5578 (3.5016)	1.3798 (1.0928)
Hong-Kong	0.6820 (3.4450)	0.3912 (1.8051)	0.6489 (2.8708)			
India	0.5948 (3.6718)	0.6323 (5.7260)	-2.9972 (3.7327)	0.6781 (5.3528)	0.8955 (13.8358)	2.0041 (3.3109)
Israel	0.3762 (1.9787)	0.5514 (2.4448)	5.3235 (0.2686)	0.5030 (2.7184)	0.4458 (3.2471)	2.0231 (2.2185)
Korea	0.5239 (2.4537)	0.5400 (1.4590)	0.3179 (3.7770)	0.5597 (3.3392)	0.7209 (4.4204)	-3.8149 (0.7516)
Mexico	0.8329 (55.3955)	0.8737 (0.0180)	8.4132 (0.0004)			
Philippines	0.7580 (5.8449)	0.8138 (7.5413)	2.0551 (2.2841)	0.3501 (1.8735)	0.7287 (4.5081)	6.2196 (2.0552)
Singapore	0.5707 (3.3617)	0.6362 (4.3971)	1.0145 (0.9253)	0.3784 (2.0098)	0.2276 (0.9916)	0.2031 (0.6987)
Turkey	0.6064 (3.7466)	0.6913 (3.9802)	-9.2585 (0.4973)	0.2914 (1.6564)	-0.0809 (0.2826)	2.2283 (0.1769)
Venezuela	0.5594 (2.6265)	0.7718 (5.6789)	1.1345 (1.9665)			

cient λ_1 is significant in the majority of the cases except in Chile, Colombia, Singapore and Turkey. The adjutment cost parameter turns out positive and significant only for India, Israel and Philippines. Its negative sign in Chile and Korea is explained by the same reason as before.

Judging from these results it appears that adjustment costs in hiring and firing of labor play a more important role in manufacturing, where the coefficient d had the appropriate sign and was significant in 6 of the 12 cases. In mining, only 3 of the 9 countries show an adjustment cost parameter that is statistically important. This evidence points towards another difference in behavior between the two sectors. We are not aware of arguments or comparative evidence to support this result.

Before leaving this section we will attempt to address an important policy issue which deserves consideration. It has been established the existence of a general negative influence of wages on employment. It remains to be established if there is some room for policy to affect the product wage in the tradeable sector, which has been obtained using the nominal exchange rate as a deflator.

There exists evidence indicating that devaluations tend to reduce real wages in the short to medium run. In particular, Cooper (1971) studied 24 such episodes in developing countries for the period 1953-66 and concluded that "...twelve months after devaluation..., general wholesale prices will have risen less than this, consumer prices will have risen by about the same as wholesale prices and, except where devaluations are small, manufacturing wages will have risen by less than consumer prices..."[20] Unfortunately, Cooper does not provide the figures in his study to assess both the quantitative effect of exchange rate changes on real wages and the variability of this relation across countries.

Using our data, an informal test to measure the short run impact of the devaluation on the product wage is provided in Table 6. Since we lack the exact dates when nominal exchange increases took place, our index of devaluation (column I) is the increase in the currency parity over the previous year.[21] Attention is focused only in those exchange rate changes which were above 15%, thus leaving outside Hong-Kong, Singapore and Venezuela which had more stable parities. Columns II and III show the percentage change in the product wage over the previous year for manufacturing and mining respectively.

From a total of 45 episodes analyzed for the manufacturing sector, the devaluation appears successful in decreasing the product wage in 28 cases (62.22%). However, there are two countries -Chile and Israel- where devaluations of 15% or more are a very common phenomenon, especially in Chile where they occur practically every year. In these environments it is typically the case that widespread inflation

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[20]Cooper (1971), p.27-28.

[21]In general, we use the average of period exchange rate. In some cases the end of period exchange rate is used because the wage data was also end of period

TABLE 6 (1)

