The Changing Structure of Employment in Italy 1980-2010: Can Investment Affect the Outcome?

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ABSTRACT. The Inforum international system connects multisectoral macroeconomic models of twelve major industrial countries via a model of bilateral trade flows at the level of 120 products. For this paper, the historical data and the forecasts to 2010 for seven of the countries – Italy, France, Spain, Germany, USA, Japan, and China – have been aggregated to 34 fairly comparable industries. The shifts in the industrial structure of employment between 1980 and 1995 are compared both among the countries and with the further shifts expected between 1995 and 2010. The countries are becoming more similar in that the share of agriculture in all of them is diminishing. In the structure of non-agricultural employment, however, they appear to be diverging. After pointing out a "low-tech drift" in the structure of Italian employment and a simultaneous drop in Italy's investment/GDP ratio, the paper asks: To what extent could Italy influence its industrial structure by increasing investment? After a condensed description of the multisectoral macroeconomic model and bilateral trade model used to answer this question, the results are presented. The experiment was successful in increasing exports and augmenting the shares of industries producing investment goods. The employment shares of Office machinery and Chemicals, however, were not increased.

How have Italian employment patterns -- the shares of employment in different industries -- changed since 1980? Has there been evidence of convergence or of specialization in these patterns? How are they likely to have changed by 2010? Can a program of investment change the outcome? This paper looks at these questions with the aid of the Inforum international system of interindustry models. This system connects dynamic multisectoral models of twelve countries through a model of bilateral trade among these countries and two catch-all regions. The models have different sectoring systems, but for this paper we have aggregated the historical and forecasted employment of seven of the countries to thirty-four fairly comparable sectors. The seven countries are Italy, Germany, France, Spain, USA, Japan, and China. (The thirty-four sectors are based on the Italian sectoring plan, and comparability is naturally greatest among the four European countries. Comparability for the USA, Japan, and China diminishes in that order, but should be fairly close in the industrial sectors.)

Section 1 looks into the question of similarity of structure and convergence or divergence in the broadest possible terms. With each country described by a vector of the shares of employment, we calculate the "distance" between each pair of countries in each of three years, 1980, 1995, and 2010. We look at the distance both with and without agriculture. Section 2 examines the shifts in employment patterns in the seven countries both in the past and also as projected in the base case forecast of the models.

Section 2 shows that Italy has experienced -- and is projected to continue to experience --structural changes which one might characterize as low-tech drift. Section 3 shows that investment in Italy has

been relatively weak and poses the question: Could stronger investment reduce the low-tech drift? Section 6 offers a very partial answer to this question on the basis of a simulation with the Inforum system in which the bilateral trade model plays a central role. Before turning to this simulation, therefore, we will, in section 4, look at a the structure of a fairly typical Inforum model, that for Italy. In section 5, we describe the bilateral trade model, which goes into the results presented in section 6.

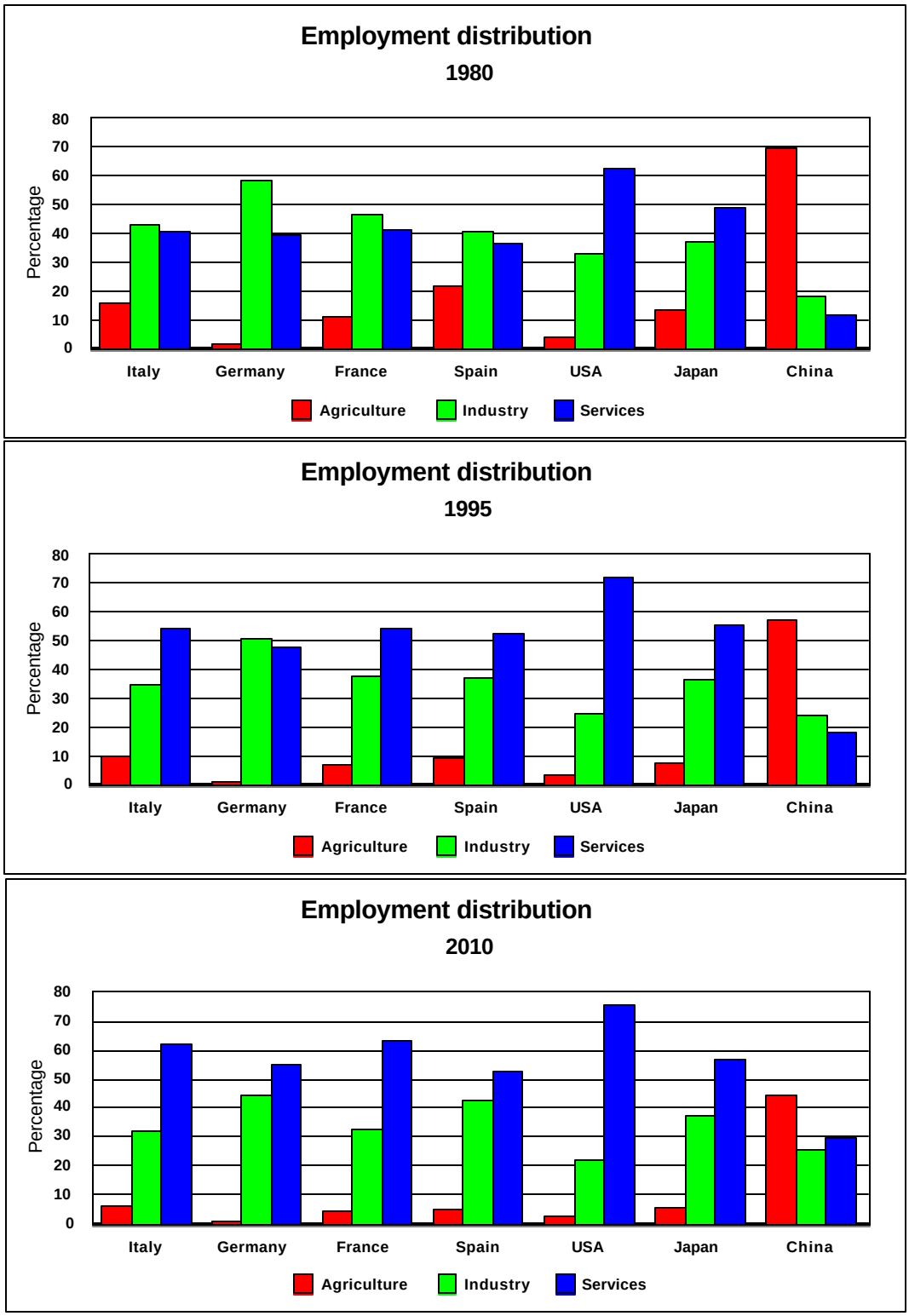
1. Distances – Are the economies approaching one another?

Figure 1 shows the shares of employment in agriculture, industry, and services for the seven countries in the three years. Agriculture's share of employment has been steadily reduced in all seven countries, though in the USA and Germany that process has gone about as far as it is likely to go. In Germany, the share is already under 1 percent, while it remains around 3 percent the USA because of important agricultural resources of land in the Midwest and climate in Florida and California. The share falls slowly but relentless where economics must wear away political resistence; namely the share has declined 3.4 percent per year over 1980-1995 period in both Italy and France, and 3.8 percent per year in Japan. By contrast, in Spain it fell at 6.0 percent per year and left Italy as the most agricultural of the industrialized countries. By 2010, however, the projections show Japan "overtaking" Italy in this respect. In China, on the other hand, in 2010 after thirty years of rapid industrialization, the share of agriculture will still be twice that of Spain thirty years earlier.

The other striking phenomenon in Figure 1 is the rise of the service sector. In 1980, employment in services exceeded that in industry only in the USA and Japan. By 1995, Italy, France, and Spain had followed suit. By 2010, all seven countries are expected to have more service than industrial employment.

