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ECONOMIC INTEGRATION AND THE CONVERGENCE OF WAGE RATES - The case of Greece, Portugal and Spain in the EC

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FIGURES

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1. AIM AND SCOPE OF THE STUDY

International economic integration has been an object of research in a large number of post-World War Two studies. The literature on economic integration can be divided into two broad categories. The first is of theoretical-analytical nature. Studies of this type are based on the neoclassical microeconomic analysis and Keynesian/monetarist macroeconomics. The second category is of historical-descriptive nature. These studies are concerned with the achievements of integration and attempt to produce some empirical verification to the theoretical concepts.

The stages of economic integration can be classified as (1) free trade area, (2) customs union, (3) liberation of factor movements and (4) cooperation in the field of economic policy. A majority of studies have been devoted to the analysis of customs unions. Much less attention has been attached to research on liberation of factor movements.

This study will focus on the effects of economic integration in the European Communities, and particularly, on the factor-price-equalizing effect of the process. Presently, there is a considerable inequality in average earnings between the Southern Member States, i.e. Greece, Portugal and Spain, and the core areas of the Community. From a macroeconomic perspective, the Community can be considered as being composed of a prosperous core and a poor periphery. The differences in the standard of living are marked between these zones. It has been estimated that ca. one third of the EC's population lives in the poor periphery. The calculation contains the newest Member States, Greece, Spain and Portugal, together with Ireland and some backward regions of other Member States. This particular study will, however, be limited to the three Southern countries.

The 12 EC countries are to form a Common Market at the beginning of 1993, by which date the barriers to free movement of goods, services, people and capital will be abolished. According to some prospects, the European market will ultimately resemble that of the United States. The aim is to create a Common Market for over 320 million people.

The further driven integration will result in more intensive intra-community trade and factor mobility. The overall removal of barriers will finally create a single market for products and services, on one hand, and on the other, for factors of production. The basic hypothesis of this research is that the existing wage rate differences between the Northern and Southern Member States will be ultimately equaled out through the integration process. Theoretically, the factor price equalization will be realized through two separate ways: (1) through trade, and (2) through factor movements. This study will concentrate on one dimension of the process, namely on the role of free mobility of labour as a cause to wage rate equalization. Spatial mobility of labour permits a more rapid equalization of wage differentials. Specifically, the primary goal of the research is to find out to what extent free mobility of labour contributes to the wage rate convergence, rather than to predict the magnitude of migratory flows between the EC-countries in the future.

An overview of the legislation concerning the common labour market, as well as a review of the history of migratory flows in Europe are presented in Chapter 2.
Chapter 3 deals with wage determination on the basis of the classical labour market theory. The role of trade unions is also considered.
Chapter 4 deals with issues concerning international trade and factor mobility. Labour mobility being the core of the study, different motives and deterrents to migration are considered. The specific nature of labour as a factor of production is emphasized. Since labour force is composed of human beings, psychological and sociological factors surely affect the movements of labour along with purely economic factors like wage rates.
The conditions prevailing in the EC are considered in Chapter 5.
From Chapter 6 on, the economic theories and the verbal reasoning are tested against economic reality. The econometric research method used in this study is the Ordinary Least Squares regression analysis. The regression function is a sort of wage model. The sample comprises 11 EC countries in 1984. In other

words, cross-section analysis is applied to receive estimates of the relative impact of various factors on wage differences. Since there are other factors in addition to labour mobility which contribute to the wage rate convergence between countries, they are considered as well.

The goal of the empirical research is bipartite:

(1) analysis, i.e. testing of economic theory and

(2) forecasting, i.e. using the numerical estimates of the coefficients to forecast the future values in the economic relationship, thereby assessing the prospects of a converging trend in wage rates within the EC.

The dimensions of the empirical test are bound to be more limited than the verbal reasoning based on the general laws of economic theory (Chapters 3-5). This is due to data deficiencies and purely technical problems.

The final analysis in Chapter 11 pulls together the empirical results, and ultimately, a possible long-run forecast for the wage rate development of Greece, Portugal and Spain is presented.

2. BACKGROUND

2.1 Wage disparities between the EC-countries

The accession of Greece (1981), Spain (1986) and Portugal (1986) to the EC gave rise to a disequilibrium, particularly when wages are concerned. The wage rates differ to such a high degree between the EC9-countries and the new Member States that the Community can be regarded as being composed of two wage zones. The wage rates in manufacturing (1984) are presented in table 2.1. Measured in ECU's, the mean monthly wage is ECU 1459. The lowest wage rate, ECU 386 (in Portugal), is only 19% of the highest, ECU 2008 (in West Germany).[1]

Table 2.2 indicates that the differences are far less marked when measuring earnings in purchasing power standards (PPS). The PPS is an artificial unit of account that represents the amount needed to buy an equivalent quantity of goods and services in each Member State. The poorest equivalence between the ECU- and PPS-rates is found in Portugal, Spain, Greece and Italy. Thus the differences in the standard of living, when measuring it by the average purchasing power of earnings, are smaller than what the comparison in ECU-terms suggests.

In this research, empirical experiments will be made both in ECU terms and in PPS terms.

For mobility PPS matters only if there is no money illusion

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1 " Wages" refer to Labour Costs which were defined in the 11th International Conference of Labour Statisticians (Geneva 1966) as follows: Labour cost is the cost incurred by the employer in the employment of labour. The statistical concept of labour cost comprises remuneration for work performed, payments in respect of time paid for but not worked, bonuses and gratuities, the cost of payments in kind, employers' social security expenditures, cost to the employer for vocational training, welfare services and miscellaneous items together with taxes regarded as labour costs.
(ILO: Yearbook of Labour Statistics 1985, p.73)

TABLE 2.1
Monthly labour costs (manual and non-manual workers)
in ECU

West Germany	France	Italy	Netherlands	Belgium	Luxembourg
2008	1734	1545	1891	1719	1574

Great Britain	Ireland	Denmark	Greece	Spain	Portugal
1417	1423	1732	623	n.a.	386

TABLE 2.2
Monthly earnings (manual and non-manual workers)
in PPS (hourly earnings)

West Germany	France	Italy	Netherlands	Belgium	Luxembourg
1166	1002	1052	1129	1156	1312
(8.27)	(7.15)	(7.31)	(8.17)	(9.00)	(9.23)

Great Britain	Ireland	Denmark	Greece	Spain	Portugal
1155	1204	1412	590	n.a.	465
(7.38)	(7.53)	(9.74)	(3.87)	-	(2.86)

CONVERSION TABLE

1 ECU =	1 PPS =
2.23811 DEM	2.180 DEM
6.87165 FRF	6.240 FRF
1381.385 ITL	1084.0 ITL
2.52334 NLG	2.370 NLG
45.442 BEL	37.1 BEL
45.442 LFR	37.6 LFR
0.59063 GBP	0.516 GBP
0.72594 IEP	0.598 IEP
8.14647 DKK	8.360 DKK
88.3437 GRD	61.3 GRD
115.6713 PTE	56.3 PTE
126.5893 ESB	82.5 ESB

(Source: Eurostat, Theme 3 Series C, Labour Costs 1984
p.78-79,96-97,108-109)

2.2 Integration of the labour market

2.2.1 Provisions

Articles of free movement of workers within the Community were already included in the ECSC Treaty in 1951. The provisions applied to jobs in the coal and steel industry.

The Treaty of Rome (1957) stipulates that nationals of other Member States shall receive the same treatment on the labour market as a state's own nationals. Free migration of workers was to be secured by the end of a 10 years' transitional period (at the latest January 1, 1970).

The principal goals covered not only free movement of workers but also freedom of establishment and service, as well as an equal right to continuous social security.

A machinery for vacancy clearancy was established to ensure close co-operation between the Member States. The stipulations on the European Co-ordination Office, The Advisory Committee and the Technical Committee were given in 1968.

Workers from the EC-states are to be given priority over workers from non-member states. The regulations do not give unequivocal rules about the treatment of nationals of third countries. The EC-states may extend certain EC advantages to workers from third countries, but the advantages are restricted to the Member State involved. Thus the EC can be considered as a free-trade area rather than a customs union as to the movements of persons.

2.2.2 Objectives

Theoretically, the objective of the establishment of a free labour market is to reap the maximum benefit from economic integration. Free movement of labour (and capital) is expected to produce a more efficient allocation of resources by allowing them to migrate from low-productivity areas to high-productivity areas.

However, the right to free movement in the EC was never intented to create massive migrations of workers. The objective was rather to achieve a balance between labour supply and demand, having regard to the fact that ideally everybody should find sufficient work in their own country. The European Co-

ordination Office, the Technical and Advisory Committees are in charge of co-ordinating the employment policies of the Member States at Community level, thereby contributing to an improved balance of the labour market.

1.2.3 Extension of integration in 1992

Even though the Treaty of Rome stipulated comprehensive freedom of movement for workers, some sectors of the economy were explicitly exluded. The freedom of employment has not been applied to the public sector, i.e. positions which imply involvement in the exercise of public authority. Also, barriers have continued to exist in sectors like banking and insurance, transport and in a number of professions, due to national standards and requirements.

The last obstacles of free labour mobility will be abolished along the intensification of integration in 1992, the main issues being:

- The qualifications for certain professions will be equalized and reciprocally approved. (directive given in 1988)
- Public offices may also be filled by nationals of other EC countries.
- Tendering for public projects will be liberated.
- The international movements of people outside the workforce will be further facilitated.

The following substract contains the main points of the declarations in the White Paper from the Commission to the European Council (June 1985) for the part of the labour market liberation.

Free movement for labour and the professions: a new initiative in favour of Community citizens

The Commission consideres it crucial that the obstacles which still exist within the Community to free movement for the self-employed and employees be removed by 1992. The Commission will take measures in order to remove cumbersome administrative procedures relating to residence permits.
... the principle of mutual trust between the Member States; the principle of the comparability of university studies between the Member States; the mutual recognition of degrees and diplomas without prior harmonization of the conditions for access to and the exercise of professions; and the extension of the general system to salary earners.
Finally, measures to ensure the free movement of individuals must not be restricted to the workforce only. Consequently, the Commission intends to increase its support for cooperation programmes between further education establishments in different

Member States with a view to promoting the mobility of students, facilitating the academic recognition of degrees and thus diplomas, and helping young people, in whose hands the future of the Community's economy lies, to think in European terms.

2.3 Migratory flows 1958-1986

The establishment of the free labour market has not produced a great increase in migration between the EC countries so far. The interpenetration degree of the European labour markets (i.e. the number of people from other EC countries divided by the total number of employees) is only 2 percent.[2]

During the EC6 stage Italy was the only Member State with strong migration outflows. The labour demand exceeded the labour supply in all Member States except Italy in the period between 1958 and 1973. The higher wage rates and the overall standard of living induced Italians to migrate North. The migrants were typically unqualified workers with a rural background.

However, the labour shortage of the receiving Member States was not satisfied by the hundreds of thousands of Italians. Between 1960 and 1974 the stock of foreign workers increased from 1.8 million to nearly 4.5 million, i.e. about 2.5-fold (Eurostat). In 1960, Italians accounted for about a half of the foreign workers in the EC. By 1973, their share had dropped to about 16 percent, primarily due to the growth of the Italian economy and the reduction of wage differences vis-a-vis the other Member States.

Migration has showed a cyclical pattern. As a consequence of the economic depression, the receiving countries tightened their immigration regulation (concerning non-EC-nationals) in 1973-74. As a result, the number of foreign workers declined from 4.5 million to 3.3 million between 1974 and 1984.

The non-EC migrants can be divided into three groups. First, Greece, Spain and Portugal constituted a significant group of emigration countries already during the EC6 stage, their combined share being as high as 29 percent in 1968. In

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[2] Journal of Common Market Studies, Vol XXVI No3, March 1988,p.337

1973, before the economic conditions changed in the receiving countries, 19 percent of the labour force of Portugal, 9 percent of the Greek and 4 percent of the Spanish workers were employed in the EC9.

The migratory experience of **Greece** is similar to that of Italy: the emigration flows were strongest between the 1950s and the early 1970s. About a million workers left the country, and 80% of them migrated to West Germany. In the late 1970s, there was an increasing number of returning migrants.

Spain also faced an emigration of about a million workers during the 1960s and early 1970s. Since then, the balance has been reversed: between 1971 and 1986 the number of Spaniards leaving for economic reasons fell from 130000 a year to 9000, and in 1986, about 19000 Spaniards returned to their country, of whom over 10000 came from the Community.[3] - Although the movement has regularly been one-way: from the lower-wage countries to North, there has been some migration in the opposite direction lately. In 1986 17000 work permits were granted by Spain to Community workers, most of whom went into the services, tourism or leisure sectors.

Portugal has given two million workers mainly to Europe but also to the U.S. Of those migrating to the Community, most went to France and West Germany.

The second group are the other Mediterranean countries, such as Turkey and Yugoslavia. The number of Turkish migrant workers in the EC stood at 600 000-700 000 in the 1970s and 1980s, being about 20 percent of the total number. Also emigrants from North-West Africa (Algeria, Morocco, Tunisia) are to be mentioned.

The third group comprises migrants from all other countries.

Tables 2.3 and 2.4 and annex 1 present the magnitude of labour migration in numerical values. However, these figures do not describe migratory flows but stocks of foreign workers. Obviously, the flows were greater in amount as opposed to stocks, as most work permits were valid for a short period.

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[3] Commission of the European Communities: "Employment in Europe", Luxembourg 1989

TABLE 2.3
First work permits granted to foreign workers by the six original Member States, 1959-1973

	Total (000)	of which EC %	of which Italy %
1958-1961	273	60	49
1962-1965	595	36	32
1966-1969	565	30	26
1970-1973	751	26	21

(Work permits abolished for workers from EC countries in 1968)
KEG,DGXV Beschäftigung ausländischer Arbeitnehmer,1975

(Source:Journal of Common Market Studies,Vol XXVI,No3 March 1988,p.322)

TABLE 2.4
Estimate of the amount of foreign labour in the EC Member States, 1960-1980, as a percentage of the host country's labour force

	Percentage of dependent labour force			
	1960	1970	1973	1980
Germany	2	6	11	9
France	6	8	11	9
Netherlands	1	3	3	4
Belgium	5	7	7	11
Luxembourg	16	21	35	37
Italy	-	-	-	-
EC6	3	5	7	6
UK	5	7	7	7
Denmark	1	1	2	2
Ireland	-	-	-	-
EC9	3	5	8	7

Source: 1960 and 1970:United Nations (1979).For Italy,Denmark and Ireland: national statistics and estimates. 1973 and 1980: KEG,Beschäftigung ausländischer Arbeitnehmer,various years

(Source: see Table 2.3)

3. LABOUR MARKET THEORIES/ WAGE DETERMINATION

This section will give a short microeconomic presentation of the basic labour market mechanisms. First,the determinants of labour demand and supply will be presented under perfect competition. The conclusions will be applied to movements of labour and finally the case of imperfect competition will be covered briefly.

3.1 Labour demand and supply

3.1.1 The demand for labour

The determinants of labour demand (for a single firm) are

1) The price of the input, i.e. the wage rate
2) The marginal product of labour, MPP_L
3) The price of the commodity, P_X
4) The amount of other factors of production
5) The prices of other factors
6) The technological progress

The market demand for labour is derived from the demand curves of individual firms. Under perfect competition, a firm will hire a factor as long as it adds more to total revenue than to total cost. The equilibrium is reached at a point where

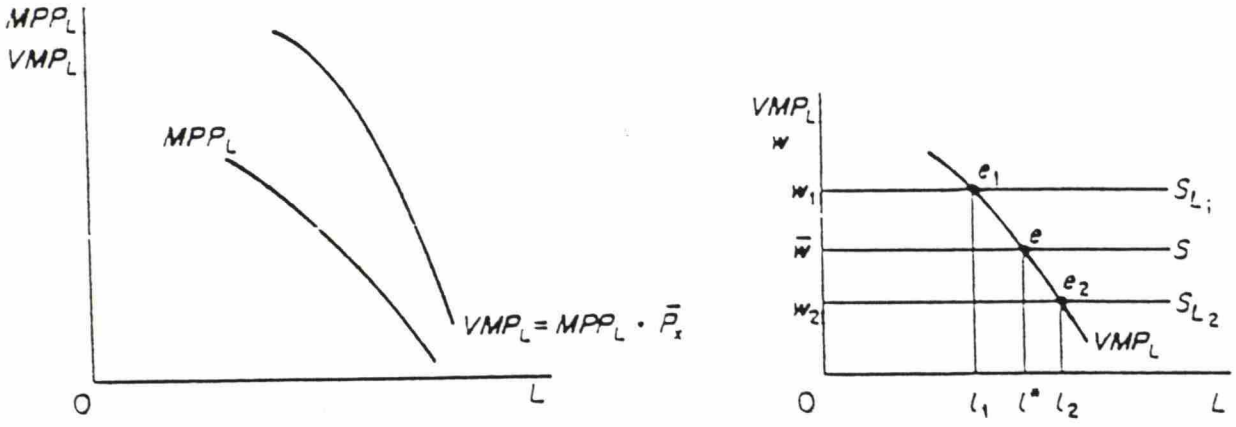
$$MC_L = VMP_L$$

$$\text{that is} \quad w = VMP_L \ ,$$

$$\text{where } MC_L = dTC / dL \quad \text{and} \quad VMP = MPP_L * P_X .$$

The $MPP_L = dY / dL$ is the slope of the production function (marginal physical product of labour). The MPP_L declines at higher levels of employment, given the law of diminishing returns (Figure 3.1). The value-of-marginal-product curve VMP_L is obtained by multiplying the MPP_L by the given price of the output, P_X at each level of employment. Consequently, the demand curve of a firm for a single variable factor is its VMP_L -curve. The MPP_L and VMP_L curves are depicted in Figure 3.1.

FIGURE 3.1



The VMP curve may be treated as the short-run demand for labour by the firm.

The long-run demand for labour, which implies that there are several variable factors of production, gives a slightly different result. A change in the wage rate leads to changes in the employment of the others. Due to a substitution effect, an output effect and and a profit-maximising effect the quantity of labour demanded varies inversely with its price (wage rate). The VMP_L curve shifts to the right in the case of a fall in wage rates. The long-run demand curve is the locus of points belonging to shifting VMP_L curves. Thus the long-run curve is downward-sloping,as well.

3.1.2 The supply of labour

The main determinants of the market supply of labour are

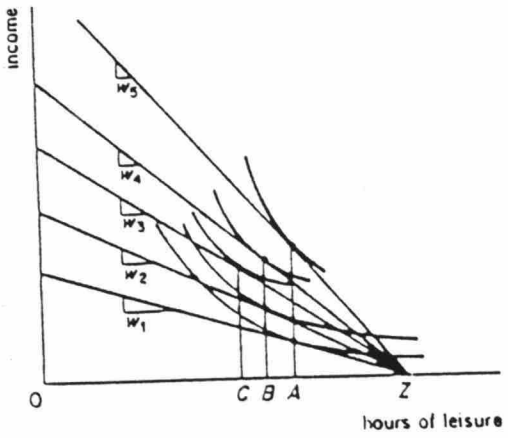
1) The price of labour (wage rate)
2) The tastes of consumers, i.e. their trade-off between leisure and work
3) The size of the population
4) The labour-force participation rate
5) The occupational, educational and geographic distribution of the labour force

The market supply of labour is obtained by summing up the supply curves of individuals. The wage rate defines the supply curve, and the other determinants are shift factors of the supply curve.

An individual's trade-off between leisure and income can be depicted by indifference curves (Figure 3.2). All the points

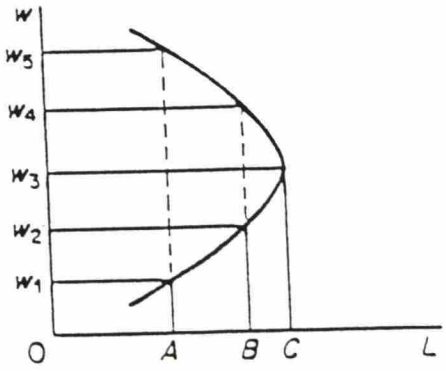
on a single indifference curve bring the same level of satisfaction to the individual. At lower wage levels a wage increase induces the individual to work more, since leisure becomes more expensive relative to work. Therefore, the labour supply curve is upward-sloping.

FIGURE 3.2



However, at higher wage levels a pay increase may create a disincentive for longer hours of work, since the income level is already considered high enough and the worker prefers to have more leisure. Thus the labour supply curve of an individual is backward-bending at higher income levels. (Figure 3.3)

FIGURE 3.3



there is a lot of evidence contradicting this

The aggregate labour supply curve can, however, be regarded as positive-sloping : although higher wage rates induce some

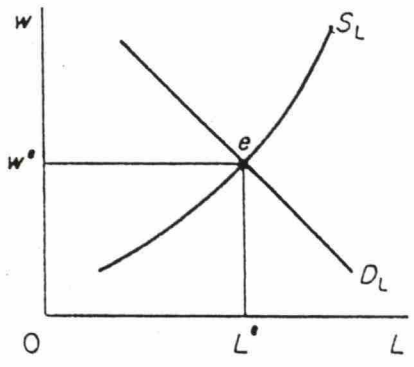
see Kitlingworth's survey

people to work less, they also raise the labour-force participation rate.

3.1.3 Wage determination in perfect markets

The factor price is determined by the intersection of the demand and supply curves. The determination of wages does not differ fundamentally from that of commodity prices, under the simplified conditions of perfect markets. As in the commodity market, the demand exceeding the supply results in a price increase. Thus a shortage of labour leads to rising wages. As a concrete example, labour costs in Sweden have lately risen considerably faster than in its concurrent countries, which can be attributed to the cronical labour shortage of Sweden in recent years. Last year the wage increases of Swedish industrial workers were on the average 10 per cent, whereas the figure was only half as much in the OECD-countries on the whole.

FIGURE 3.4



3.1.4 The basic theory and the movements of labour

As described above, the wage rate will be equal to the VMP_L in equilibrium, i.e. $W/P = MPP_L$. Therefore, the labour supply will be highest in areas and occupations where the marginal productivity of labour is highest, when assuming free mobility of labour. So, the MPP_L determines the direction of labour movements. Theoretically, the movement of labour raises wages in the emigration country, where the capital endowment relative to labour increases, and respectively, it lowers wages in the

immigration country. However, also nonmonetary factors play a significant role in labour movements. They will be discussed in chapter 4.3.

3.1.5 Factor pricing in imperfectly competitive markets

The basic mechanism is the same in imperfect as in perfect markets. However, the determinants of labour demand and supply are different.

If the firm has monopolistic power in the product market, the factor is paid its MRP (marginal revenual product), i.e. MPP * MR_x, which is less than the VMP. This can be called monopolistic exploitation. - If the firm additionally has monopsonistic power in the input market, the factor price will be even lower.

The cases of bilateral monopoly and unilateral monopoly on the labour side (in the input market) are of great importance in reality. They refer to trade unionism, which will be discussed next.

3.2 **The Role of Trade Unions**

The determination of wage rates through pure market forces is largely vitiated by the collective bargaining procedure in West-European countries. The employees are unionized so as to attain monopoly power on labour supply side. The operation is based on the possibility of strikes, through which the trade unions pressure the employers to agree to their requirements. Likewise, the employers are organized. The wage rates, fringe benefits and other conditions are agreed in the collective bargaining process at regular intervals.

According to several surveys made in the U.S., union workers earn between 5 and 25 per cent more than non-union workers with the same observable characteristics. There are also important differences between union and non-union jobs in other dimensions:

1) Non-wage benefits make up a significantly larger share of total compensation in the union sector than in the non-union

sector. (Freeman 1981)
2) The structure of compensation in the union sector is such that the variance of earnings is lower than in the non-union sector both overall and for workers in particular industries and occupations. (Freeman 1980, Block and Kuskin 1978)
3) Quits from union jobs occur at lower rates than quits from non-union jobs. (Freeman 1980)
4) The layoff rate and cyclical swings in employment are larger in the union sector than in the non-union sector.
(Medoff 1979)
5) Formal mechanisms for settling disputes between employers and their employees are more common in unionized branches.
6) The working setting is more rigidly structured in the union sector. (Duncan and Stafford 1980) [4]

Based on the preceding list of observed differences in the position of a union and a non-union worker, one can draw the conclusion that the partnership in a labour union provides security and stability to a worker (except for nr.4). Since the role of labour unions differs across countries, a strong labour union may act indirectly as an attraction for potential immigrants , provided that the immigrants have the chance to join the union, thereby sharing in the achieved monopoly power.

On the other hand, a question that has raised much dispute lately, are the "illegal" workers who come into a country without a work permit and are ready to work for wages inferior to the ones stipulated in the collective agreement. Thus there are also groups of workers that do not form part of the labour unions and thereby threat their monopoly power. This issue will be dealt with in subsection 3.2.3 after first giving a concise presentation on the basic labour market settings.

3.2.1 Bilateral monopoly

Bilateral monopoly arises when both employers (firms) and workers (labour) are unionized. The union of firms is a monopsonist (single buyer) and the labour union acts as a monopolist

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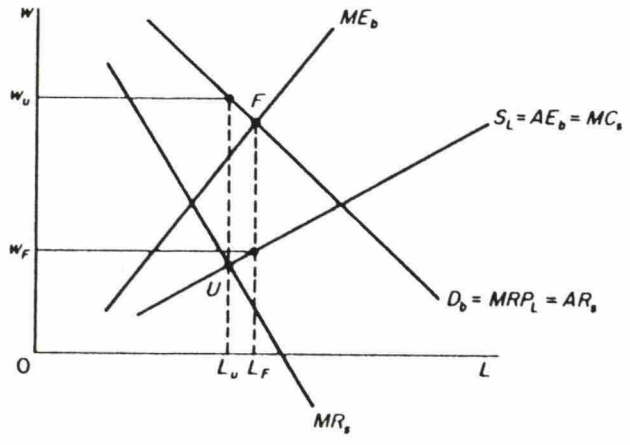
[4] Handbook of Labour Economics, Vol 12, edited by Orley C. Ashenfelter and Richard Layard, 1986,p.1039

(single seller) in the labour market. The situation is depicted in Figure 3.5.

FIGURE 3.5



Definitions:

D_b Demand curve of the union of firms (buyer)

$D_b = MRP_L$; $D_b = AR_S$ average revenue for the labour union (seller)

MR_S The seller's marginal revenue

S_L Supply of labour

$S_L = AE_b$ average expense of the buyer;

$S_L = MC_S$ marginal cost of the seller

ME_b Marginal expense of the buyer;

Being a monopsonist, the buyer (employer) must pay a higher wage when he hires an additional worker. The marginal expense curve lies above the AE_b curve.

The equilibrium positions of the two parties do not intersect. The equilibrium for the monopsonist is found at point F where his marginal expense for labour ME_b equals his marginal revenual product of labour MRP_L. So the union of firms is willing to hire L_F units of labour for a wage rate equal to W_F. Equivalently, the labour union finds its equilibrium at point U where $MR_S = MC_S$. This corresponds to the wage rate w_u and labour supply L_u.

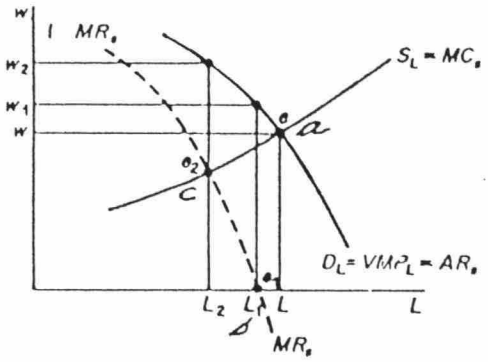
The wage rate and the quantity of labour employed are indeter-

minate in the pure bilateral monopoly model. W_u and W_F are the upper and lower limits of the wage rate. The solution depends on the relative bargaining power of the two parties. However, if the labour union does not aim at the maximisation of the total gains ($MR_S = MC_S$), but has alternative goals, a solution can be found. The alternative goals could be the maximisation of employment or the maximisation of wage rates for a given level of employment - or an intermediate objective.

3.2.2 Monopoly labour union versus competitive firms

If firms have no monopsonistic power, the solution depends on the goals pursued by the labour union.

FIGURE 3.6



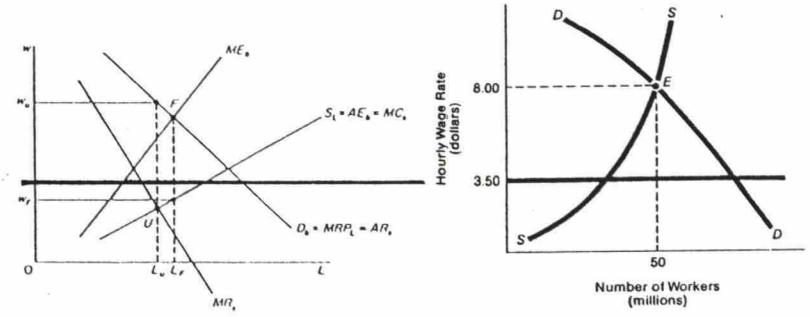
(1) If the union aims at the maximisation of employment, the solution is found at point a (in Figure 3.6), where $D_L = S_L$.
(2) If the goal is to maximise total wage receipts, the equilibrium is at point b where $MR_S = 0$. However, a rise in the wage rate will result in a lower level of employment. Whether it will increase the total wage receipts, depends on the elasticity of labour demand by firms.
(3) The maximisation of total gains is reached at point c, where $MR_S = MC_S$.

3.2.3 Trade Unions and Foreign Workers

The bargaining position of a labour union will be undermined if there emerges a sufficiently large group of workers who remain outside the union and do not follow the agreed terms. The monopoly will be broken by the new operators in the market. The most obvious case are foreign workers who come from a low-wage country. Two alternative cases can be outlined depending on how the wage rate stipulated in the collective agreement places itself in relation to the market-clearing rate under perfect markets (i.e. the marginal productivity of labour at the full-employment level).
The consideration refers to persistent wage distortions, not only to equilibriums related to economic fluctuations.

a) Stipulated wage rate below perfect market equilibrium rate

FIGURE 3.7



labour shortage

In Figure 3.7, the curves on the left side depict the bilateral monopoly situation (in a submarket), and the resulting distorted wage rate is connected to the picture of free market supply and demand curves on the right side.

In case a), the wage rate in one submarket (a particular sector, e.g. hospital staff) has been placed below the theoretical competitive market equilibrium rate through the collective bargaining procedure. Assuming interindustry labour mobility in the long run, the result is a shortage of labour in the submarket. Therefore, the employers are eager to hire workers

for any terms. A typical consequence is a flow of (temporary) workers from a country where the pay is lower in the corresponding market.

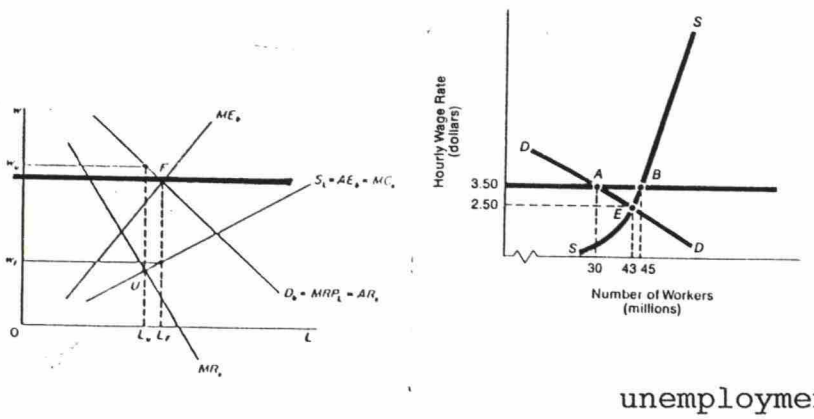
A variant of the resulting situation is the use by firms of illegal workers, i.e. employees without a proper working contract, working on a non-permanent basis without paying taxes or contributing to social security payments.

The consequence to union workers is not critical as long as the labour shortage prevails ; there is no preoccupation with the security of employment on the individual level. Gradually, however,the labour shortage will recede through the immigration flows.

An illustrative example are the Esthonian and Hungarian building site workers in Finland. There is a serious shortage of labour in construction, and so the pressure to to "import labour" is hard. There is a temptation for firms to hire foreigners without work permits for lower wages than those stipulated in the collective agreement. The Esthonians, for their part, are willing to offer their labour services in this way since the pay surpasses amply the one in their home region. - However, the principle of the trade unions is unanimous: the same stipulations of collective agreements and legislation on work conditions should apply to foreign workers as well as Finns. The union of building workers has threatened with a strike such building companies that hire workers of the above-mentioned type.

b) Stipulated wage rate above perfect market equilibrium rate

FIGURE 3.8



unemployment

One can draw a parallel between the situation of a trade union acting as a monopoly in a sector of the labour market and an oligopoly-cartel / monopoly in the commodity market. The oligopoly-cartel (e.g. bauxite producers' union) faces the same problems in attempting to raise the commodity price by reducing supply as the labour union in aiming at a wage increase:

1. Substitutes may be introduced to the market. <=> Labour will be partly replaced by capital.
2.Other suppliers may break the monopoly power. <=> foreign workers.

If the minimum wage in a submarket is stipulated to be higher than the equilibrium rate, the consequence is increased unemployment. Again, assuming interindustry labour movements and an elastic labour supply in the long run, the sector with perceived risen wage rates attracts workers, whereas firms face increaced labour costs and tend to shift towards the use of other factors of production. Recalling the trade-off of the labour union between wage and employment levels, one could assume that the craft union has made a deliberate choice to raise the total wage receipts and simultaneously sacrifice a maximum level of employment. The high wages still attract foreign workers, but as opposed to case a), the domestic workers have now a well-grounded reason to resist immigration. The firms have a strong incentive to replace costly domestic workers with "cheap foreign labour".

4. INTERNATIONAL TRADE AND FACTOR MOBILITY

4.1 Factor price equalization

According to the Heckscher-Ohlin-Samuelson theory, free trade tends to equalize factor prices between countries. On the other hand, free factor mobilility is likely to lead to the same conclusion.

1) Factor price equalization through trade

The basic assumptions of the simple 2-2-2-Heckscher-Ohlin-Samuelson model are as follows:

1. There are two countries, two goods and two factors of production (L,K)
2. The supplies of the two factors are fixed; the factors are immobile between countries but completely mobile between industries in home country.
3. Perfect competition ($P=MC$, $W/P=MPP_L$)
4. The two countries are totally alike except for factor endowments; same technology; identical indifference curves. The HOS-model emphasizes factor endowments as the most important determinant of comparative advantage.
5. Constant returns to scale
6. The industries can be classified unambiguously as either capital intensive or labour intensive. Industry A is labour intensive relative to capital compared to industry B if, at identical wages and rents, it employs more workers per unit of capital than does industry B.