Devaluation and the product wage

Country	Year	Devaluation (I)	Product wage change: Manufacturing (II)	Product wage change: Mining (III)
Chile	1963	73.22	-23.45	-20.82
	1964	26.15	17.68	-15.50
	1965	29.51	2.67	-2.16
	1966	26.85	10.40	-14.19
	1967	25.66	-1.32	55.88
	1968	37.47	1.36	-13.59
	1969	31.24	3.12	-3.51
	1970	31.04	3.32	14.55
	1972	29.19	18.06	-8.13
	1973	58.23	46.62	21.34
	1974	2100.00	-78.74	-73.99
	1975	590.91	-36.23	12.34
	1976	210.53	19.86	9.50
	1977	60.76	58.79	64.97
Colombia	1957	51.00	-8.64	-26.22
	1958	68.51	-28.26	-29.68
	1963	29.31	6.89	3.21
	1965	16.44	-9.12	-2.41
	1966	28.82	-14.68	-15.77
Ecuador	1970	16.21	-11.89	
	1971	19.52	-9.80	
India	1966	33.54	-21.76	
	1966*	58.58		-42.41
	1967	17.92	-11.26	
Israel	1962	61.11	-30.84	-30.75
	1968	15.13	-4.80	-10.87
	1975	42.15	-1.12	52.98
	1976	25.40	0.74	-5.31
	1977	31.74	2.10	-1.14
	1978	66.92	-5.41	-19.14
	1979	45.70	13.81	13.16
	1980	100.96	-4.17	-3.96
	1981	123.24		43.02
Korea	1961	97.67	-42.97	-38.54
	1964	64.50	-27.56	-42.12
	1965	24.51	-9.22	-13.46
	1975	20.87	2.89	61.61
	1980	25.50	-18.25	-11.29

TABLE 6 (2)

Devaluation and the product wage

Country	Year	Devaluation (1)	Product wage change	
			Manufacturing (II)	Mining (III)
Mexico	1976	59.60	-24.93	
Philippines	1962	85.40	0.14	-45.03
	1970	51.28	-8.51	-32.29
Turkey	1960	73.93	-39.94	-40.39
	1961	84.80	-57.43	-40.99
	1970	27.78	-17.37	-2.44
	1971	29.74	-14.98	14.93
	1978	34.89	16.32	2.35
	1979	28.01	-6.59	-10.78

Notes: (i) India's exchange rates for manufacturing and mining were not the same because the data for wages was reported at different moments of the year.
(ii) Chile's exchange rate is for April of each year, consistent with the wage data.
(iii) All figures in percentage values.

is undergoing, which gets incorporated in agents' decisions; a devaluation is then likely to affect real wages only if it is higher than expected. On the other hand, devaluations in inflationary scenarios cease to be a purely exogenous policy measure, but rather it is more of an inevitable response of the authority.

Indeed, if we leave aside Chile and Israel, exchange rate increases were accompanied by product wage decreases in 19 of the remaining 23 cases (82.61%).

The mining sector presents very similar evidence in this respect. Out of a total of 42 devaluations, a short run decrease in the product wage is observed in 29 cases (69.05%). When Chile and Israel are left out, this pattern of behavior is observed in 15 out of the remaining 19 episodes (78.95%).

Overall, there appears to be strong evidence indicating that medium to large devaluations provoke a decline in the product wage of tradeable goods. Exceptions to this rule are environments with substantial ongoing inflation where devaluations are likely to be the inevitable and expected course of action of the authority.

5. World demand: an extension.

In this section we will pursue an extension of the model, by studying the effect of world demand in employment determination for tradeables. The motivation for this is the generalized belief that a healthy growth in industrialized economies is crucial for the success of developing countries' exports. An interesting recent work by Cline (1984) places heavy emphasis on this variable, as becomes clear from his own words that follow. "Although several developing countries achieved impressive growth of manufacturing exports to industrial country markets during the seventies, it is unclear whether this performance can be repeated in the eighties. Over the next decade economic growth in the advanced countries seems likely to be considerably slower than the postwar average...raising doubts about market expansion."[22]

This argument is beyond doubt true for the group of developing countries taken as a whole, but does not necessarily apply to all its individual members. In particular, we would expect to find a positive influence of world demand (wd) on employment (and thus output) in the tradeable sector of countries above a certain size, while small economies are expected to be price takers.

To formalize this argument we can consider a simple deterministic model of supply (q^s) and demand (q^d) for tradeable goods, where all variables are expressed in logarithms

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[22]Cline (1984), p. 34.