If we limit ourselves to thinking in the broad divisions used in Figure 1, then there is no question that the economies are converging. That convergence is also visible in "milage triangle" shown in Table 1a. It presents the Euclidian distance between the employment share vectors of each pair of countries in in 1980, 1995, and 2010. The shares on which the distances are based appear in Table A in the appendix. The share vectors are expressed in percent so that the largest possible entry is 100 and the smallest is 0; the distance is the square root of the sum of squares of the differences of shares of the individual industries. The greatest possible distance between two countries would occur if one country had all of its employment in one industry and the other had all its employment in another. In that case, the distance would be $100^* \sqrt{2} = 141.4$.

Figure 1. Distribution of Employment among Agriculture, Industry, and Services



The closest two economies are Italy and Spain in all years, and they are closest in 1995. Not surprisingly, China is the most distant from all the others and in 1980 actually came close to half of the maximum distance in its distance from both the USA and Germany, the low agriculture countries. On the other hand, the most striking evidence for convergence is between China and all the other countries in both history and forecast. Similarly, historically, Spain shows convergence with all countries except Japan; but in the forecast, it shows convergence only with Germany and China. Historically, France diverges from all countries except Spain and China. Historically, the USA diverges from France and Germany and converges with all the other countries. Germany converges with Spain and China and diverges from the other countries.

Without China, there are 15 distances; 9 of them show convergence in the past; 2 in the future. China adds 6 more distances, and all of them show convergence in both periods. Broadly speaking, convergence seems to occur where there are initially large differences in the share in agriculture; elsewhere, divergence appears.

Table 1a. Distances among Employment Patterns of Countries – Whole Economy

Germany	France	Spain	USA	Japan	China	
			1980			
15.62	9.94	7.78	15.03	13.43	56.61	Italy
	13.86	21.59	13.67	21.68	69.54	Germany
		16.10	12.82	19.60	62.41	France
			20.71	12.29	50.83	Spain
				18.89	68.20	USA
					58.22	Japan
			1995			
15.25	11.13	5.33	12.98	15.17	49.81	Italy
	15.85	14.83	19.12	23.74	58.21	Germany
		11.55	16.34	23.33	54.41	France
			13.67	15.23	50.18	Spain
				15.47	56.22	USA
					50.45	Japan
			2010			
18.26	11.09	9.75	13.37	18.15	45.51	Italy
	20.55	14.55	21.71	24.60	48.35	Germany
		13.84	17.54	25.52	47.00	France
			16.57	18.48	43.54	Spain
				16.53	46.00	USA
					41.04	Japan

This observation led us to wonder what would appear if we calculated the distances based on the shares of non-agricultural employment. The results are shown in Table 1b. The most striking difference

between the two tables is that in the second China has become a quite normal country. In fact, Japan is closer to China than to any of the other countries. The USA is closer to China than it is to Germany. This proximity is especially surprising because of the total absence in the Chinese model of six sectors: Recovery and repair, Sea and air transport, Auxiliary transport services, Recreation and culture, Private education, and Private health services. (The first four have no corresponding sector in the model; the services are aggregated into other sectors. The model has a health sector and an education sector, but we have considered them as part of the government sector.)

Table 1b. Distances among Employment Patterns of Countries – Industry and Services

			1980			
Germany	France	Spain	USA	Japan	China	
9,42	9,15	5,89	10,90	15,47	12.73	Italy
	12,60	11,50	13,89	19.11	12.61	Germany
		12,76	12,41	21,24	12.07	France
			12,94	12,42	15.78	Spain
				16,93	17.69	USA
					24.84	Japan
			1995			
Germany	France	Spain	USA	Japan	China	
13,68	11,16	5,77	12,40	16,47	12,00	Italy
	15,96	13,43	19,32	23,33	16.65	Germany
		11,78	17,05	24,61	16.20	France
			13,39	16,51	10.53	Spain
				15,18	18.84	USA
					17.92	Japan
			2010			
Germany	France	Spain	USA	Japan	China	
18,35	11,24	10,19	13,69	19,03	19.37	Italy
	20,96	14,45	21,93	24.60	23.68	Germany
		14,22	18,08	26,27	22.85	France
			16,98	19,18	17.78	Spain
				16,61	21.36	USA
					17.80	Japan

The other striking observation based on Table 1b is that convergence has virtually disappeared! In the historical period, only 2 of the 15 non-Chinese distances show convergence, though 3 of the 6 distances from China do. In the forecast, there is only one case of convergence (China and Japan) and it is very, very slight (from 17.92 to 17.80). The general picture which emerges is that different countries have adapted to the revolution in agricultural technology at different rates, but that as all come to grips with it, there is an appearance of convergence. Outside agriculture, however, convergence seems to be the exception rather than the rule. Specialization seems to be the order of the day.

2. The Anatomy of Divergence

For ease of comparison, the annual rates of change of the shares of non-agricultural employment have been computed and are displayed in Table 2. Following the table are bar graphs of these rates of change.

The most striking feature of the table or the graphs is that the source of divergence lies not in the direction of change. Nearly all of the countries show reductions in the shares of manufacturing and increases in the shares of the service sectors. For the most part, relative speed, not direction is what matters. Italy is outstanding for its slow rate of decline in Textiles and clothing, in Leather shoes and footwear, and in Agricultural and industrial machinery, and in Non-metallic mineral products (stone, clay and glass products.) It has lost employment share particularly fast -- one of the two fastest, or a close third -- in Chemical products, Metal products, Electrical goods, Office and computing machinery, Motor vehicles, Food and tobacco, Wood and furniture, Paper and printing products, Plastic products and rubber, and Recovery and repair services. The list of sectors where Italy is distinguished by hanging on to employment share are those generally connected with low wages, while those where Italy is leading the decline include most of the high-wage, high-tech sectors.

On the other hand, Italy is a leader in the growth of Private health services, Recreation and culture, and Other private services.

There is only one sector in which Italy seems to be going in the opposite direction from the other countries, namely, Private educational services. The Germans, Japanese, Americans, and, to some extent, the Spanish have recognized that private education has advantages that are worth paying for and are increasing the share of expenditures on it. Not so in Italy, especially not in the forecast.

The forecasts for Italy show accelerating rates of decline in Electricity, Non-metallic mineral products, Chemicals, Metal products, Office and computing machinery, Electrical goods, Motor vehicles, Other transportation equipment, Textiles, Leather, Paper, Plastic products. Accelerated positive growth in employment share appears in Petroleum refining, Hotels and restaurants, and Private health services.

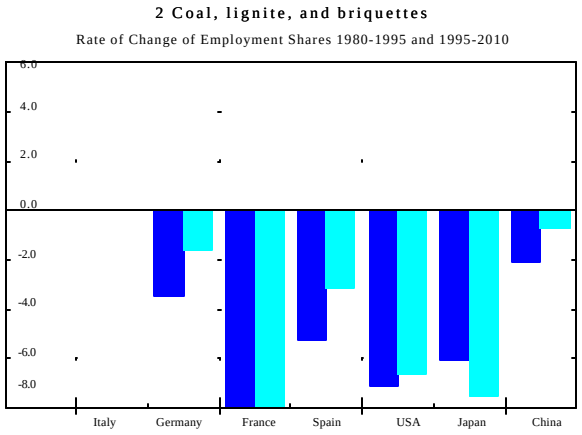
China is the one country where several significant differences of direction appear. Perhaps the most striking is in Wholesale and retail trade, a sector which has been remarkably constant in employment share in the other countries both in the history and the forecast. In 1980, it was a totally undeveloped part of the Chinese economy, looked down up by good communists as the essence of bourgeois degeneracy. The growth since the changes of 1979 have been stunning to even the casual visitor. Similarly, the construction industry, nearly constant in the other countries, has flourished in China. Transport was notoriously bad in 1980 and has expanded its share of employment. China has also seen the largest decline in the share of employment in the government sector. All of the countries have seen a growing share of employment in Hotels and restaurants, but this growth has been particularly striking in China. The forecast anticipates, however, a slightly reduced share for this sector.