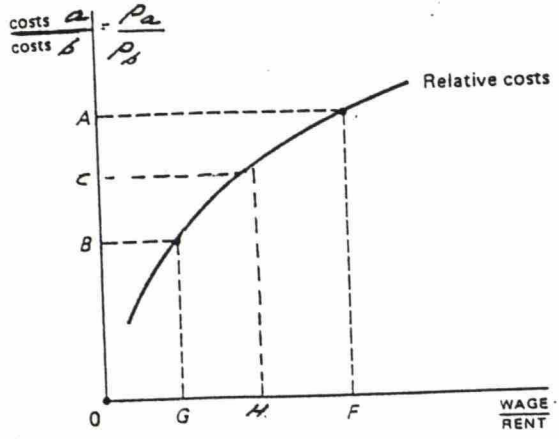
Free trade between two countries, i.e. the abolishment of tariffs and other barriers to trade, results in one single commodity market. Free trade will cause factor prices to become more equal and finally it will lead to total factor price equalization if both countries continue to produce both goods.

The two countries face the same technological relative cost curve depicted in Figure 4.1. A wage rise increases the production cost of the labour-intensive good (a) relative to the cost of the capital-intensive good (b).

The price ratio of the goods equals the ratio of their production costs (OB and OA), since in the long-run equilibrium P_a = production $cost_a(w,r)$ and P_b = production $cost_b(w,r)$. In autarky, the wage-rental ratio is relatively low in the labour-abundant country 1 (OG), because the MPP_L is lower than in country 2. Equivalently, the wage-rental ratio is relatively high in country 2 (OF). Country 1 has a comparative advantage in the labour-intensive good a, and country 2 in b.

Free trade between the countries results in world commodity prices somewhere between the autarkic prices (e.g. OC). OC equals relative production costs in the two countries and therefore also the wage-rental ratio OH.
If either country specializes, trade leads only to partial factor price equalization. In a situation where both countries specialize factor prices are not equalized.

FIGURE 4.1



Extension of the basic 2-2-2 model

The basic 2-2-2 world is a special case. The number goods and factors is usually greater than two in the real world, and the number of factors does not necessarily equal that of goods. However, the model has been proved to be valid also in higher

dimensions. The only required condition is that the number of factors does not exceed the number of goods.

2) Factor price equalization through international factor movements

Absolute productivity differences form the basis for factor movements. Labour (/capital) will migrate from a country where its marginal productivity is low to where it is higher, in accordance with the assumption $MPP_L = W/P$. ($MPP_K = r/P$)

Perfectly free labour mobility creates a single international labour market, where interstate wage differentials gradually disappear. The workers would not be willing to supply labour in country 1 if the wage rate were higher in country 2. Accordingly, areas and occupations with labour shortage face upward pressure in wages.

4.1.1 Trade and factor movements as substitutes

An optimal allocation of production within a union can be obtained either by free trade or factor mobility, both of which tend to equalize factor prices between countries. A country where labour is abundant might as well import capital and export labour as export labour-intensive goods.

The similarity of factor endowments determines the outcome of the integration process. If factor endowments are close enough in countries 1 and 2, both countries continue to produce both goods under free trade conditions and subsequently trade leads to complete factor price equalization. There is no incentive for factors to move. Free trade is a complete substitute for international factor mobility in this case. Thus in the light of this theory it might be argued that as to the EC area, the elimination of trade barriers would increase the mobility of goods and therefore reduce the need for factor movements across countries. (Mundell,1957, American Economic Review,vol 47,p.321) This statement refers to the original Member States (EC6).

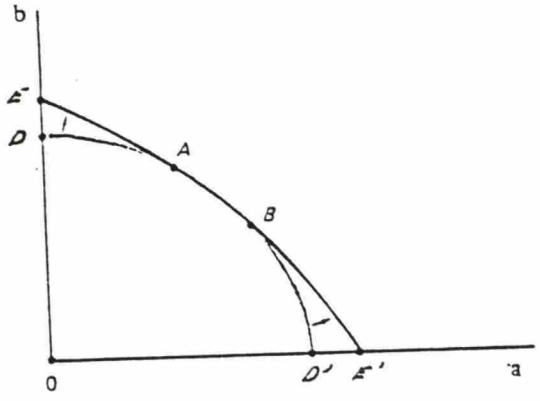
However, if either country specializes, trade will not equalize factor prices completely because in this case production costs

need not equal international prices. Now trade is only a partial substitute for factor mobility.

In Figure 4.2, the union production possibility frontier DD′ is illustrated under free trade conditions. Trade causes factor price equalization between A and B, where both countries produce both goods. - If a factor becomes internationally mobile, the frontier shifts outward, except for the area where the factor prices are already equalized by trade.

Both factor prices (w and r) are equalized on the frontier EE′ because also the price of the immobile factor will be equalized through competitive forces between the countries. For instance, if capital were mobile internationally but labour not, the country with higher worker remunerations would not be competitive in the commodity market as the producers would face the same capital costs but higher labour costs than in the other country. Consequently, despite the separate labour markets, the wage would have to be the same in both countries. So, theoretically, the mobility of one factor is sufficient to cause convergence in all factor prices.

FIGURE 4.2



4.1.2 Trade and factor movements as complements

Contrary to the preceding conclusions, factor movements generated by interstate factor price differences may also lead to an increace in community trade. In this case the basis for trade is something else than differences in relative factor endowments between countries (as in the HOS-model). Instead of that, trade might be caused by differences in production technology, returns to scale or imperfect competition (etc.).

Markusen (1983) states that these models suggest a more general idea: The widely held notion that trade in goods and factors are substitutes is in fact a rather special result which is a general characteristic only of factor proportions models.[5] - In the beginning the relative endowments are equal and become then unequalized through international factor movements, which occur as a consequence of differing marginal productivities (caused by e.g. technological differences). The factor movements create a factor proportions basis for trade. Trade and factor movements are thus complements.

4.2 **Changes in K/L-ratio: implications**

4.2.1 Wage rigidity downwards

Theoretically, between two countries, of which one is labour-abundant relative to capital and hence a low-wage country and the other is the opposite, the conjoint impact of trade and migratory flows is to raise prices and the K/L ratio in the first country and lower the ratio in the latter. Thus the wages would tend to rise in the emigration country and drop in the immigration country.

Macmillen (1978) has stated that migrant labour tends to depress the wages of the indigenous labour force in the host country. This argument, however, presumes perfect price and wage flexibility. In reality, prices and wages show downward

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[5] Markusen,James R., Journal of International Economics, vol 14, 1983, p.341 "Factor movements and commodity trade as complements"

rigidity. So it can be concluded that the deflationary pressure in the host country does not lead to reductions of wages but rather slows down the upward movement of wage rates relative to those in the low-wage country. Thus it can be argued that the wage gap between the Southern periphery and the core areas of the EC is likely to diminish.

4.2.2 The impact of minimum wage legislation and social policies on capital inflows

According to the theory, if capital flows into a low-wage country, the K/L ratio is bound to rise, and consequently the MPP_L rises thereby increasing real wages. The import of technology accompanied by foreign investment has an equal effect. In general, an increase in the labour cost, if matched by a rise in productivity, will not create distortions within an economic union.

In the face of imperfect labour markets, minimum wage legislation is regarded as desirable from the humanitarian point of view. However, if a low-wage country within the union raises its average wage level by minimum wage legislation, the measure may entail economic costs to the country. Also measures to reduce income inequalities in a country through social policy have identical consequenses. The underlying reason is that capital tends to move to countries where tax-financed income-redistributional measures are applied to a lesser degree. An action undertaken by a member country to reduce its internal income inequalities will augment the exportation of capital to other member states and reduce capital imports. In other words, the country will lose some of its attractiveness from the viewpoint of investors. This would be detrimental to underdeveloped economies, as the capital inflows would be impeded and the process of growth would be slowed down. Similarly, countries with more advanced minimum wage legislation may lose capital to other participating economies. - It should be pointed out that the preceding consideration applies mainly to labour intensive foreign investment.

As a concrete example, Portugal has enjoyed considerable foreign investment since its entry in the Community in 1986.

Foreign investment amounted to USD 1.5 billion in 1989. The economy has recovered and the standard of living is rising. So far especially the labour intensive textile industry has attracted foreign capital into the country, which can be attributed to the marked labour cost differential compared to the Northern EC states. The future development of the country is dependent on how effectively it can maintain its attractiveness as opposed to the new East European economies. So, if the minimum wages were raised substantially by state action, the capital flows might be directed elsewhere, which would have a disadvantegous impact for the whole economy.

4.3 **Determinants of labour movements**

Labour mobility can be defined in a number of ways. Labour can move among occupations, industries, skill categories and regions. The theory of labour supply predicts that workers move in response to earnings differentials. It is labour`s basic drive to seek those conditions and locations where its labour power can be exchanged for the most desirable wages and levels of well-being.

When regarding international labour movements, it can be said that wage earners will have an incentive to move if the difference between earnings at the place of immigration and that of emigration is greater than the sum of (a) interest on the direct cost of movement and (b) the intangible costs of migration.[6] However, this conclusion is valid only for the case of perfect rationality and perfect information of vacancies.

Labour is a special case among factors of production because the owners of labour must accompany their labour services. Therefore, non-monetery factors, as well as irrationality, play a significant role in migration.

The principal causes and obstacles of migration are presented in the following two subsections.

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[6] B.Balassa, The Theory of Economic Integration 1962,p.86 (J.E.Meade)

There exists lots of literature on migration it should have been reviewed including the Harbert-model

4.3.1 Causes of migration

Migration is like an adjustment flow responding to spatial differentials. So it is the existing difference in relative attraction elements which matters. Within this scenario there remains, however, three major areas for debate: the appropriate form of the differentials - absolute versus relative differences ; the list of variables whose differentials contribute to relative attractiveness of alternative locations; and the relative importance and interaction among these contributing factors.[7]

/ where?

There is historical evidence that supports the view that labour tends to move in response to persistent earnings differentials. Labour seeks higher market prices for its labour power. - The concept "wage" can be divided into two components. The first is the fixed value needed to reconstitute labour at a physiologically determined level of health care, nutrition and biological conditions for reproduction. The second is the moral and historical component, which includes variable social costs of production - expenditures for the educational, housing, general welfare and cultural base necessary for maintenance of work force. This is the element of the wage which varies most between areas, thereby constituting wage zones.

Serious doubts exist, however, as to the straightforward causal relation between wage differences and migratory flows. Viewing average wages in different locations may be deceptive; the demographic composition across populations must not be disregarded. For example, educated workers generally earn higher wages; thus countries with a high educational level (for the whole population) are associated with higher average earnings.

In addition to pure wage differences, there is a number of other factors acting as an impetus for migration. One significant factor are the social benefits like free medical services or family allowances. Old-age pensions and unemployment compensations are also to be taken into account, since although the workers do not receive these benefits immediately or never

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[7] Global Trends in Migration: Theory and Research on International Population Movements, edited by Kritz,Keely,Tomasi,1983,p.85

may receive them, one can argue that the workers take them into account in evaluating their earnings. As a matter of fact, they are often considered as part of the earnings. It can be argued that workers may move to a country where the MPP_L is lower than in the home country, if in the country of immigration the state provides social benefits the sum of which is sufficiently larger than the wage differential. However, in most cases high-wage countries also offer social benefits of a higher level.

Moreover, institutional factors like taxation play a role in migration. Lower tax rates in an area attract especially workers with high earnings and above-average wealth. The free mobility of labour in the 1990's will lead to a situation where states and companies have to compete for workers, and in particular, for skilled managers and other key personnel. Taxation will affect their choice of domicile. The development will inevitably lead to equalization of tax rates across countries. European countries have already started competing by lowering their tax rates. For instance, the marginal tax rate (at maximum) has been lowered down to about 40 per cent in the United Kingdom and will be cut to 51 per cent in Sweden next year.

Still another factor cited as influencing the flow of migrants is legislation on work conditions. Stipulations on the rights of workers, regulations on the period of notice and workers' chances to have a voice in company management differ substantially between countries. The leadership style and the position of an employee is totally different in the Mediterranean area from that e.g. in West Germany, where the employees have their representatives in the governing bodies of companies. Safe and comfortable work facilities and remunerations for overtime work are further examples.

Furthermore, work hours and the lenght of annual vacations are quite different between countries. For example, a Portuguese works on the average 1948 hours/year, whereas a West German works only 1692 hours/year. The work hours in some industrial countries are shown in Table 4.1.

4.3.2 Deterrents to migration

The abolition of national restrictions is a necessary, but not a sufficient condition for achieving desirable labour movements. Obstacles to migration are caused by sociological, psychological and economic factors. Economically, migration is a costly undertaking for an individual/ a family, involving an initial sacrifice in return for a stream of higher earnings subsequent to movement. What makes the decision to emigrate costly, are the travel costs and the costs of supporting oneself while seeking work in the new place. - Irrational motives, such as national, religious and racial prejudices, and language barriers, as well as the "propensity to stick to the birth place" restrict emigration. The psychic cost of separation from home country is not out of relevance. - The same social and cultural differences are operative on the side of the population of the immigration country as well. Economic motives, such as the preoccupation with the security of employment and fear of a reduction of wages in the case of mass migration, have similar effects. Thus the degree of local resentment tends to deter immigration.

In addition, the absence of perfect information about work opportunities and other circumstances in the place of immigration deter people from migrating. Historically, migratory flows have been strongest between countries in geographical proximity or with cultural affinity. So, the greatest number of foreign workers in Sweden are from Finland; in Switzerland from Italy; in the U.S. from Canada and Mexico; and in South Africa from Mosambique and Lesotho.

In the light of migratory flows in Europe in past decades, the above mentioned incentives for migration seem well founded when considering the emigration and immigration countries. Similarly, the disincentives for emigration that have acted as an obstacle to migration are bound to prevent massive migrations of workers in the future, even though the lifting of administrative obstacles is likely to increase the flow of wage earners inside the Community. The migration alone will, therefore, not be sufficient to eliminate intercountry differences in wage rates.

TABLE 4.1 HOURS OF WORK IN SOME INDUSTRIAL COUNTRIES

Hours of work per week in manufacturing, all industries

1987		
Belgium	33.0 (a)	
Canada	38.8 (b)	
Denmark	32.5 (a)	
Finland	32.2 (a)	
France	38.7 (a)	
Great Britain	42.2 (a)	
Greece	39.2 (b)	
Ireland	41.1 (a)	
Japan	46.3 (a)	
Portugal	38.9 (a)	(1986)
Spain	35.4 (a)	
Switzerland	42.4 (b)	
U.S.	41.0 (b)	

Notice: Where possible, the data presented are statistics of average hours actually worked; where such data are lacking, statistics of average hours paid for are given. The two types of statistics on hours of work are indicated by the following codes: a) Hours actually worked

b) Hours paid for

Source: ILO, Year Book of Labour Statistics 1988

Average number of hours worked during the year

All industries, manual and non-manual workers

	hours	index : average EUR-12=100
Germany	1692	96.3
France	1682	95.7
Italy	1728	98.3
Netherlands	1658	94.4
Belgium	1537	87.5
Great Britain	1880	107.0
Ireland	1919	109.2
Denmark	1740	99.0
Greece	1831	104.2
Spain	n.a.	n.a.
Portugal	1948	110.9

Source: Eurostat, Series 3 ,Theme C, Labour Costs 1984

to be found where?

5. THE CASE OF THE EC

5.1 The hypothesis of converging wages in the EC

On the basis of the preceding theoretical framework it can be argued the convergence of wage rates (factor rewards) is highly probable in the EC-area the deeper the integration developes. There is much evidence that labour tends to move in response to persistent differences in earnings. In the case of the low-wage countries, Greece, Portugal and Spain, the existing wage difference vis-a-vis the EC9 countries is likely to be a strong incentive for migration. This has already been seen in the past decades when `de facto` freedom of international labour migration prevailed. The common labour market in the 90's might strengthen the tendency when `de jure` free movement of labour in the EC12 states is established. The three countries will participate in the common labour market after the end of the transitional period.(for Greece, ended in 1987)

Also the further liberalization of trade and the deregulation of capital movements between the low-wage and the EC9 states will be significant contributors to the converging tendency of wage rates.

However, the outcome is not as straightforward as the theory suggests. The conclusions are reached in a completely static framework under rather restrictive assumptions. In reality, there are a number of factors that counteract or impair the mechanism. These problems will complicate the empirical verification of the theories.

5.2 Releasing the restrictive assumptions

The basic HOS-theory is based on the presumptions of perfect competition and constant returns of scale, as well as a similar production technology and demand structure. This raises the question whether the conclusions are valid also when the presumptions are released.

Some studies suggest that the Hechscher-Ohlin-theory of

international trade is valid also under conditions of monopolistic competition and increasing returns to scale (Kankaanpää, 1989). A labour abundant country still exports labour intensive goods and imports capital intensive goods. Imperfect competition and scale returns determine the mode of trade between specific industries / lines of business, i.e. on the micro-level. Generally, equalization of factor prices takes place also under these conditions.

When considering the assumptions specifically in the context of the EC countries, it is very much to the purpose of this study to set the EC9 countries and the low-wage states opposite each other. - Relative factor endowments differ between the two groups, the Southern countries being less capital-abundant, and also on a lower technological level. Greece, Portugal and Spain can be classified as NIC's (Newly Industrialized Countries). The agricultural sector is still the largest employer for Portugal, with 26.1% of workers and also for Spain with 17.5%, compared to the Northern EC countries with 6.4% (Straubhaar, 1984). The factor endowments do not, however, differ to such a high extent that full specialization would occur. - What comes to conditions of free trade, the EC countries are neighbours geographically speaking, and so the transport costs do not create a significant barrier to trade. Tariff barriers and quantitive restrictions were eliminated by 1968, and the remaining invisible barriers to trade will be abolished in the 1990's.

As to the wage rate convergence through labour mobility, one of the counteracting/confusing factors is the role of trade unions. Also, the non-monetary factors as an impetus/deterrent to migration act in the same way.

All in all, the conditions prevailing in the EC countries do not overturn the validity of the factor price equalization theory, but they are bound to complicate the adaptation of the models to reality.

5.3 Migration potential from Greece, Spain and Portugal

The migratory flows from the three Southern countries have reduced significantly since the mid-1970s. The governments of the former emigration countries have taken measures to stimulate the local development and to improve education opportunities.

For **Greece**, the return of previous migrants is considered positive. Further economic development is needed to prevent mass emigration from re-emerging. However, at this stage, the Greek economy is weak and undiversified. Apart from Athens there are few centres of economic development with the potential to serve as a base for future employment growth other than those related to tourism.

In **Spain**, the development of social protection systems over the last ten years has partly reduced the pressures for migration. However, the unemployment stands currently at a high level (18.75% in 1989, OECD Employment Outlook). The return of Spanish migrant workers has further contributed to this worsened unemployment situation. Straubhaar (1984) estimated the migration potential of Spain and Portugal by regressing absolute unemployment in the originating countries and aggregated absolute unemployment in some receiving countries against the migration potential. His conclusion was that because of domestic unemployment, about 950000 workers would be willing to migrate in the immediate future. In view of the unemployment in many host states, however, many immigrants would remain without work.

In **Portugal**, the migration potential would be about 1.7 million workers according to Straubhaar. A perception of the current state of the Portuguese economy confirms the supposition. There is a high concentration of low productivity agricultural employment and there are serious unemployment problems in the coastal areas.

In sum, there remains a large potential for migration from Southern Europe if development strategies are not able to generate sufficient new employment opportunities to offset those gradually being lost through agricultural decline.

5.4 Future prospects - alternative scenario

The European labour market is currently more of a concept than reality. In the past 10-15 years, migration has shown a falling trend. In the long run, however, the prospects may be altered. The mass movements of labour in the past - a flow of unqualified workers from low-wage countries - are now seen as a reflection of imbalanced development rather than as a model of future European mobility. It is possible that there will be a higher level of mobility in general, including particularly the more qualified workers.

There are a number of arguments which could imply greater mobility:

1) According to opinion polls (Eurobarameter), the opportunity for mobility is perceived advantageous by a majority of Community citizens.

2) The reductions in institutional obstacles could have a major effect (e.g. mutual recognition of qualification).

3) There are imbalances in demand and supply of specialists across the Community with apparent excess supply in certain professions in some countries and shortages in others.

4) Increased commercial and economic integration will inevitably bring closer contact and co-operation between European citizens and in turn lead to employment opportunities offered and sought. (Commission of the European Communities: "Employment in Europe",1989)

The perception of citizenship and domicile may be altered in the long run, and finally the European labour market may resemble that of the United States. In a single labour (and capital) market, wage differentials are bound to disappear. The evidence from the United States supports this view: the decreasing magnitude of the wage differential between the North and South in the United States, which at the beginning of the century was estimated to be some 100 percent in favour of the North and which has now virtually disappeared, went hand in hand with decreasing differentials in capital-labour ratios.

All in all, the extent of migration in Europe is dependent

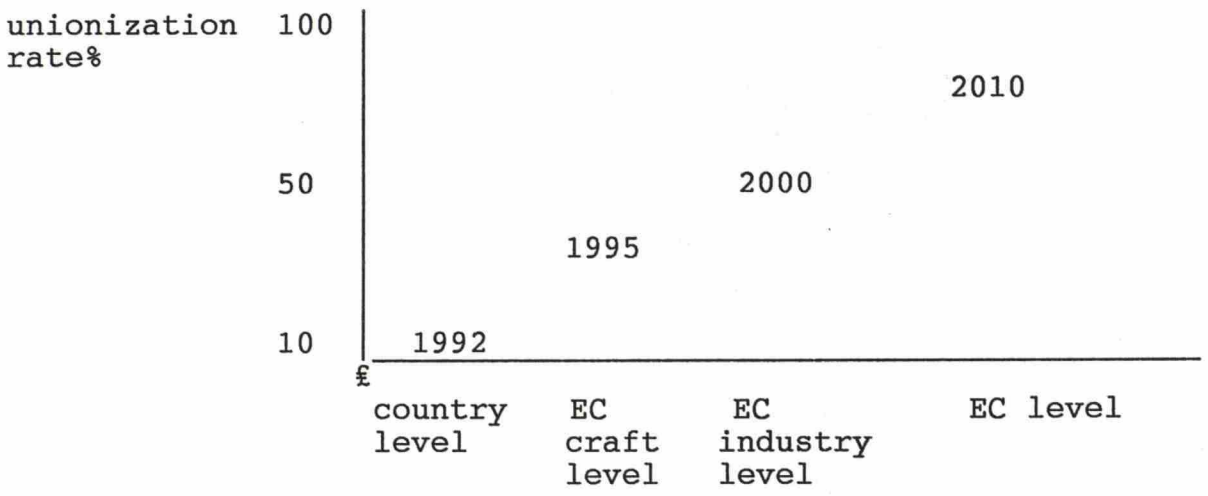
on a number of complex factors, many of which are linked to the development of the Internal Market.

5.5 Trade unions in the EC

The integration of the Community brings a number of challenges to European labour market organizations. The integration will affect work conditions, work security, labour mobility, taxation, worker participation etc. The most significant change, however,is the change in the role of the national labour market organizations. They have to accommodate themselves to drastic structural changes and to the liberation of market forces. The trade unions will not be able to maintain their former institutional authority. When the borders between national markets disappear, the distribution of power over labour markets will be reshaped.

Various scenarios have been brought up. In one model the development of the negotiation procedure has four stages: first, the collective bargaining negotiations are run at a country level (the present situation); second, at the craft level (European multinational company negotiations); third, at the industry level (e.g.the whole European metal industry), and, fourth, at the EC level in Brussels. The model is based on the interdependence between the unionization rate and the degree of centralization of negotiations, of which there is evidence on the national level. (Kauppinen 1989)
The stages are presented in Figure 5.1.

FIGURE 5.1



5.5.1 Current stage: labour market organizations in EC countries

The role of trade unions differs substantially between the EC countries. They can be classified as to the unionization rate and, in addition, as to the comprehensiveness (extent of issues covered) and conclusiveness (number of workers and employers whom the agreement concerns) of agreements.

The unionization rate is as low as 20% in France, Spain and Portugal, and in general lower than 50% of workers in all EC countries. Only Belgium makes an exception. Low unionization rate relates to decentralized negotiations, e.g. France and Spain. In West Germany, Great Britain and Italy the unionization rate stands at 30-40% and the negotiations are run at the craft union level.

The trade union may possess such power in certain branches in a particular country that it can prevent non-union workers from entering the branch. As one example,the British "closed shop" procedure and as another, the Finnish Sailor Union. There may also be stipulations that force an unorganized employer to follow the collective agreement. Thus the conclusiveness is higher than what the pure unionization rate suggests, and the problem of cheap foreign labour (temporary immigrants) is diminished.

5.5.2 Pan-european unions

In addition to separate national trade unions in the EC-countries, a pan-European co-operational organisation of workers, ETUC, as well as a union of European employers, UNICE, have been established. The unions are managed by representatives of the national unions. UNICE has representatives of the employers and the industrial sector from all EC-and EFTA-countries as well as from Turkey, Cyprus, San Marino and Malta. Equivalently, most trade unions are represented in ETUC. Neither of the unions is authorized to negotiate officially with the governing bodies of the EC but their demands are considered in Brussels on many areas.

According to ETUC, the need for pan-European labour unions will be more pronounced the further the integration process

proceeds. It is a question of harmonization of work conditions in a market where multinational firms operate under pan-European regulations. The primary goal pursued by ETUC is to establish extensive basic rights to European workers and to reduce the working hour and labour cost differentials to prevent a degradation of the less developed areas of the Community. ETUC sets itself against the disadvantageous implications of the liberation: the work conditions being established in accordance with the lowest standards and negotiations being shifted to the pan-european level.

In contradiction to that, UNICE is against the idea of pan-European stipulations on workers' rights. They argue that the European competitiveness vis-a-vis the USA and Japan is best secured under pure market forces.

However, the pan-European co-operation organisations have not reached marked political power so far. The ability of the labour unions to maintain their monopoly power and their role in wage determination is highly dependent on the further progress made in forming a unified front. The question is whether they will be acknowledged as equal negotiation partners by the European employers and the EC Commission.

6. EMPIRICAL VERIFICATION: INTRODUCTION

6.1 Introduction

The factor-price-equalization (FPE) theorem by Heckscher and Samuelson has received little attention in empirical tests within the field of international trade theories. A pioneering study on the equalization of labour costs in six EC countries was published in the Journal of Common Market Studies (by A. Tovias from the Hebrew University, 1982). Tovias' conclusion was that partial labour cost convergence had really taken place in the period 1958-1971. The model used in the study was a "black box" model and the integrating factors were not presented explicitly. Later studies (by Gremmen 1985, van Mourik 1987) include some explanatory variables, and they confirm the conclusions, though minor modifications are presented.

- However, these studies are based on highly simplified models and, among other things, they ignore the influence of factor movements on the convergence of labour costs.

The specification of the model used in this study will be presented after going through the former model first.

6.2 The basic model

The equation to verify the FPE theorem was specified as follows:

$$\ln(w_i/w_j) = b_0 + b_1\ln(k_i/l_i \;/\; k_j/l_j) + b_2\ln(tr_{ij}) + e$$

(Journal of Common Market Studies,vol XXIII,1985 No 3, Gremmen: Testing the FPE Theorem in the EC)

w = labour costs
i = country i
j = country j
b_0 = a constant
tr_{ij} = index for trade involvement between i and j : $m_i + m_j$
(m_{ij} = imports from j to i divided by national income in i , $m_{ij} = M_{ij}/Y_i$)
k/l = indicator of the amount of physical capital per worker

The endogenous variable is the ratio of labour costs in country i and j. The more complete the factor price equalization, the closer the left-hand-side variable is to unity.

The basic model includes two explanatory variables, which are regarded as the most relevant in explaining wage differences between countries. - The differences in capital-labour ratios are commonly viewed as important explanatory variables for wage differentials. This has been verified by the studies on the North-South wage differential in the USA. Also, Harberger (American Economic Review 70, May 1980, "Vignettes of World Capital Market") stated that the capital-labour ratio explained about 90 percent of wage differentials (,whereas less than 30 percent of capital reward differentials).

- In accordance with the FPE-theorem, free trade will lead to unification of factor prices. The index of trade intensity between countries i and j indicates the intensity of trade relations between the countries relative to the total production of each country. The higher this figure, the lower trade barriers (including transport costs) must be.

$m_{ij} = M_{ij}/Y_i$ and $m_{ji} = M_{ji}/Y_j$

where M_{ij} = imports from j to i

Y_i = national income in i

The indices are linked together so as to find out the total trade involvement (overall level of trade) between countries i and j.

$$tr_{ij} = M_{ij}/Y_i + M_{ji}/Y_j$$

That is the sum of the countries' average propensities to import each other's goods.

Gremmen tested the equation by forming pairs of countries so that the left hand side of the equation was always positive. The sample for the regression (ordinary least squares) comprised the original members of the EC (with the omission of Luxembourg) and, secondly, a case with less intensive trade relations was taken up - 26 countries scattered all over the world. The first regression was carried out by pooling time-series data (1959-1979) and cross-section data. The second was simply on a cross-section basis.

The results of the regression analysis proved the FPE-theorem valid in the case of the EC, i.e. trade intensity was a significant explanatory variable for wage differences in the

EC6 countries. However, because the R^2-coefficient was low, there must be other important explanatory variables. The result of the cross-sectional regression on a worldwide scale were again very much in line with the FPE-theorem.

The next step would be to find out to what extent free mobility of factors of production and other circumstances have contributed to the convergence of wages within the Community area.

6.3 Specification of the new model

The model used in this study is an extension of Gremmen's model. In addition to the K/L-ratio and the trade intensity index, at least three variables are relevant in explaining wage differentials:
labour mobility, capital mobility and the relative bargaining power of trade unions in country i and j.

6.3.1 Labour mobility index

As clarified in section 4.1, labour movements tend to equalize factor rewards in different areas. The index could be constructed as follows:

$$LMOB = \frac{\text{migrants from country i (in a given year) in country j}}{\text{number of total labour force in country j}}$$

The index gives the stock of migrants each selected emigration country working in each selected host country (for instance Spaniards in Germany) as a portion of total labour force in the host country.

6.3.2 Capital mobility index

Theoretically, factor price equalization should take place also if only one factor becomes mobile (Section 4.1.1). So, to test the influence of capital mobility on the convergence of

wages, a capital mobility index is needed. If the capital markets between two countries are highly integrated, capital movements are supposed to be governed by highest rewards within the union, taking into account the estimated degree of risk and uncertainty.

$$CMOB = \frac{R_i - R_j}{\text{largest difference in the sample}}$$

(Journal of Common Market Studies,vol XXVI March 1988,No3,p.333 "International Movements of Labour under Conditions of Economic Integration")

R_i-R_j is the difference in real interest rates (e.g.central-bank discount rates) between countries i and j. Countries with highly integrated capital markets should have no significant real interest rate differences. Thus the Fisher effect (domestic interest theory) is applied here, i.e. the real interest rates should be equal across countries in spite of differing nominal interest rates (real interest rate + inflation rate). The real rate of interest is used since capital is attracted by real rates. For example, in the early 1980s capital flowed to the United States as the real rate of interest was higher than in European countries; the nominal U.S.interest rate was high and simultaneously the inflation rate was low. Usually, however,the nominal interest rate reflects the expected inflation and the inflation rate,in turn, is reflected in the exchange rate. Real rates of interest should be the same in an integrated capital market within a region. In practice, government regulation and taxes cause differences in real interest rates. If the interdependence is not perfect, governments have control over their domestic rates of interest, and thus it is possible to maintain a real rate of interest below/above that of other countries.

The variable R_i-R_j is divided by the largest difference in the sample so as to obtain a series ranging from 0 to 1. The closer the index to 0, the more perfect the capital market integration. For instance,

CMOB = 14-14 /10 = 0

CMOB = 15-6 / 10 = 0.9

6.3.3 Relative bargaining power of trade unions

As the role of trade unions is significant in most West-European countries, their relative strength might be an explanatory variable for wage differences between countries. The more the unions possess bargaining power in a particular country, the more influence on wages they can have as compared to the other explanatory variables.

The relative bargaining power is, however, difficult to express in quantitive terms. One possibility could be an index describing the unionization rate (members of trade unions as a percentage of total labour force). Nevertheless, it is not sure that there is any straightforward correlation between the unionization rate and the bargaining power. Generally, the power of an interest group consists of three componenents: 1) the unionization rate, 2) the power to mobilize members and 3) the influence on the opposite party.

The role of labour unions is controversial, as noted in chapters 3.2.3 and 5.5. Furthermore, qualified data may not be available. Therefore, the variable must be left out of the model.

The possibility of incorporating the variable into the model by using dummy technique will be discussed later.

there exists literature on this

##

THE PROTOTYPE MODEL

$$(w_i/w_j) = b_0 + b_1(k_i/l_i\ /k_j/l_j) + b_2(tr_{ij}) + b_3LMOB + b_4CMOB + e$$

##

The experimental formulation of the model is linear. The endogenous variable is the ratio of wages in a chosen pair of countries. The explanatory variables are the following: the capital/labour endowment ratio and the mobility of goods, people and capital between the countries.

Definitions:

w = labour costs/earnings

i = country i

j = country j

b_0 = a constant

k/l = the indication of the amount of physical capital per worker

tr = the index for trade involvement between i and j

$M_{ij}/Y_i + M_{ji}/Y_j$

LMOB = the index for labour mobility between i and j

CMOB = the index for capital mobility between i and j

6.4 **Method of Research**

The authors of the former surveys mentioned earlier in this study pointed out that their methods were defective in many dimensions. "A conclusive answer as to the question of the influence of economic integration on the behaviour of wages would require a more comprehensive model in which demand and supply conditions on both product and factor markets, the relative economic conjuncture of the Member States and tariff and non-tariff barriers to trade and factor migration, are specified in more detail. The construction of such a (general equilibrium) model, though, would go far beyond the scope of a single economist's career." (Aad van Mourik, "Testing the Factor Price Equalization Theorem in the EC: An alternative Approach: A Comment", Journal of Common Market Studies, Vol XXVI, September 1987).