(12) $q^s = a_0 - a_1(w-p^*-e)$

(13) $q^d = b_0 - b_1(p^*+e-p) + b_2y^*$

Supply is expressed as a negative function of the product wage, while demand depends on a relative price of tradeable to nontradeable goods (p^*+e-p) and on world income (y^*). The equilibrium level of output of tradeables (q) can be solved from (12) and (13) as

(14) $q = \left(\frac{a_0b_1+a_1b_0}{a_1+b_1} \right) - \left(\frac{a_1b_1}{a_1+b_1} \right)(w-p) + \left(\frac{a_1b_2}{a_1+b_1} \right)y^*$

If the country is a price taker in the market for commerciable goods, it faces an infinitely elastic demand ($b_1 \cong \infty$), in which case it is apparent that the coefficient of world income in equation (14) becomes negligible, and the equation becomes

(14') $q = a_0 - a_1(w-p)$

Due to the very restrictive form of the production function in this model (necessary to implement the rational expectations assumption), it is not possible to derive formally the influence of the wd variable in the employment equation. Thus, we will introduce it in an ad-hoc way to estimate, always by three stage least squares, the system below

(9) $w_t=c_1w_{t-1}$

(15) $n_t=\beta_1n_{t-1}+\beta_2w_t+\beta_3wd_t+\eta_t$

The measure of wd used is total imports of industrialized countries divided by their import unit value index, and demeaned and detrended as the other variables. Based on the simple model outlined in equations (12)-(14) we expect to find a positive and significant effect of wd on employment only for the "big" countries in our sample, measured in terms of exports. We notice from Table 1 that our sample of countries is clearly divided in two groups with respect to export size, looking at 1980 figures; the small ones, all of them with exports below $9 billion (Chile, Colombia, Ecuador, India, Israel, Philippines and Turkey) and the big ones, whose exports exceed $15 billion (Hong-Kong, Korea, Mexico, Singapore and Venezuela).

Nonetheless, an important difference arises in the large countries of the group when the composition of exports is considered, as shown in Table 7. The figures indicate an overwhelming concentration in manufacturing exports for Hong-Kong, Korea and Singapore, while Mexico and Venezuela are strongly biased towards mining exports (oil). This evidence indicates that the big countries in the sample with respect to manufacturing trade are the 3 former Asian nations.

The results, reported in Table 8, give strong support to our earlier discussion. Not one of the small countries show a significant effect of world demand on manufacturing employment, and Mexico and Venezuela follow the same pattern. On the other hand, Hong-Kong, Singapore and Korea show a positive and substantially higher effect

TABLE 7

Composition of exports: five largest countries.

Country	manufacturing (%)	mining (%)
Hong-Kong	99.1	0.3
Korea	94.2	0.5
Mexico	28.4	46.8
Singapore	87.5	1.1
Venezuela	33.5	66.3

Notes: (i) Figures are for the year 1980, except for Mexico whose data corresponds to 1979 (1980 was not available).

Source: Yearbook of International Trade Statistics, United Nations.

TABLE 8

The influence of world demand: manufacturing.

(three stage least squares)

Country	wage equation (9)		employment equation (12)			
	w_{t-1}	D-H	n_{t-1}	w_t	wd_t	D-H
Chile	0.4086 (1.8265)	0.7555	0.2795 (1.4601)	0.1994 (1.5999)	-0.2368 (0.8582)	0.6797
Colombia	0.8023 (6.5641)	3.1039	0.7862 (6.8750)	-0.0512 (1.4572)	0.0974 (1.2665)	0.2005
Ecuador	0.4395 (2.1920)	3.7220	0.5291 (3.0942)	-0.2214 (2.2248)	-0.1614 (1.2908)	-1.8765
Hong-Kong	0.6820 (3.4450)	2.5344	0.4518 (2.0376)	-0.7209 (3.5573)	0.3686 (2.0949)	2.3272
India	0.5948 (3.6718)	2.5679	0.7500 (6.6568)	0.1185 (3.8867)	0.0922 (1.7755)	1.7753
Israel	0.3762 (1.9787)	1.2763	0.4583 (1.2528)	-0.2057 (0.4573)	0.1976 (0.9260)	1.4111*
Korea	0.5239 (2.4537)	3.9185	1.0792 (1.7000)	-1.3619 (2.1767)	1.3318 (1.1976)	1.2812*
Mexico	0.8389 (7.4609)	-0.6432	0.0949 (0.1095)	-1.1387 (0.7793)	0.2327 (0.5560)	1.8107*
Philippines	0.7580 (5.8449)	1.6615	0.8247 (7.5389)	-0.1646 (2.5700)	0.0456 (0.6230)	1.1375
Singapore	0.5707 (3.3617)	0.6068	0.4835 (5.5006)	-0.0187 (0.0576)	1.2571 (4.3550)	2.1422
Turkey	0.6064 (3.7466)	2.3573	0.5506 (2.3970)	0.0501 (0.5832)	0.2242 (1.0289)	1.6419*
Venezuela	0.5594 (2.6265)	1.2197	0.8384 (5.4871)	-0.5325 (3.4268)	0.2176 (1.3605)	0.8394

Notes: (i) The column below wd_t reports the coefficient of world demand in the employment equation.