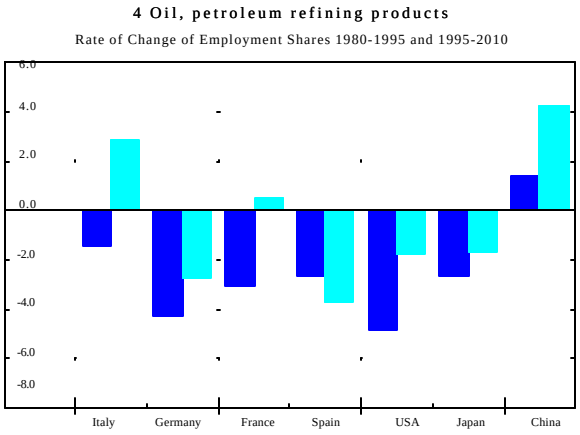
Table 2. Annual Rates of Change of Shares in Non-agricultural Employment

		Italy	Germany	France	Spain	USA	Japan	China
2	Coal, lignite, and briquettes							
	1980-1995	0.00	-3.45	-9.50	-5.21	-7.08	-6.06	-2.12
	1995-2010	0.00	-1.56	-8.52	-3.14	-6.59	-7.48	-0.73
	1995-2010	0.00						
4	Oil, petroleum refining products							
	1980-1995	-1.43	-4.26	-3.08	-2.63	-4.84	-2.66	1.45
	1995-2010	2.83	-2.71	0.50	-3.69	-1.73	-1.64	4.22
	1995-2010	2.81						
5	Electricity, gas, water							
	1980-1995	-1.00	0.04	1.02	-1.79	-0.93	0.57	0.55
	1995-2010	-1.37	0.51	1.71	-1.33	-0.54	-0.89	-1.37
	1995-2010	-1.51						
7	Ferrous & non-ferrous ores							
	1980-1995	-4.42	-4.02	-4.32	-4.62	-4.71	-1.38	0.22
	1995-2010	-3.49	-3.21	-3.09	-2.79	-1.65	-2.36	-1.21
	1995-2010	-2.95						
8	Non-metalic mineral products							
	1980-1995	-1.73	-2.39	-3.37	-2.34	-2.65	-2.70	-0.89
	1995-2010	-2.01	-2.44	-2.34	0.18	-0.61	-1.48	-0.51
	1995-2010	-0.90						
9	Chemical products							
	1980-1995	-1.88	-0.66	-0.70	-2.34	-2.00	-0.91	0.10
	1995-2010	-4.45	-0.85	-1.10	-2.94	-1.15	-0.33	0.29
	1995-2010	-4.58						
10	Metal products							
	1980-1995	-2.61	-0.85	-1.81	-1.50	-2.18	-1.40	-0.78
	1995-2010	-3.31	-0.96	-0.37	1.03	-0.50	-0.33	0.13
	1995-2010	-2.94						
11	Agricultural and industrial machinery							
	1980-1995	-1.92	-0.88	-2.78	-1.95	-2.91	-0.59	-3.93
	1995-2010	-1.20	-1.00	-0.80	-0.59	0.44	1.37	-9.61
	1995-2010	-1.09						
12	Office, precision, and optical instruments							
	1980-1995	-2.06	-0.67	-1.03	0.09	-2.76	-2.13	-1.08
	1995-2010	-4.36	-0.01	-2.64	-0.92	-1.43	0.85	-4.58
	1995-2010	-4.70						
13	Electrical Goods							
	1980-1995	-2.51	-0.76	-3.49	-2.23	-2.10	1.03	-0.18
	1995-2010	-3.56	-1.32	-6.00	-0.62	-1.62	-0.15	-2.46
	1995-2010	-3.58						
14	Motor vehicles							
	1980-1995	-3.94	-0.94	-3.59	-1.34	-0.13	-0.80	-0.45
	1995-2010	-5.02	-0.62	-3.12	-2.09	-1.91	1.96	-1.51
	1995-2010	-5.04						
15	Other transport equipment							
	1980-1995	-2.52	-1.99	-2.50	-6.42	-3.38	-2.43	0.00
	1995-2010	-6.15	-1.04	-1.65	-1.63	0.56	-0.15	0.00
	1995-2010	-6.17						
16	Food and tobacco							
	1980-1995	-1.89	-1.45	-0.26	-1.78	-1.71	0.37	-0.81
	1995-2010	-1.71	-0.82	0.29	-1.07	-2.44	-1.22	-1.76
	1995-2010	-2.10						

		Italy	Germany	France	Spain	USA	Japan	China
21 Textiles and clothing								
	1980-1995	-1.86	-5.61	-4.85	-3.64	-3.32	-5.30	-2.07
	1995-2010	-2.42	-4.46	-3.62	0.32	-3.31	-7.15	-1.22
	1995-2010	-2.90						
22 Leather, shoes and footwear								
	1980-1995	-2.16	-7.20	-4.51	-6.01	-7.08	-2.86	-0.92
	1995-2010	-4.42	-5.09	-0.41	0.68	-0.94	-2.86	-0.03
	1995-2010	-4.43						
23 Wood and furniture								
	1980-1995	-2.59	-1.24	-1.90	-3.17	-0.97	-1.32	-1.79
	1995-2010	-2.03	-1.57	-0.75	2.09	-0.99	-2.86	1.69
	1995-2010	-1.77						
24 Paper and printing products								
	1980-1995	-1.74	-0.89	-0.46	-0.65	-0.51	-0.38	-0.77
	1995-2010	-3.13	-1.84	-1.06	2.63	-0.85	-1.08	-0.93
	1995-2010	-3.05						
25 Plastic products and rubber								
	1980-1995	-1.27	1.16	-0.84	-2.00	0.14	1.48	-1.27
	1995-2010	-3.54	-0.05	-1.27	-3.20	-1.32	-0.59	-0.68
	1995-2010	-3.19						
26 Other manufacturing industry								
	1980-1995	-2.11	-0.62	0.00	-5.63	-1.64	-2.33	-0.21
	1995-2010	-2.52	-2.17	0.00	1.99	-2.46	1.61	-2.07
	1995-2010	-2.24						
27 Building and construction								
	1980-1995	-1.14	-1.25	-1.73	-0.62	-0.37	-0.11	3.59
	1995-2010	0.43	-0.04	-1.74	1.16	0.18	0.88	-1.42
	1995-2010	2.21						
28 Recovery and repair services								
	1980-1995	-0.43	0.00	-0.67	-0.05	1.52	1.65	0.00
	1995-2010	-2.63	0.00	0.66	-0.61	0.27	-0.35	0.00
	1995-2010	-2.77						
29 Wholesale and retail trade								
	1980-1995	0.79	-0.49	-0.07	0.14	-0.07	-0.85	3.06
	1995-2010	-1.30	0.34	-0.21	-1.84	-0.52	-0.30	3.33
	1995-2010	-1.24						
30 Hotels and restaurants								
	1980-1995	0.53	1.99	1.50	2.20	1.11	1.67	4.01
	1995-2010	1.07	-0.17	0.79	0.42	0.12	0.67	-1.97
	1995-2010	0.64						
31 Inland transport services								
	1980-1995	0.89	-3.72	0.90	-0.45	-5.33	-0.47	1.26
	1995-2010	-1.28	-3.96	0.44	-1.15	-2.46	1.04	1.06
	1995-2010	-1.26						
32 Sea and air transport services								
	1980-1995	-1.62	-4.11	0.00	-1.40	2.19	-0.58	0.00
	1995-2010	-0.23	-3.25	0.00	-2.48	0.50	-2.53	0.00
	1995-2010	-0.71						
33 Auxiliary transport Services								
	1980-1995	-1.35	1.85	0.00	-0.11	1.08	-0.49	0.00
	1995-2010	-0.92	1.78	0.00	-0.66	-0.05	-3.86	0.00
	1995-2010	-1.14						