One possibility to go further would be to construct a model based on time-series evidence, in which labour mobility, capital mobility and goods mobility are simultaneously analyzed. However, as this study comprises all the EC countries 1990 (except Luxembourg), the realization of an empirical time-series analysis would prove too difficult; data from all EC countries for a time interval long enough is not available,

why not use pooled data

particularly when the newest Member States are concerned. As the three Southern Member States are expressly the focus of the study, the time series data method is evidently inappropriate.

So, the testing of the model is carried out on a cross-section basis for the most recent year for which adequate data are available (1984).

The observation table is constructed by forming 110 pairs from 11 EC countries. Each country acts as a numerator 11 times and as a denumerator 11 times. So there are altogether 110 observations. The observation table and the formulas that have been used in the computer calculation of the observations are shown in Appendix III.

The multiple regression analysis (ordinary least squares) that uses these data is carried out by a computer program LIMDEP, version of Jan 1986, copyright William H.Greene, 1985.

The course of the research is outlined as follows:
First, the prototype model is used in the regression.
Second, the results are interpreted and the sources of error are searched. The evaluation consists of deciding whether the parameter estimates are theoretically meaningful and statistically significant. The results will be evaluated as to (a) economic criteria (the sign and possibly the size of the parameters), (b) statistical criteria / first-order tests (R-squared, t-test) and (c) econometric criteria / second-order tests (tests of autocorrelation and multicollinearity).
Third, other formulations of the model are tested. The objective is to find a formulation of the prototype model that provides empirical results in line with the theory, and particularly, to observe the behaviour (values) of the LMOB coefficient in the alternative outlinings. The experimentation will involve models with (a) various variables and (b) various mathematical forms. The process of choosing between the various models will involve both the a priori and economic-theoretical considerations, and the statistical evidence will also be regarded.

what the hell does this have to do in cross-section analysis?

6.5 Assumptions of the Ordinary Least Squares method

In order to be able to evaluate the results, the assumptions related to the selected method of research are to be stated explicitly. The assumptions of OLS (ordinary least squares) are as follows:

Assumption 1: e_i (the error term) is a random real variable
Assumption 2: The mean value of e is zero. $E(e)=0$
Assumption 3: The variance of e_i is constant (homoscedasticity)
Assumption 4: The variable e_i has a normal distribution.
Assumption 5: The random terms of different observations are independent.
Assumption 6: The random term is independent of the explanatory variables.
Assumption 7: The explanatory variables are measured without error.
Assumption 8: The explanatory variables are not perfectly linearly correlated.
Assumption 9: The macrovariables should be correctly aggregated.
Assumption 10: The relationship is correctly specified.

6.6 Sources of Data and Definitions of Variables

The data are compiled from 11 EC countries for the year 1984. Luxembourg is excluded because it is so small that accidental factors of all sorts may distort the picture to a large extent. In addition, Luxembourg appears frequently as a part of Belgium in the statistical sources.

The inclusion of countries outside the EC (e.g. Turkey, Morocco, Algeria, Sweden, Switzerland) could have raised the creditability of the results by providing more information on areas with strong migratory out-or inflows, but because of the inavailability of adequate data they must be left out.

The data collection method is presented below, and the numerical values are found in Appendix II.

DATA COLLECTION METHOD

For each country the following data:

the most recent year with all required data available;
* w earnings or labour costs per unit of time
  # Eurostat 1984 Theme 3, Series C
* k gross fixed capital formation (1984)
  # IMF:International Financial Statistics 1989
* l number of employees (1984)
  # OECD: Labour Force Statistics 1967-87 (1989)

w and l refer to wages and employees in manufacturing

* M imports from country i (1984)
  # 1. Eurostat (1986),Theme 6, Series A, External Trade
  # 2. IMF: Direction of Trade Statistics Yearbook 1988
* Y national income
  # Imf:International Financial Statistics 1989
* LMOB stock of foreign workers from each country j in country i (1981-82)
  # Eurostat 1981-82 Theme 3, Series C, Censuses of Population in the Community countries 1981-82
* r various interest rates (1984)
  # International Financial Statistics 1989

6.6.1 Wages

The wage data are compiled from the publication Eurostat, Theme 3, Series C, Labour Costs 1984. All the figures are from the year 1984.

Two types of wages are used in the study. First, the regression is carried out with hourly earnings for manual and non-manual workers in all industries. The Eurostat publication provides earnings data in Purchasing Power Standards (PPS). The aspect of comparison of the purchasing power of earnings in the Member States thus becomes accentuated. The use of the PPS in the empirical cross-section analysis is justifiable on the grounds that it offers an aspect of wage in real terms from the viewpoint of a worker. Second, monthly labour costs are used in another regression.

For Spain, the figures are from the Yearbook of Labour Statistics 1988, ILO (the data were missing in Eurostat). The labour costs were given in ESB, and they are transformed into ECU by using the exchange rate 126.56 ESB/ECU, which is the

annual average of daily rates in 1984. (Eurostat,External Trade 1987,Theme 6,Series A) The conversion rate for earnings (PPS) is 82.5 ESB/PPS.

The definition for labour costs as it was presented in the Eurostat publication is as follows:

Labour Costs

Under labour costs, the survey covered the following elements of the expenditure borne by employers in connection with the employment of workers:
(a) Direct pay for time worked including overtime, bonuses and gratuities payable regularly at each pay period.
(b) Other bonuses and gratuities not paid regularly at each pay period
(c) Payments for days not worked:
- paid annual holidays,
- holiday bonuses,
- paid public holidays,
- other statutory, contractual or voluntarily paid holidays.
(d) Benefits in kind and corresponding compensatory payments (especially housing, heating, food and clothing)
(e) Social security contributions and family allowances paid by the employer
(f) Other social expenditure (especially transport, cultural and medical facilities).
(g) Vocational training costs. These include payments to apprentices.
(h) Taxes and social subsidies.

Earnings

The concept 'earnings' was not specified in Eurostat. However, as the definition of 'labour costs' corresponded that of the Twelfth International Conference of Labour Statisticians (Geneva 1973), it is likely that the similar official definition for 'earnings' was applied here:

The concept of earnings as applied in wages statistics, relates to remuneration in cash and in kind paid to employees, as a rule at regular intervals, for time worked or work done together with remuneration for time not worked, such as annual vacation, other paid leave or holidays. Earnings exclude employers' contributions in respect of their employees paid to social security and pension schemes and also the benefits received by employees under these schemes. Earnings also exclude severance and termination pay.
Statistics of earnings should relate to employees' gross remuneration, i.e. the total before any deductions are made in respect of taxes and other obligations of employees.

6.6.2 Capital Formation (K)

The index k_i/l_i / k_j/l_j includes the capital formation k. The data are from the publication International Financial Statistics, Yearbook 1989. The gross fixed capital formation is defined as follows:

The outlays (purchases and own account production) of industries, producers of government services and producers of private non-profit services to households, on additions of new durable goods to their stocks of fixed assets less their net sales of similar second-hand and scrapped goods. Excluded are the outlays of government on durable goods for military use. Included are acquisitions of reproducible and non-reproducible durable goods, except land, mineral deposits, timber tracts and the like, for civilian use; work-in-progress on construction projects; capital repairs; outlays on the improvement of land and on the development and extension of timber tracts, plantations, vineyards etc. which take considerably more than a year to become productive, until they become productive; the acquisition of breeding stock, draught animals, dairy cattle and the like; and the transfer costs in connection with purchases ans sales of land, mineral deposits, timber tracts, etc.

6.6.3 Labour force (L)

The other variable in the same index is the total labour force in a country. The source is the OECD publication Labour Force Statistics 1967-87, 1989.

Labour force is composed of the following elements:

The total labour force or currently active population comprises all persons who fulfil the requirements for inclusion among the employed or unemployed as defined below.

1. Total employment:
a) paid employment
b) self-employment
2. Unemployed

All persons above a specified age who were:
a) without work
b) currently available for work
c) seeking work

6.6.4 National Income (Y)

The index TR_{ij} includes national income. The data are from the International Financial Statistics, Yearbook 1989. The figures were given in national currencies and they are transformed into ECU by using the annual averages of the daily rates in 1984. The definition is as follows:

The gross domestic product is equal to the total of the gross expenditure on the final uses of the domestic supply of goods and services valued at purchasers' values less imports of goods and services valued c.i.f.; or the sum of the compensation of employees, consumption of fixed capital, operating surplus and indirect taxes, net, of resident producers and import duties.

6.6.5 Imports (M)

The index TR_{ij} also includes imports. The sources are 1) Eurostat: External Trade (1986,1987), Theme 6, Series A and 2) IMF: Direction of Trade Statistics, Yearbook 1988 (for data missing in the first source). The currency transformations are made in the same procedure as earlier noted. Imports of goods and services are defined as follows:

In principle,all transfers of the ownership of goods from non-residents of a country to residents and services provided by non-resident producers to residents of the country. In practice,the imports of goods may consist of the inward movement of merchandise across the customs frontier of a country and of other goods across the boundaries of her domestic territory, including the direct purchases of the government services and residents of the country abroad. Since imports of merchandise are valued c.i.f., imports also include the charges of resident producers for transport and insurance services in respect of these imports.

6.6.6 Migrants

The index LMOB contains the concept 'migrants'. The data are collected from Eurostat,Theme 3,Series C, Censuses of Population in the Community countries 1981-82. The source provides the total population by nationality of all EC11 countries.
The latest published data are from the year 1982.

In the case of the censuses in the United Kingdom and Ireland a question on birthplace was asked instead of nationality, and the data are compiled on the basis of this information. Birthplace and nationality are, of course two clearly distinct topics and some distortion must result from combining the two in single tables.
The concept 'migrant' will be discussed later.

6.6.7 Interest Rate (r)

The interest rate is included in the index CMOB. The data for 1984 are from International Financial Statistics, Yearbook 1989. Several types of interest rates could be used: first, the discount rate, i.e. the rate at which the monetary authorities lend or discount eligible paper for deposit money banks. The discount rate for each country is the end value of the year 1984. For Great Britain, the rate was specified in the source as "London clearing banks' base rate" and for Spain, "Bank of Spain rate". Second, another trial run could be made with the lending rate, i.e. interest rate on short or medium term credits to private sector. Further alternatives might be the money market rate (the rate at which short-term borrowings are effected between financial institutions) or the government bond yield (long-term paper).
The source provided nominal rates, and they are thus converted into real rates by subtracting the inflation rate in the corresponding year from the nominal rate in each country.

assumes that the investor is willing to move personally between the countries

7. REGRESSION WITH THE PROTOTYPE MODEL

7.1 A priori hypotheses

The first run is carried out with the linear equation:

$$w_i/w_j = b_0 + b_1(k_i/l_i\ /k_j/l_j) + b_2TR_{ij} + b_3LMOB + b_4CMOB + e$$

The null hypothesis is

H_0: $b_1 = b_2 = b_3 = b_4 = 0$

and the alternative hypothesis is

H_1: $b_1 \neq 0,\ b_2 \neq 0,\ b_3 \neq 0,\ b_4 \neq 0$

Hourly earnings are used for the left-hand side variable w_i/w_j and real discount rates for CMOB.

7.2 Results: a comment

Ordinary least squares estimates	
Number of observations	110
R-Squared	0.78531
Adjusted R-Squared	0.77713
F-Statistic (4,105)	96.01768
Significance of F-Test	0.000000

VARIABLE	COEFFICIENT	STD.ERROR	T-RATIO	(SIG.LVL)
constant	0.384	0.0771	4.987	(0.00000)
X1=(k/l /k/l)	0.677	0.0347	19.519	(0.00000)
X2=TR_{ij}	-0.000992	0.000531	-1.866	(0.06210)
X3=LMOB	-0.608	1.719	-0.353	(0.72372)
X4=CMOB	0.105	0.0603	1.736	(0.08257)

The square of the correlation coefficient R^2 (coefficient of determination) is used for judging the explanatory power of the linear regression, and it determines the proportion of the variation in w_i/w_j which is explained by variations in the regressors. The R-Squared proved to be relatively high, approximately 0.79.

In multiple regression, the R-Squared must be adjusted. The inclusion of additional variables in the function usually raises the coefficient of multiple regression; however, when

a new regressor is introduced, the numerator of the expression for R-Squared is increased, while the denumerator remains the same.

One-variable model

$$R\text{-Squared}_{y,x1} = \Sigma (\hat{Y}_i-\bar{Y})^2 \; / \; \Sigma (Y_i-\bar{Y})^2 =$$
$$\Sigma \left((x_i-\bar{x})(y_i-\bar{y}) \right)^2 / \Sigma (x_i-\bar{x})^2 \; \Sigma (y_i-\bar{y})^2 =$$
$$\hat{b}_1 \; \Sigma \left((x_i-\bar{x})(y_i-\bar{y}) \right) / \Sigma (y_i-\bar{y})^2$$

k-variable model

$$R\text{-Squared}_{y,x1,..,xk} = \left(\hat{b}_1 \Sigma (y_i-\bar{y})(x_1i-\bar{x}1) + \hat{b}_2 \Sigma (y_i-\bar{y})(x_{2i}-\bar{x}2) \right.$$
$$\left. +...+ \hat{b}_k \; \Sigma (y_i-\bar{y})(xk-\bar{x}k) \right) / \Sigma (y_i-Y)^2$$

(A.Koutsoyiannis: Theory of Econometrics,2.ed.,1977,p.128)

The R-Squared must be adjusted by taking into account the degrees of freedom which decrease as new regressors are introduced into thr equation.

R-Squared adjusted = $1 - (1-R^2)$ n-1 /N-K

n = number of sample observations

N = number of parameters

If the sample is large, R-Squared and adjusted R-Squared are approximately equal, as is the case in this study, adjusted R-Squared = 0.78.

The t-test indicates whether the parameter estimates are significantly different from zero (H_0). Here, the theoretical t-value t(0.05,106) is appr. 1.66.

X1 (k/l /k/l)	t = 19.519
X2 (TR)	t = 1.866
X3 (LMOB)	t = 0.353
X4 (CMOB)	t = 1.736

The signs of the coefficients of the parameter estimates, however, are controversial. When the a priori hypothesis of the signs were being established, it was noted that the model in this particular form with 110 pairs of countries does not perform well. The results become irrational, as the following clarification suggests.

The variable w_i/w_j receives values close to unity if the wage difference is small and values close to zero or significantly larger than 1 if the difference is large.
As a consequense of the construction method of the observation table - 110 pairs out of 11 countries - each pair gets two different wage-ratios, e.g.
West-Germany/Greece = 1.976 and Greece/West-Germany = 0.506

The behaviour of the variable TR_{ij} is clear; it receives large values in case trade is intensive between countries i and j. However, each numerical value of the TR-index appears two times in the observations since the index is symmetrical.

The variable k_i/l_i /k_j/l_j behaves in the same way as w_i/w_j.

The LMOB variable is the only one that is unambiguous. The value is the higher the larger the share of immigrants from country j is.

The variable CMOB is an index that should range between 0 and 1. However, negative values distort the results, and if each observation value is turned to positive by adding the same constant to each value, the index is no more meaningful.
E.g. A. Denmark, Italy (2.50-8.10)/6.50 = -0.862
B. Italy, Denmark (8.10-2.50)/6.50 = 0.862

Consequently, it seems impossible to set a priori hypotheses of the signs. The type of correlation between the regressors and the regressant is highly ambiguous.
The same is valid for a formulation with differences w_i-w_j (and $k_i/l_i - k_j/l_j$) instead of ratios.
If the pairs were chosen in such a manner that no distorting negative values would appear in the observations, the number of observations would fall very low (below 10). This was the method used in Gremmen's study, but it is not applicable here as the model contains more variables. E.g. it does not always hold that when $w_i/w_j > 0$, CMOB > 0.
So, the variables and the method of forming the pairs had to be redefined.

7.3 Corrected formulation

The problems are avoided by the following transformations:

1. The variable w_i/w_j receives the following form:

$$\frac{ABS|w_i - w_j|}{\text{largest difference}}$$

The absolute value of the difference of wages in country i and j is divided by the largest difference in the sample.

2. The variable k_i/l_j /k_j/l_j is transformed into

$$\frac{ABS\ |k_i/l_i - k_j/l_j|}{\text{largest difference}}$$

3. In the CMOB index, the nominator is presented as an absolute value.

Furthermore, since the 110 observations would contain twice the same value for w_i-w_j, $k_i/l_i - k_j/l_j$, CMOB and TR_{ij}, the other half of the pairs (Italy-France, France-Italy) is excluded. The number of observations falls to 55 pairs.

7.3.1 A priori hypotheses

The second model is carried out with the reformed model:

$$\frac{ABS\ |w_i-w_j\ |}{\text{max difference}} = b_0 + b_1 \frac{ABS|k_i/l_i - k_j/l_j|}{\text{max difference}} + b_2TR_{ij} + b_3LMOB$$

$$+ b_4CMOB + e$$

The null hypothesis is

H_o: $b_1 = b_2 = b_3 = b_4 = 0$

and the alternative hypothesis is

H_1: $b_1>0$, $b_2<0$, $b_3<0$, $b_4>0$

The H_1 a priori signs are set on the basis of the behaviour of the indices and the following economic-theoretical argumentation:

VARIABLE	VALUE	DIFFERENCE /RELATION BETWEEN COUNTRY i AND j in respective variable
$X5 = \frac{ABS\lvert w_i - w_j \rvert}{\text{max difference}}$	$\frac{}{} \rightarrow 0$ $\frac{}{} \rightarrow 1$	small large
$X1 = \frac{ABS\lvert k_i/l_i - k_j/l_j \rvert}{\text{max difference}}$	$\frac{}{} \rightarrow 0$ $\frac{}{} \rightarrow 1$	small large

A large difference in capital endowment per worker is associated with a large wage difference. ----> POSITIVE SIGN

$X2 = TR_{ij}$	large	intensive trade

Intensive trade is associated with small wage differences. ----> NEGATIVE SIGN

X3 = LMOB	large	strong labour mobility

Strong labour mobility should cause wage differences to diminish. ----> NEGATIVE SIGN

X4 = CMOB	----> 0 ----> 1	small large

Far integrated capital markets are supposed to be associated with small wage differences.----> POSITIVE SIGN

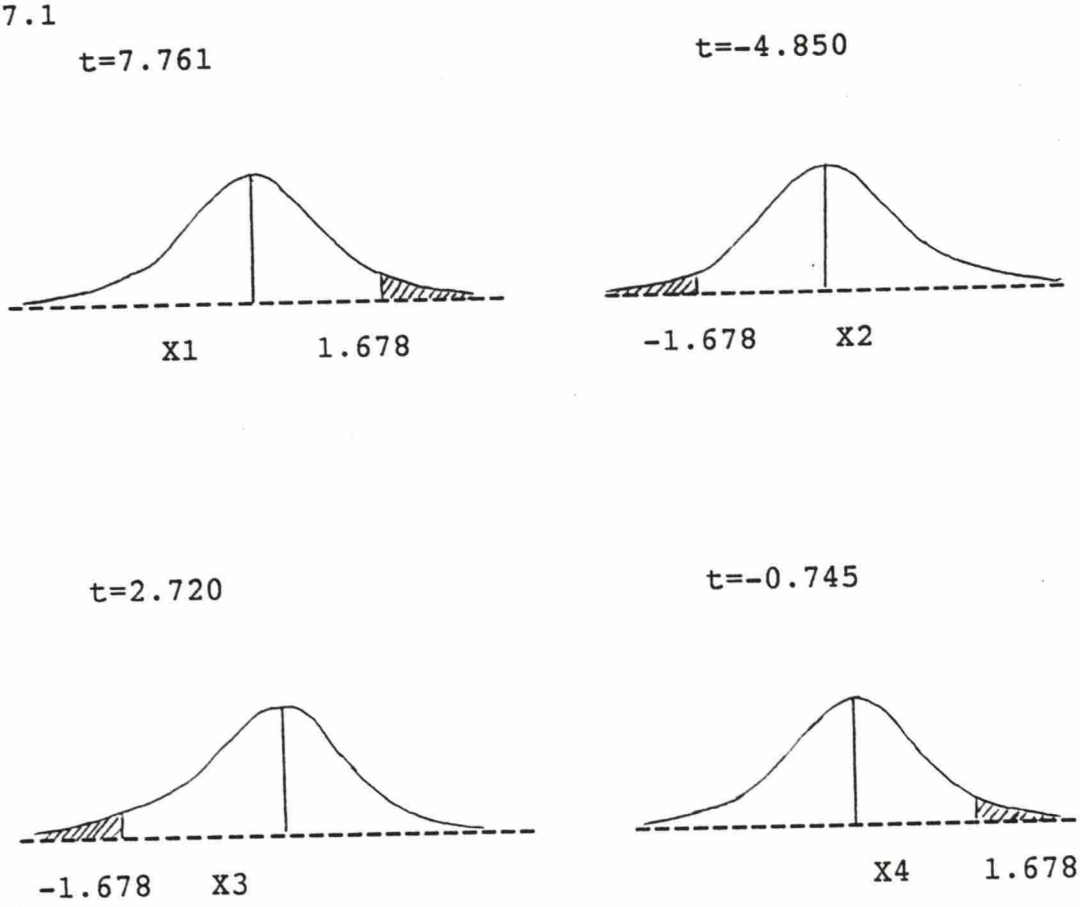
7.3.2 Results

Number of observations	55
R-Squared	0.55696
Adjusted R-Squared	0.52152
F-Statistic (4,50)	15.71434
Significance of F-Test	0.00000

VARIABLE	COEFFICIENT	STD.ERROR	T-RATIO	(SIG.LVL)
Constant	0.210	0.0630	3.318	(0.00091)
X1	0.756	0.0974	7.761	(0.00000)
X2	-0.00290	0.000598	-4.850	(0.00000)
X3	4.443	1.634	2.720	(0.00653)
X4	-0.0553	0.0742	-0.745	(0.45620)

The Adjusted R-Squared has fallen to 0.52. The value of F-Statistic is good, implying that the overall significance of the regression is high. The one-tail t-test results are shown in Figure 7.1.

FIGURE 7.1



The theoretical t-value at the 5 percent confidence level (t 0.05,51) is appr.1.678.
The parameter estimates of X1 and X2 fulfil the a priori criteria concerning the sign and, furthermore, the values are statistically significant. They fall within the critical area shaded in the picture. The null hypothesis can be rejected for their part.
On the contrary, the variables X3 (LMOB) and X4 (CMOB) do not provide satisfactory results. They receive signs opposite to the economic a priori criteria.
At this stage the equation would appear with numerical values as follows:

could it be because of simultaneity? one would expect large LMOB when wage differentials are large

$$X5 = \underset{}{0.210} + \underset{(3.318)}{0.756}*X1 - \underset{(7.761)}{0.00290}*X2 + \underset{(-4.850)}{4.443}*X3 - \underset{(2.720)}{0.0553}*X4 + \underset{(-0.745)}{e}$$

(The numbers in brackets are t-values.)
Since the regression did not provide satisfactory results for the part of the variables LMOB and CMOB, alternative model specifications will be experimented. Before that, however, the sources of error associated with this model specification are considered.

7.4 Sources of error

this is meaningless: no

7.4.1 Serial correlation

The method of producing the final variables used in the regressions raises an evident risk of serial correlation among successive values of variables: each country appears several times as a minuend and several times as a subtrahend, depending on its running number. Autocorrelation (serial correlation) is usually associated with time series data, but it may exist in cross-section analysis as well if the sample is not random. Autocorrelation refers to the relationship between successive values of the same variable. Autocorrelation is a common phenomenon in most economic variables, but usually it is only

where is no natural order for the observations

the random variable whose serial correlation is tested. The method of ordinary least squares requires the covariance of e_i and e_j to be equal to zero:

$$\mathrm{cov}(e_i,e_j) = E((e_i-E(e_i)) (e_j-E(e_j))) = E(e_ie_j) = 0$$

(Assumption 5)

In this research, one could presume that the nature of the observations, which are pairs of 11 countries, causes serial correlation. For instance, the capital endowment per worker in Belgium acts as a minuend in ten indices.

Serial correlation has a number of disruptive effects. When the random variables are serially dependent, the variances of e may be underestimated. Furthermore, if both the e's and the explanatory variables are positively autocorrelated, the variances of the parameter estimates are likely to be seriously underestimated. Thus there is a danger to accept insignificant explanatory variables as significant.

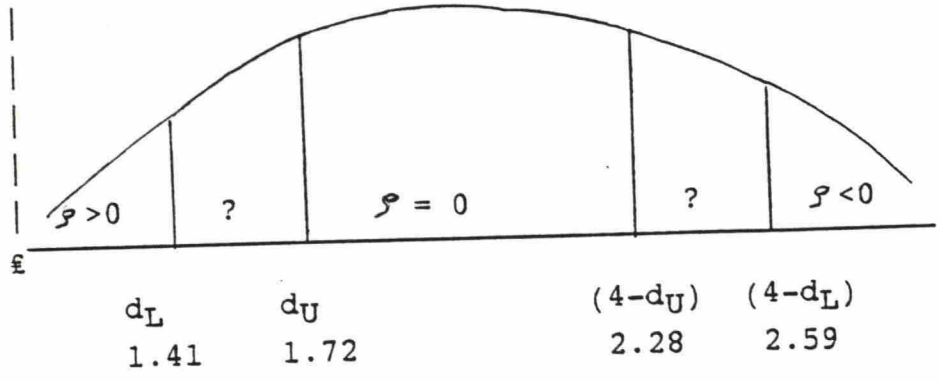
Even though serial correlation could certainly be associated with this research, the results of the trial regression proved to be the opposite. The estimated autocorrelation for transformed residuals (iteration by the Prais-Winsten method) is as low as -0.0421. (The computer program makes iterations to eliminate the possible autocorrelation. Autocorrelation for untransformed residuals was 0.30518.)
Autocorrelation is estimated by the Durbin-Watson test, which is used for detecting linear first-order autocorrelation.
The alternative hypotheses are:

H_0: $\rho = 0$

H_1: $\rho \neq 0$

The critical regions of the Durbin-Watson test are shown in Figure 7.2.

FIGURE 7.2



d_L = lower limit
d_U = upper limit
n = 55
k = number of explanatory variables excluding the constant term = 4
$d_L(55,4)$ = 1.41
$d_U(55,4)$ = 1.72

The result of the test is 1.91574, indicating that autocorrelation is practically nonexistent. However, the possibility of serial correlation must not be disregarded in the alternative model specifications. It will be pointed out should it appear.

7.4.2 Cross correlation

It is highly probable that the regressors used in this research have interdependence with each other. For example, a low capital endowment ratio is usually associated with migration outflows. A high correlation between two regressors may impair the accuracy of the parameter estimates.

When two variables are changing in the same way, it becomes difficult to establish the influence of each one regressor on the regressant separately. The parameter estimate values may be seriously imprecise and unstable. Multicollinearity may even cause a change in the sign of the parameter estimates. Furthermore, the standard errors tend to increase, thereby

raising the danger to reject a variable whose standard error appears high, although it is an important explanatory variable.

The simple correlation coefficients between the variables are shown in the following table:

	X1	X2	X3	X4	X5
X1		-0.17	-0.15	0.07	0.65
X2			0.64	0.042	-0.43
X3				0.16	-0.18
X4					0.005

X1 = ABS(k_i/l_i - k_j/l_j) / max difference
X2 = TR_{ij}
X3 = LMOB
X4 = CMOB
X5 = ABS(w_i-w_j)/ max difference

The only relation in which the correlation amounts to such a high figure that it may cause problems is that between the explanatory variables TR_{ij} and LMOB, R = 0.64.
It can also be pointed out that the variables X3 and X5 correlate negatively (R = -0.18), as expected on the economic-theoretical basis concerning the factor-price-equalizing effect. The correlation, however, is weak and can be attributed to accidental factors.

A revised version of Frisch's 'Confluence Analysis' is used here to test multicollinearity. The procedure is to regress the dependent variable on each one of the explanatory variables separately. First, an elementary equation is formed by choosing the explanatory variable that appears to give the best results on economic and statistical criteria. Here, the equation

$$X5 = b_0 + b_1 * X1$$

is chosen. Then, additional variables are gradually inserted and the effect on the t-values and the R-Squared is examined.

A new variable is classified as useful, superflous or detrimental:

(a) If the new variable raises the R-Squared and does not cause an unacceptable change in the a priori signs, it is considered useful and included in the equation.

(b) If the new variable does not raise the R-Squared and does not affect to any considerable extent the signs or values of the coefficients, it is considered as superflous and it is not included among the explanatory variables.

(c) If the new variable affects to a large extent the signs or values of the coefficients, it is considered detrimental. The variable cannot be omitted because since in doing so its influence would be absorbed by the other coefficients and by the random term. The consequence would be a violation of the Assumption that the random term and the explanatory variables are independent.

Detecting the effects of multicollinearity : test results

First, the elementary regressions are formed:

(1) $X5 = b_0 + b_1*X1 + e$

(2) $X5 = b_0 + b_1*X1 + b_2*TR_{ij} + e$

(3) $X5 = b_0 + b_1*X1 + b_2*TR_{ij} + b_3*LMOB + e$

(4) $X5 = b_0 + b_1*X1 + b_2*TR_{ij} + b_4*CMOB + e$

(5) $X5= b_0 + b_1*X1 + b_3*LMOB + b_4*CMOB + e$

The results of the regressions are shown in the following table. The numbers in brackets are t-values.

	constant	b_1	b_2	b_3	b_4	R^2
X5=f(X1)	0.161	0.565 (6.209)				0.421
X5=f(X1,X2)	0.180	0.711 (6.812)	-0.00185 (-3.764)			0.530
X5=f(X1,X2,X3)	0.188	0.747 (7.735)	-0.00289 (-4.849)	4.250 (2.635)		0.554
X5=f(X1,X2,X4)	0.189	0.714 (6.758)	-0.00183 (-3.685)		-0.0247 (-0.307)	0.530
X5=f(X1,X3,X4)	0.113	0.748 (6.212)		-1.007 (-0.658)	-0.0370 (-0.399)	0.430

The introduction of X2 improves the R-Squared from 0.42 up to 0.53, and the value of the b_1-coefficient does not turn unacceptable. The coefficient of X2 has the right sign and is statistically significant. The variable X2 is considered useful.
The introduction of X3 does not impair the results , but the sign of the variable is incorrect on a priori grounds. So X3 would be considered as superflous.
The same applies to X4.
Thus the best fit is obtained from the function X5=f(X1,X2).

The last regression was done because of the high correlation between X2 and X3. When the variable X2 is omitted, X3 appears with the right sign. However, it would be statistically significant only at a confidence level of 0.51. The overall fit is naturally decreased, because X2 is a significant explanatory factor. All in all, the intercorrelation between X2 and X3 seems to be problematic.

If multicollinearity has serious effects on the coefficient estimates of important factors, a corrective solution should be sought. One of the corrective methods is that of increasing the sample size. By doing that, high covariances among estimated parameters can be reduced because these covariances are inversely proportional to sample size. However, this method functions only if the intercorrelation happens to exist in the sample used but not in the whole population, or if multicollinearity is due to errors of measurement. In this study, the perceived high intercorrelation between X2 and X3 might not appear in a sample of countries scattered all over the world. Furthermore, the order of countries in the table from which the pairs are constructed may affect the results. This is tested in subsection 7.5.

Another way of overcoming multicollinearity is to introduce additional equations into the model, thereby expressing meaningfully the relationships between the multicollinear explanatory variables. The simultanous-equation model could then be estimated with a simultanous-equation technique.

In this reseach, it seems advisable to test whether the high intercorrelation between X2 and X3 is real or merely due to the method of forming the pairs.

7.5 Regression with a transformed order of countries

The method of forming 55 different pairs out of 11 countries has a fundamental defect: the results are weighted by the order of the countries in the list. For example, if Belgium and Denmark are the first and second countries at the top of the list, they will appear as a minuend in ten and nine pairs, whereas the second last one will appear as a minuend only in one pair and as a subtrahend in nine pairs. Thus the sort of correlation in trade intensity and labour mobility between the first countries receives a different weight than that of the countries at the bottom of the list.

The first order was as follows:
Belgium, Denmark, France, Great Britain, Greece, Ireland, Italy, Netherlands, Portugal, Spain, West Germany.

Now, the following order is used:
Italy, Portugal, Spain, Greece, Belgium, Denmark, France, Great Britain, Ireland, Netherlands,West Germany.
The emigration countries now appear at the top of the list. The change was done to see to what extent it affects the results.
The results are shown below.

Number of observations	55
R-Squared	0.53744
Adjusted R-Squared	0.50043
F-Statistic (4,50)	14.52348
Significance of F-Test	0.00000

VARIABLE	COEFFICIENT	T-RATIO	(SIG.LVL)
constant	0.198	2.804	(0.00505)
X1	0.582	4.551	(0.00001)
X2	-0.00140	-2.019	(0.04352)
X3	0.661	0.477	(0.63365)
X4	0.0531	0.722	(0.46999)

The values of the coefficient estimates of X1 and X2 are not affected detrimentally. X3 (LMOB) is the only variable that is not symmetrical, and therefore the value of the coefficient estimate has changed perceptibly (from 4.443 to 0.661). However, X3 still has the wrong sign. X4 receives the correct sign but it is still statistically insignificant.

The simple correlation coefficients are shown below:

	X1	X2	X3	X4	X5
X1		-0.16	-0.12	0.07	0.65
X2			0.59	0.06	-0.41
X3				0.13	-0.16
X4					0.005

The results are nearly identical with the earlier results. Even though the variable X3 (LMOB) is asymmetrical, the correlation coefficients have changed only slightly. The correlation between TR_{ij} (X2) and LMOB (X3) is still relatively high, R=0.59. Thus the intercorrelation between X2 and X3 is not due to the choise of the pairs. It seems that trade and labour tend to move in the same direction. The poor results for LMOB might be due to the multicollinearity, but as LMOB never appears with a statistically significant value, not even in a regression without TR_{ij}, other reasons are to be considered.

The variable X3 (LMOB) receives a positive sign in the regressions nearly without exception, which is against the assumed factor price equalizing effect. The reasons are clear, and they will be discussed in Chapter 9.

The last column in the table indicates the relative influence of the different explanatory variables on wage differences. It is evident that the capital endowment difference is the best explanatory factor for wage differences, R(X1,X5)=0.65. The same was valid in the case with the other order of countries.

As the R-Squared and the values of the coefficients were approximately the same in the first and second arrangements

(Adjusted R-Squared 0.521 vs. 0.500), it can be concluded that the reversal of the order does not nullify the results, and the first version is maintained in the successive regressions.