Other notes as (i) and (ii) in Table3.

of the world demand variable on employment. The coefficients of wd are also significant for the former two Asian countries. If we recall that the estimated value for β_3 can be interpreted as the elasticity of employment with respect to world demand (evaluated in 1970), a 10% increase in the foreign variable provokes a short run employment gain of 3.69% in Hong-Kong, of 13.32% in Korea and of 12.57% in Singapore.[23]

The wage coefficient in equation (11) maintains its sign everywhere. Its size is significantly affected in Singapore, where it becomes very close to zero, and in Hong-Kong and Venezuela, where it grows importantly. Wages are now less significant in explaining employment for Chile, Colombia and Mexico, although in this latter case the estimation of equation (11) by 3SLS has never been successful. The opposite happens in Hong-Kong and Venezuela, where wages become more significant.

The estimation of equations (9) and (12) was also carried out for the mining sector, where the coefficient β_3 proved to be insignificant in all of the cases. This suggests that all the countries in our sample can be safely considered as price takers in the mining sector. To avoid a proliferation of tables these latter results are not reported.

Summarizing this piece of evidence, it appears that world demand is only important for tradeable employment in the manufacturing

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[23]Korea's figures should be interpreted tentatively since the coefficient β_3 is not significant in this country.

sector of the biggest exporting countries when taken on an individual basis. This does not necessarily undermine, of course, the importance of this variable for the group of developing countries as a whole.

Careful disaggregated analysis should be done to extract further conclusions, since the effect estimated is for the average manufacturing and mining sectors. As Cline has argued, LDC's have non-negigible shares of industrialized countries' markets in some sub-sectors within manufacturing; for these, world demand may be a significant variable even at the individual level.

5. Conclusion and policy implications.

A simple dynamic, rational-expectations model has been developed to examine the employment-real wage relationship for the manufacturing and mining sectors of 12 developing countries. A key element of the model is the existence of a negative contemporaneous influence of the product wage on employment. The results show this prediction to be correct in 9 out of 12 countries (significantly in 7 of them) for the manufacturing sector. A plausible explanation for the 3 cases which do not work according to the model is the influence of trade policy, which has not been quantified in this study. This argument receives considerable support from Krueger (1978), since precisely the 3 countries in question were found to be either heavily reliant on quantitative -as opposed to price- restrictions to trade (India and Turkey) or which experienced repeated attempts of liberalization, none of which endured (Chile). A somehow different pattern emerges in the mining sector where 6 out of the 9 countries considered show a negative influence of wages on employment, the effect being significant in only 3 of them.

This evidence in the manufacturing sector stands in contrast to the findings of Geary and Kennan (1982) for industrialized economies, and tends to agree with Sachs (1982, 1983). It also sheds some doubt toward the structuralist argument stressing a fundamental lack of responsiveness of supply to price incentives in developing countries. Another conclusion which emerges from these results is the existence of a different pattern of behavior in manufacturing as opposed to mining. This result is likely to happen because the latter sector tends to be more heavily state-owned in LDC's, and thus might be expected to perform less in a profit-maximizing way.

The model also predicts that if product wages are highly autocorrelated, then employment will strongly respond to the current wage, because a wage change will be considered as a permanent one by agents. Even though a formal test of the above hypothesis was not possible due to the lack of overidentifying restrictions, a simple correlation test shows the expected sign in both manufacturing and mining, although the correlation appears to be rather weak.

An extension of the model allowed us to consider the effect of world demand in employment, which appears to be substantially weak in manufacturing and nil in mining, for the individual countries. This result tends to undercut an ongoing concern about the importance of world demand for developing countries when taken on an individual basis. The small country assumption appears then as an adequate representation for most of the cases analyzed.

Some policy implications emerge from the above results. In dealing with the tradeable sector, our measure of the product wage was obtained using the nominal exchange rate as a deflator. Evidence has been provided in this study and in Cooper (1971) indicating that devaluations tend to reduce real wages in the short and medium run. This policy appears thus as a useful tool to increase profitability and drive resources to the tradeable sector in developing countries. Indeed, what must be reduced for this effect to operate is the product wage and not necessarily the CPI deflated real wage, which seems to be an easier and less painful task to accomplish. This issue is of primary importance since most of the countries under study have a heavy foreign debt burden, and the generation of a sizable trade surplus appears as the only sensible strategy to cope with it. Appropriately designed exchange rate management appears to suggest that this goal is possible through the expansion of both export and import substitution activities in an environment of stable trade policy.

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