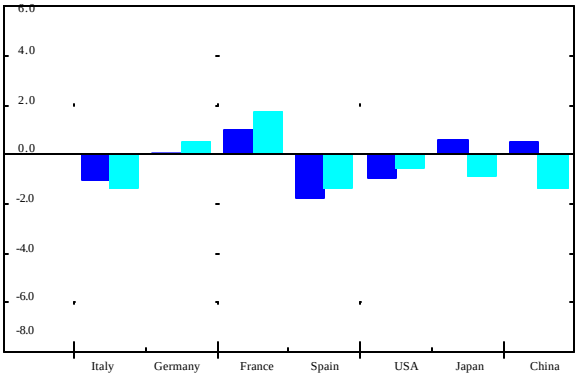
	Italy	Germany	France	Spain	USA	Japan	China
34 Communication							
1980-1995	-0.01	-0.44	0.17	1.92	-1.60	-0.48	-1.92
1995-2010	-2.41	0.02	-2.67	-2.22	-4.17	-4.07	0.33
1995-2010	-2.74						
35 Banking and insurance							
1980-1995	0.99	1.08	4.66	1.00	0.34	-0.15	2.34
1995-2010	-0.20	1.09	0.05	0.91	0.45	1.19	0.51
1995-2010	-0.25						
36 Other private services							
1980-1995	4.89	0.00	2.42	6.99	3.16	1.79	0.00
1995-2010	4.21	0.00	2.87	1.72	1.71	0.61	0.00
1995-2010	4.00						
37 Private education services							
1980-1995	-0.71	1.41	0.00	0.56	1.98	1.69	0.00
1995-2010	-6.09	2.47	0.00	0.08	0.24	0.50	0.00
1995-2010	-5.41						
38 Private health services							
1980-1995	2.21	3.04	0.00	0.27	2.01	1.68	0.00
1995-2010	3.93	1.57	0.00	-1.82	0.92	-0.99	0.00
1995-2010	3.60						
39 Recreation and culture							
1980-1995	2.51	2.63	0.00	1.39	2.31	1.67	0.00
1995-2010	0.76	1.60	0.00	0.49	1.08	-0.06	0.00
1995-2010	0.39						
40 Government and non-profit institutions							
1980-1995	0.63	1.30	0.78	1.99	-1.07	-0.14	-2.08
1995-2010	0.88	-0.04	0.01	0.53	-0.44	-0.60	-1.47
1995-2010	0.45						





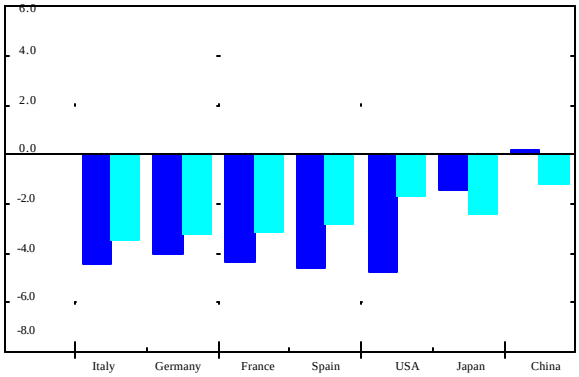
5 Electricity, gas, water

Rate of Change of Employment Shares 1980-1995 and 1995-2010



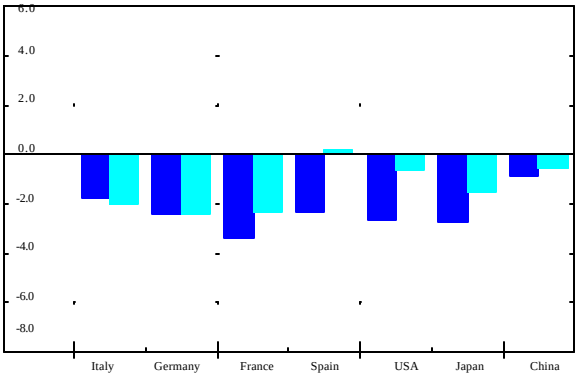
7 Ferrous & non-ferrous ores

Rate of Change of Employment Shares 1980-1995 and 1995-2010



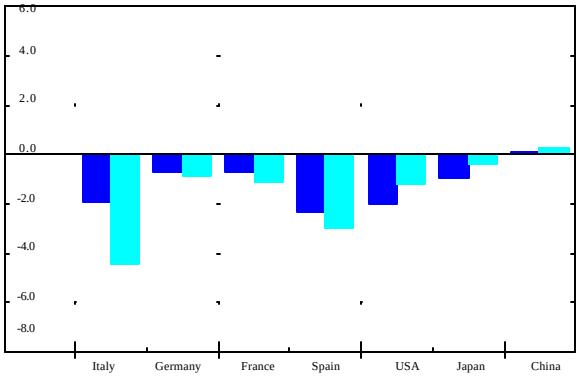
8 Non-metalic mineral products

Rate of Change of Employment Shares 1980-1995 and 1995-2010



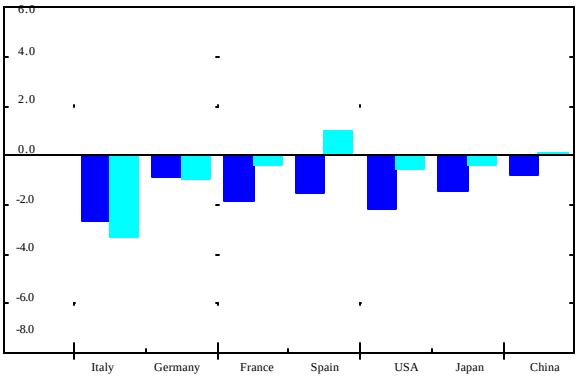
9 Chemical products

Rate of Change of Employment Shares 1980-1995 and 1995-2010



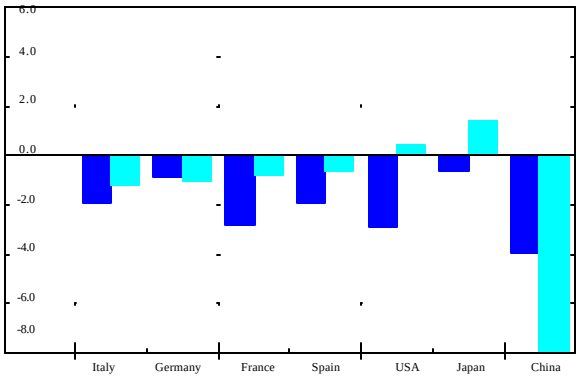
10 Metal products

Rate of Change of Employment Shares 1980-1995 and 1995-2010



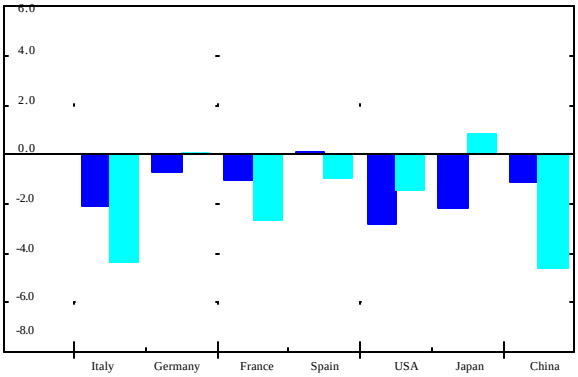
11 Agricultural and industrial machinery

Rate of Change of Employment Shares 1980-1995 and 1995-2010



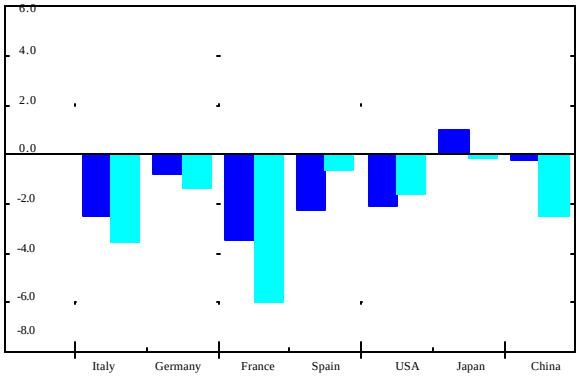
12 Office, precision, and optical instruments