8. REGRESSIONS WITH AN ALTERNATIVE MODEL SPECIFICATION AND VARIABLE DEFINITION

In most cases economic theory does not explicitly state the mathematical form of economic relationships. Therefore, it is necessary to experiment with various forms (linear, nonlinear) and then choose the one that provides the most satisfactory results. The mistaken mathematical form of the function is one of the errors of specification, and the results (estimates of coefficients) will be unreliable if the model is not correctly specified.

In this research, the theoretical framework constructed in previous chapters leaves the formulation of the function indeterminate. The second transformation of the model is done by taking logarithms of all the variables, thereby assuming a non-linear form.

8.1 **Log-model**

The variables are transformed in the following way:

$$\log(X5) = \log(b_0) + b_1(\log X1) + b_2(\log X2) + b_3(\log X3) + b_4\log(X4) + e$$

The results are not satisfactory; the Adjusted R-Squared has fallen as low as 0.25692.

There are other criteria of selecting between models; R^2 is the least useful

VARIABLE	COEFFICIENT	T-RATIO	(SIG.LVL)
constant	1.683	1.481	(0.13865)
X1	0.437	3.185	(0.00145)
X2	-0.492	-3.144	(0.00167)
X3	0.138	1.372	(0.17009)
X4	0.0223	0.196	(0.84423)

X1 and X2 are still the only variables that fulfil the a priori and statistical criteria.

There are innumerable versions of a model, and the log-form is merely one of them. The choice of the mathematical form of the relationship connecting the regressand and regressors is often facilitated by the examination of scatter diagrams, where the dependent variable and each of the explanatory variables in turn are plotted against each other.

The scatter diagrams against X5 do not, however, reveal any distinct functional form that would be better grounded than the linear one. They are shown in Figures 8.1, 8.2, 8.3 and 8.4.

FIGURE 8.1

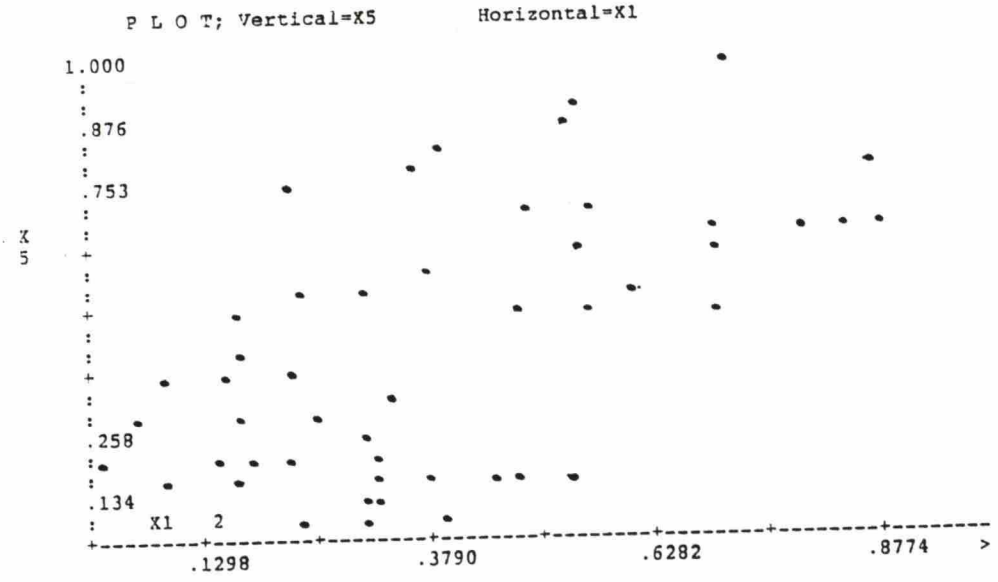


FIGURE 8.2

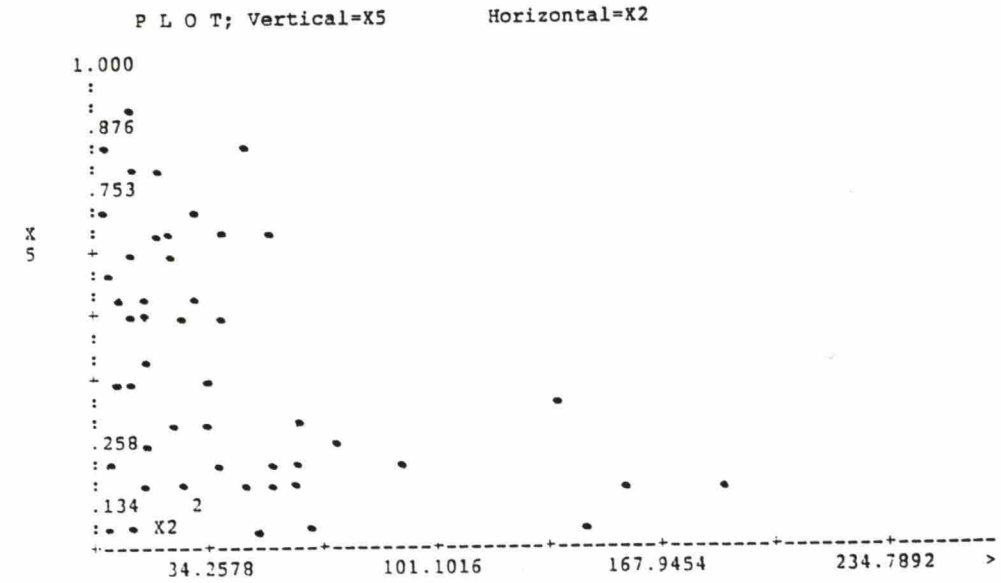


FIGURE 8.3

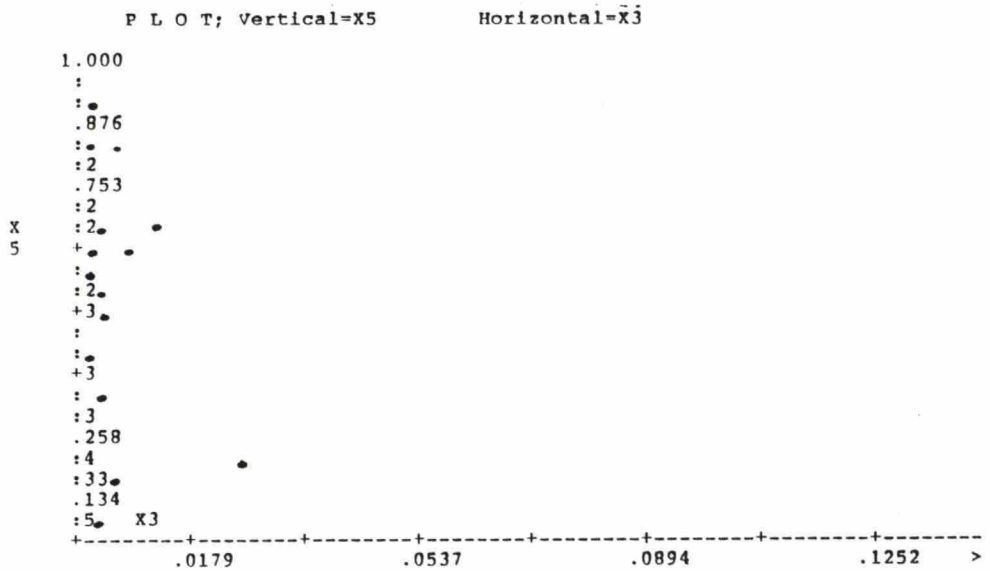
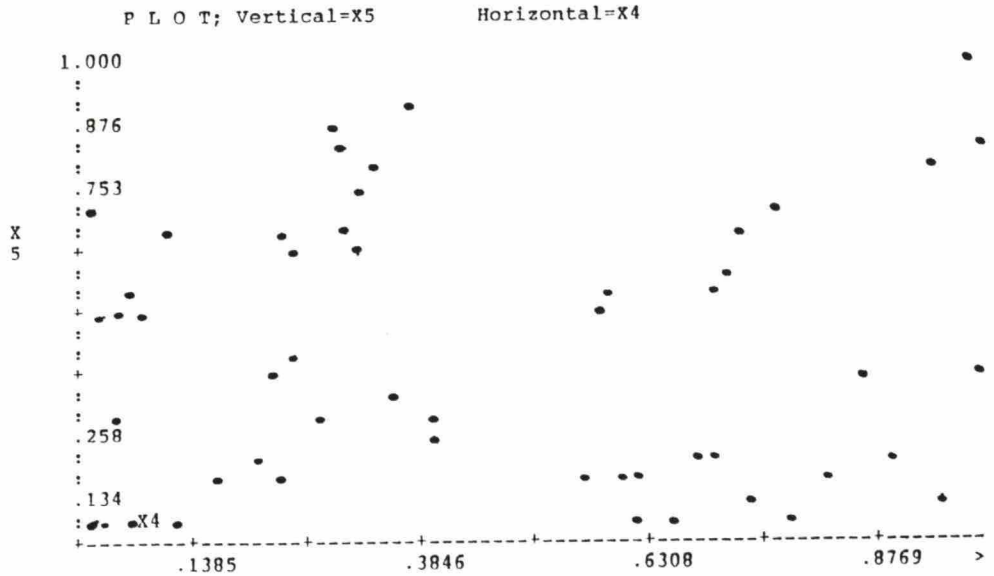


FIGURE 8.4



8.2 Wages: Monthly labour costs

The best empirical equivalent of a variable cannot be defined unambiguously. When the concept 'wages' is defined as labour costs, employers' view is accentuated. Furthermore, since the Eurostat source provides the monthly labour costs in ECU, the point of view of international competitiveness is in the forefront.

The labour costs also reflect social welfare in a country more clearly than earnings, since employers' contributions in respect of their employees paid to security and pension schemes as well as transport, cultural and medical facilities are included in labour cost data but excluded from earnings data.

The rate of interest is also changed: the discount rate is replaced by the money market rate.

Number of observations	55
R-Squared	0.83414
Adjusted R-Squared	0.82087
F-Statistic (4,50)	62.86254
Significance of F-Test	0.00000

VARIABLE	COEFFICIENT	T-RATIO	(SIG.LVL)
constant	0.105	2.474	(0.01337)
X1	0.966	14.908	(0.00000)
X2	-0.00198	-4.913	(0.00000)
X3	2.883	2.700	(0.00694)
X4	-0.0730	-1.159	(0.24641)

The adjusted R-Squared has risen substantially, up to 0.82. This implies that a better overall fit is obtained by using monthly labour costs (ECU) instead of hourly earnings (PPS). The significance of the variables is, however, similar to the earlier results. X1 and X2 are significant explanatory variables, whereas X3 and X4 are in contradiction with the a priori hypotheses.

Obviously, the reasons for the unsatisfactory results have to be looked into.

9. OBSTACLES TO VERIFICATION

The focus of this research is to observe the behaviour (value and sign) of the variable LMOB. After the various regressions carried out so far it can be perceived that the variable behaves regularly opposite to the factor-price-equalization theory. The construction of the empirical form of the variable can be critized, which will be done in a subsequent chapter. There are, however, more obvious reasons for the problem of empirical verification.

9.1 Underlying reasons

The underlying obstacle to the verification of the wage-rate-equalizing effect of labour movements is evidently the nature of the history of migratory flows within Europe in past decades. This research uses cross-section data from the year 1984, and the data solely reflect the fact that mass migration has been directed from low-wage to high-wage countries. Thus the causal relation between the variables X3 (LMOB) and X5 (ABS w_i-w_j/max difference) runs in the opposite direction than what the equation suggests. It is evidently impossible to produce a forecast with these data for the long-run future, when the labour market liberation has progressed further and the migratory flows perhaps follow another pattern. So far labour migration has simply not been extensive enough to cause wage rate convergence.

The integration process is still far from complete. The year 1984, which was picked up for the cross-section analysis,

simply represents a specific stage of the process. The problem of verification is inherent in the cross-section analysis; a time-series would be needed to examine whether the process is in line with the theory.

One possibility to trace out the direction of the development is to use comparative statistics. Another (or more) reference year is picked up for cross-section analysis, in this case an earlier year, e.g.1974. Thus two estimates of the same relationship for two different cross-section samples are obtained. One could then outline the trend of development by comparing the results of the two reference years.
It can be tested whether the two estimated functions differ significantly, in which case it is concluded that the relationship is changing from one sample to the other. The difference between the two estimated functions can be tested by an adaptation of F-test suggested by Chow (Test of equality between coefficients obtained from different samples).
The test runs in the following way:

First, the two samples 1974 and 1984 are pooled together. The pooled function is computed and the unexplained variation (sum $e^2(p)$ = restricted sum of squared residuals RSSS) is estimated.

Second, a regression analysis is performed on each sample separately, and the unexplained variations (sum $e^2(1)$ and sum $e^2(2)$) are estimated.

Third, the unexplained variations of the two samples are added together to form a total unexplained variation.
(sum $e^2(1)$ + sum $e^2(2)$ = unrestricted sum of squared residuals URSS)

Fourth, the above sum is substracted from the pooled residual variance of stage 1:

$$\text{sum } e^2(p) - (\text{sum } e^2(1) + \text{sum } e^2(2)) = \text{RSSS} - \text{URSS}$$

Fifth, the following ratio is formed:

$$F = \frac{\text{RSSS} - \text{URSS} \;/\; K}{\text{URSS} \;/\; (n1+n2-2K)}$$

K = number of estimated parameters
n_i = sample size

The observed F-value is compared with the theoretical value of F(0.05) with due degrees of freedom (K and n1+n2-2K). The null hypothesis is that the coefficient estimates obtained from different samples do not differ significantly. If the observed F-value falls within the critical region, the null hypothesis is rejected and it can be concluded that the relationship between wage rates and the regressors has changed over time.
However, the Chow-test does not reveal to which variable the change in the function can be attributed. To decide which coefficient has changed, additional information is required.

Although this kind of further research could be highly illustative, it will not be carried out in this research due to data deficiencies and the limited scope of the study.

9.2 **Two-way causation**

It is clear that there is a two-way causal relation between wage differences and labour mobility. So far the there has been evidence mostly on the effect of wage differences on migration. However, the other causation is theoretically plausible as well.
It can be argued that e.g. U.S. time-series data might have been more suitable for this study than EC data. In EC data, the relation "wage differences --> labour mobility" is dominant. There are only few examples of migration between industrial countries, as the case of Benelux-countries or the relatively high penetration of Britons in Ireland.

Which variables will be endogenous and which will be considered exogenous in a model depends on the purpose of the model as well as on the nature of the variables. The two-way causation between labour mobility and wage differences, however, produces a violation against the assumptions of OLS.

(Assumption 6: E(Xe)=0)
The application of the least squares assumes that the explanatory variables are truly exogenous. If this does not hold, the method yields biased and inconsistent estimates. The number of equations in a model ought to be equal to the number of endogenous variables. Thus a multi-equation model would be advisable in this study.

10. CRITIQUE AND IMPROVEMENTS

10.1 **Critique of the variable LMOB**

Two kinds of complications are associated with the variable LMOB: first and foremost, the above mentioned two-way causal relation between wage differences and labour mobility raises controversy about the a priori sign of the coefficient of the variable LMOB as a regressor.
Second, the concept 'migrant' is not unambiguous.

10.1.1 Controversial sign of the coefficient

The variable LMOB is a stock variable, and the determination of its sign is not straightforward due to the two-way causation. The basic hypothesis of this study is that wage differences have been eliminated by labour mobility (along with other equalizing factors) at the final stage of the integration process. Therefore, it is well-grounded to argue that the larger the stock of migrants from country i in country j, the smaller the wage difference has become. Correspondingly, where the wage differences are large, the labour mobility has not yet been sufficient to create convergence. This argumentation leads to a negative sign of the coefficient.
However, a positive sign is associated with the other direction

of the causal relation. Wage differentials act as an incentive for migration: the larger the wage differential, the stronger the incentive to emigrate from the low-wage country(j), and thus the larger the stock of migrants from country j in country i (high-wage country).

The problem of the two-way causation is inherent in this study. A method of pooling cross-section and time-series data could have illustrated the interaction better. In subchapter 10.4, the relation between LMOB and wage differences is reversed and LMOB acts as a regressant in the equation.

10.1.2 The concept 'migrant'

The variable LMOB is imperfect in describing labour mobility between countries in the sense that it only explains the 1982 stocks of migrants from each selected sending country living in each selected host country. This raises the question 'who is a migrant'.

First, the data fail to reflect migratory flows, which include temporary workers and are thus a much wider concept. The number of fixed period working agreements has increased lately. It is estimated that more than a million employees work on a temporary basis within the EC area. Still, a very low portion of the fixed-period workers emigrate to another country, namely 1% of the whole sector. (Kauppalehti 19.4.1990) The number is, however, expected to increase after 1992. The market for odd jobs is concentrated in five countries: Netherlands, Britain, France, Germany and Belgium. The typical temporary worker is young - two thirds of them are younger than 30 years - and male.

The wages of temporary workers tend to be inferior to those paid to permanent workers. This has raised the issue of import of cheap labour; e.g. Dutch employers have already sought the opportunity to obtain temporary labour force from Spain and Portugal for periods of 2-6 months.

Second, the variable LMOB ignores frontier workers. Frontier workers are defined as people who live in one Member State , to which they normally return daily or weekly, but are employed in another Member State. The issue is conceptual - the

frequency of return determines whether or not a person is a migrant or a frontier worker.
The largest volume of intra-Community frontier workers is between West Germany and its neighbours. The largest single movement of frontier workers is from France to Germany, standing at a level of 35000 workers. Other major flows are from France, Belgium and Germany into Luxembourg (between 20000 and 25000), between Belgium and Netherlands (20000), between Belgium and France (15000) and from the Netherlands to Germany (10000). The movement is in most cases one way: from the lower wage country to neighbouring states where wages are higher and job opportunities better.

Were the magnitude of frontier workers large enough to have an impact on wage formation, they could constitute a major defect for the variable LMOB, which counts only immigrants living in the host country.

Third, the statistics refer to the population of a selected country by **nationality**, not by country of origin.

10.2 Critique of the statistical counterpart of Capital endowment K

The statistical counterpart of the variable K/L, which should be an indication for the amount of capital per worker, does not correspond with the theoretical concept. The figure simply depicts the amount of gross fixed capital formation during a year (1984). Thus the amount of capital formation during a specific year is used as a proxy for the whole stock of capital.

Some corrective measures can be outlined, though none of them is without pitfalls.

First, if time series analysis had been applied, a lagged variable could have provided a solution. In a distributed lag model, the influence of the explanatory variable on the regressand is distributed over a number of past values of the variable. By that means investment over a longer period could have

been included in the function.

Second, if adequate data had been available, the variable K/L could have been corrected in a way that is applicable to cross-section analysis as well. For year t, the stock of capital is set equal to the total gross fixed asset formation (in prices of a specific year) during the years t-21 up to t-1. The calculated figure is then divided by the number of employees in year t. The method assumes arbitrarily a 20-year life span of a machine.

A further possibility is to use a variable that is expected to correlate strongly with the capital endowment K as a proxy for it. A suggestion could be "commercial energy consumption in kWh" during a specific year.

Another proxy for the capital endowment widely in use is GNP/capita. In this study, it can be incorporated into the equation as follows:

$$X1 = \frac{\text{ABS } (GNP_i/\text{population in i} - GNP_j/\text{population in j})}{\text{largest difference in the sample}}$$

As before, the value of the variable ranges between zero and one. A trial regression with this formulation for X1 is presented in subchapter 10.4.

10.3 Critique of the variable CMOB

Real interest rates were used in the capital mobility index CMOB. The purpose of the variable is to test the influence of integration within one factor market (capital market) over the price determination in another factor market (wages in the labour market). All rests on the assumption that the more equal the interest rates across countries, the further integrated the capital market. However, capital movements are directed by nominal rather than real interest rates. If real interest rates are used, inflation is incorporated into the model and it causes a disturbance factor.

A regression with nominal rates of interest is presented in the next subchapter.

10.4 Regressions: additional runs

10.4.1 Regression with revised variable formulations

The amendments discussed in the preceding subchapters are included in the following regression.
In X1, GNP/capita is used as a proxy for capital endowment K. The interest rate used in CMOB is the nominal money market rate. For X5, the wage rate is "hourly earnings,PPS". The other formulations remain as before.

Results

Number of observations	55
R-Squared	0.63999
Adjusted R-Squared	0.61119
F-Statistic (4,50)	22.22108
Significance of F-test	0.000000

VARIABLE	COEFFICIENT	T-RATIO	(SIG.LVL)
constant	0.0827	1.330	(0.18359)
X1	0.724	7.261	(0.00000)
X2	-0.00119	-1.895	(0.05810)
X3	0.124	0.078	(0.93811)
X4	0.152	1.627	(0.10376)

The values of X1,X2 and X4 are in line with the a priori hypothesis, even though the significance level is relatively high for X4 (P=0.10376). LMOB (X3) appears again with a positive sign.
- X1 proved to be a significant regressor with the new formulation as well. A better fit was obtained for X4 (CMOB) with nominal interest rates. The controversy about the sign of LMOB is dealt with in the following subchapter.

10.4.2 Reversed equation

The original equation is reversed in the following way in order to shed light on the interaction between wage differences and LMOB. It is evident that the theoretical basis for the reversed equation is weak.

$$LMOB = b_0 + b_1*X1 + b_2*TR_{ij} + b_3*X5 + b_4*CMOB + e$$
$$(X3) \qquad\qquad (X2)$$

$$X5 = ABS(w_i - w_j)/\text{max difference}$$

The a priori signs of the coefficients are set as follows:

VARIABLE	VALUE	DIFFERENCE / RELATION BETWEEN COUNTRY i AND j in respective variable
X3 (LMOB)	large	strong labour mobility (large stock built up)
X1	--> 0	small
	--> 1	large

A large difference in capital endowment is associated with a large wage difference, which in turn acts as an impetus to labour movements.
--> POSITIVE SIGN.

$X2 = TR_{ij}$	large	intensive trade

If the relation between trade and factor movements is **complementary**, strong commercial relations are associated with strong LMOB. --> POSITIVE SIGN.

On the other hand, the relation may be **substitutive**.
--> NEGATIVE SIGN.

X4 = CMOB	--> 0	small
	--> 1	large

The more integrated the capital market, the more integrated the labour market.
--> POSITIVE SIGN.

X5 (wage variable)	--> 0	small
	--> 1	large

A large wage difference acts as an incentive for emigration from the low-wage country.

The determination of the sign for X5 produces complications which did not appear in the original equation (in which the basic hypothesis was opposite: LMOB leads to wage rate convergence). This is due to the structure of the variable:

e.g. When Spain(low-wage country)=i, Germany(high-wage country)=j, the value of the variable X5 is
ABS(4.06-8.27) / 6.88 = 0.612 ('high')
and the value of LMOB is 0.0065 ('high').

(LMOB = migrants from country i in country j / total labour force in j)

Thus the sign ought to be POSITIVE.

However, when Netherlands(high-wage country)=i, Portugal(low-wage country)=j, the value of X5 is
ABS(8.17-2.86) / 6.88 = 0.772 ('high')
and the value of LMOB is 0.0001478 ('low').

--> The sign ought to be NEGATIVE.

This signifies naturally that the flow is merely one-way, from a low-wage country towards a high-wage country but not the opposite. This is reflected in the stock.

The data are constructed arbitrarily so that a high-wage country appears randomly as the i-country and as the j-country. Therefore the sign cannot be determined.

Results

Number of observations	55
R-Squared	0.44716
Adjusted R-Squared	0.40293
F-Statistic (4,50)	10.11036
Significance of F-test	0.000000

VARIABLE	COEFFICIENT	T-RATIO	(SIG.LVL)
constant	-0.0118	-2.236	(0.02991)
X1	0.0165	1.324	(0.19161)
X2	0.000266	5.909	(0.00000)
X4	0.00180	0.206	(0.83754)
X5	-0.00404	-0.332	(0.74109)

As noted before, there is a relatively strong positive correlation between TR_{ij}(X2) and LMOB (see 7.4.2 R(X2,X3)=0.64) ; X2 is the only regressor that is statistically significant here (P=0.00000). The positive sign implies that the relation between trade and labour mobility is complementary in the case of the EC countries.
The wage variable(X5) is not statistically significant. The correlation coefficient R(X5,X3)=-0.18 (See 7.4.2), also implying that the interaction is not as strong as presumed. However, the results do not nullify the a priori hypothesis of the study but can merely be attributed to the structure of the data and to the random order of the pairs.

A stepwise regression procedure was also applied to the reversed equation:
(P-values,i.e. sig.levels in brackets)

	constant	b_1	b_2	b_4	b_5	R^2
X3=f(X5)	0.00906				-0.0128 (0.178)	0.0339
X3=f(X1,X5)	0.00662	0.0194 (0.227)			-0.0263 (0.075)	0.0609
X3=f(X1,X2,X5)	-0.0114	-0.167 (0.181)	0.000265 (0.0000)		0.00356 (0.764)	0.447
X3=f(X1,X4,X5)	0.00684	0.0195 (0.231)		-0.000909 (0.936)	-0.0260 (0.088)	0.0610

The table illustrates the interaction better. X5 (the wage difference variable) is statistically significant at the 10 per cent risk level in regressions nr.2 and 4. The poor significance of X5 in regression nr.3 (P=0.764) is evidently attributable to the fairly strong correlation between X2 and X5, R(X2,X5)=-0.43 (see 7.4.2), which causes disturbances.
All in all, the table implies that the best explanatory variables for LMOB are TR_{ij}(X2) and X5(the wage difference variable).

The controversy about the relationship between X5(wage differences) and X3(LMOB) may be summarized as follows:
The simple correlation coefficient R(X5,X3)=-0.18. The correlation is negative but too low to be statistically significant.
The basic hypothesis of the study runs as follows:
(1) $ABS(w_i-w_j)$ / max difference = f(LMOB)
Labour mobility is the cause to wage rate convergence. Assuming that the influence only runs in this direction, the a priori sign is to be set NEGATIVE.
In the tests it appeared, however, with a positive sign. Whether the positive sign is justified, can be experimented by setting LMOB as a regressor.

When the opposite direction of the interaction is considered, the sign for X5 is indeterminate, as discussed above.
(2) LMOB=f(X3)
The variable X5 proved to be significant at the 10 per cent risk level when TR_{ij} was omitted from the function.

When the interaction between X3 and X5 is considered as a simultaneous process as it is in reality, the following argumentation holds:
The influence of the first type (1) is to be connected primarily with the later stages of the integration process. Labour mobility has already equalized the wage rates; i.e. where the wage difference is small between two countries, the stock of immigrants from country i (former low-wage country) is large in country j (former high-wage country).
In the early stages of the process, the hypothesis (2) is dominant: wage differences are a cause to labour movements. Although the sign of X5 is indeterminate in equation (2), it can be argued that the relationship now implies a positive sign to LMOB(X3) in the original equation(1): where the labour mobility is strong (large stock of migrants from a low-wage country in a high-wage country) the wage differences must have been high.
The empirical results have been opposite to the basic hypothesis (1) throughout the study. This can be attributed to the fact that the integration process within the EC is still at an early stage.

10.5 Autocorrelation in cross-section analysis

In time-series data, autocorrelation means correlation between successive values of the same variable at successive points of time caused e.g. by economic fluctuations or a major shock. In cross-section data, it is detrimental only if the sample is not random but arranged according to some criterion, e.g. size order.
In this study, the order of countries was chosen arbitrarily, and thus it is meaningless to estimate autocorrelation. The subsection 7.4.1 is to be deleted.

10.6 Introducing a Dummy variable: Trade unions

As discussed in Chapter 3.2, the power of a trade union may act as an incentive for immigration by providing higher incomes and security for a worker. Besides this, the role of trade unions varies to some extent across the EC countries (see Chapter 5.5.1). To test whether the relative bargaining power of trade unions has an impact on wage rate differentials, a dummy variable (binary variable) could be introduced.

A dummy variable is used as a proxy to categorical and qualitative factors. It is given the value one (1) if a specific characteristic is present and the value zero (0) if not. The use of a dummy variable requires that the observations are divided unambiguously into two groups. However, the strength of a labour union is not easy to categorize, as clarified earlier. In addition, the statistical sources concerning industrial relations are inadequate and inappropriate for determining the strength of a union. For instance, the ILO publication Year Book of Labour Statistics only provides data on strikes and lock-outs during a 10-year period. This kind of data can merely be associated with the degree of tranquillity in the industrial relations and it does not necessarily have any distinct connection to bargaining power.

The model would appear in the following form with a dummy variable:

$$X5 = b_0 + b_1*X1 + b_2*X2 + b_3*X3 + b_4*X4 + b_5*D + e$$

where D = 1 if strong labour unions in country i
0 if weak labour unions

The incorporation of the dummy variable would also prove technically difficult, remembering that the regressant is a wage rate difference divided by the largest difference in the sample. The binary variable should also adopt a form that includes the respective value for both of the countries of the observation in question. Since the binary variable possesses either the value 1 or the value 0,it is practically infeasible.

11. FINAL ANALYSIS

11.1 The role of labour mobility in wage rate convergence

The empirical test, due to its defects, could not support the hypothesis of wage rate convergence resulting from labour migration in an integrated union. Labour migration by 1984 had not been extensive enough to bring about an equalizing effect between the South and the North. Intercountry differences in wage rates have persisted, primarily as a result of inertia due to sociological and psychological obstacles and the high valuation of intangibles on the part of the workers.
In addition, imperfect information about job opportunities acts as a brake on the labour migration.

Two countries may be regarded as equal by a worker despite differing money wage rates if other types of worker remuneration are considered, e.g. vacations, overtime payments, social services etc. Also other than pecuniary advantages are to be taken into consideration, such as legislation on work conditions, and more generally, the prevailing housing situation in the home country versus the one prevailing in the potential host country.
In addition, taxation plays a central role. Both of the concepts 'hourly earnings' and 'labour costs' can be criticized on the grounds that the statistics relate to employees' gross remuneration. Thus the effect of taxation in wage rate comparisons when a worker is choosing the place of residence does not come forward.
The personal income tax varies substantially across the EC countries, being as low as 5.7 percent in Greece and 44.5 percent in Denmark (1988) of gross earnings of an unmarried average production worker. A better indication of the net income of a worker is 'take-home pay' as a percentage of gross earnings. It takes into account the income tax and employees' social security contributions. For a Greek, it is 81.0 percent of gross earnings and for a Dane, 53.4 percent.
- The personal income tax at the income level of an average production worker is presented in Table 11.1. Table 11.2

presents take-home pay and cash transfers as a percentage of gross earnings. The income tax and employees' social security contributions as percentage of gross earnings are depicted in Chart 11.1.

It can be argued that the real ('effective') income differences have not been large enough to break the inconvenience factor inherent in migration.

Whether migration will be more extensive after the process of forming the Common labour market has been completed, remains open. Removal of the remaining obstacles to free movement is unlikely, in itself, to produce a new wave of mass migration. However, as noted earlier, there remains a large potential for migration from many areas of Southern Europe, where the agricultural sector is contracting through the structural change and future employment is dependent on local development strategies. The most likely prospect would be a gradual, progressive increase in the general level of Community-wide mobility, led by the more highly skilled, who already have a wider concept of their labour market, and who also will thus be the first to exploit the greater opportunities of free movement. (Commission of the European Communities: "Employment in Europe",1989,p.154)

The final answer to the question of converging wage rates, however, is dependent on the overall integration.

TABLES 11.1, 11.2

PERSONAL INCOME TAX AT THE INCOME LEVEL OF AN APW
(Excluding the effects of non-standard tax reliefs)

IMPOT SUR LE REVENU DES PERSONNES PHYSIQUES AU NIVEAU DE SALAIRE EQUIVALENT A CELUI DE L'OM
(Effets des abattements fiscaux non forfaitaires non compris)

Country	Single people Célibataires				Two-child families Famille avec deux enfants				Pays
	Expressed as a percentage of gross earnings En pourcentage du salaire brut								
	1985	1986	1987	1988	1985	1986	1987	1988	
Australia	21.9	22.2	22.4	23.9	16.8	17.4	17.8	19.8	Australie
Austria	10.2	10.8	9.5	9.8	7.6	8.3	6.4	6.8	Autriche
Belgium	23.7	23.5	23.5	23.4	16.4	15.9	15.6	15.1	Belgique
Canada	19.4	20.7	21.3	19.5	10.3	11.4	12.2	10.4	Canada
Denmark	40.0	40.4	44.0	44.5	34.3	35.0	35.7	36.1	Danemark
Finland	30.5	30.3	30.6	31.8	25.3	24.5	25.1	26.7	Finlande
France	7.4	7.2	6.8	6.8	-	-	-	-	France
Germany	18.1	18.1	18.6	18.1	10.9	8.3	8.6	8.8	Allemagne
Greece	3.2	5.1	3.9	5.7	-	3.4	2.5	3.6	Grèce
Ireland	26.7	26.8	27.9	27.0	16.1	16.9	17.8	18.0	Irlande
Italy	18.4	17.7	18.4	18.8	16.2	14.6	15.2	15.6	Italie
Japan	8.8	9.0	8.5	8.1	2.8	3.0	2.7	2.3	Japon
Luxembourg	16.7	16.4	14.0	13.4	2.2	2.1	1.0	0.7	Luxembourg
Netherlands	11.3	11.7	11.9	11.8	8.4	8.8	8.9	8.9	Pays-Bas
New Zealand	27.9	25.7	23.6	23.9	24.8	24.9	23.6	23.9	Nlle-Zélande
Norway	22.7	22.7	22.7	24.4	15.0	15.1	15.2	17.2	Norvège
Portugal	5.2	3.3	5.1	6.0	4.6	2.5	4.0	6.0	Portugal
Spain	12.2	13.8	14.1	11.3	7.8	9.6	10.0	6.5	Espagne
Sweden	35.6	36.1	36.6	37.2	33.9	34.5	35.0	35.8	Suède
Switzerland	11.2	11.4	11.0	10.8	6.4	6.9	6.5	6.5	Suisse
Turkey	22.9	22.0	21.2	n.a.	22.7	22.0	21.2	n.a.	Turquie
United Kingdom	22.3	21.6	20.3	18.9	17.9	17.4	16.5	15.4	Royaume-Uni
United States	22.8	19.9	20.0	18.5	15.3	12.4	13.3	11.6	Etats-Unis

. TAKE-HOME PAY PLUS CASH TRANSFERS

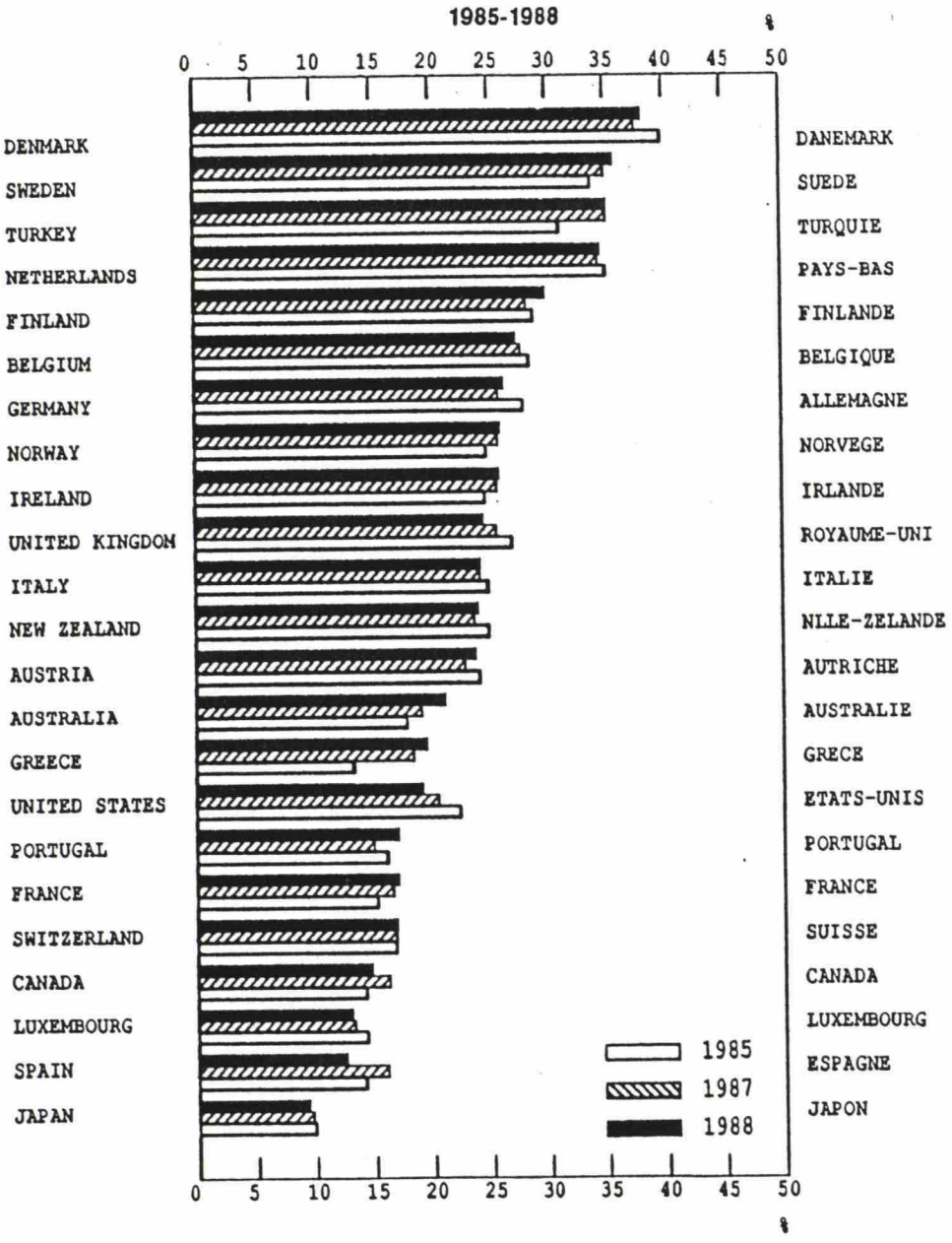
REMUNERATION NETTE PLUS TRANSFERTS EN ESPECES

Country	Single people Célibataires				Two-child families Famille avec deux enfants				Pays
	Expressed as a percentage of gross earnings En pourcentage du salaire brut								
	1985	1986	1987	1988	1985	1986	1987	1988	
Australia	77.1	76.6	76.4	74.8	85.5	84.5	83.8	81.6	Australie
Austria	73.4	72.7	74.1	73.3	91.4	90.0	92.7	91.2	Autriche
Belgium	64.3	64.5	64.4	64.5	82.2	83.0	84.3	86.0	Belgique
Canada	76.7	75.4	74.6	76.2	89.0	87.8	86.9	88.3	Canada
Denmark	53.7	53.2	54.0	53.4	64.1	63.3	66.5	67.3	Danemark
Finland	65.8	66.3	66.0	64.8	77.4	78.4	77.7	76.0	Finlande
France	77.4	77.0	76.5	76.0	92.3	91.6	90.7	90.2	France
Germany	65.0	64.8	64.3	64.4	76.9	79.1	78.8	78.1	Allemagne
Greece	83.6	81.7	82.8	81.0	104.1	100.7	101.6	100.5	Grèce
Ireland	64.8	65.7	64.4	65.3	78.6	79.3	78.0	77.6	Irlande
Italy	73.0	73.4	72.7	72.6	81.9	84.7	79.7	84.1	Italie
Japan	84.2	84.0	84.5	84.9	90.2	90.0	90.3	90.7	Japon
Luxembourg	71.1	71.4	73.8	74.3	94.5	95.8	97.2	97.1	Luxembourg
Netherlands	62.0	62.8	62.6	62.6	72.8	73.5	73.0	73.1	Pays-Bas
New Zealand	72.1	74.3	76.4	76.1	84.5	83.3	85.3	81.4	Nlle-Zélande
Norway	67.3	66.2	66.4	66.6	83.3	82.4	82.9	83.5	Norvège
Portugal	83.3	85.4	83.9	83.0	87.8	91.5	90.2	87.8	Portugal
Spain	81.6	80.2	79.9	82.7	86.7	84.8	84.4	87.9	Espagne
Sweden	64.4	63.9	63.4	62.8	75.4	74.2	74.8	73.4	Suède
Switzerland	78.5	78.3	78.7	78.8	89.4	89.9	90.0	89.8	Suisse
Turkey	68.7	68.7	64.8	n.a.	68.9	68.7	64.8	n.a.	Turquie
United Kingdom	68.7	69.4	70.7	72.1	81.5	81.7	82.2	82.7	Royaume-Uni
United States	70.2	72.9	72.8	74.0	77.7	80.4	79.5	80.8	Etats-Unis

CHART 11.1
Source: OECD 1989, The Tax Benefit Position of Production Workers 1985-88 (Tables 11.1,11.2,Chart 11.1)

INCOME TAX AND EMPLOYEES' SOCIAL SECURITY CONTRIBUTIONS
AS PERCENTAGE OF GROSS EARNINGS (1)
One-earner families at APW's wage level

IMPOT SUR LE REVENU ET COTISATIONS SALARIALES DE SECURITE SOCIALE
EN POURCENTAGE DU SALAIRE BRUT (1)
Un salaire par ménage, égal à celui d'un ouvrier moyen



11.2 Overall integration and factor price equalization

In a perfectly competitive setting and in autarky, the K/L ratio determines wage differentials between separate markets. The significance of the K/L ratio is expected to remain high also when trade is introduced.
The empirical results support this view strongly. The coefficient estimate of X1 was statistically significant in all regressions, the significance level (P-value) being 0.00. The numerical value of the coefficient estimate varied between appr. 0.47 and 0.96. However, some caution is to be attached to the results remembering the defectiveness of the statistical counterpart of K.

The first dimension of economic integration, trade involvement, also proved significant in explaining wage differentials. The coefficient estimate of X2 was statistically significant in the first regression (subsection 7.3.2) with a P-value of 0.00. When the order of countries was reversed, the estimate was still significant (P-value = 0.043). Furthermore, the value of the coefficient estimate was relatively stable, varying between -0.00119 and -0.00290.

The idea of the substitution between trade and factor mobility needs to be brought up again (See 4.1.1). "An increase in trade impediments stimulates factor movements and an increase in restrictions to factor movements stimulates trade." (Mundell 1957,p.321)
In the light of the history of the EC, the view appears to be relevant, migration figures declining most for countries that were included in the Community. For instance, the migratory outflows from Italy declined as the standard of living rose along with the commercial intercourse with the Community. A similar development pattern is likely to recur in the case of Greece, Portugal and Spain. Thus it can be argued that the wage rate convergence will occur dominantly due to trade instead of labour mobility.

On the other hand, factor trade and commodity trade can be seen as complements, as well. (See 4.1.2)

11.3 The combined effect of trade and labour mobility

Trade and migration become complements instead of substitutes, when the basis for trade is other than differing factor endowments (classical view). The basis could stem from differences in technology, preference structure or factor taxes. An example of the complementary relation between migration and commodity trade is the trade in computers and software among regions unequally endowed with technological possibilities. Frequently, trade in computers and software is accompanied by movements of technical engineers and programmers.
Thus factor trade and commodity trade act together to reinforce the tendency towards more equal factor prices.

The results of the regression with a reversed equation (See 10.4.2, LMOB as a regressant) support the view of a complementary relation, TR_{ij} appearing with a positive sign. Thus this is in contradiction to the argumentation above (11.2), which is more clearly based on time-series consideration.

The classification of the future relation between labour migration and trade is not essential from the aspect of the final outcome concerning the wage rate convergence. As the integration deepens, trade will be intensified between the South and the North, and the possible migration will only reinforce the equalization process.

11.4 Disadvantageous repercussions to Greece, Portugal and Spain

Although it can be concluded that the wage rate differentials between the core areas and the periphery of the Community are likely to diminish in the long run, the conclusion only refers to the **average** wage level in a country.

Although the average level of wages rises, there may emerge changes that are structurally disadvantegous for a country:

(1) regional imbalances
(2) changes in the structure of labour force.

First, regional imbalances within a country may be aggravated through international economic integration. The UN Economic Commission for Europe gave an expression concerning the Italian unification in the 1950's : "disparities in income levels, once established, have a vicious tendency to become more pronounced in the absence of positive intervention." (Balassa, 1962). - When considering the Italian economy now, after more than 30 years of integration, a distinct tendency of industrial concentration in the Northern regions of the country can be perceived, the Southern parts being poor and underdeveloped. This is due to agglomerative tendencies: new investment goes primarily to regions which are already the most developed within the country. The agglomerative factors comprise economies of scale, availability of related industries, good infrastructure such as transportation and communication facilities, and marketing factors.
Moreover, the regional disparities in per capita incomes tend to be much larger in the less developed countries of Europe, such as Spain, Portugal and Greece, and also Italy, than in the highly industrialized economies. This can be attributed partly to the fact that the "spread-effects" emanating from the highly developed centers to backward areas are stronger in developed countries where the communication facilities are better and the dissemination of technology is easier due to a higher level of education. Secondly, regional policy has been considerably sronger in advanced countries than in underdeveloped countries.

Thus the future economic integration may lead to the emergence (aggravation) of polarization tendencies in Greece, Portugal and Spain. The liberation may aggravate interregional inequalities and may also impede the development of backward regions.

Therefore, regional development policies are of great importance. Regional policy should be used to encourage the movement of industries to backward areas. The principal forms are (1) improvement of the infrastructure (public utilities, transportation facilities and social services) and (2) subsidi-

zation of industries (tax reductions, provision of capital and outright subsidies).

For the full effectiveness of the measures, their coordination in the whole Community is necessary. The aim of coordinated regional policy was pronounced already in the Treaty of Rome. As an example, the contributions granted to Portugal out of the Community budget funds have been of great importance to the country.

In sum, not only the increase in national income per head but also interregional disparities have to be considered in judging the effects of migration.

Another cost of integration is the possible loss of human capital through strong emigration, i.e. disadvantageous changes in the structure of labour. The full guarantee of free movement of labour is double-edged for the countries of origin.

- On the positive side, in case the migrants are mainly low-skilled workers from a region with underemployment, the conditions of the remaining population are only eased. Moreover, the emigrants' remittances make a contribution to their incomes.
- On the other hand, there is a risk that workers who are an integral part of the production process will also emigrate. The withdrawal of specialists is a serious human capital loss. It is bound to decelerate the rate of development, and therefore attractions to persuade the highly educated workers to stay are needed.

11.5 **Conclusion**

It can be concluded on the basis of the reasoning made in this study that the wage rate convergence is likely to take place between the three Southern Member States and the core areas of the Community in the long term. Labour migration will evidently contribute to the development, although the extent and pattern of future migrations are open.

The main goal of economic integration is an increase in welfare. Therefore, to ensure community-wide welfare, regional policy and well defined labour market goals are required.

To what extent and in which time-table the equalization occurs, remains to be seen.

REFERENCES: BOOKS AND ARTICLES

1. Balassa, Bela: "The Theory of Economic Integration", London 1962

2. Commission of the European Communities: "Employment in Europe", Luxembourg 1989

3. Commission of the European Communities: "Freedom of Movement for Workers within the Community", Brussels 1977

4. Commission of the European Communities: "White Paper", Brussels,1985

5. Etelä-Suomen Sanomat 15.5.1990: "Kesä lisää rakennuksille pyrkiviä ulkomaalaisia"

6. Ethier,Wilfred J.: "Modern International Economics", New York 1988

7. Global Trends in Migration: Theory and Research on International Population Movements, edited by Mary M. Kritz, Charles B.Keely and Silvano M.Tomasi, New York 1983

8. Gremmen,Hans J.: "Testing the Factor Price Equalization Theorem in the EC: An alternative Approach" Journal of Common Market Studies, vol XXIII, No3, March 1985

9. Haack,W.G.C.M. : "The Selectivity of Economic Integration Theories" Journal of Common Market Studies, vol XXI,No4,June 1983

10. Handbook of Labour Economics, Vol 2, edited by Orley C. Ashenfelter and Richard Layard, Amsterdam 1986

11. Helsingin Sanomat 10.8.1990: "EY-jäsenyys sysäsi Portugalin kasvuun"

12. Helsingin Sanomat 29.1.1989 B7, R.Jokelin: "EY mittaa uudelleen työläisen perusoikeuksia"

13. Kankaanpää,Veli-Matti: "Yhdentyvätkö tuotannontekijäkustannukset? Suomen ja Italian vaatetusteollisuusyritysten pääomakustannukset 1967-1986"
Taloudellisen suunnittelukeskuksen selvityksiä,nro 32, Helsinki 1989

14. Kauppalehti 14.2.1990, Marttinen,Leena: "Ruotsalaisekonomistit Carlssonin kriisipaketista: hallitus hoitaa oireita - ei tautia"

15. Kauppalehti 19.4.1990: "Tilapäistyön kysyntä kasvaa Euroopassa"

16. Kauppinen,Timo: "EY ja ammattiyhdistysliike", Työpoliittinen katsaus 15/89

17. Koutsoyiannis,A.: "Modern Microeconomics", London 1979

18. Koutsoyiannis,A.:"Theory of Econometrics", London 1977

19. Markusen, James R.: "Factor Movements and Commodity Trade as Complements"
Journal of International Economics, vol 14,1983

20. Meerhagen,M.A.G. : "International Economic Institutions", New York 1987

21. Molle,W. , van Mourik,A. : "International Movements of Labour under Conditions of Economic Integration"
Journal of Common Market Studies, vol XXVI, No3, March 1988

22. van Mourik,Aad: "Testing the Factor Price Equalization Theorem in the EC: An alternative Approach: A Comment"
Journal of Common Market Studies, vol XXVI, No1, Sept.1987

23. Mundell,R.A.:"International trade and factor mobility", American Economic Review 1957, Vol 47

24. Straubhaar,Thomas: "The Accession of Spain and Portugal to the EC from the Aspect of the Free Movement of Labour in an enlarged Common Labour Market"
International Migration 22,1984

25. Tekniikka ja talous 1.6.1990, Nyroos,Arja: "Teollisuusmaat alentavat kilpaa veroja"

26. Tovias,Alfred: "Testing Factor Price Equalization in the EEC"
Journal of Common Market Studies, vol XX, No4, June 1982

STATISTICAL SOURCES

1. Eurostat 1984, Theme 3, Series C, Labour Costs 1984
2. Eurostat 1986, Theme 6, Series A, External Trade
3. Eurostat 1981-82, Theme 3, Series C, Censuses of Population in the Community Countries
4. ILO: Yearbook of Labour Statistics,1988
5. IMF: Direction of Trade Statistics, Yearbook 1988
6. IMF: International Financial Statistics 1989
7. OECD: Labour Force Statistics, 1967-87, 1989
8. OECD: The Tax Benefit Position of Production Workers 1985-88, Paris 1989

APPENDIX I

Table of migration (Chapter 2.3)

Annex 1

Development of Stocks of Foreign Workers in Selected Countries

Sending country + variable:	Host Country							
	France	Germany	Netherlands	Belgium	Sweden	Austria	Switzerland	Total
Italy:								
1969	632	515	14	176	5	1	523	1866
1974	230	405	10	70	3	2	306	1026
1980	152	326	8	70	0	2	234	792
Greece:								
1969	11	271	2	14	6	0	8	312
1974	5	233	2	6	8	0	5	259
1980	0	136	2	5	7	0	0	150
Spain:								
1969	668	207	18	48	3	0	88	1032
1974	265	160	19	34	2	0	75	555
1980	147	88	11	17	0	0	62	325
Portugal:								
1969	367	38	3	4	1	0	2	415
1974	475	81	4	4	1	0	3	568
1980	398	59	4	4	0	0	0	465
Yugoslavia:								
1969	43	332	2	3	14	48	16	458
1974	50	495	9	3	23	166	23	769
1980	0	359	7	2	23	115	31	537
Turkey:								
1969	7	322	14	11	2	8	8	372
1974	25	585	33	10	2	29	14	695
1980	0	625	39	13	0	28	21	726
Morocco:								
1969	120	9	13	21	0	0	0	163
1974	130	15	23	30	0	0	0	198
1980	134	0	28	20	0	0	0	182
Algeria:								
1969	562	3	0	3	0	0	0	568
1974	440	0	0	3	0	0	0	443
1980	309	0	0	2	0	0	0	311
Tunisia:								
1969	73	3	1	0	0	0	0	77
1974	70	11	1	0	0	0	0	82
1980	60	0	1	2	0	0	0	63
Total:								
1969	2483	1700	67	280	31	57	645	5263
1974	1690	1985	101	160	39	197	426	4598
1980	1200	1593	100	135	30	145	348	3551

Sources: Sopemi, OECD, Paris, various volumes.

APPENDIX II

statistical data

	(K)	(L)	(Y)	(W)	(R1)	(R2)	(W2)
	bn ECU	1000	bn ECU	hourly earnings, PPS	discount rate	money market rate	monthly labour cost,ECU
Belgium	15,43	4214	99,78	9,00	11,00	14,00	1719
Denmark	11,94	2720	69,40	9,74	7,00	13,40	1732
France	122,30	23867	364,76	7,15	9,50	18,85	1734
Britain	93,18	27265	546,94	7,38	9,56	9,65	1417
Greece	7,95	3868	43,03	3,87	20,50	20,50	623
Ireland	4,89	1307	22,71	7,53	14,00	12,92	1423
Italy	111,02	23323	526,51	7,31	16,50	22,23	1545
Holland	29,45	5773	158,62	8,17	5,00	8,88	1891
Portugal	5,79	4540	24,25	2,86	25,00	27,05	386
Spain	37,21	13870	220,35	4,06	12,50	16,58	935
W-Germany	158,39	27629	784,50	8,27	4,50	9,82	2008

	Consumer price index 1985=100
Belgium	95.4
Denmark	95.5
France	94.6
Britain	94.3
Greece	83.8
Ireland	94.9
Italy	91.6
Holland	97.8
Portugal	83.8
Spain	91.9
W-Germany	97.9

IMPORTING COUNTRIES

	Belgi	Denma	Franc	Brita	Greec	Irela	Italy	Holla	Portu	Spain	Germa
Belgium		645	12644	5850	304	263	3947	8834	211	535	13823
Denmark	343		888	2790	114	106	812	653	50	180	3243
France	10239	900		9928	1545	557	13321	5159	793	3147	20644
Britain	4605	1936	10821		484	5909	4666	6935	679	2212	14322
Greece	124	51	576	493		15	1022	191	9	77	1354
Ireland	315	80	995	4385	45		347	639	29	166	1240
Italy	2512	707	12775	6401	1181	251		2301	476	1545	15151
Holland	12915	1294	9284	8743	752	560	5237		351	734	27278
Portugal	238	108	850	1103	20	34	323	375		339	972
Spain	825	201	4464	2866	165	122	1764	1175	846		3065
Germany	13885	4481	22688	18335	2040	923	17061	17496	1025	3617	

Citizen of TOTAL POPULATION BY NATIONALITY (foreigners)

	Belgi	Denma	Franc	Brita	Greec	Irela	Italy	Holla	Portu	Spain	Ge
Belgium		283	50200	3090	3321	490	6967	21842	454	4961	31200
Denmark	1722		2440	5042	1264	410	12985	978	50	2974	12700
France	103512	1693		25179	8323	1997	23043	5584	12079	22451	53100
Britain	23080	9573	34180		14022	186965	11227	32542	3105	18953	56200
Greece	21230	550	7860	20016		109	6089	3400	50	346	308600
Ireland	1019	757	1880	474604	339		624	2115	50	718	3900
Italy	279700	1695	333740	94138	4357	1350		20228	801	7163	659000
Holland	66233	1538	13980	15178	1764	1710	3121		671	6727	109300
Portugal	10482	1002	764860	12008	267	98	50	8319		20268	113000
Spain	58255	250	321440	22056	1356	763	50	21781	8081		180400
Germany	26756	8362	43840	44624	20233	3482	14826	38324	3628	22990	