Rate of Change of Employment Shares 1980-1995 and 1995-2010



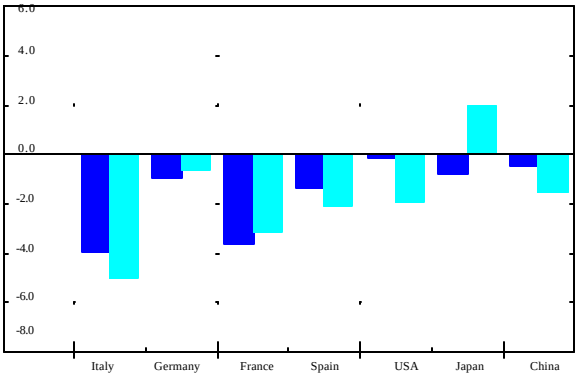
13 Electrical Goods

Rate of Change of Employment Shares 1980-1995 and 1995-2010



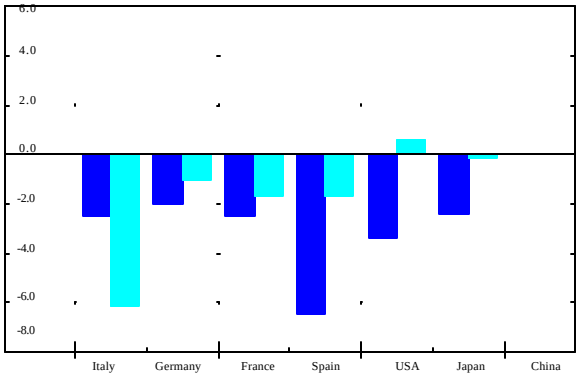
14 Motor vehicles

Rate of Change of Employment Shares 1980-1995 and 1995-2010



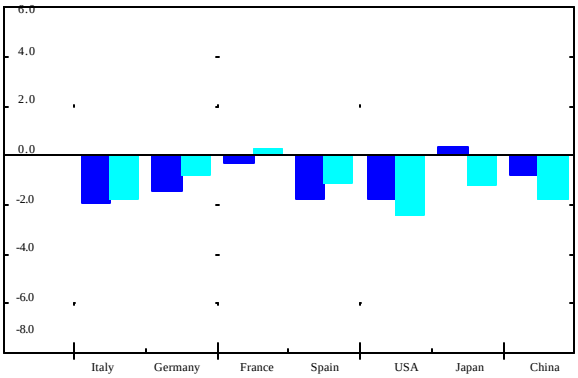
15 Other transport equipment

Rate of Change of Employment Shares 1980-1995 and 1995-2010



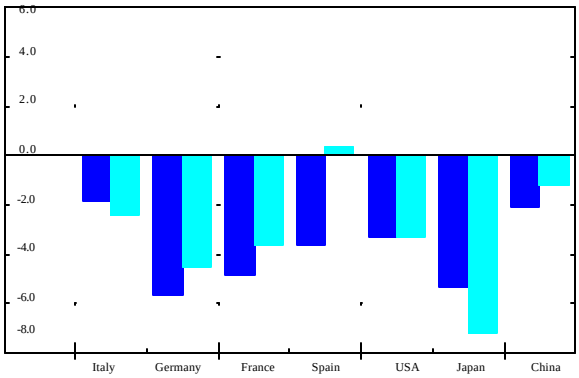
16 Food and tobacco

Rate of Change of Employment Shares 1980-1995 and 1995-2010



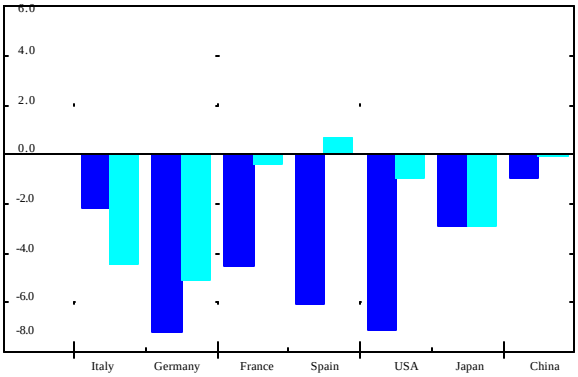
21 Textiles and clothing

Rate of Change of Employment Shares 1980-1995 and 1995-2010



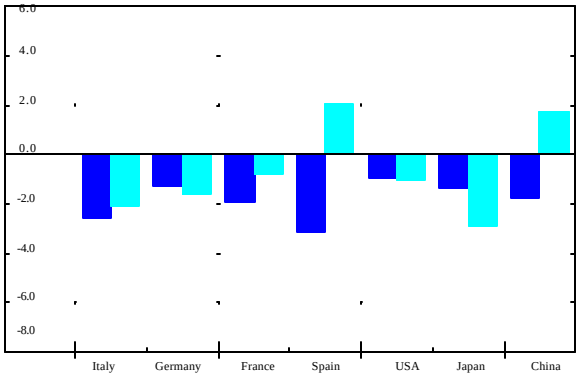
22 Leather, shoes and footwear

Rate of Change of Employment Shares 1980-1995 and 1995-2010



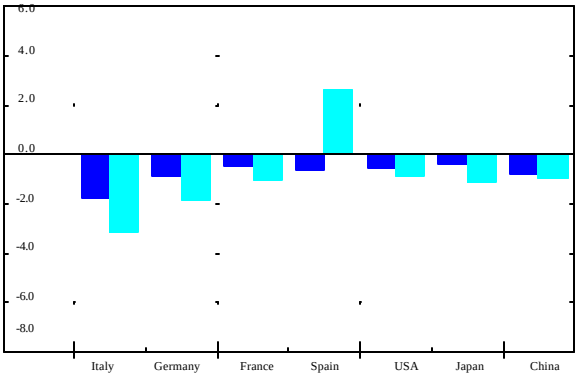
23 Wood and furniture

Rate of Change of Employment Shares 1980-1995 and 1995-2010



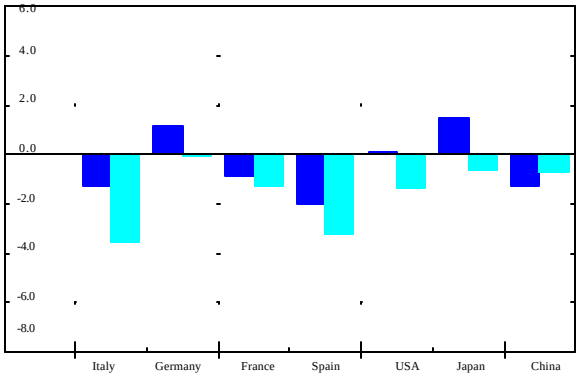
24 Paper and printing products

Rate of Change of Employment Shares 1980-1995 and 1995-2010



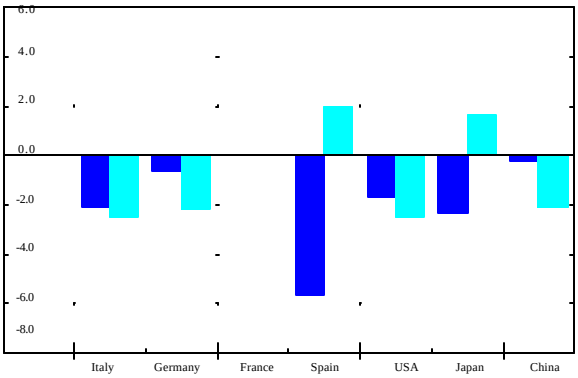
25 Plastic products and rubber

Rate of Change of Employment Shares 1980-1995 and 1995-2010



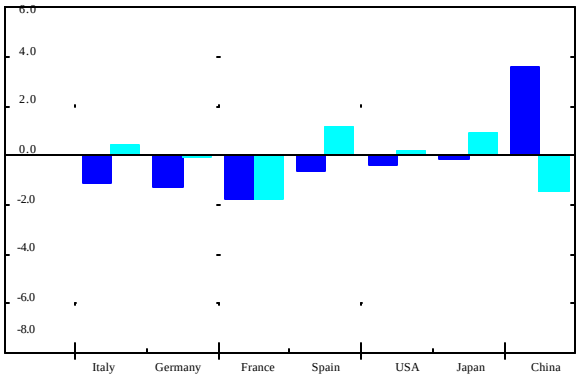
26 Other manufacturing industry

Rate of Change of Employment Shares 1980-1995 and 1995-2010



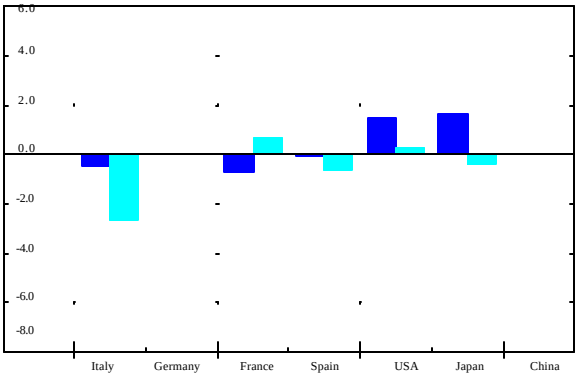
27 Building and construction

Rate of Change of Employment Shares 1980-1995 and 1995-2010



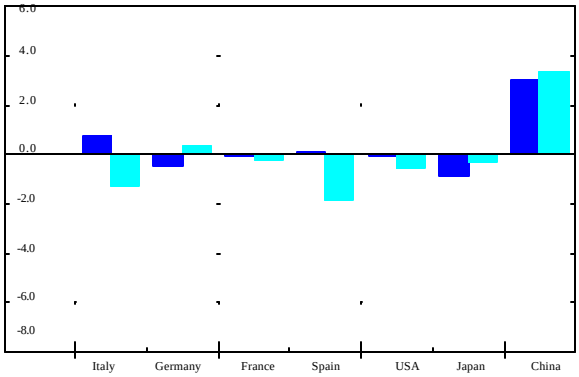
28 Recovery and repair services

Rate of Change of Employment Shares 1980-1995 and 1995-2010



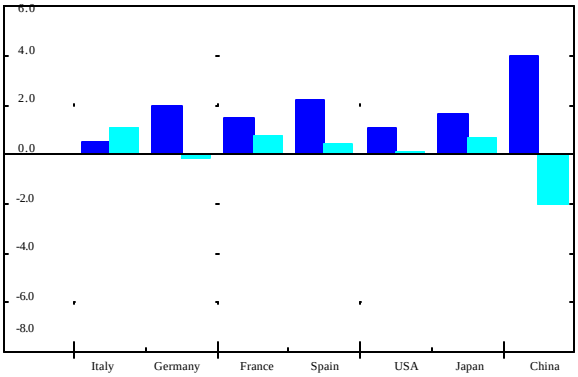
29 Wholesale and retail trade

Rate of Change of Employment Shares 1980-1995 and 1995-2010



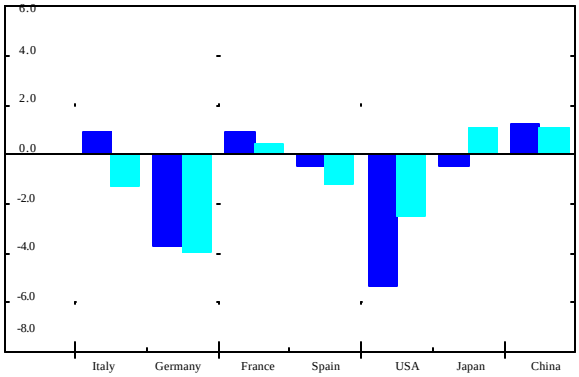
30 Hotels and restaurants

Rate of Change of Employment Shares 1980-1995 and 1995-2010



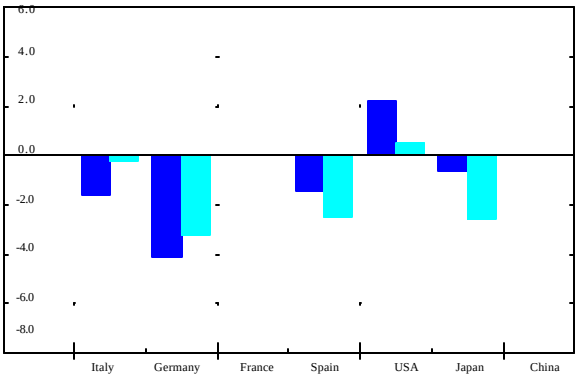
31 Inland transport services

Rate of Change of Employment Shares 1980-1995 and 1995-2010



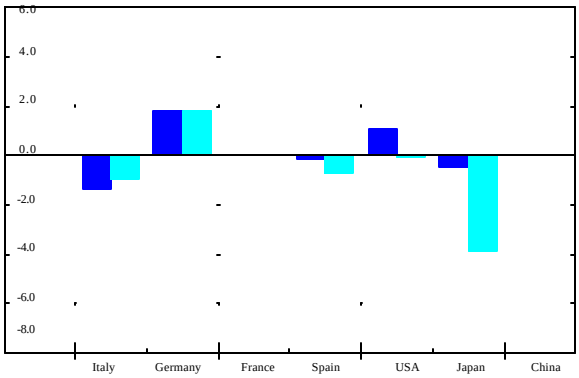
32 Sea and air transport services

Rate of Change of Employment Shares 1980-1995 and 1995-2010



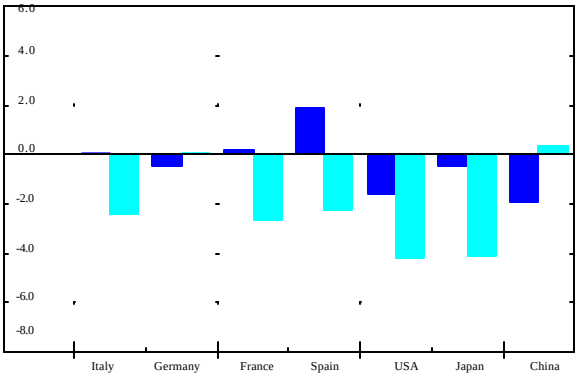
33 Auxiliary transport Services

Rate of Change of Employment Shares 1980-1995 and 1995-2010



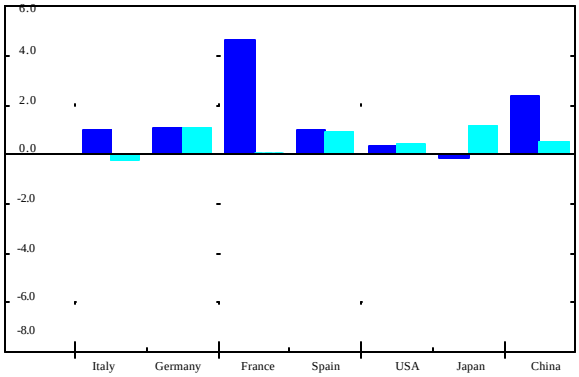
34 Communication

Rate of Change of Employment Shares 1980-1995 and 1995-2010



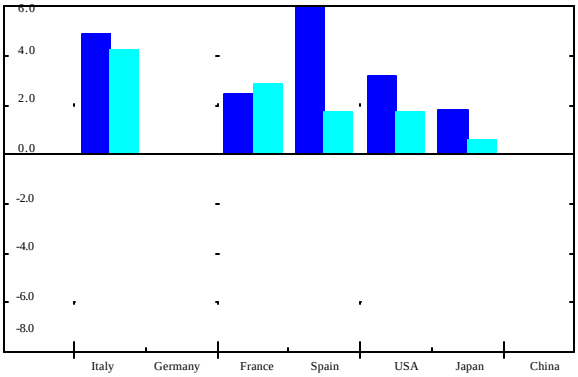