APPENDIX III

Observations and formulas

110 pairs of countries

X1= k_i/l_i / k_j/l_j

X2= $M_{ij}/Y_i + M_{ji}/Y_j$

X3= migrants from country i in country j/total labour force in j

X4= (r_i-r_j)/largest difference in the sample

X5= w_i/w_j

55 pairs of countries

Corrected formulation (7.3)

```
RIVI:  1  I=1,j=2   (Belgium,Denmark)
(15.43/4214000.00)/(11.94/2720000.00)=0.834
343.00/99.78+645.00/69.40=12.732
283.00/2720000.00=0.0001040
(6.40-2.50)/6.5=0.600
9.00/9.74=0.924

RIVI:  2  I=1,j=3   (Belgium,France)
(15.43/4214000.00)/(122.30/23867000.00)=0.715
10239.00/99.78+12644.00/364.76=137.280
50200.00/23867000.00=0.0021033
(6.40-4.10)/6.5=0.354
9.00/7.15=1.259

RIVI:  3  I=1,j=4   (Belgium,Britain)
(15.43/4214000.00)/(93.18/27265000.00)=1.071
4605.00/99.78+5850.00/546.94=56.847
3090.00/27265000.00=0.0001133
(6.40-3.86)/6.5=0.391
9.00/7.38=1.220

RIVI:  4  I=1,j=5   (Belgium,Greece)
(15.43/4214000.00)/(7.95/3868000.00)=1.782
124.00/99.78+304.00/43.03=8.308
3321.00/3868000.00=0.0008586
(6.40-4.30)/6.5=0.323
9.00/3.87=2.326

RIVI:  5  I=1,j=6   (Belgium,Ireland)
(15.43/4214000.00)/(4.89/1307000.00)=0.979
315.00/99.78+263.00/22.71=14.738
490.00/1307000.00=0.0003749
(6.40-8.90)/6.5=-0.385
9.00/7.53=1.195

RIVI:  6  I=1,j=7   (Belgium,Italy)
(15.43/4214000.00)/(111.02/23323000.00)=0.769
2512.00/99.78+3947.00/526.51=32.672
6967.00/23323000.00=0.0002987
(6.40-8.10)/6.5=-0.262
9.00/7.31=1.231

RIVI:  7  I=1,j=8   (Belgium,Holland)
(15.43/4214000.00)/(29.45/5773000.00)=0.718
12915.00/99.78+8834.00/158.62=185.128
21842.00/5773000.00=0.0037835
(6.40-2.80)/6.5=0.554
9.00/8.17=1.102

RIVI:  8  I=1,j=9   (Belgium,Portugal)
(15.43/4214000.00)/(5.79/4540000.00)=2.871
238.00/99.78+211.00/24.25=11.086
454.00/4540000.00=0.0001000
(6.40-8.80)/6.5=-0.369
9.00/2.86=3.147

RIVI:  9  I=1,j=10   (Belgium,Spain)
(15.43/4214000.00)/(37.21/13870000.00)=1.365
825.00/99.78+535.00/220.35=10.696
4961.00/13870000.00=0.0003577
(6.40-4.40)/6.5=0.308
9.00/4.06=2.217
```

```
RIVI: 10  I=1,j=11   (Belgium,Germany)
(15.43/4214000.00)/(158.39/27629000.00)=0.639
13885.00/99.78+13823.00/784.50=156.776
31200.00/27629000.00=0.0011292
(6.40-2.40)/6.5=0.615
9.00/8.27=1.088

RIVI: 11  I=2,j=1   (Denmark,Belgium)
(11.94/2720000.00)/(15.43/4214000.00)=1.199
645.00/69.40+343.00/99.78=12.732
1722.00/4214000.00=0.0004086
(2.50-6.40)/6.5=-0.600
9.74/9.00=1.082

RIVI: 12  I=2,j=3   (Denmark,France)
(11.94/2720000.00)/(122.30/23867000.00)=0.857
900.00/69.40+888.00/364.76=15.403
2440.00/23867000.00=0.0001022
(2.50-4.10)/6.5=-0.246
9.74/7.15=1.362

RIVI: 13  I=2,j=4   (Denmark,Britain)
(11.94/2720000.00)/(93.18/27265000.00)=1.284
1936.00/69.40+2790.00/546.94=32.997
5042.00/27265000.00=0.0001849
(2.50-3.86)/6.5=-0.209
9.74/7.38=1.320

RIVI: 14  I=2,j=5   (Denmark,Greece)
(11.94/2720000.00)/(7.95/3868000.00)=2.136
51.00/69.40+114.00/43.03=3.384
1264.00/3868000.00=0.0003268
(2.50-4.30)/6.5=-0.277
9.74/3.87=2.517

RIVI: 15  I=2,j=6   (Denmark,Ireland)
(11.94/2720000.00)/(4.89/1307000.00)=1.173
80.00/69.40+106.00/22.71=5.820
410.00/1307000.00=0.0003137
(2.50-8.90)/6.5=-0.985
9.74/7.53=1.293

RIVI: 16  I=2,j=7   (Denmark,Italy)
(11.94/2720000.00)/(111.02/23323000.00)=0.922
707.00/69.40+812.00/526.51=11.730
12985.00/23323000.00=0.0005567
(2.50-8.10)/6.5=-0.862
9.74/7.31=1.332

RIVI: 17  I=2,j=8   (Denmark,Holland)
(11.94/2720000.00)/(29.45/5773000.00)=0.861
1294.00/69.40+653.00/158.62=22.762
978.00/5773000.00=0.0001694
(2.50-2.80)/6.5=-0.046
9.74/8.17=1.192
```

```
RIVI: 18  I=2,j=9   (Denmark,Portugal)
(11.94/2720000.00)/(5.79/4540000.00)=3.442
108.00/69.40+50.00/24.25=3.618
50.00/4540000.00=0.0000110
(2.50-8.80)/6.5=-0.969
9.74/2.86=3.406

RIVI: 19  I=2,j=10   (Denmark,Spain)
(11.94/2720000.00)/(37.21/13870000.00)=1.636
201.00/69.40+180.00/220.35=3.713
2974.00/13870000.00=0.0002144
(2.50-4.40)/6.5=-0.292
9.74/4.06=2.399

RIVI: 20  I=2,j=11   (Denmark,Germany)
(11.94/2720000.00)/(158.39/27629000.00)=0.766
4481.00/69.40+3243.00/784.50=68.702
12700.00/27629000.00=0.0004597
(2.50-2.40)/6.5=0.015
9.74/8.27=1.178

RIVI: 21  I=3,j=1   (France,Belgium)
(122.30/23867000.00)/(15.43/4214000.00)=1.399
12644.00/364.76+10239.00/99.78=137.280
103512.00/4214000.00=0.0245638
(4.10-6.40)/6.5=-0.354
7.15/9.00=0.794

RIVI: 22  I=3,j=2   (France,Denmark)
(122.30/23867000.00)/(11.94/2720000.00)=1.167
888.00/364.76+900.00/69.40=15.403
1693.00/2720000.00=0.0006224
(4.10-2.50)/6.5=0.246
7.15/9.74=0.734

RIVI: 23  I=3,j=4   (France,Britain)
(122.30/23867000.00)/(93.18/27265000.00)=1.499
10821.00/364.76+9928.00/546.94=47.818
25179.00/27265000.00=0.0009235
(4.10-3.86)/6.5=0.037
7.15/7.38=0.969

RIVI: 24  I=3,j=5   (France,Greece)
(122.30/23867000.00)/(7.95/3868000.00)=2.493
576.00/364.76+1545.00/43.03=37.484
8323.00/3868000.00=0.0021518
(4.10-4.30)/6.5=-0.031
7.15/3.87=1.848

RIVI: 25  I=3,j=6   (France,Ireland)
(122.30/23867000.00)/(4.89/1307000.00)=1.370
995.00/364.76+557.00/22.71=27.254
1997.00/1307000.00=0.0015279
(4.10-8.90)/6.5=-0.738
7.15/7.53=0.950

RIVI: 26  I=3,j=7   (France,Italy)
(122.30/23867000.00)/(111.02/23323000.00)=1.076
12775.00/364.76+13321.00/526.51=60.324
23043.00/23323000.00=0.0009880
(4.10-8.10)/6.5=-0.615
7.15/7.31=0.978
```

```
RIVI: 27  I=3,j=8   (France,Holland)
(122.30/23867000.00)/(29.45/5773000.00)=1.004
9284.00/364.76+5159.00/158.62=57.977
5584.00/5773000.00=0.0009673
(4.10-2.80)/6.5=0.200
7.15/8.17=0.875

RIVI: 28  I=3,j=9   (France,Portugal)
(122.30/23867000.00)/(5.79/4540000.00)=4.018
850.00/364.76+793.00/24.25=35.031
12079.00/4540000.00=0.0026606
(4.10-8.80)/6.5=-0.723
7.15/2.86=2.500

RIVI: 29  I=3,j=10   (France,Spain)
(122.30/23867000.00)/(37.21/13870000.00)=1.910
4464.00/364.76+3147.00/220.35=26.520
22451.00/13870000.00=0.0016187
(4.10-4.40)/6.5=-0.046
7.15/4.06=1.761

RIVI: 30  I=3,j=11   (France,Germany)
(122.30/23867000.00)/(158.39/27629000.00)=0.894
22688.00/364.76+20644.00/784.50=88.515
53100.00/27629000.00=0.0019219
(4.10-2.40)/6.5=0.262
7.15/8.27=0.865

RIVI: 31  I=4,j=1   (Britain,Belgium)
(93.18/27265000.00)/(15.43/4214000.00)=0.933
5850.00/546.94+4605.00/99.78=56.847
23080.00/4214000.00=0.0054770
(3.86-6.40)/6.5=-0.391
7.38/9.00=0.820

RIVI: 32  I=4,j=2   (Britain,Denmark)
(93.18/27265000.00)/(11.94/2720000.00)=0.779
2790.00/546.94+1936.00/69.40=32.997
9573.00/2720000.00=0.0035195
(3.86-2.50)/6.5=0.209
7.38/9.74=0.758

RIVI: 33  I=4,j=3   (Britain,France)
(93.18/27265000.00)/(122.30/23867000.00)=0.667
9928.00/546.94+10821.00/364.76=47.818
34180.00/23867000.00=0.0014321
(3.86-4.10)/6.5=-0.037
7.38/7.15=1.032

RIVI: 34  I=4,j=5   (Britain,Greece)
(93.18/27265000.00)/(7.95/3868000.00)=1.663
493.00/546.94+484.00/43.03=12.149
14022.00/3868000.00=0.0036251
(3.86-4.30)/6.5=-0.068
7.38/3.87=1.907
```

```
RIVI: 35  I=4,j=6   (Britain,Ireland)
(93.18/27265000.00)/(4.89/1307000.00)=0.913
4385.00/546.94+5909.00/22.71=268.211
186965.00/1307000.00=0.1430490
(3.86-8.90)/6.5=-0.775
7.38/7.53=0.980

RIVI: 36  I=4,j=7   (Britain,Italy)
(93.18/27265000.00)/(111.02/23323000.00)=0.718
6401.00/546.94+4666.00/526.51=20.565
11227.00/23323000.00=0.0004814
(3.86-8.10)/6.5=-0.652
7.38/7.31=1.010

RIVI: 37  I=4,j=8   (Britain,Holland)
(93.18/27265000.00)/(29.45/5773000.00)=0.670
8743.00/546.94+6935.00/158.62=59.706
32542.00/5773000.00=0.0056369
(3.86-2.80)/6.5=0.163
7.38/8.17=0.903

RIVI: 38  I=4,j=9   (Britain,Portugal)
(93.18/27265000.00)/(5.79/4540000.00)=2.680
1103.00/546.94+679.00/24.25=30.017
3105.00/4540000.00=0.0006839
(3.86-8.80)/6.5=-0.760
7.38/2.86=2.580

RIVI: 39  I=4,j=10   (Britain,Spain)
(93.18/27265000.00)/(37.21/13870000.00)=1.274
2866.00/546.94+2212.00/220.35=15.279
18953.00/13870000.00=0.0013665
(3.86-4.40)/6.5=-0.083
7.38/4.06=1.818

RIVI: 40  I=4,j=11   (Britain,Germany)
(93.18/27265000.00)/(158.39/27629000.00)=0.596
18335.00/546.94+14322.00/784.50=51.779
56200.00/27629000.00=0.0020341
(3.86-2.40)/6.5=0.225
7.38/8.27=0.892

RIVI: 41  I=5,j=1   (Greece,Belgium)
(7.95/3868000.00)/(15.43/4214000.00)=0.561
304.00/43.03+124.00/99.78=8.308
21230.00/4214000.00=0.0050380
(4.30-6.40)/6.5=-0.323
3.87/9.00=0.430

RIVI: 42  I=5,j=2   (Greece,Denmark)
(7.95/3868000.00)/(11.94/2720000.00)=0.468
114.00/43.03+51.00/69.40=3.384
550.00/2720000.00=0.0002022
(4.30-2.50)/6.5=0.277
3.87/9.74=0.397

RIVI: 43  I=5,j=3   (Greece,France)
(7.95/3868000.00)/(122.30/23867000.00)=0.401
1545.00/43.03+576.00/364.76=37.484
7860.00/23867000.00=0.0003293
(4.30-4.10)/6.5=0.031
3.87/7.15=0.541
```

```
RIVI: 44  I=5,j=4   (Greece,Britain)
(7.95/3868000.00)/(93.18/27265000.00)=0.601
484.00/43.03+493.00/546.94=12.149
20016.00/27265000.00=0.0007341
(4.30-3.86)/6.5=0.068
3.87/7.38=0.524

RIVI: 45  I=5,j=6   (Greece,Ireland)
(7.95/3868000.00)/(4.89/1307000.00)=0.549
45.00/43.03+15.00/22.71=1.706
109.00/1307000.00=0.0000834
(4.30-8.90)/6.5=-0.708
3.87/7.53=0.514

RIVI: 46  I=5,j=7   (Greece,Italy)
(7.95/3868000.00)/(111.02/23323000.00)=0.432
1181.00/43.03+1022.00/526.51=29.387
6089.00/23323000.00=0.0002611
(4.30-8.10)/6.5=-0.585
3.87/7.31=0.529

RIVI: 47  I=5,j=8   (Greece,Holland)
(7.95/3868000.00)/(29.45/5773000.00)=0.403
752.00/43.03+191.00/158.62=18.680
3400.00/5773000.00=0.0005889
(4.30-2.80)/6.5=0.231
3.87/8.17=0.474

RIVI: 48  I=5,j=9   (Greece,Portugal)
(7.95/3868000.00)/(5.79/4540000.00)=1.612
20.00/43.03+9.00/24.25=0.836
50.00/4540000.00=0.0000110
(4.30-8.80)/6.5=-0.692
3.87/2.86=1.353

RIVI: 49  I=5,j=10   (Greece,Spain)
(7.95/3868000.00)/(37.21/13870000.00)=0.766
165.00/43.03+77.00/220.35=4.184
346.00/13870000.00=0.0000249
(4.30-4.40)/6.5=-0.015
3.87/4.06=0.953

RIVI: 50  I=5,j=11   (Greece,Germany)
(7.95/3868000.00)/(158.39/27629000.00)=0.359
2040.00/43.03+1354.00/784.50=49.135
308600.00/27629000.00=0.0111694
(4.30-2.40)/6.5=0.292
3.87/8.27=0.468

RIVI: 51  I=6,j=1   (Ireland,Belgium)
(4.89/1307000.00)/(15.43/4214000.00)=1.022
263.00/22.71+315.00/99.78=14.738
1019.00/4214000.00=0.0002418
(8.90-6.40)/6.5=0.385
7.53/9.00=0.837
```

```
RIVI: 52  I=6,j=2   (Ireland,Denmark)
(4.89/1307000.00)/(11.94/2720000.00)=0.852
106.00/22.71+80.00/69.40=5.820
757.00/2720000.00=0.0002783
(8.90-2.50)/6.5=0.985
7.53/9.74=0.773

RIVI: 53  I=6,j=3   (Ireland,France)
(4.89/1307000.00)/(122.30/23867000.00)=0.730
557.00/22.71+995.00/364.76=27.254
1880.00/23867000.00=0.0000788
(8.90-4.10)/6.5=0.738
7.53/7.15=1.053

RIVI: 54  I=6,j=4   (Ireland,Britain)
(4.89/1307000.00)/(93.18/27265000.00)=1.095
5909.00/22.71+4385.00/546.94=268.211
474604.00/27265000.00=0.0174071
(8.90-3.86)/6.5=0.775
7.53/7.38=1.020

RIVI: 55  I=6,j=5   (Ireland,Greece)
(4.89/1307000.00)/(7.95/3868000.00)=1.820
15.00/22.71+45.00/43.03=1.706
339.00/3868000.00=0.0000876
(8.90-4.30)/6.5=0.708
7.53/3.87=1.946

RIVI: 56  I=6,j=7   (Ireland,Italy)
(4.89/1307000.00)/(111.02/23323000.00)=0.786
251.00/22.71+347.00/526.51=11.711
624.00/23323000.00=0.0000268
(8.90-8.10)/6.5=0.123
7.53/7.31=1.030

RIVI: 57  I=6,j=8   (Ireland,Holland)
(4.89/1307000.00)/(29.45/5773000.00)=0.733
560.00/22.71+639.00/158.62=28.687
2115.00/5773000.00=0.0003664
(8.90-2.80)/6.5=0.938
7.53/8.17=0.922

RIVI: 58  I=6,j=9   (Ireland,Portugal)
(4.89/1307000.00)/(5.79/4540000.00)=2.934
34.00/22.71+29.00/24.25=2.693
50.00/4540000.00=0.0000110
(8.90-8.80)/6.5=0.015
7.53/2.86=2.633

RIVI: 59  I=6,j=10   (Ireland,Spain)
(4.89/1307000.00)/(37.21/13870000.00)=1.395
122.00/22.71+166.00/220.35=6.125
718.00/13870000.00=0.0000518
(8.90-4.40)/6.5=0.692
7.53/4.06=1.855

RIVI: 60  I=6,j=11   (Ireland,Germany)
(4.89/1307000.00)/(158.39/27629000.00)=0.653
923.00/22.71+1240.00/784.50=42.224
3900.00/27629000.00=0.0001412
(8.90-2.40)/6.5=1.000
7.53/8.27=0.911
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RIVI: 61  I=7,j=1   (Italy,Belgium)
(111.02/23323000.00)/(15.43/4214000.00)=1.300
3947.00/526.51+2512.00/99.78=32.672
279700.00/4214000.00=0.0663740
(8.10-6.40)/6.5=0.262
7.31/9.00=0.812

RIVI: 62  I=7,j=2   (Italy,Denmark)
(111.02/23323000.00)/(11.94/2720000.00)=1.084
812.00/526.51+707.00/69.40=11.730
1695.00/2720000.00=0.0006232
(8.10-2.50)/6.5=0.862
7.31/9.74=0.751

RIVI: 63  I=7,j=3   (Italy,France)
(111.02/23323000.00)/(122.30/23867000.00)=0.929
13321.00/526.51+12775.00/364.76=60.324
333740.00/23867000.00=0.0139833
(8.10-4.10)/6.5=0.615
7.31/7.15=1.022

RIVI: 64  I=7,j=4   (Italy,Britain)
(111.02/23323000.00)/(93.18/27265000.00)=1.393
4666.00/526.51+6401.00/546.94=20.565
94138.00/27265000.00=0.0034527
(8.10-3.86)/6.5=0.652
7.31/7.38=0.991

RIVI: 65  I=7,j=5   (Italy,Greece)
(111.02/23323000.00)/(7.95/3868000.00)=2.316
1022.00/526.51+1181.00/43.03=29.387
4357.00/3868000.00=0.0011264
(8.10-4.30)/6.5=0.585
7.31/3.87=1.889

RIVI: 66  I=7,j=6   (Italy,Ireland)
(111.02/23323000.00)/(4.89/1307000.00)=1.272
347.00/526.51+251.00/22.71=11.711
1350.00/1307000.00=0.0010329
(8.10-8.90)/6.5=-0.123
7.31/7.53=0.971

RIVI: 67  I=7,j=8   (Italy,Holland)
(111.02/23323000.00)/(29.45/5773000.00)=0.933
5237.00/526.51+2301.00/158.62=24.453
20228.00/5773000.00=0.0035039
(8.10-2.80)/6.5=0.815
7.31/8.17=0.895

RIVI: 68  I=7,j=9   (Italy,Portugal)
(111.02/23323000.00)/(5.79/4540000.00)=3.732
323.00/526.51+476.00/24.25=20.242
801.00/4540000.00=0.0001764
(8.10-8.80)/6.5=-0.108
7.31/2.86=2.556
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RIVI: 69  I=7,j=10   (Italy,Spain)
(111.02/23323000.00)/(37.21/13870000.00)=1.774
1764.00/526.51+1545.00/220.35=10.362
7163.00/13870000.00=0.0005164
(8.10-4.40)/6.5=0.569
7.31/4.06=1.800

RIVI: 70  I=7,j=11   (Italy,Germany)
(111.02/23323000.00)/(158.39/27629000.00)=0.830
17061.00/526.51+15151.00/784.50=51.717
659000.00/27629000.00=0.0238517
(8.10-2.40)/6.5=0.877
7.31/8.27=0.884

RIVI: 71  I=8,j=1   (Holland,Belgium)
(29.45/5773000.00)/(15.43/4214000.00)=1.393
8834.00/158.62+12915.00/99.78=185.128
66233.00/4214000.00=0.0157174
(2.80-6.40)/6.5=-0.554
8.17/9.00=0.908

RIVI: 72  I=8,j=2   (Holland,Denmark)
(29.45/5773000.00)/(11.94/2720000.00)=1.162
653.00/158.62+1294.00/69.40=22.762
1538.00/2720000.00=0.0005654
(2.80-2.50)/6.5=0.046
8.17/9.74=0.839

RIVI: 73  I=8,j=3   (Holland,France)
(29.45/5773000.00)/(122.30/23867000.00)=0.996
5159.00/158.62+9284.00/364.76=57.977
13980.00/23867000.00=0.0005857
(2.80-4.10)/6.5=-0.200
8.17/7.15=1.143

RIVI: 74  I=8,j=4   (Holland,Britain)
(29.45/5773000.00)/(93.18/27265000.00)=1.493
6935.00/158.62+8743.00/546.94=59.706
15178.00/27265000.00=0.0005567
(2.80-3.86)/6.5=-0.163
8.17/7.38=1.107

RIVI: 75  I=8,j=5   (Holland,Greece)
(29.45/5773000.00)/(7.95/3868000.00)=2.482
191.00/158.62+752.00/43.03=18.680
1764.00/3868000.00=0.0004560
(2.80-4.30)/6.5=-0.231
8.17/3.87=2.111

RIVI: 76  I=8,j=6   (Holland,Ireland)
(29.45/5773000.00)/(4.89/1307000.00)=1.363
639.00/158.62+560.00/22.71=28.687
1710.00/1307000.00=0.0013083
(2.80-8.90)/6.5=-0.938
8.17/7.53=1.085

RIVI: 77  I=8,j=7   (Holland,Italy)
(29.45/5773000.00)/(111.02/23323000.00)=1.072
2301.00/158.62+5237.00/526.51=24.453
3121.00/23323000.00=0.0001338
(2.80-8.10)/6.5=-0.815
8.17/7.31=1.118
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RIVI: 78  I=8,j=9   (Holland,Portugal)
(29.45/5773000.00)/(5.79/4540000.00)=4.000
375.00/158.62+351.00/24.25=16.838
671.00/4540000.00=0.0001478
(2.80-8.80)/6.5=-0.923
8.17/2.86=2.857

RIVI: 79  I=8,j=10   (Holland,Spain)
(29.45/5773000.00)/(37.21/13870000.00)=1.902
1175.00/158.62+734.00/220.35=10.739
6727.00/13870000.00=0.0004850
(2.80-4.40)/6.5=-0.246
8.17/4.06=2.012

RIVI: 80  I=8,j=11   (Holland,Germany)
(29.45/5773000.00)/(158.39/27629000.00)=0.890
17496.00/158.62+27278.00/784.50=145.073
109300.00/27629000.00=0.0039560
(2.80-2.40)/6.5=0.062
8.17/8.27=0.988

RIVI: 81  I=9,j=1   (Portugal,Belgium)
(5.79/4540000.00)/(15.43/4214000.00)=0.348
211.00/24.25+238.00/99.78=11.086
10482.00/4214000.00=0.0024874
(8.80-6.40)/6.5=0.369
2.86/9.00=0.318

RIVI: 82  I=9,j=2   (Portugal,Denmark)
(5.79/4540000.00)/(11.94/2720000.00)=0.291
50.00/24.25+108.00/69.40=3.618
1002.00/2720000.00=0.0003684
(8.80-2.50)/6.5=0.969
2.86/9.74=0.294

RIVI: 83  I=9,j=3   (Portugal,France)
(5.79/4540000.00)/(122.30/23867000.00)=0.249
793.00/24.25+850.00/364.76=35.031
764860.00/23867000.00=0.0320468
(8.80-4.10)/6.5=0.723
2.86/7.15=0.400

RIVI: 84  I=9,j=4   (Portugal,Britain)
(5.79/4540000.00)/(93.18/27265000.00)=0.373
679.00/24.25+1103.00/546.94=30.017
12008.00/27265000.00=0.0004404
(8.80-3.86)/6.5=0.760
2.86/7.38=0.388

RIVI: 85  I=9,j=5   (Portugal,Greece)
(5.79/4540000.00)/(7.95/3868000.00)=0.621
9.00/24.25+20.00/43.03=0.836
267.00/3868000.00=0.0000690
(8.80-4.30)/6.5=0.692
2.86/3.87=0.739
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RIVI: 86 I=9,j=6   (Portugal,Ireland)
(5.79/4540000.00)/(4.89/1307000.00)=0.341
29.00/24.25+34.00/22.71=2.693
98.00/1307000.00=0.0000750
(8.80-8.90)/6.5=-0.015
2.86/7.53=0.380

RIVI: 87 I=9,j=7   (Portugal,Italy)
(5.79/4540000.00)/(111.02/23323000.00)=0.268
476.00/24.25+323.00/526.51=20.242
50.00/23323000.00=0.0000021
(8.80-8.10)/6.5=0.108
2.86/7.31=0.391

RIVI: 88 I=9,j=8   (Portugal,Holland)
(5.79/4540000.00)/(29.45/5773000.00)=0.250
351.00/24.25+375.00/158.62=16.838
8319.00/5773000.00=0.0014410
(8.80-2.80)/6.5=0.923
2.86/8.17=0.350

RIVI: 89 I=9,j=10   (Portugal,Spain)
(5.79/4540000.00)/(37.21/13870000.00)=0.475
846.00/24.25+339.00/220.35=36.425
20268.00/13870000.00=0.0014613
(8.80-4.40)/6.5=0.677
2.86/4.06=0.704

RIVI: 90 I=9,j=11   (Portugal,Germany)
(5.79/4540000.00)/(158.39/27629000.00)=0.222
1025.00/24.25+972.00/784.50=43.507
113000.00/27629000.00=0.0040899
(8.80-2.40)/6.5=0.985
2.86/8.27=0.346

RIVI: 91 I=10,j=1   (Spain,Belgium)
(37.21/13870000.00)/(15.43/4214000.00)=0.733
535.00/220.35+825.00/99.78=10.696
58255.00/4214000.00=0.0138242
(4.40-6.40)/6.5=-0.308
4.06/9.00=0.451

RIVI: 92 I=10,j=2   (Spain,Denmark)
(37.21/13870000.00)/(11.94/2720000.00)=0.611
180.00/220.35+201.00/69.40=3.713
250.00/2720000.00=0.0000919
(4.40-2.50)/6.5=0.292
4.06/9.74=0.417

RIVI: 93 I=10,j=3   (Spain,France)
(37.21/13870000.00)/(122.30/23867000.00)=0.524
3147.00/220.35+4464.00/364.76=26.520
321440.00/23867000.00=0.0134680
(4.40-4.10)/6.5=0.046
4.06/7.15=0.568

RIVI: 94 I=10,j=4   (Spain,Britain)
(37.21/13870000.00)/(93.18/27265000.00)=0.785
2212.00/220.35+2866.00/546.94=15.279
22056.00/27265000.00=0.0008089
(4.40-3.86)/6.5=0.083
4.06/7.38=0.550

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RIVI: 95  I=10,j=5   (Spain,Greece)
(37.21/13870000.00)/(7.95/3868000.00)=1.305
77.00/220.35+165.00/43.03=4.184
1356.00/3868000.00=0.0003506
(4.40-4.30)/6.5=0.015
4.06/3.87=1.049

RIVI: 96  I=10,j=6   (Spain,Ireland)
(37.21/13870000.00)/(4.89/1307000.00)=0.717
166.00/220.35+122.00/22.71=6.125
763.00/1307000.00=0.0005838
(4.40-8.90)/6.5=-0.692
4.06/7.53=0.539

RIVI: 97  I=10,j=7   (Spain,Italy)
(37.21/13870000.00)/(111.02/23323000.00)=0.564
1545.00/220.35+1764.00/526.51=10.362
50.00/23323000.00=0.0000021
(4.40-8.10)/6.5=-0.569
4.06/7.31=0.555

RIVI: 98  I=10,j=8   (Spain,Holland)
(37.21/13870000.00)/(29.45/5773000.00)=0.526
734.00/220.35+1175.00/158.62=10.739
21781.00/5773000.00=0.0037729
(4.40-2.80)/6.5=0.246
4.06/8.17=0.497

RIVI: 99  I=10,j=9   (Spain,Portugal)
(37.21/13870000.00)/(5.79/4540000.00)=2.104
339.00/220.35+846.00/24.25=36.425
8081.00/4540000.00=0.0017800
(4.40-8.80)/6.5=-0.677
4.06/2.86=1.420

RIVI:100  I=10,j=11   (Spain,Germany)
(37.21/13870000.00)/(158.39/27629000.00)=0.468
3617.00/220.35+3065.00/784.50=20.322
180400.00/27629000.00=0.0065294
(4.40-2.40)/6.5=0.308
4.06/8.27=0.491

RIVI:101  I=11,j=1   (Germany,Belgium)
(158.39/27629000.00)/(15.43/4214000.00)=1.566
13823.00/784.50+13885.00/99.78=156.776
26756.00/4214000.00=0.0063493
(2.40-6.40)/6.5=-0.615
8.27/9.00=0.919

RIVI:102  I=11,j=2   (Germany,Denmark)
(158.39/27629000.00)/(11.94/2720000.00)=1.306
3243.00/784.50+4481.00/69.40=68.702
8362.00/2720000.00=0.0030743
(2.40-2.50)/6.5=-0.015
8.27/9.74=0.849
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RIVI:103  I=11,j=3    (Germany,France)
(158.39/27629000.00)/(122.30/23867000.00)=1.119
20644.00/784.50+22688.00/364.76=88.515
43840.00/23867000.00=0.0018368
(2.40-4.10)/6.5=-0.262
8.27/7.15=1.157

RIVI:104  I=11,j=4    (Germany,Britain)
(158.39/27629000.00)/(93.18/27265000.00)=1.677
14322.00/784.50+18335.00/546.94=51.779
44624.00/27265000.00=0.0016367
(2.40-3.86)/6.5=-0.225
8.27/7.38=1.121

RIVI:105  I=11,j=5    (Germany,Greece)
(158.39/27629000.00)/(7.95/3868000.00)=2.789
1354.00/784.50+2040.00/43.03=49.135
20233.00/3868000.00=0.0052309
(2.40-4.30)/6.5=-0.292
8.27/3.87=2.137

RIVI:106  I=11,j=6    (Germany,Ireland)
(158.39/27629000.00)/(4.89/1307000.00)=1.532
1240.00/784.50+923.00/22.71=42.224
3482.00/1307000.00=0.0026641
(2.40-8.90)/6.5=-1.000
8.27/7.53=1.098

RIVI:107  I=11,j=7    (Germany,Italy)
(158.39/27629000.00)/(111.02/23323000.00)=1.204
15151.00/784.50+17061.00/526.51=51.717
14826.00/23323000.00=0.0006357
(2.40-8.10)/6.5=-0.877
8.27/7.31=1.131

RIVI:108  I=11,j=8    (Germany,Holland)
(158.39/27629000.00)/(29.45/5773000.00)=1.124
27278.00/784.50+17496.00/158.62=145.073
38324.00/5773000.00=0.0066385
(2.40-2.80)/6.5=-0.062
8.27/8.17=1.012

RIVI:109  I=11,j=9    (Germany,Portugal)
(158.39/27629000.00)/(5.79/4540000.00)=4.495
972.00/784.50+1025.00/24.25=43.507
3628.00/4540000.00=0.0007991
(2.40-8.80)/6.5=-0.985
8.27/2.86=2.892

RIVI:110  I=11,j=10    (Germany,Spain)
(158.39/27629000.00)/(37.21/13870000.00)=2.137
3065.00/784.50+3617.00/220.35=20.322
22990.00/13870000.00=0.0016575
(2.40-4.40)/6.5=-0.308
8.27/4.06=2.037
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RIVI:  1  I=1,j=2   (Belgium,Denmark)
(15.43/4214000.00)-(11.94/2720000.00)/4.45E-6= 1.636E-01
343.00/99.78+645.00/69.40=12.732
283.00/2720000.00=0.0001040
(6.40-2.50)/6.5=0.600
(9.00-9.74)/6.88=0.108

RIVI:  2  I=1,j=3   (Belgium,France)
(15.43/4214000.00)-(122.30/23867000.00)/4.45E-6= 3.287E-01
10239.00/99.78+12644.00/364.76=137.280
50200.00/23867000.00=0.0021033
(6.40-4.10)/6.5=0.354
(9.00-7.15)/6.88=0.269

RIVI:  3  I=1,j=4   (Belgium,Britain)
(15.43/4214000.00)-(93.18/27265000.00)/4.45E-6= 5.484E-02
4605.00/99.78+5850.00/546.94=56.847
3090.00/27265000.00=0.0001133
(6.40-3.86)/6.5=0.391
(9.00-7.38)/6.88=0.235

RIVI:  4  I=1,j=5   (Belgium,Greece)
(15.43/4214000.00)-(7.95/3868000.00)/4.45E-6= 3.610E-01
124.00/99.78+304.00/43.03=8.308
3321.00/3868000.00=0.0008586
(6.40-4.30)/6.5=0.323
(9.00-3.87)/6.88=0.746

RIVI:  5  I=1,j=6   (Belgium,Ireland)
(15.43/4214000.00)-(4.89/1307000.00)/4.45E-6= 1.793E-02
315.00/99.78+263.00/22.71=14.738
490.00/1307000.00=0.0003749
(6.40-8.90)/6.5=0.385
(9.00-7.53)/6.88=0.214

RIVI:  6  I=1,j=7   (Belgium,Italy)
(15.43/4214000.00)-(111.02/23323000.00)/4.45E-6= 2.469E-01
2512.00/99.78+3947.00/526.51=32.672
6967.00/23323000.00=0.0002987
(6.40-8.10)/6.5=0.262
(9.00-7.31)/6.88=0.246

RIVI:  7  I=1,j=8   (Belgium,Netherlands)
(15.43/4214000.00)-(29.45/5773000.00)/4.45E-6= 3.235E-01
12915.00/99.78+8834.00/158.62=185.128
21842.00/5773000.00=0.0037835
(6.40-2.80)/6.5=0.554
(9.00-8.17)/6.88=0.121

RIVI:  8  I=1,j=9   (Belgium,Portugal)
(15.43/4214000.00)-(5.79/4540000.00)/4.45E-6= 5.362E-01
238.00/99.78+211.00/24.25=11.086
454.00/4540000.00=0.0001000
(6.40-8.80)/6.5=0.369
(9.00-2.86)/6.88=0.892

RIVI:  9  I=1,j=10   (Belgium,Spain)
(15.43/4214000.00)-(37.21/13870000.00)/4.45E-6= 2.200E-01
825.00/99.78+535.00/220.35=10.696
4961.00/13870000.00=0.0003577
(6.40-4.40)/6.5=0.308
(9.00-4.06)/6.88=0.718
```

```
RIVI: 10  I=1,j=11   (Belgium,Germany)
(15.43/4214000.00)-(158.39/27629000.00)/4.45E-6= 4.654E-01
13885.00/99.78+13823.00/784.50=156.776
31200.00/27629000.00=0.0011292
(6.40-2.40)/6.5=0.615
(9.00-8.27)/6.88=0.106

RIVI: 11  I=2,j=3   (Denmark,France)
(11.94/2720000.00)-(122.30/23867000.00)/4.45E-6= 1.651E-01
900.00/69.40+888.00/364.76=15.403
2440.00/23867000.00=0.0001022
(2.50-4.10)/6.5=0.246
(9.74-7.15)/6.88=0.376

RIVI: 12  I=2,j=4   (Denmark,Britain)
(11.94/2720000.00)-(93.18/27265000.00)/4.45E-6= 2.185E-01
1936.00/69.40+2790.00/546.94=32.997
5042.00/27265000.00=0.0001849
(2.50-3.86)/6.5=0.209
(9.74-7.38)/6.88=0.343

RIVI: 13  I=2,j=5   (Denmark,Greece)
(11.94/2720000.00)-(7.95/3868000.00)/4.45E-6= 5.246E-01
51.00/69.40+114.00/43.03=3.384
1264.00/3868000.00=0.0003268
(2.50-4.30)/6.5=0.277
(9.74-3.87)/6.88=0.853

RIVI: 14  I=2,j=6   (Denmark,Ireland)
(11.94/2720000.00)-(4.89/1307000.00)/4.45E-6= 1.457E-01
80.00/69.40+106.00/22.71=5.820
410.00/1307000.00=0.0003137
(2.50-8.90)/6.5=0.985
(9.74-7.53)/6.88=0.321

RIVI: 15  I=2,j=7   (Denmark,Italy)
(11.94/2720000.00)-(111.02/23323000.00)/4.45E-6= 8.324E-02
707.00/69.40+812.00/526.51=11.730
12985.00/23323000.00=0.0005567
(2.50-8.10)/6.5=0.862
(9.74-7.31)/6.88=0.353

RIVI: 16  I=2,j=8   (Denmark,Netherlands)
(11.94/2720000.00)-(29.45/5773000.00)/4.45E-6= 1.599E-01
1294.00/69.40+653.00/158.62=22.762
978.00/5773000.00=0.0001694
(2.50-2.80)/6.5=0.046
(9.74-8.17)/6.88=0.228

RIVI: 17  I=2,j=9   (Denmark,Portugal)
(11.94/2720000.00)-(5.79/4540000.00)/4.45E-6= 6.999E-01
108.00/69.40+50.00/24.25=3.618
50.00/4540000.00=0.0000110
(2.50-8.80)/6.5=0.969
(9.74-2.86)/6.88=1.000
```

```
RIVI: 18  I=2,j=10   (Denmark,Spain)
(11.94/2720000.00)-(37.21/13870000.00)/4.45E-6= 3.836E-01
201.00/69.40+180.00/220.35=3.713
2974.00/13870000.00=0.0002144
(2.50-4.40)/6.5=0.292
(9.74-4.06)/6.88=0.826

RIVI: 19  I=2,j=11   (Denmark,Germany)
(11.94/2720000.00)-(158.39/27629000.00)/4.45E-6= 3.018E-01
4481.00/69.40+3243.00/784.50=68.702
12700.00/27629000.00=0.0004597
(2.50-2.40)/6.5=0.015
(9.74-8.27)/6.88=0.214

RIVI: 20  I=3,j=4   (France,Britain)
(122.30/23867000.00)-(93.18/27265000.00)/4.45E-6= 3.835E-01
10821.00/364.76+9928.00/546.94=47.818
25179.00/27265000.00=0.0009235
(4.10-3.86)/6.5=0.037
(7.15-7.38)/6.88=0.033

RIVI: 21  I=3,j=5   (France,Greece)
(122.30/23867000.00)-(7.95/3868000.00)/4.45E-6= 6.896E-01
576.00/364.76+1545.00/43.03=37.484
8323.00/3868000.00=0.0021518
(4.10-4.30)/6.5=0.031
(7.15-3.87)/6.88=0.477

RIVI: 22  I=3,j=6   (France,Ireland)
(122.30/23867000.00)-(4.89/1307000.00)/4.45E-6= 3.108E-01
995.00/364.76+557.00/22.71=27.254
1997.00/1307000.00=0.0015279
(4.10-8.90)/6.5=0.738
(7.15-7.53)/6.88=0.055

RIVI: 23  I=3,j=7   (France,Italy)
(122.30/23867000.00)-(111.02/23323000.00)/4.45E-6= 8.183E-02
12775.00/364.76+13321.00/526.51=60.324
23043.00/23323000.00=0.0009880
(4.10-8.10)/6.5=0.615
(7.15-7.31)/6.88=0.023

RIVI: 24  I=3,j=8   (France,Netherlands)
(122.30/23867000.00)-(29.45/5773000.00)/4.45E-6= 5.145E-03
9284.00/364.76+5159.00/158.62=57.977
5584.00/5773000.00=0.0009673
(4.10-2.80)/6.5=0.200
(7.15-8.17)/6.88=0.148

RIVI: 25  I=3,j=9   (France,Portugal)
(122.30/23867000.00)-(5.79/4540000.00)/4.45E-6= 8.649E-01
850.00/364.76+793.00/24.25=35.031
12079.00/4540000.00=0.0026606
(4.10-8.80)/6.5=0.723
(7.15-2.86)/6.88=0.624

RIVI: 26  I=3,j=10   (France,Spain)
(122.30/23867000.00)-(37.21/13870000.00)/4.45E-6= 5.486E-01
4464.00/364.76+3147.00/220.35=26.520
22451.00/13870000.00=0.0016187
(4.10-4.40)/6.5=0.046
(7.15-4.06)/6.88=0.449
```

```
RIVI: 27  I=3,j=11   (France,Germany)
(122.30/23867000.00)-(158.39/27629000.00)/4.45E-6= 1.367E-01
22688.00/364.76+20644.00/784.50=88.515
53100.00/27629000.00=0.0019219
(4.10-2.40)/6.5=0.262
(7.15-8.27)/6.88=0.163

RIVI: 28  I=4,j=5   (Britain,Greece)
(93.18/27265000.00)-(7.95/3868000.00)/4.45E-6= 3.061E-01
493.00/546.94+484.00/43.03=12.149
14022.00/3868000.00=0.0036251
(3.86-4.30)/6.5=0.068
(7.38-3.87)/6.88=0.510

RIVI: 29  I=4,j=6   (Britain,Ireland)
(93.18/27265000.00)-(4.89/1307000.00)/4.45E-6= 7.277E-02
4385.00/546.94+5909.00/22.71=268.211
186965.00/1307000.00=0.1430490
(3.86-8.90)/6.5=0.775
(7.38-7.53)/6.88=0.022

RIVI: 30  I=4,j=7   (Britain,Italy)
(93.18/27265000.00)-(111.02/23323000.00)/4.45E-6= 3.017E-01
6401.00/546.94+4666.00/526.51=20.565
11227.00/23323000.00=0.0004814
(3.86-8.10)/6.5=0.652
(7.38-7.31)/6.88=0.010

RIVI: 31  I=4,j=8   (Britain,Netherlands)
(93.18/27265000.00)-(29.45/5773000.00)/4.45E-6= 3.784E-01
8743.00/546.94+6935.00/158.62=59.706
32542.00/5773000.00=0.0056369
(3.86-2.80)/6.5=0.163
(7.38-8.17)/6.88=0.115

RIVI: 32  I=4,j=9   (Britain,Portugal)
(93.18/27265000.00)-(5.79/4540000.00)/4.45E-6= 4.814E-01
1103.00/546.94+679.00/24.25=30.017
3105.00/4540000.00=0.0006839
(3.86-8.80)/6.5=0.760
(7.38-2.86)/6.88=0.657

RIVI: 33  I=4,j=10   (Britain,Spain)
(93.18/27265000.00)-(37.21/13870000.00)/4.45E-6= 1.651E-01
2866.00/546.94+2212.00/220.35=15.279
18953.00/13870000.00=0.0013665
(3.86-4.40)/6.5=0.083
(7.38-4.06)/6.88=0.483

RIVI: 34  I=4,j=11   (Britain,Germany)
(93.18/27265000.00)-(158.39/27629000.00)/4.45E-6= 5.203E-01
18335.00/546.94+14322.00/784.50=51.779
56200.00/27629000.00=0.0020341
(3.86-2.40)/6.5=0.225
(7.38-8.27)/6.88=0.129
```

```
RIVI: 35  I=5,j=6   (Greece,Ireland)
(7.95/3868000.00)-(4.89/1307000.00)/4.45E-6= 3.789E-01
45.00/43.03+15.00/22.71=1.706
109.00/1307000.00=0.0000834
(4.30-8.90)/6.5=0.708
(3.87-7.53)/6.88=0.532

RIVI: 36  I=5,j=7   (Greece,Italy)
(7.95/3868000.00)-(111.02/23323000.00)/4.45E-6= 6.078E-01
1181.00/43.03+1022.00/526.51=29.387
6089.00/23323000.00=0.0002611
(4.30-8.10)/6.5=0.585
(3.87-7.31)/6.88=0.500

RIVI: 37  I=5,j=8   (Greece,Netherlands)
(7.95/3868000.00)-(29.45/5773000.00)/4.45E-6= 6.845E-01
752.00/43.03+191.00/158.62=18.680
3400.00/5773000.00=0.0005889
(4.30-2.80)/6.5=0.231
(3.87-8.17)/6.88=0.625

RIVI: 38  I=5,j=9   (Greece,Portugal)
(7.95/3868000.00)-(5.79/4540000.00)/4.45E-6= 1.753E-01
20.00/43.03+9.00/24.25=0.836
50.00/4540000.00=0.0000110
(4.30-8.80)/6.5=0.692
(3.87-2.86)/6.88=0.147

RIVI: 39  I=5,j=10   (Greece,Spain)
(7.95/3868000.00)-(37.21/13870000.00)/4.45E-6= 1.410E-01
165.00/43.03+77.00/220.35=4.184
346.00/13870000.00=0.0000249
(4.30-4.40)/6.5=0.015
(3.87-4.06)/6.88=0.028

RIVI: 40  I=5,j=11   (Greece,Germany)
(7.95/3868000.00)-(158.39/27629000.00)/4.45E-6= 8.264E-01
2040.00/43.03+1354.00/784.50=49.135
308600.00/27629000.00=0.0111694
(4.30-2.40)/6.5=0.292
(3.87-8.27)/6.88=0.640

RIVI: 41  I=6,j=7   (Ireland,Italy)
(4.89/1307000.00)-(111.02/23323000.00)/4.45E-6= 2.289E-01
251.00/22.71+347.00/526.51=11.711
624.00/23323000.00=0.0000268
(8.90-8.10)/6.5=0.123
(7.53-7.31)/6.88=0.032

RIVI: 42  I=6,j=8   (Ireland,Netherlands)
(4.89/1307000.00)-(29.45/5773000.00)/4.45E-6= 3.056E-01
560.00/22.71+639.00/158.62=28.687
2115.00/5773000.00=0.0003664
(8.90-2.80)/6.5=0.938
(7.53-8.17)/6.88=0.093

RIVI: 43  I=6,j=9   (Ireland,Portugal)
(4.89/1307000.00)-(5.79/4540000.00)/4.45E-6= 5.542E-01
34.00/22.71+29.00/24.25=2.693
50.00/4540000.00=0.0000110
(8.90-8.80)/6.5=0.015
(7.53-2.86)/6.88=0.679
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```
RIVI: 44  I=6,j=10   (Ireland,Spain)
(4.89/1307000.00)-(37.21/13870000.00)/4.45E-6= 2.379E-01
122.00/22.71+166.00/220.35=6.125
718.00/13870000.00=0.0000518
(8.90-4.40)/6.5=0.692
(7.53-4.06)/6.88=0.504

RIVI: 45  I=6,j=11   (Ireland,Germany)
(4.89/1307000.00)-(158.39/27629000.00)/4.45E-6= 4.475E-01
923.00/22.71+1240.00/784.50=42.224
3900.00/27629000.00=0.0001412
(8.90-2.40)/6.5=1.000
(7.53-8.27)/6.88=0.108

RIVI: 46  I=7,j=8   (Italy,Netherlands)
(111.02/23323000.00)-(29.45/5773000.00)/4.45E-6= 7.668E-02
5237.00/526.51+2301.00/158.62=24.453
20228.00/5773000.00=0.0035039
(8.10-2.80)/6.5=0.815
(7.31-8.17)/6.88=0.125

RIVI: 47  I=7,j=9   (Italy,Portugal)
(111.02/23323000.00)-(5.79/4540000.00)/4.45E-6= 7.831E-01
323.00/526.51+476.00/24.25=20.242
801.00/4540000.00=0.0001764
(8.10-8.80)/6.5=0.108
(7.31-2.86)/6.88=0.647

RIVI: 48  I=7,j=10   (Italy,Spain)
(111.02/23323000.00)-(37.21/13870000.00)/4.45E-6= 4.668E-01
1764.00/526.51+1545.00/220.35=10.362
7163.00/13870000.00=0.0005164
(8.10-4.40)/6.5=0.569
(7.31-4.06)/6.88=0.472

RIVI: 49  I=7,j=11   (Italy,Germany)
(111.02/23323000.00)-(158.39/27629000.00)/4.45E-6= 2.186E-01
17061.00/526.51+15151.00/784.50=51.717
659000.00/27629000.00=0.0238517
(8.10-2.40)/6.5=0.877
(7.31-8.27)/6.88=0.140

RIVI: 50  I=8,j=9   (Netherlands,Portugal)
(29.45/5773000.00)-(5.79/4540000.00)/4.45E-6= 8.598E-01
375.00/158.62+351.00/24.25=16.838
671.00/4540000.00=0.0001478
(2.80-8.80)/6.5=0.923
(8.17-2.86)/6.88=0.772

RIVI: 51  I=8,j=10   (Netherlands,Spain)
(29.45/5773000.00)-(37.21/13870000.00)/4.45E-6= 5.435E-01
1175.00/158.62+734.00/220.35=10.739
6727.00/13870000.00=0.0004850
(2.80-4.40)/6.5=0.246
(8.17-4.06)/6.88=0.597
```

```
RIVI: 52  I=8,j=11   (Netherlands,Germany)
(29.45/5773000.00)-(158.39/27629000.00)/4.45E-6= 1.419E-01
17496.00/158.62+27278.00/784.50=145.073
109300.00/27629000.00=0.0039560
(2.80-2.40)/6.5=0.062
(8.17-8.27)/6.88=0.015

RIVI: 53  I=9,j=10   (Portugal,Spain)
(5.79/4540000.00)-(37.21/13870000.00)/4.45E-6= 3.163E-01
846.00/24.25+339.00/220.35=36.425
20268.00/13870000.00=0.0014613
(8.80-4.40)/6.5=0.677
(2.86-4.06)/6.88=0.174

RIVI: 54  I=9,j=11   (Portugal,Germany)
(5.79/4540000.00)-(158.39/27629000.00)/4.45E-6= 1.002E+00
1025.00/24.25+972.00/784.50=43.507
113000.00/27629000.00=0.0040899
(8.80-2.40)/6.5=0.985
(2.86-8.27)/6.88=0.786

RIVI: 55  I=10,j=11   (Spain,Germany)
(37.21/13870000.00)-(158.39/27629000.00)/4.45E-6= 6.854E-01
3617.00/220.35+3065.00/784.50=20.322
180400.00/27629000.00=0.0065294
(4.40-2.40)/6.5=0.308
(4.06-8.27)/6.88=0.612
```