35 Banking and insurance

Rate of Change of Employment Shares 1980-1995 and 1995-2010



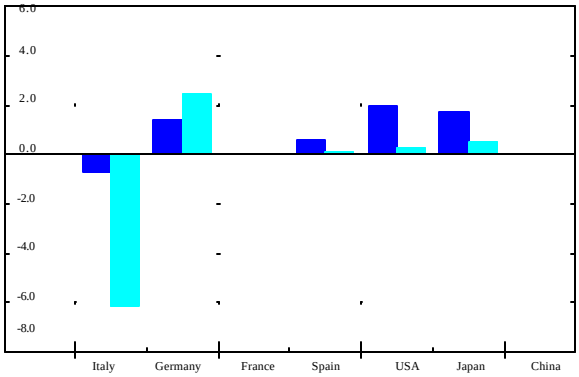
36 Other private services

Rate of Change of Employment Shares 1980-1995 and 1995-2010



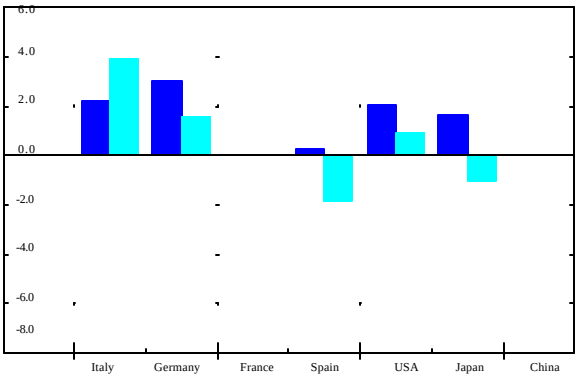
37 Private education services

Rate of Change of Employment Shares 1980-1995 and 1995-2010



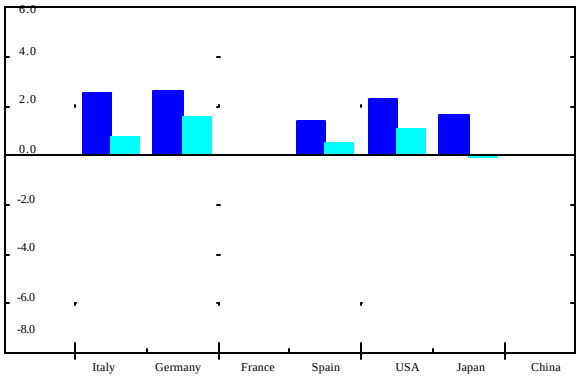
38 Private health services

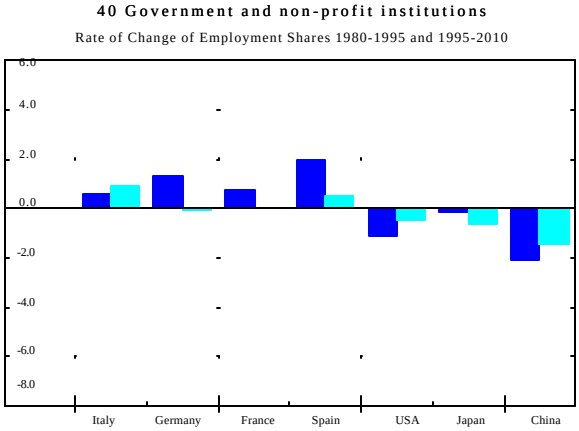
Rate of Change of Employment Shares 1980-1995 and 1995-2010



39 Recreation and culture

Rate of Change of Employment Shares 1980-1995 and 1995-2010



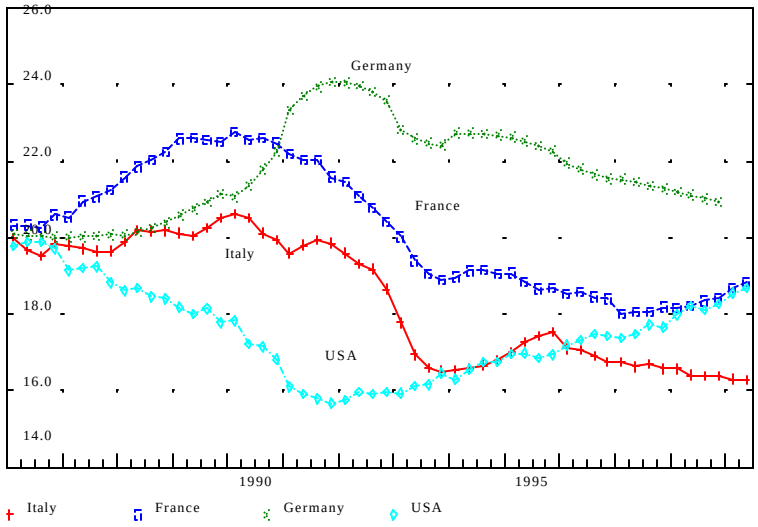


3. An Experiment with Investment in Italy

We have seen that economic development in Italy seems characterized by low-tech drift. While we have been looking at employment shares, we could also have looked at growth in output. Over the years since 1986, Italian production grew more slowly that French, German, and Spanish production in Chemicals and pharmaceuticals, Computing, precision, and optical instruments, Automobiles, and Other transportation equipment. Italy also grew more slowly than France and Spain in all of the food and beverage industries. Its areas of relatively good performance were in "light" industries such as Textiles and apparel, Leather and shoes, Furniture and wood products, and Rubber products -- areas associated neither with high wages nor with skill requirements nor with large capital requirements nor with important technological content.

Over this same period since 1980, fixed investment in Italy fell from over 24 percent of Gross Domestic Product (GDP) in 1980 to under 17 percent in 1997. Figure 1 shows this ratio for Italy in comparison with France, Germany, and the United States for the years 1986 to 1998. In 1986, there was surprising similarity among the countries in this ratio; all four had investment of essentially 20 percent of GDP. Since then, Italy has fallen below its two close European neighbors in every year. Each of them has had a period of expansion of the investment share followed more recently by declining ratios, which, however, remain well above the Italian ratio. The American ratio has been growing since a low in 1990 and now surpasses the Italian ratio.

Fig.2 Share of Gross Investment in GDP