APPENDIX IV

Regressions:

1. Regression with the prototype model (Chapters 7.1, 7.2)
2. Regressions with the corrected formulation (Chapter 7.3)
   - basic run (7.3.2)
   - multicollinearity (7.4.2)
3. Regression with a transformed order of countries (Chapter 7.5)
4. Regression with a log-model (Chapter 8.1)
5. Regression with monthly labour costs and money market rate of interest (Chapter 8.2)

1.) Regression with the prototype model (Chapters 7.1, 7.2)

M D E P
sion of January, 1986

L I S T I N G O F R A W D A T A

ervation data	Number Sample	X1	X2	X3	X4	X5
1	1	.83413	12.732	.10400E-03	.60000	.92402
2	2	.71457	137.28	.21033E-02	.35385	1.2587
3	3	1.0714	56.847	.11330E-03	.39077	1.2195
4	4	1.7815	8.3076	.85860E-03	.32308	2.3256
5	5	.97867	14.738	.37490E-03	-.38462	1.1952
6	6	.76923	32.672	.29870E-03	-.26154	1.2312
7	7	.71777	185.13	.37835E-02	.55385	1.1016
8	8	2.8711	11.086	.10000E-03	-.36923	3.1469
9	9	1.3649	10.696	.35770E-03	.30769	2.2167
10	10	.63872	156.78	.11292E-02	.61538	1.0883
11	11	1.1988	12.732	.40860E-03	-.60000	1.0822
12	12	.85666	15.403	.10220E-03	-.24615	1.3622
13	13	1.2845	32.997	.18490E-03	-.20923	1.3198
14	14	2.1358	3.3842	.32680E-03	-.27692	2.5168
15	15	1.1733	5.8203	.31370E-03	-.98462	1.2935
16	16	.92219	11.730	.55670E-03	-.86154	1.3324
17	17	.86050	22.762	.16940E-03	-.46154E-01	1.1922
18	18	3.4420	3.6181	.11000E-04	-.96923	3.4056
19	19	1.6363	3.7131	.21440E-03	-.29231	2.3990
20	20	.76573	68.702	.45970E-03	.15385E-01	1.1778
21	21	1.3994	137.28	.24564E-01	-.35385	.79444
22	22	1.1673	15.403	.62240E-03	.24615	.73409
23	23	1.4994	47.818	.92350E-03	.36923E-01	.96883
24	24	2.4931	37.484	.21518E-02	-.30769E-01	1.8475
25	25	1.3696	27.254	.15279E-02	-.73846	.94954
26	26	1.0765	60.324	.98800E-03	-.61538	.97811
27	27	1.0045	57.977	.96730E-03	.20000	.87515
28	28	4.0180	35.031	.26606E-02	-.72308	2.5000
29	29	1.9101	26.520	.16187E-02	-.46154E-01	1.7611
30	30	.89385	88.515	.19219E-02	.26154	.86457
31	31	.93335	56.847	.54770E-02	-.39077	.82000
32	32	.77854	32.997	.35195E-02	.20923	.75770
33	33	.66694	47.818	.14321E-02	-.36923E-01	1.0322
34	34	1.6628	12.149	.36251E-02	-.67692E-01	1.9070
35	35	.91345	268.21	.14305	-.77538	.98008
36	36	.71796	20.565	.48140E-03	-.65231	1.0096
37	37	.66994	59.706	.56369E-02	.16308	.90330
38	38	2.6798	30.017	.68390E-03	-.76000	2.5804
39	39	1.2739	15.279	.13665E-02	-.83077E-01	1.8177
40	40	.59615	51.779	.20341E-02	.22462	.89238
41	41	.56132	8.3076	.50380E-02	-.32308	.43000
42	42	.46821	3.3842	.20220E-03	.27692	.39733
43	43	.40110	37.484	.32930E-03	.30769E-01	.54126
44	44	.60140	12.149	.73410E-03	.67692E-01	.52439
45	45	.54935	1.7063	.83400E-04	-.70769	.51394
46	46	.43178	29.387	.26110E-03	-.58462	.52941
47	47	.40290	18.680	.58890E-03	.23077	.47368
48	48	1.6116	.83593	.11000E-04	-.69231	1.3531
49	49	.76612	4.1840	.24900E-04	-.15385E-01	.95320
50	50	.35852	49.135	.11169E-01	.29231	.46796

51	51	1.0218	14.738	.24180E-03	.38462	.83667
52	52	.85231	5.8203	.27830E-03	.98462	.77310
53	53	.73014	27.254	.78800E-04	.73846	1.0531
54	54	1.0948	268.21	.17407E-01	.77538	1.0203
55	55	1.8203	1.7063	.87600E-04	.70769	1.9457
56	56	.78599	11.711	.26800E-04	.12308	1.0301
57	57	.73341	28.687	.36640E-03	.93846	.92166
58	58	2.9337	2.6930	.11000E-04	.15385E-01	2.6329
59	59	1.3946	6.1254	.51800E-04	.69231	1.8547
60	60	.65264	42.224	.14120E-03	1.0000	.91052
61	61	1.3000	32.672	.66374E-01	.26154	.81222
62	62	1.0844	11.730	.62320E-03	.86154	.75051
63	63	.92894	60.324	.13983E-01	.61538	1.0224
64	64	1.3928	20.565	.34527E-02	.65231	.99051
65	65	2.3160	29.387	.11264E-02	.58462	1.8889
66	66	1.2723	11.711	.10329E-02	-.12308	.97078
67	67	.93311	24.453	.35039E-02	.81538	.89474
68	68	3.7325	20.242	.17640E-03	-.10769	2.5559
69	69	1.7743	10.362	.51640E-03	.56923	1.8005
70	70	.83034	51.717	.23852E-01	.87692	.88392
71	71	1.3932	185.13	.15717E-01	-.55385	.90778
72	72	1.1621	22.762	.56540E-03	.46154E-01	.83881
73	73	.99553	57.977	.58570E-03	-.20000	1.1427
74	74	1.4927	59.706	.55670E-03	-.16308	1.1070
75	75	2.4820	18.680	.45600E-03	-.23077	2.1111
76	76	1.3635	28.687	.13083E-02	-.93846	1.0850
77	77	1.0717	24.453	.13380E-03	-.81538	1.1176
78	78	4.0000	16.838	.14780E-03	-.92308	2.8566
79	79	1.9015	10.739	.48500E-03	-.24615	2.0123
80	80	.88986	145.07	.39560E-02	.61538E-01	.98791
81	81	.34830	11.086	.24874E-02	.36923	.31778
82	82	.29053	3.6181	.36840E-03	.96923	.29363
83	83	.24888	35.031	.32047E-01	.72308	.40000
84	84	.37317	30.017	.44040E-03	.76000	.38753
85	85	.62050	.83593	.69000E-04	.69231	.73902
86	86	.34087	2.6930	.75000E-04	-.15385E-01	.37981
87	87	.26792	20.242	.21000E-05	.10769	.39124
88	88	.25000	16.838	.14410E-02	.92308	.35006
89	89	.47538	36.425	.14613E-02	.67692	.70443
90	90	.22246	43.507	.40899E-02	.98462	.34583
91	91	.73268	10.696	.13824E-01	-.30769	.45111
92	92	.61115	3.7131	.91900E-04	.29231	.41684
93	93	.52355	26.520	.13468E-01	.46154E-01	.56783
94	94	.78499	15.279	.80890E-03	.83077E-01	.55014
95	95	1.3053	4.1840	.35060E-03	.15385E-01	1.0491
96	96	.71705	6.1254	.58380E-03	-.69231	.53918
97	97	.56359	10.362	.21000E-05	-.56923	.55540
98	98	.52590	10.739	.37729E-02	.24615	.49694
99	99	2.1036	36.425	.17800E-02	-.67692	1.4196
100	100	.46797	20.322	.65294E-02	.30769	.49093
101	101	1.5656	156.78	.63493E-02	-.61538	.91889
102	102	1.3060	68.702	.30743E-02	-.15385E-01	.84908
103	103	1.1188	88.515	.18368E-02	-.26154	1.1566
104	104	1.6774	51.779	.16367E-02	-.22462	1.1206
105	105	2.7892	49.135	.52309E-02	-.29231	2.1370
106	106	1.5322	42.224	.26641E-02	-1.0000	1.0983
107	107	1.2043	51.717	.63570E-03	-.87692	1.1313
108	108	1.1238	145.07	.66385E-02	-.61538E-01	1.0122
109	109	4.4951	43.507	.79910E-03	-.98462	2.8916
110	110	2.1369	20.322	.16575E-02	-.30769	2.0369

```
DEL COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2,X3,X4;AR1$

 Ordinary    Least Squares Estimates

 Dependent Variable.....      X5
 Number of Observations.....          110.
 Mean of Dependent Variable..       1.17148
 Std. Dev. of Dep. Variable..         .68572
 Std. Error of Regression....         .32373
 Sum of Squared Residuals....      11.004
 R - Squared.................         .78531
 Adjusted R - Squared........         .77713
 F-Statistic (  4,  105).....       96.01768
 Significance of F-Test......         .00000
 Log-Likelihood..............     -29.519
 Restricted (Slopes=0) Log-L.     -114.08
 Chi-Squared ( 4)............      169.13
 Significance Level..........      .32173E-13

 Durbin - Watson Statistic.....       .97678
 Estimated Autocorrelation (Rho).....  .51161

ariable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
E        .307315      .6501E-01    4.727 ( .00002)   1.0000       .00000
         .722309      .4050E-01   17.837 ( .00000)   1.2269       .85036
        -.363452E-03  .7153E-03    -.508 ( .61845)   40.147      50.174
        -1.60860      2.314        -.695 ( .49548)   .46102E-02  .15567E-
         .503840E-01  .6323E-01     .797 ( .43298)   .00000       .54339

 AR(1) Disturbance

 Initial Value of Rho =      .51161

 Maximum Iterations =           20

 Method = Prais - Winsten

 Iteration= 1, Rho=  .5116, Sum of Squares=       7.7998

 Iteration= 2, Rho=  .5637, Sum of Squares=       7.7666

 Iteration= 3, Rho=  .5670, Sum of Squares=       7.7664

 Final Value of Rho =     .56700

 Durbin - Watson for Untransformed Residuals =      .86561
 Std. Deviation of Autocorrelated Error =      .33022

 Std. Deviation of White Noise =      .27197

 Durbin-Watson for Transformed Residuals =  2.18856
 Autocorrelation of Transformed Residuals = -.0943
```

riable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of
	.384525	.7711E-01	4.987	(.00000)	1.0000	.00000
	.677948	.3473E-01	19.519	(.00000)	1.2269	.85036
	-.992281E-03	.5319E-03	-1.866	(.06210)	40.147	50.174
	-.607640	1.719	-.353	(.72372)	.46102E-02	.15567E-
	.104677	.6030E-01	1.736	(.08257)	-.25835E-18	.54339

2.) Regressions with the corrected formulation (Chapter 7.3)
    - basic run (7.3.2)
    - multicollinearity (7.4.2)

APPENDIX V

Additional regressions (Chapter 10.4)

L I S T I N G O F R A W D A T A

rvation data	Number Sample	X1	X2	X3	X4	X5
1	1	.30810	12.732	.10400E-03	.33021E-01	.10756
2	2	.14120	137.28	.21033E-02	.26692	.26890
3	3	.19820E-01	56.847	.11330E-03	.23941	.23547
4	4	.51570	8.3076	.85860E-03	.35773	.74564
5	5	.31920	14.738	.37490E-03	.59439E-01	.21366
6	6	.74200E-01	32.672	.29870E-03	.45294	.24564
7	7	.92600E-01	185.13	.37835E-02	.28178	.12064
8	8	.69190	11.086	.10000E-03	.71822	.89244
9	9	.38670	10.696	.35770E-03	.14199	.71802
10	10	.23400	156.78	.11292E-02	.23005	.10610
11	11	.16690	15.403	.10220E-03	.29994	.37645
12	12	.32790	32.997	.18490E-03	.20638	.34302
13	13	.82380	3.3842	.32680E-03	.39075	.85320
14	14	.62730	5.8203	.31370E-03	.26417E-01	.32122
15	15	.38230	11.730	.55670E-03	.48597	.35320
16	16	.21550	22.762	.16940E-03	.24876	.22820
17	17	1.0000	3.6181	.11000E-04	.75124	1.0000
18	18	.69480	3.7131	.21440E-03	.17501	.82558
19	19	.74040E-01	68.702	.45970E-03	.19703	.21366
20	20	.16100	47.818	.92350E-03	.50633	.33430E-
21	21	.65690	37.484	.21518E-02	.90809E-01	.47674
22	22	.46040	27.254	.15279E-02	.32636	.55233E-
23	23	.21540	60.324	.98800E-03	.18602	.23256E-
24	24	.48610E-01	57.977	.96730E-03	.54871	.14826
25	25	.83310	35.031	.26606E-02	.45129	.62355
26	26	.52790	26.520	.16187E-02	.12493	.44913
27	27	.92820E-01	88.515	.19219E-02	.49697	.16279
28	28	.49590	12.149	.36251E-02	.59714	.51017
29	29	.29940	268.21	.14305	.17997	.21802E-
30	30	.54380E-01	20.565	.48140E-03	.69235	.10174E-
31	31	.11240	59.706	.56369E-02	.42378E-01	.11483
32	32	.67210	30.017	.68390E-03	.95762	.65698
33	33	.36690	15.279	.13665E-02	.38140	.48256
34	34	.25390	51.779	.20341E-02	.93561E-02	.12936
35	35	.19650	1.7063	.83400E-04	.41717	.53198
36	36	.44150	29.387	.26110E-03	.95212E-01	.50000
37	37	.60830	18.680	.58890E-03	.63952	.62500
38	38	.17620	.83593	.11000E-04	.36048	.14680
39	39	.12900	4.1840	.24900E-04	.21574	.27616E-
40	40	.74980	49.135	.11169E-01	.58778	.63953
41	41	.24500	11.711	.26800E-04	.51238	.31977E-
42	42	.41180	28.687	.36640E-03	.22234	.93023E-
43	43	.37270	2.6930	.11000E-04	.77766	.67878
44	44	.67500E-01	6.1254	.51800E-04	.20143	.50436
45	45	.55320	42.224	.14120E-03	.17061	.10756
46	46	.16680	24.453	.35039E-02	.73473	.12500
47	47	.61770	20.242	.17640E-03	.26527	.64680
48	48	.31250	10.362	.51640E-03	.31095	.47238
49	49	.30820	51.717	.23852E-01	.68299	.13953
50	50	.78450	16.838	.14780E-03	1.0000	.77180
51	51	.47930	10.739	.48500E-03	.42378	.59738
52	52	.14140	145.07	.39560E-02	.51734E-01	.14535E-
53	53	.30520	36.425	.14613E-02	.57622	.17442
54	54	.92600	43.507	.40899E-02	.94827	.78634
55	55	.62070	20.322	.65294E-02	.37204	.61192

```
L COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2,X3,X4$

Ordinary    Least Squares Estimates

Dependent Variable.....      X5
Number of Observations.....          55.
Mean of Dependent Variable..      .36897
Std. Dev. of Dep. Variable..      .27942
Std. Error of Regression....      .17423
Sum of Squared Residuals....    1.5178
R - Squared.................      .63999
Adjusted R - Squared........      .61119
F-Statistic (  4,   50).....     22.22108
Significance of F-Test......      .00000
Log-Likelihood..............    20.564
Restricted (Slopes=0) Log-L.   -7.4137
Chi-Squared ( 4)............    55.956
Significance Level..........    .32173E-13
```

iable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of
	.826658E-01	.6217E-01	1.330 (.18359)	1.0000	.00000
	.723519	.9965E-01	7.261 (.00000)	.38111	.25376
	-.119155E-02	.6288E-03	-1.895 (.05810)	40.147	50.406
	.124249	1.600	.078 (.93811)	.43391E-02	.19393E-
	.151994	.9343E-01	1.627 (.10376)	.37674	.25377

```
L COMMAND: CRMODEL;LHS=X3;RHS=ONE,X1,X2,X4,X5$

Ordinary    Least Squares Estimates

Dependent Variable.....      X3
Number of Observations.....          55.
Mean of Dependent Variable..      .00434
Std. Dev. of Dep. Variable..      .01939
Std. Error of Regression....      .01498
Sum of Squared Residuals....    .11227E-01
R - Squared.................      .44716
Adjusted R - Squared........      .40293
F-Statistic (  4,   50).....     10.11036
Significance of F-Test......      .00000
Log-Likelihood..............    155.50
Restricted (Slopes=0) Log-L.    139.32
Chi-Squared ( 4)............    32.365
Significance Level..........    .33455E-07
```

iable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of
	-.118240E-01	.5287E-02	-2.236 (.02991)	1.0000	.00000
	.165213E-01	.1248E-01	1.324 (.19161)	.38111	.25376
	.265953E-03	.4501E-04	5.909 (.00000)	40.147	50.406
	.180286E-02	.8746E-02	.206 (.83754)	.37674	.25377
	-.403723E-02	.1215E-01	-.332 (.74109)	.36897	.27942

```
L COMMAND: CRMODEL;LHS=X3;RHS=ONE,X5$

Ordinary    Least Squares Estimates

Dependent Variable.....      X3
Number of Observations.....          55.
Mean of Dependent Variable..      .00434
Std. Dev. of Dep. Variable..      .01939
Std. Error of Regression....      .01924
Sum of Squared Residuals....   .19619E-01
R - Squared.................      .03395
Adjusted R - Squared........      .01572
F-Statistic (  1,   53).....     1.86236
Significance of F-Test......      .17812
Log-Likelihood..............    140.25
Restricted (Slopes=0) Log-L.    139.32
Chi-Squared ( 1)............    1.8714
Significance Level..........    .17132


iable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
      .905738E-02   .4322E-02    2.095 ( .04102)   1.0000       .00000
     -.127875E-01   .9370E-02   -1.365 ( .17823)   .36897       .27942


L COMMAND: CRMODEL;LHS=X3;RHS=ONE,X1,X5$

Ordinary    Least Squares Estimates

Dependent Variable.....      X3
Number of Observations.....          55.
Mean of Dependent Variable..      .00434
Std. Dev. of Dep. Variable..      .01939
Std. Error of Regression....      .01915
Sum of Squared Residuals....   .19071E-01
R - Squared.................      .06092
Adjusted R - Squared........      .02480
F-Statistic (  2,   52).....     1.68677
Significance of F-Test......      .19509
Log-Likelihood..............    141.01
Restricted (Slopes=0) Log-L.    139.32
Chi-Squared ( 2)............    3.3815
Significance Level..........    .18438


iable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
      .662240E-02   .4741E-02    1.397 ( .16854)   1.0000       .00000
      .194296E-01   .1590E-01    1.222 ( .22724)   .38111       .25376
     -.262566E-01   .1444E-01   -1.819 ( .07484)   .36897       .27942
```

```
L COMMAND: CRMODEL;LHS=X3;RHS=ONE,X1,X2,X5$

Ordinary    Least Squares Estimates

Dependent Variable.....      X3
Number of Observations.....          55.
Mean of Dependent Variable..      .00434
Std. Dev. of Dep. Variable..      .01939
Std. Error of Regression....      .01484
Sum of Squared Residuals....   .11237E-01
R - Squared.................      .44669
Adjusted R - Squared........      .41414
F-Statistic (  3,   51).....    13.72398
Significance of F-Test......      .00000
Log-Likelihood..............   155.52
Restricted (Slopes=0) Log-L.   139.32
Chi-Squared ( 3)............   32.407
Significance Level..........   .30478E-08


iable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------

     -.113671E-01   .4755E-02   -2.391 ( .02062)   1.0000       .00000
      .166992E-01   .1233E-01    1.354 ( .18172)   .38111       .25376
      .265466E-03   .4452E-04    5.963 ( .00000)   40.147       50.406
     -.356528E-02   .1182E-01    -.302 ( .76418)   .36897       .27942



L COMMAND: CRMODEL;LHS=X3;RHS=ONE,X1,X4,X5$

Ordinary    Least Squares Estimates

Dependent Variable.....      X3
Number of Observations.....          55.
Mean of Dependent Variable..      .00434
Std. Dev. of Dep. Variable..      .01939
Std. Error of Regression....      .01934
Sum of Squared Residuals....   .19069E-01
R - Squared.................      .06104
Adjusted R - Squared........      .00581
F-Statistic (  3,   51).....    1.10519
Significance of F-Test......      .35561
Log-Likelihood..............   140.98
Restricted (Slopes=0) Log-L.   139.32
Chi-Squared ( 3)............   3.3205
Significance Level..........   .34480


iable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------

      .683606E-02   .5472E-02    1.249 ( .21735)   1.0000       .00000
      .195168E-01   .1609E-01    1.213 ( .23077)   .38111       .25376
     -.908874E-03   .1127E-01    -.081 ( .93605)   .37674       .25377
     -.259977E-01   .1493E-01   -1.742 ( .08771)   .36897       .27942
```

L I S T I N G O F R A W D A T A

rvation Number data	Sample	X1	X2	X3	X4	X5
1	1	.16360	12.732	.10400E-03	.60000	.10756
2	2	.32870	137.28	.21033E-02	.35385	.26890
3	3	.54840E-01	56.847	.11330E-03	.39077	.23547
4	4	.36100	8.3076	.85860E-03	.32308	.74564
5	5	.17930E-01	14.738	.37490E-03	.38462	.21366
6	6	.24690	32.672	.29870E-03	.26154	.24564
7	7	.32350	185.13	.37835E-02	.55385	.12064
8	8	.53620	11.086	.10000E-03	.36923	.89244
9	9	.22000	10.696	.35770E-03	.30769	.71802
10	10	.46540	156.78	.11292E-02	.61538	.10610
11	11	.16510	15.403	.10220E-03	.24615	.37645
12	12	.21850	32.997	.18490E-03	.20923	.34302
13	13	.52460	3.3842	.32680E-03	.27692	.85320
14	14	.14570	5.8203	.31370E-03	.98462	.32122
15	15	.83240E-01	11.730	.55670E-03	.86154	.35320
16	16	.15990	22.762	.16940E-03	.46154E-01	.22820
17	17	.69990	3.6181	.11000E-04	.96923	1.0000
18	18	.38360	3.7131	.21440E-03	.29231	.82558
19	19	.30180	68.702	.45970E-03	.15385E-01	.21366
20	20	.38350	47.818	.92350E-03	.36923E-01	.33430E-
21	21	.68960	37.484	.21518E-02	.30769E-01	.47674
22	22	.31080	27.254	.15279E-02	.73846	.55233E-
23	23	.81830E-01	60.324	.98800E-03	.61538	.23256E-
24	24	.51450E-02	57.977	.96730E-03	.20000	.14826
25	25	.86490	35.031	.26606E-02	.72308	.62355
26	26	.54860	26.520	.16187E-02	.46154E-01	.44913
27	27	.13670	88.515	.19219E-02	.26154	.16279
28	28	.30610	12.149	.36251E-02	.67692E-01	.51017
29	29	.72770E-01	268.21	.14305	.77538	.21802E-
30	30	.30170	20.565	.48140E-03	.65231	.10174E-
31	31	.37840	59.706	.56369E-02	.16308	.11483
32	32	.48140	30.017	.68390E-03	.76000	.65698
33	33	.16510	15.279	.13665E-02	.83077E-01	.48256
34	34	.52030	51.779	.20341E-02	.22462	.12936
35	35	.37890	1.7063	.83400E-04	.70769	.53198
36	36	.60780	29.387	.26110E-03	.58462	.50000
37	37	.68450	18.680	.58890E-03	.23077	.62500
38	38	.17530	.83593	.11000E-04	.69231	.14680
39	39	.14100	4.1840	.24900E-04	.15385E-01	.27616E-
40	40	.82640	49.135	.11169E-01	.29231	.63953
41	41	.22890	11.711	.26800E-04	.12308	.31977E-
42	42	.30560	28.687	.36640E-03	.93846	.93023E-
43	43	.55420	2.6930	.11000E-04	.15385E-01	.67878
44	44	.23790	6.1254	.51800E-04	.69231	.50436
45	45	.44750	42.224	.14120E-03	1.0000	.10756
46	46	.76680E-01	24.453	.35039E-02	.81538	.12500
47	47	.78310	20.242	.17640E-03	.10769	.64680
48	48	.46680	10.362	.51640E-03	.56923	.47238
49	49	.21860	51.717	.23852E-01	.87692	.13953
50	50	.85980	16.838	.14780E-03	.92308	.77180
51	51	.54350	10.739	.48500E-03	.24615	.59738
52	52	.14190	145.07	.39560E-02	.61538E-01	.14535E-
53	53	.31630	36.425	.14613E-02	.67692	.17442
54	54	1.0020	43.507	.40899E-02	.98462	.78634
55	55	.68540	20.322	.65294E-02	.30769	.61192

```
:L COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2,X3,X4;AR1$

 Ordinary    Least Squares Estimates

 Dependent Variable.....      X5
 Number of Observations.....          55.
 Mean of Dependent Variable..      .36897
 Std. Dev. of Dep. Variable..      .27942
 Std. Error of Regression....      .19328
 Sum of Squared Residuals....     1.8678
 R - Squared.................      .55696
 Adjusted R - Squared........      .52152
 F-Statistic (  4,   50).....    15.71434
 Significance of F-Test......      .00000
 Log-Likelihood..............     14.858
 Restricted (Slopes=0) Log-L.    -7.4137
 Chi-Squared ( 4)............     44.543
 Significance Level..........     .55324E-11

 Durbin - Watson Statistic.....      1.3896
 Estimated Autocorrelation (Rho).....    .30518

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
       .223736       .6574E-01    3.403 ( .00134)   1.0000        .00000
       .695236       .1102        6.309 ( .00000)   .36962        .24340
      -.260518E-02   .6876E-03   -3.789 ( .00041)   40.147        50.406
       3.11780       1.807        1.726 ( .09069)   .43391E-02    .19393E-
      -.467960E-01   .8529E-01    -.549 ( .58571)   .44185        .31489

 AR(1) Disturbance

 Initial Value of Rho =      .30518

 Maximum Iterations =           20


 Method = Prais - Winsten

 Iteration= 1, Rho=  .3052, Sum of Squares=       1.6754

 Iteration= 2, Rho=  .3453, Sum of Squares=       1.6724

 Iteration= 3, Rho=  .3492, Sum of Squares=       1.6724

 Final Value of Rho =     .34923

 Durbin - Watson for Untransformed Residuals =      1.3008
 Std. Deviation of Autocorrelated Error =      .19521

 Std. Deviation of White Noise =      .18289

 Durbin-Watson for Transformed Residuals =  1.91574
 Autocorrelation of Transformed Residuals =   .0421
```

```
able  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
       .208997       .6299E-01    3.318 ( .00091)   1.0000       .00000
       .755718       .9737E-01    7.761 ( .00000)   .36962       .24340
      -.289914E-02   .5977E-03   -4.850 ( .00000)   40.147       50.406
       4.44348      1.634         2.720 ( .00653)   .43391E-02   .19393E-
      -.552819E-01   .7419E-01    -.745 ( .45620)   .44185       .31489


L COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2;AR1$

Ordinary    Least Squares Estimates

Dependent Variable.....      X5
Number of Observations.....        55.
Mean of Dependent Variable..     .36897
Std. Dev. of Dep. Variable..     .27942
Std. Error of Regression....     .19519
Sum of Squared Residuals....    1.9812
R - Squared.................     .53007
Adjusted R - Squared........     .51200
F-Statistic (  2,   52).....    29.32746
Significance of F-Test......     .00000
Log-Likelihood..............    13.316
Restricted (Slopes=0) Log-L.   -7.4137
Chi-Squared ( 2)............    41.459
Significance Level..........    .83527E-13

Durbin-Watson for Transformed Residuals =  1.92185
Autocorrelation of Transformed Residuals =   .0391

iable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
       .179597       .5618E-01    3.197 ( .00139)   1.0000       .00000
       .711196       .1044        6.812 ( .00000)   .36962       .24340
      -.185426E-02   .4926E-03   -3.764 ( .00017)   40.147       50.406


L COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2,X3;AR1$

Ordinary    Least Squares Estimates

Dependent Variable.....      X5
Number of Observations.....        55.
Mean of Dependent Variable..     .36897
Std. Dev. of Dep. Variable..     .27942
Std. Error of Regression....     .19195
Sum of Squared Residuals....    1.8791
R - Squared.................     .55430
Adjusted R - Squared........     .52808
F-Statistic (  3,   51).....    21.14185
Significance of F-Test......     .00000
Log-Likelihood..............    14.737
Restricted (Slopes=0) Log-L.   -7.4137
Chi-Squared ( 3)............    44.302
Significance Level..........    .35915E-12

Durbin-Watson for Transformed Residuals =  1.89803
Autocorrelation of Transformed Residuals =   .0510
```

riable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of
	.188293	.5596E-01	3.365	(.00077)	1.0000	.00000
	.747298	.9661E-01	7.735	(.00000)	.36962	.24340
	-.289201E-02	.5964E-03	-4.849	(.00000)	40.147	50.406
	4.24975	1.613	2.635	(.00841)	.43391E-02	.19393E-

EL COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2,X4;AR1$

Ordinary Least Squares Estimates

Dependent Variable.....	X5
Number of Observations.....	55.
Mean of Dependent Variable..	.36897
Std. Dev. of Dep. Variable..	.27942
Std. Error of Regression....	.19699
Sum of Squared Residuals....	1.9791
R - Squared.....	.53057
Adjusted R - Squared.....	.50296
F-Statistic (3, 51).....	19.21439
Significance of F-Test.....	.00000
Log-Likelihood.....	13.311
Restricted (Slopes=0) Log-L.	-7.4137
Chi-Squared (3).....	41.450
Significance Level.....	.32559E-11