The coincidence of the low-tech shift with the fall in the investment/GDP ratio suggests – though it certainly does not prove – a connection between the two. We were therefore led to ask, To what extent can Italy influence its industrial structure by increasing investment? We do not pretend to offer a complete answer, but only to look at the changes that would come about because of a connection between Italian exports and investment in Italy. In doing so, we use the Inforum international system of multisectoral macroeconomic (MM) models and particularly the bilateral trade model which links them.

The mechanism we use to generate this effect is somewhat unconventional, not because we wish to innovate but because we are not able to resolve statistically what form of the conventional mechanism should be used. Conventional microeconomic theory suggests that increasing investment would increase the capital/output ratio and therefore should reduce the labor/output ratio. The reduced labor/output ratio would lead to lower unit costs of production, which would lead to lower prices, which would lead to increased exports, which would stimulate domestic production. That process should be simple to model. But it isn't.

The problem is that industry capital stocks, at least as measured by ISTAT, have maintained an almost constant ratio to output over the last two decades while output per employee has increased *steadily*. Clearly, this development is not the work of a static production function. Some sort of technological change must be introduced. There is no shortage of possible ways to do so. The problem is that there are very slim statistical grounds for preferring one form of technological change to another, but the different forms may have very different implications for the effects of a policy of stimulating investment. At one extreme, capital per unit of output may be fixed and all technical progress affects employment only. In this case, extra investment is simply wasted. At the other extreme, all technical progress may be embodied in new capital and all progress due ultimately to investment, but investment has been smooth enough that the progress looks steady. In this case, increasing investment would be very

important. We are not trying to say that the determination of the correct explanation is either unimportant or ultimately impossible. We only say that it is not simple, and that we, therefore, have taken a different, less conventional approach to the question at the expense of recognizing that our answers may be very partial.