Durbin-Watson for Transformed Residuals = 1.92422
Autocorrelation of Transformed Residuals = .0379

riable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of
	.188759	.6420E-01	2.940	(.00328)	1.0000	.00000
	.714214	.1057	6.758	(.00000)	.36962	.24340
	-.183917E-02	.4991E-03	-3.685	(.00023)	40.147	50.406
	-.246385E-01	.8032E-01	-.307	(.75903)	.44185	.31489
	.223453	.1326	1.685	(.09206)		

```
L COMMAND: PLOT;LHS=X1;RHS=X5$

     P L O T; Vertical=X5          Horizontal=X1

1.000                                               .
 :
 :                                      .
 .876                                  .
 :                           .
 :                         .
 .753            .
 :                                  .    .
 :                                                 .      .  .  .
 +                                      .          .
 :                          .
 :                .    .                     .
 +           .                     .     .         .
 :
 :           .
 +     .    .    .
 :                       .
 :   .       .     .
 .258                  .
 :.        .  .  .      .
 :     .     .          .   .    . .   .
 .134                  ..
 :    X1   2      .    .     .
 +--------+--------+--------+--------+--------+--------+--------+--------+-------
         .1298             .3790             .6282             .8774    >

L COMMAND: PLOT;LHS=X2;RHS=X5$

     P L O T; Vertical=X5          Horizontal=X2

1.000
 :
 :  .
 .876
 :.          .
 :  . .
 .753
 :.      .
 :    ..    .   .
 +  .  .
 :.
 : . .   .
 +  .. .  .
 :
 :   .
 + ..     .
 :                                      .
 :     .  .      .
 .258.              .
 :.        .   .  .       .
 :   .  .    .  .  .                         .       .
 .134    2
 :. . X2       .   .                     .
 +--------+--------+--------+--------+--------+--------+--------+--------+-------
       34.2578          101.1016          167.9454          234.7892    >
```

```
L COMMAND: PLOT;LHS=X3;RHS=X5$

    P L O T; Vertical=X5         Horizontal=X3

1.000
 :
 :.
 .876
 :. .
 :2
 .753
 :2
 :2.   .
 +.  .
 :.
 :2.
 +3.
 :
 :.
 +3
 : .
 :3
 .258
 :4           .
 :33.
 .134
 :5.  X3
 +--------+--------+--------+--------+--------+--------+--------+--------
         .0179             .0537             .0894             .1252    >
L COMMAND: PLOT;LHS=X4;RHS=X5$

    P L O T; Vertical=X5         Horizontal=X4

1.000                                                                  .
 :
 :                         .
 .876                .
 :                    .                                                 .
 :                      .                                           .
 .753                  .
 :.                                                     .
 :      .        .    .                              .
 +                .    .
 :                                                  .
 :   .                                     .       .
 + .. .                                   .
 :
 :                .
 +              .                                              .        .
 :                        .
 :  .               .        .
 .258                        .
 :             .    .                             ..             .
 :          .    .                       .  ..              .
 .134                                                 .              .
 :.. .X4 .                                   .  .        .
 +--------+--------+--------+--------+--------+--------+--------+--------
         .1385             .3846             .6308             .8769    >
```

```
L COMMAND: CRMODEL;LHS=X1;RHS=ONE,X2$

Ordinary    Least Squares Estimates

Dependent Variable.....      X1
Number of Observations.....          55.
Mean of Dependent Variable..      .36962
Std. Dev. of Dep. Variable..      .24340
Std. Error of Regression....      .24221
Sum of Squared Residuals....    3.1092
R - Squared.................      .02814
Adjusted R - Squared........      .00980
F-Statistic (  1,   53).....     1.53466
Significance of F-Test......      .22087
Log-Likelihood..............    .94648
Restricted (Slopes=0) Log-L.    .17554
Chi-Squared ( 1)............    1.5419
Significance Level..........    .21434

Durbin - Watson Statistic.....      2.0827
Estimated Autocorrelation (Rho).....   -.41330E-01

iable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
       .402145       .4190E-01    9.597 ( .00000)   1.0000       .00000
     -.810056E-03    .6539E-03   -1.239 ( .22098)   40.147       50.406


L COMMAND: CRMODEL;LHS=X1;RHS=ONE,X3$

Ordinary    Least Squares Estimates

Dependent Variable.....      X1
Number of Observations.....          55.
Mean of Dependent Variable..      .36962
Std. Dev. of Dep. Variable..      .24340
Std. Error of Regression....      .24301
Sum of Squared Residuals....    3.1299
R - Squared.................      .02165
Adjusted R - Squared........      .00319
F-Statistic (  1,   53).....     1.17307
Significance of F-Test......      .28367
Log-Likelihood..............    .76354
Restricted (Slopes=0) Log-L.    .17554
Chi-Squared ( 1)............    1.1760
Significance Level..........    .27817

Durbin - Watson Statistic.....      2.0216
Estimated Autocorrelation (Rho).....   -.10823E-01

iable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
       .377638       .3359E-01   11.242 ( .00000)   1.0000       .00000
     -1.84695        1.705       -1.083 ( .28377)   .43391E-02   .19393E-
```

```
L COMMAND: CRMODEL;LHS=X1;RHS=ONE,X4$

Ordinary    Least Squares Estimates

Dependent Variable.....      X1
Number of Observations.....          55.
Mean of Dependent Variable..      .36962
Std. Dev. of Dep. Variable..      .24340
Std. Error of Regression....      .24508
Sum of Squared Residuals....    3.1834
R - Squared.................      .00495
Adjusted R - Squared........     -.01382
F-Statistic (  1,   53).....      .26371
Significance of F-Test......      .60972
Log-Likelihood..............    .29799
Restricted (Slopes=0) Log-L.    .17554
Chi-Squared ( 1)............    .24491
Significance Level..........    .62068

Durbin - Watson Statistic.....      2.0120
Estimated Autocorrelation (Rho).....   -.60091E-02

iable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
       .345593       .5729E-01    6.032 ( .00000)   1.0000       .00000
       .543879E-01   .1059         .514 ( .60976)   .44185       .31489

L COMMAND: CRMODEL;LHS=X1;RHS=ONE,X5$

Ordinary    Least Squares Estimates

Dependent Variable.....      X1
Number of Observations.....          55.
Mean of Dependent Variable..      .36962
Std. Dev. of Dep. Variable..      .24340
Std. Error of Regression....      .18693
Sum of Squared Residuals....    1.8521
R - Squared.................      .42109
Adjusted R - Squared........      .41016
F-Statistic (  1,   53).....    38.55096
Significance of F-Test......      .00000
Log-Likelihood..............    15.193
Restricted (Slopes=0) Log-L.    .17554
Chi-Squared ( 1)............    30.035
Significance Level..........    .74086E-11

Durbin - Watson Statistic.....      1.8053
Estimated Autocorrelation (Rho).....    .97335E-01

iable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
       .161052       .4200E-01    3.835 ( .00034)   1.0000       .00000
       .565275       .9104E-01    6.209 ( .00000)   .36897       .27942
```

```
EL COMMAND: CRMODEL;LHS=X2;RHS=ONE,X3$

 Ordinary    Least Squares Estimates

 Dependent Variable.....      X2
 Number of Observations.....          55.
 Mean of Dependent Variable..    40.14668
 Std. Dev. of Dep. Variable..    50.40570
 Std. Error of Regression....    38.89841
 Sum of Squared Residuals....   80194.
 R - Squared.................       .41550
 Adjusted R - Squared........       .40447
 F-Statistic (  1,   53).....    37.67539
 Significance of F-Test......       .00000
 Log-Likelihood..............  -278.39
 Restricted (Slopes=0) Log-L.  -293.15
 Chi-Squared ( 1)............   29.507
 Significance Level..........   .11849E-10

 Durbin - Watson Statistic.....      2.1345
 Estimated Autocorrelation (Rho).....  -.67255E-01

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
      32.8768       5.377       6.114 ( .00000)   1.0000        .00000
      1675.42       273.0       6.138 ( .00000)   .43391E-02    .19393E-

EL COMMAND: CRMODEL;LHS=X2;RHS=ONE,X4$

 Ordinary    Least Squares Estimates

 Dependent Variable.....      X2
 Number of Observations.....          55.
 Mean of Dependent Variable..    40.14668
 Std. Dev. of Dep. Variable..    50.40570
 Std. Error of Regression....    50.83364
 Sum of Squared Residuals....  .13696E+06
 R - Squared.................       .00178
 Adjusted R - Squared........      -.01705
 F-Statistic (  1,   53).....       .09464
 Significance of F-Test......       .75957
 Log-Likelihood..............  -293.11
 Restricted (Slopes=0) Log-L.  -293.15
 Chi-Squared ( 1)............   .70056E-01
 Significance Level..........   .79126

 Durbin - Watson Statistic.....      2.2521
 Estimated Autocorrelation (Rho).....  -.12605

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
      37.1606       11.88       3.127 ( .00289)   1.0000        .00000
      6.75809       21.97        .308 ( .75959)   .44185        .31489
```

```
EL COMMAND: CRMODEL;LHS=X2;RHS=ONE,X5$

 Ordinary    Least Squares Estimates

 Dependent Variable.....      X2
 Number of Observations.....          55.
 Mean of Dependent Variable..    40.14668
 Std. Dev. of Dep. Variable..    50.40570
 Std. Error of Regression....    45.83008
 Sum of Squared Residuals....  .11132E+06
 R - Squared.................      .18862
 Adjusted R - Squared........      .17331
 F-Statistic (  1,   53).....    12.32086
 Significance of F-Test......      .00092
 Log-Likelihood..............  -287.41
 Restricted (Slopes=0) Log-L.  -293.15
 Chi-Squared ( 1)............   11.468
 Significance Level..........   .75605E-04

 Durbin - Watson Statistic.....      2.3032
 Estimated Autocorrelation (Rho).....  -.15159

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
      69.0548       10.30        6.707 ( .00000)   1.0000       .00000
     -78.3471       22.32       -3.510 ( .00093)   .36897       .27942


EL COMMAND: CRMODEL;LHS=X3;RHS=ONE,X4$

 Ordinary    Least Squares Estimates

 Dependent Variable.....      X3
 Number of Observations.....          55.
 Mean of Dependent Variable..      .00434
 Std. Dev. of Dep. Variable..      .01939
 Std. Error of Regression....      .01931
 Sum of Squared Residuals....  .19771E-01
 R - Squared.................      .02646
 Adjusted R - Squared........      .00810
 F-Statistic (  1,   53).....     1.44072
 Significance of F-Test......      .23536
 Log-Likelihood..............  140.04
 Restricted (Slopes=0) Log-L.  139.32
 Chi-Squared ( 1)............  1.4471
 Significance Level..........  .22900

 Durbin - Watson Statistic.....      2.0230
 Estimated Autocorrelation (Rho).....  -.11491E-01

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
     -.875095E-04   .4515E-02    -.019 ( .98461)   1.0000       .00000
      .100185E-01   .8347E-02    1.200 ( .23546)   .44185       .31489
```

```
EL COMMAND: CRMODEL;LHS=X3;RHS=ONE,X5$

 Ordinary    Least Squares Estimates

 Dependent Variable.....      X3
 Number of Observations.....          55.
 Mean of Dependent Variable..      .00434
 Std. Dev. of Dep. Variable..      .01939
 Std. Error of Regression....      .01924
 Sum of Squared Residuals....   .19619E-01
 R - Squared.................      .03395
 Adjusted R - Squared........      .01572
 F-Statistic (  1,   53).....     1.86236
 Significance of F-Test......      .17812
 Log-Likelihood..............    140.25
 Restricted (Slopes=0) Log-L.    139.32
 Chi-Squared ( 1)............    1.8714
 Significance Level..........    .17132

 Durbin - Watson Statistic...........     2.0635
 Estimated Autocorrelation (Rho).....   -.31764E-01

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
        .905738E-02   .4322E-02    2.095 ( .04102)   1.0000       .00000
       -.127875E-01   .9370E-02   -1.365 ( .17823)   .36897       .27942


EL COMMAND: CRMODEL;LHS=X4;RHS=ONE,X5$

 Ordinary    Least Squares Estimates

 Dependent Variable.....      X4
 Number of Observations.....          55.
 Mean of Dependent Variable..      .44185
 Std. Dev. of Dep. Variable..      .31489
 Std. Error of Regression....      .31785
 Sum of Squared Residuals....    5.3544
 R - Squared.................      .00003
 Adjusted R - Squared........     -.01884
 F-Statistic (  1,   53).....      .00145
 Significance of F-Test......      .96974
 Log-Likelihood..............   -14.002
 Durbin - Watson Statistic...........     2.1665
 Estimated Autocorrelation (Rho).....   -.83261E-01

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
        .439669       .7141E-01    6.157 ( .00000)   1.0000       .00000
        .590097E-02   .1548         .038 ( .96974)   .36897       .27942
```

3.) Regression with a transformed order of countries
(Chapter 7.5)

L I S T I N G O F R A W D A T A

ervation Number data	Sample	X1	X2	X3	X4	X5
1	1	.78310	20.242	.17640E-03	.10769	.64680
2	2	.46680	10.362	.51640E-03	.56923	.47238
3	3	.60780	29.387	.11264E-02	.58462	.50000
4	4	.24690	32.672	.66374E-01	.26154	.24564
5	5	.83240E-01	11.730	.62320E-03	.86154	.35320
6	6	.81830E-01	60.324	.13983E-01	.61538	.23256E-
7	7	.30170	20.565	.34527E-02	.65231	.10174E-
8	8	.22890	11.711	.10329E-02	.12308	.31977E-
9	9	.76680E-01	24.453	.35039E-02	.81538	.12500
10	10	.21860	34.335	.23852E-01	.87692	.13953
11	11	.31630	36.425	.14613E-02	.67692	.17442
12	12	.17530	.83593	.69000E-04	.69231	.14680
13	13	.53620	11.086	.24874E-02	.36923	.89244
14	14	.69990	3.6181	.36840E-03	.96923	1.0000
15	15	.86490	35.031	.32047E-01	.72308	.62355
16	16	.48140	30.017	.44040E-03	.76000	.65698
17	17	.55420	2.6930	.75000E-04	.15385E-01	.67878
18	18	.85980	16.838	.14410E-02	.92308	.77180
19	19	1.0020	42.392	.40899E-02	.98462	.78634
20	20	.14100	4.1840	.35060E-03	.15385E-01	.27616E-
21	21	.22000	10.696	.13824E-01	.30769	.71802
22	22	.38360	3.7131	.91900E-04	.29231	.82558
23	23	.54860	26.520	.13468E-01	.46154E-01	.44913
24	24	.16510	15.279	.80890E-03	.83077E-01	.48256
25	25	.23790	6.1254	.58380E-03	.69231	.50436
26	26	.54350	10.739	.37729E-02	.24615	.59738
27	27	.68540	16.805	.65294E-02	.30769	.61192
28	28	.36100	8.3076	.50380E-02	.32308	.74564
29	29	.52460	3.3842	.20220E-03	.27692	.85320
30	30	.68960	37.484	.32930E-03	.30769E-01	.47674
31	31	.30610	12.149	.73410E-03	.67692E-01	.51017
32	32	.37890	1.7063	.83400E-04	.70769	.53198
33	33	.68450	18.680	.58890E-03	.23077	.62500
34	34	.82640	47.581	.11169E-01	.29231	.63953
35	35	.16360	12.732	.10400E-03	.60000	.10756
36	36	.32870	137.28	.21033E-02	.35385	.26890
37	37	.54840E-01	56.847	.11330E-03	.39077	.23547
38	38	.17930E-01	14.738	.37490E-03	.38462	.21366
39	39	.32350	185.13	.37211E-02	.55385	.12064
40	40	.46540	140.92	.11292E-02	.61538	.10610
41	41	.16510	15.403	.10220E-03	.24615	.37645
42	42	.21850	32.997	.18490E-03	.20923	.34302
43	43	.14570	5.8203	.31370E-03	.98462	.32122
44	44	.15990	22.762	.16940E-03	.46154E-01	.22820
45	45	.30180	64.981	.45970E-03	.15385E-01	.21366
46	46	.38350	47.818	.92350E-03	.36923E-01	.33430E-
47	47	.31080	27.254	.15279E-02	.73846	.55233E-
48	48	.51450E-02	57.977	.96730E-03	.20000	.14826
49	49	.13670	64.831	.19219E-02	.26154	.16279
50	50	.72770E-01	268.21	.14305	.77538	.21802E-
51	51	.37840	59.706	.56369E-02	.16308	.11483
52	52	.52030	35.348	.20341E-02	.22462	.12936
53	53	.30560	28.687	.36640E-03	.93846	.93023E-
54	54	.44750	40.801	.14120E-03	1.0000	.10756
55	55	.14190	113.78	.39560E-02	.61538E-01	.14535E-

```
EL COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2,X3,X4;AR1$

Ordinary    Least Squares Estimates

Dependent Variable.....      X5
Number of Observations.....          55.
Mean of Dependent Variable..      .36897
Std. Dev. of Dep. Variable..      .27942
Std. Error of Regression....      .19749
Sum of Squared Residuals....     1.9501
R - Squared.................      .53744
Adjusted R - Squared........      .50043
F-Statistic (  4,   50).....    14.52348
Significance of F-Test......      .00000
Log-Likelihood..............    13.672
Restricted (Slopes=0) Log-L.   -7.4137
Chi-Squared ( 4)............    42.171
Significance Level..........    .31325E-10

Durbin - Watson Statistic.....      1.4377
Estimated Autocorrelation (Rho).....    .28113

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------

      .202104       .6567E-01    3.078 ( .00341)   1.0000        .00000
      .693753       .1123        6.176 ( .00000)   .36962        .24340
    -.237747E-02    .6933E-03   -3.429 ( .00124)   38.038        48.284
     2.09079        1.568        1.333 ( .18855)   .69817E-02    .21385E-
    -.310528E-01    .8643E-01    -.359 ( .72093)   .44185        .31489


AR(1) Disturbance

Initial Value of Rho =      .28113

Maximum Iterations =           20


Method = Prais - Winsten

Iteration= 1, Rho=  .2811, Sum of Squares=       1.7412

Iteration= 2, Rho=  .3846, Sum of Squares=       1.7101

Iteration= 3, Rho=  .4292, Sum of Squares=       1.7042

Iteration= 4, Rho=  .4484, Sum of Squares=       1.7031

Iteration= 5, Rho=  .4565, Sum of Squares=       1.7029

Iteration= 6, Rho=  .4599, Sum of Squares=       1.7029

Iteration= 7, Rho=  .4614, Sum of Squares=       1.7029

Final Value of Rho =     .46136
```

```
Durbin - Watson for Untransformed Residuals =      1.0761
Std. Deviation of Autocorrelated Error =       .20808

Std. Deviation of White Noise =       .18455

Durbin-Watson for Transformed Residuals =  2.00110
Autocorrelation of Transformed Residuals = -.0006

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
       .198214       .7069E-01    2.804 ( .00505)   1.0000       .00000
       .528012       .1160        4.551 ( .00001)   .36962       .24340
      -.139937E-02   .6932E-03   -2.019 ( .04352)   38.038       48.284
       .660610      1.386          .477 ( .63365)   .69817E-02   .21385E-
       .531175E-01   .7352E-01     .722 ( .46999)   .44185       .31489


EL COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2;AR1$

 Ordinary    Least Squares Estimates

 Dependent Variable.....      X5
 Number of Observations.....        55.
 Mean of Dependent Variable..     .36897
 Std. Dev. of Dep. Variable..     .27942
 Std. Error of Regression....     .19714
 Sum of Squared Residuals....    2.0210
 R - Squared.................     .52064
 Adjusted R - Squared........     .50220
 F-Statistic (  2,   52).....    28.23864
 Significance of F-Test......     .00000
 Log-Likelihood..............    12.769
 Restricted (Slopes=0) Log-L.   -7.4137
 Chi-Squared ( 2)............    40.366
 Significance Level..........    .20531E-12


 Durbin-Watson for Transformed Residuals =  1.99593
 Autocorrelation of Transformed Residuals =  .0020

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
       .217060       .6404E-01    3.389 ( .00070)   1.0000       .00000
       .526449       .1131        4.653 ( .00000)   .36962       .24340
      -.116375E-02   .5232E-03   -2.224 ( .02614)   38.038       48.284


EL COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2,X3;AR1$

 Ordinary    Least Squares Estimates

 Dependent Variable.....      X5
 Number of Observations.....        55.
 Mean of Dependent Variable..     .36897
 Std. Dev. of Dep. Variable..     .27942
 Std. Error of Regression....     .19580
 Sum of Squared Residuals....    1.9552
 R - Squared.................     .53625
```

```
Adjusted R - Squared.....          .50897
F-Statistic (  3,   51).....      19.65730
Significance of F-Test......       .00000
Log-Likelihood..............      13.645
Restricted (Slopes=0) Log-L.     -7.4137
Chi-Squared ( 3)............      42.118
Significance Level..........     .19455E-11

Durbin-Watson for Transformed Residuals =  2.00017
Autocorrelation of Transformed Residuals = -.0001

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
      .215492       .6293E-01    3.424 ( .00062)   1.0000        .00000
      .549897       .1148        4.790 ( .00000)   .36962        .24340
    -.149981E-02    .6896E-03   -2.175 ( .02964)   38.038        48.284
      .886461       1.383         .641 ( .52148)   .69817E-02    .21385E-

EL COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2,X4;AR1$

Ordinary    Least Squares Estimates

Dependent Variable.....      X5
Number of Observations.....          55.
Mean of Dependent Variable..      .36897
Std. Dev. of Dep. Variable..      .27942
Std. Error of Regression....      .19899
Sum of Squared Residuals....     2.0195
R - Squared.................      .52099
Adjusted R - Squared........      .49281
F-Statistic (  3,   51).....     18.48984
Significance of F-Test......       .00000
Log-Likelihood..............     12.755
Restricted (Slopes=0) Log-L.    -7.4137
Chi-Squared ( 3)............     40.338
Significance Level..........     .76458E-11

Durbin-Watson for Transformed Residuals =  1.99621
Autocorrelation of Transformed Residuals =  .0019

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
      .197239       .7114E-01    2.772 ( .00556)   1.0000        .00000
      .508791       .1137        4.475 ( .00001)   .36962        .24340
    -.114745E-02    .5235E-03   -2.192 ( .02840)   38.038        48.284
      .594857E-01   .7180E-01     .828 ( .40739)   .44185        .31489
```

4.) Regression with a log-model (Chapter 8.1)

L I S T I N G O F R A W D A T A

rvation data	Number Sample	X1	X2	X3	X4	X5
1	1	.16360	12.732	.10400E-03	.60000	.10756
2	2	.32870	137.28	.21033E-02	.35385	.26890
3	3	.54840E-01	56.847	.11330E-03	.39077	.23547
4	4	.36100	8.3076	.85860E-03	.32308	.74564
5	5	.17930E-01	14.738	.37490E-03	.38462	.21366
6	6	.24690	32.672	.29870E-03	.26154	.24564
7	7	.32350	185.13	.37835E-02	.55385	.12064
8	8	.53620	11.086	.10000E-03	.36923	.89244
9	9	.22000	10.696	.35770E-03	.30769	.71802
10	10	.46540	156.78	.11292E-02	.61538	.10610
11	11	.16510	15.403	.10220E-03	.24615	.37645
12	12	.21850	32.997	.18490E-03	.20923	.34302
13	13	.52460	3.3842	.32680E-03	.27692	.85320
14	14	.14570	5.8203	.31370E-03	.98462	.32122
15	15	.83240E-01	11.730	.55670E-03	.86154	.35320
16	16	.15990	22.762	.16940E-03	.46154E-01	.22820
17	17	.69990	3.6181	.11000E-04	.96923	1.0000
18	18	.38360	3.7131	.21440E-03	.29231	.82558
19	19	.30180	68.702	.45970E-03	.15385E-01	.21366
20	20	.38350	47.818	.92350E-03	.36923E-01	.33430E-
21	21	.68960	37.484	.21518E-02	.30769E-01	.47674
22	22	.31080	27.254	.15279E-02	.73846	.55233E-
23	23	.81830E-01	60.324	.98800E-03	.61538	.23256E-0
24	24	.51450E-02	57.977	.96730E-03	.20000	.14826
25	25	.86490	35.031	.26606E-02	.72308	.62355
26	26	.54860	26.520	.16187E-02	.46154E-01	.44913
27	27	.13670	88.515	.19219E-02	.26154	.16279
28	28	.30610	12.149	.36251E-02	.67692E-01	.51017
29	29	.72770E-01	268.21	.14305	.77538	.21802E-
30	30	.30170	20.565	.48140E-03	.65231	.10174E-
31	31	.37840	59.706	.56369E-02	.16308	.11483
32	32	.48140	30.017	.68390E-03	.76000	.65698
33	33	.16510	15.279	.13665E-02	.83077E-01	.48256
34	34	.52030	51.779	.20341E-02	.22462	.12936
35	35	.37890	1.7063	.83400E-04	.70769	.53198
36	36	.60780	29.387	.26110E-03	.58462	.50000
37	37	.68450	18.680	.58890E-03	.23077	.62500
38	38	.17530	.83593	.11000E-04	.69231	.14680
39	39	.14100	4.1840	.24900E-04	.15385E-01	.27616E-
40	40	.82640	49.135	.11169E-01	.29231	.63953
41	41	.22890	11.711	.26800E-04	.12308	.31977E-
42	42	.30560	28.687	.36640E-03	.93846	.93023E-
43	43	.55420	2.6930	.11000E-04	.15385E-01	.67878
44	44	.23790	6.1254	.51800E-04	.69231	.50436
45	45	.44750	42.224	.14120E-03	1.0000	.10756
46	46	.76680E-01	24.453	.35039E-02	.81538	.12500
47	47	.78310	20.242	.17640E-03	.10769	.64680
48	48	.46680	10.362	.51640E-03	.56923	.47238
49	49	.21860	51.717	.23852E-01	.87692	.13953
50	50	.85980	16.838	.14780E-03	.92308	.77180
51	51	.54350	10.739	.48500E-03	.24615	.59738
52	52	.14190	145.07	.39560E-02	.61538E-01	.14535E-
53	53	.31630	36.425	.14613E-02	.67692	.17442
54	54	1.0020	43.507	.40899E-02	.98462	.78634
55	55	.68540	20.322	.65294E-02	.30769	.61192

```
Creating -> X1=LOG(X1)
Creating -> X2=LOG(X2)
Creating -> X3=LOG(X3)
Creating -> X4=LOG(X4)
Creating -> X5=LOG(X5)

L COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2,X3,X4;AR1$

Ordinary    Least Squares Estimates

Dependent Variable.....      X5
Number of Observations.....          55.
Mean of Dependent Variable..    -1.46278
Std. Dev. of Dep. Variable..     1.16986
Std. Error of Regression....     1.00845
Sum of Squared Residuals....    50.848
R - Squared.................      .31196
Adjusted R - Squared........      .25692
F-Statistic (  4,   50).....     5.66760
Significance of F-Test......      .00077
Log-Likelihood..............   -76.004
Restricted (Slopes=0) Log-L.   -86.170
Chi-Squared ( 4)............    20.332
Significance Level..........    .42935E-03

Durbin - Watson Statistic.....      1.6414
Estimated Autocorrelation (Rho).....    .17932

riable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
---------------------------------------------------------------------------
      1.28340       1.187        1.082 ( .28470)    1.0000        .00000
      .433860       .1437        3.020 ( .00401)   -1.3046        .96704
     -.458462       .1661       -2.761 ( .00809)    3.0804       1.1894
      .924218E-01   .1039         .889 ( .37828)   -7.4904       1.8985
      .600538E-01   .1192         .504 ( .61667)   -1.2593       1.1645


AR(1) Disturbance

Initial Value of Rho =      .17932

Maximum Iterations =           20


Method = Prais - Winsten

Iteration= 1, Rho=  .1793, Sum of Squares=      49.0727

Iteration= 2, Rho=  .2020, Sum of Squares=      49.0490

Iteration= 3, Rho=  .2047, Sum of Squares=      49.0492

Final Value of Rho =     .20465
```

Durbin - Watson for Untransformed Residuals = 1.5901
Std. Deviation of Autocorrelated Error = 1.0119

Std. Deviation of White Noise = .99045

Durbin-Watson for Transformed Residuals = 1.90862
Autocorrelation of Transformed Residuals = .0457

iable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of
	1.68292	1.136	1.481	(.13865)	1.0000	.00000
	.437294	.1373	3.185	(.00145)	-1.3046	.96704
	-.492428	.1566	-3.144	(.00167)	3.0804	1.1894
	.137793	.1004	1.372	(.17009)	-7.4904	1.8985
	.222744E-01	.1134	.196	(.84423)	-1.2593	1.1645

5.) Regression with monthly labour costs and money market rate of interest (Chapter 8.2)

L I S T I N G O F R A W D A T A

rvation Number data	Sample	X1	X2	X3	X4	X5
1	1	.16360	12.732	.10400E-03	.52466E-01	.80148E-
2	2	.32870	137.28	.21033E-02	.42497	.92478E-
3	3	.54840E-01	56.847	.11330E-03	.38300	.18619
4	4	.36100	8.3076	.85860E-03	.53515	.67571
5	5	.17930E-01	14.738	.37490E-03	.16579	.18249
6	6	.24690	32.672	.29870E-03	.46485	.10728
7	7	.32350	185.13	.37835E-02	.28541	.10604
8	8	.53620	11.086	.10000E-03	.15215	.82182
9	9	.22000	10.696	.35770E-03	.96537E-01	.48335
10	10	.46540	156.78	.11292E-02	.17629	.17818
11	11	.16510	15.403	.10220E-03	.47744	.12330E-
12	12	.21850	32.997	.18490E-03	.33054	.19420
13	13	.52460	3.3842	.32680E-03	.48269	.68372
14	14	.14570	5.8203	.31370E-03	.11333	.19051
15	15	.83240E-01	11.730	.55670E-03	.51731	.11529
16	16	.15990	22.762	.16940E-03	.23295	.98027E-
17	17	.69990	3.6181	.11000E-04	.20462	.82984
18	18	.38360	3.7131	.21440E-03	.44071E-01	.49137
19	19	.30180	68.702	.45970E-03	.12382	.17016
20	20	.38350	47.818	.92350E-03	.80797	.19544
21	21	.68960	37.484	.21518E-02	.96013	.68496
22	22	.31080	27.254	.15279E-02	.59077	.19174
23	23	.81830E-01	60.324	.98800E-03	.39874E-01	.11652
24	24	.51450E-02	57.977	.96730E-03	.71039	.96794E-
25	25	.86490	35.031	.26606E-02	.27282	.83107
26	26	.54860	26.520	.16187E-02	.52151	.49260
27	27	.13670	88.515	.19219E-02	.60126	.16893
28	28	.30610	12.149	.36251E-02	.15215	.48952
29	29	.72770E-01	268.21	.14305	.21721	.36991E-
30	30	.30170	20.565	.48140E-03	.84785	.78915E-
31	31	.37840	59.706	.56369E-02	.97587E-01	.29223
32	32	.48140	30.017	.68390E-03	.53515	.63564
33	33	.16510	15.279	.13665E-02	.28646	.29716
34	34	.52030	51.779	.20341E-02	.20672	.36437
35	35	.37890	1.7063	.83400E-04	.36936	.49322
36	36	.60780	29.387	.26110E-03	1.0000	.56843
37	37	.68450	18.680	.58890E-03	.24974	.78175
38	38	.17530	.83593	.11000E-04	.68730	.14612
39	39	.14100	4.1840	.24900E-04	.43861	.19236
40	40	.82640	49.135	.11169E-01	.35887	.85388
41	41	.22890	11.711	.26800E-04	.63064	.75216E-
42	42	.30560	28.687	.36640E-03	.11962	.28853
43	43	.55420	2.6930	.11000E-04	.31794	.63933
44	44	.23790	6.1254	.51800E-04	.69255E-01	.30086
45	45	.44750	42.224	.14120E-03	.10493E-01	.36067
46	46	.76680E-01	24.453	.35039E-02	.75026	.21332
47	47	.78310	20.242	.17640E-03	.31270	.71455
48	48	.46680	10.362	.51640E-03	.56139	.37608
49	49	.21860	51.717	.23852E-01	.64113	.28545
50	50	.85980	16.838	.14780E-03	.43757	.92787
51	51	.54350	10.739	.48500E-03	.18888	.58940
52	52	.14190	145.07	.39560E-02	.10913	.72133E-
53	53	.31630	36.425	.14613E-02	.24869	.33847
54	54	1.0020	43.507	.40899E-02	.32844	1.0000
55	55	.68540	20.322	.65294E-02	.79748E-01	.66153

```
L COMMAND: CRMODEL;LHS=X5;RHS=ONE,X1,X2,X3,X4;AR1$

Ordinary    Least Squares Estimates

Dependent Variable.....      X5
Number of Observations.....          55.
Mean of Dependent Variable..      .37003
Std. Dev. of Dep. Variable..      .27870
Std. Error of Regression....      .11796
Sum of Squared Residuals....    .69570
R - Squared.................      .83414
Adjusted R - Squared........      .82087
F-Statistic (  4,   50).....     62.86254
Significance of F-Test......      .00000
Log-Likelihood..............    42.017
Restricted (Slopes=0) Log-L.   -7.2725
Chi-Squared ( 4)............    98.579
Significance Level..........    .32173E-13

Durbin - Watson Statistic.....      1.6532
Estimated Autocorrelation (Rho).....    .17341


iable  Coefficient  Std. Error  T-ratio (Sig.Lvl)   Mean of X  Std.Dev.of
-------------------------------------------------------------------------
      .114598       .4239E-01    2.703 ( .00941)  1.0000       .00000
      .959693       .6699E-01   14.326 ( .00000)  .36962       .24340
    -.197210E-02    .4199E-03   -4.697 ( .00002)  40.147       50.406
     2.68011        1.084        2.472 ( .01695)  .43391E-02   .19393E-
    -.872326E-01    .6488E-01   -1.344 ( .18498)  .36402       .24874


AR(1) Disturbance

Initial Value of Rho =      .17341

Maximum Iterations =           20



Method = Prais - Winsten

Iteration= 1, Rho=  .1734, Sum of Squares=        .6823

Iteration= 2, Rho=  .1820, Sum of Squares=        .6825

Final Value of Rho =     .18199

Durbin - Watson for Untransformed Residuals =      1.6352
Std. Deviation of Autocorrelated Error =      .11883

Std. Deviation of White Noise =      .11684
```

Durbin-Watson for Transformed Residuals = 1.94749
Autocorrelation of Transformed Residuals = .0263

iable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of
	.105270	.4256E-01	2.474	(.01337)	1.0000	.00000
	.965869	.6479E-01	14.908	(.00000)	.36962	.24340
	-.197800E-02	.4026E-03	-4.913	(.00000)	40.147	50.406
	2.88325	1.068	2.700	(.00694)	.43391E-02	.19393E-
	-.730418E-01	.6302E-01	-1.159	(.24641)	.36402	.24874