The heart of our approach lies in the bilateral trade model that links multisectoral macroeconomic models of fourteen countries and two broad regions. In the linking model, the share of Italy in the imports of, say, Agricultural machinery in, say, Germany depends, in part, on the growth of the capital stock of the Agricultural machinery industry in Italy relative to the growth of the capital stock in this industry in all countries in the system from which Germany imports Agricultural machines. Prices also enter into the determination of import shares, but in many cases they prove incapable of explaining the changes in these shares. Why? Probably because there have been changes in the quality of products from different countries which are not reflected in the reported prices. This quality effect may be the result of investment in the exporting industry. The classic example is the automobile industry in Japan which "bought" a sizable share of the world market by investing in the machinery necessary to make high quality cars at affordable prices. Car buyers realized that they could get "a lot of car for the money" with the Japanese brands, though the price statistics showed no big drop. The purpose of the relative capital stock variable is to pick up such quality effects.

The bilateral trade model works at the level of 120 products and shows the flows of these products between each pair of countries or regions in the system. This system includes Canada, USA, Mexico, Austria, Belgium, France, Germany, Italy, Spain, UK, Japan, China, Korea, Taiwan, Other OECD, and Rest of the World. The models of the various countries are "macro" in the sense that they generate the main variables of concern in macroeconomics: GDP, employment, unemployment, inflation, interest rates, government deficits or surpluses, balance of payments, and so on. But they are also multisectoral; and, in so far as possible, they build up aggregates from industry level data, which is the real center of interest in them. Thus, employment is the sum of employment in all industries, investment is the sum of investment in all industries, total compensation of employees is the sum of compensation of employees in all industries, imports are the sum of imports by products, and so on. Of course, some variables, such as the interest rate, have no industry dimension.

This study begins from a base run of the entire system. All the country models and the bilateral trade model are run iteratively until mutually consistent solutions are found. Then we run an Italian scenario with a stimulus to investment and rerun the models for France, Germany, Spain, USA, Japan, and China to get a new solution consistent with the Italian high investment scenario. We then look at the changes in the outputs of the Italian industries between the base and the high-investment scenario.

Conceptually, therefore, the experiment is quite simple. There is, however, a considerable amount of machinery brought to bear on the question. We must try to explain the essence of that machinery without burdening the reader with an indigestible mass of information. In section 4, the Italian model is described. It is a fairly representative model of the system; some are more developed, some less.

Most are, like the Italian one, built by a partner in the country and adapted to the statistics and the economy of the country. Section 5 gives a brief description of the bilateral trade model. Section 6 lays out the scenarios; section 5 examines the effects of the investment stimulus; and section 6 summarizes the paper and its results.

4. The Italian Model

The accounting structure and data

A structural model of an economy begins with an accounting system. In fact, an accounting system is already a model, since each balance in the accounts is an equation. Their number is also the number of the endogenous variables which are necessarily accompanied by a large number of exogenous variables. Adding econometrically estimated equations among variables in the accounting system reduces the number of exogenous variables but at the same time introduces the thinking of the model builder. We shall therefore begin with a description of the accounting framework and then move to the econometric equations.

INTIMO – the Interindustry Italian Model – begins from the Italian input-output table (Tavola dell'Economia Italiana) and the institutional accounts. The input-output table used in the model has 44 sectors; 40 sectors represent the private component of the economy; 4 sectors represent non-market sectors: 3 for Government and 1 for non-profits. The table distinguishes between domestic and foreign production in each cell, and the model preserves this distinction.

The table used in the model has had non-deductible value added taxes (VAT) removed from intermediate and final demand flows. A fundamental assumption of input-output is that a lira's worth of a particular product requires the same inputs no matter where across the product's row that lira of sales appears. This assumption is flagrantly violated in the tables published with flows including nondeductible VAT. For example, in such a table, paper sold to firms appears without VAT while the same paper sold to households appears with VAT. The removal of the nondeductible VAT, therefore, makes the input-output calculations move valid and moves the table much closer to a factor-cost rather than a market-price basis. Besides the VAT matrix, the bundle of excise and other ad valorem taxes has been represented in a matrix specifically built for the model where about thirty different indirect taxes are listed.

The Institutional accounts have been aggregated into three sectors: Enterprises, Households and Government. In the European System of Accounts (ESA) there are seven institutional accounts: 1) Production 2) Generation of income 3) Distribution of income, 4) Use of income, 5) Capital, 6) Financial, and 7) Current transactions (with rest of the world). The input-output table and the Institutional accounts are closely linked. Aggregates from the intermediate consumption and value added matrixes in the input-output table go into the first two accounts, Production and Generation. INTIMO then models the third and seventh accounts, the Distribution of income and Current

transactions accounts to calculate disposable income. The Use of income and Capital accounts allow computation of macroeconomic variables such as saving, investment, consumption, inventory changes in nominal terms. Needless to say, the household disposable income which results from the computation in the institutional accounts is not necessarily the one which was assumed in the computation of households in the input-output accounts. The model must be solved iteratively to insure that the two are equal.

Equations from input-output identities

In an input-output table there are two sets of accounting identities:

$$Aq + f = q \qquad A'p + v = p \tag{1}$$

where q is the (column) vector of sectoral outputs, f is the vector of final demand, the sum of consumption, investment, inventory changes and net exports, v is the value added vector per unit of output, p is the vector of sectoral prices and, finally, $A = [a_{ij}]$ is the matrix of coefficients so that $q_j * a_{ij} = q_{ij}$ where q_{ij} is the flow from sector i to sector j in the input-output table; matrix A is also known as "input-output technical coefficient matrix". The set of equations on the left side are known as the "fundamental equation in the input-output analysis" or "the Leontief equation"; the set of equations on the right side may be named as the "Leontief price equation".

In INTIMO, all these variables should have also a t subscript to emphasize that they vary over time, so that the equation for the determination of output would be

$$q_t = A_t q_t + f_t. \tag{2a}$$

In the determination of prices, the distinction between foreign and domestic products is important. For the price equations, we need to separate the A_t into a matrix of domestic inputs, H_t and imported inputs, T_t, such that $A_t = H_t + T_t$. The then equation for determining the domestic prices is

$$p_t = H_t p_t + T_t p^m_t + v_t \tag{2b}$$

where p_t^m is the vector of import prices. While the elements of matrix A may be interpreted as "technical" coefficients, H and T matrices simply distinguish the origin of inputs, a distinction which is useful for analyzing the impact of foreign prices on domestic prices but independent of any technological consideration. We do not have annual input-output tables in Italy, but we have historical series on outputs, final demands, imports, domestic prices, and foreign prices. From these series and the 1988 input-output table, we have made a series of A, H, and T tables from which we project future tables.

Behavioral equations

In very general terms, the real and price sides of INTIMO (or any MM model) can be presented in the following form

$$q = Aq + f(q,p,z_R) \qquad p = Hp + Tp^m + v(p,q,z_N) \tag{3}$$

where z_R and z_N are vectors of variables not appearing in the input-output table, such as interest rates, money supply, or population. Note the "crossovers"; prices appear in the final demands and physical outputs appear in the price equations. We omit the *t* subscripts which should be understood on each matrix or vector. We have not included a dependence of the matrices on prices because that dependence has not been built into the present version of INTIMO. There is no problem in principle or theory in doing so, but there are very substantial empirical problems. Besides these equations, there are equations that do not have a sectoral dimension, such as the equations for collecting personal taxes or making up the government accounts.

We now turn to the forms and content of the various behavioral equations that make up the *f* and *v* functions in these equations.

Let us begin with the description of a demand system used to model *Personal Consumption Expenditure*. It is hard to judge the usefulness of a demand system without any reference to the use to be made of it. Thus, an MM model is a good testing ground for a demand system because it is fairly clear what it has to do. It will be used for fairly long-term growth studies so it must have an analytical form able to deal with significant growth in real income, with demographic and other trends, and with changes in relative prices. It must allow both complementarity and substitution among the different goods. Prices should affect the marginal propensity to consume with respect to income and the extent of that influence should be an empirical question and not decided by the form of the function. Following the same reasoning, income will surely make the demand for any good varying according to its specific propensity to consume, but increasing income should surely not make any demand to go negative.

INTIMO model now uses the *Perhaps Adequate Demand System* (PADS) (Almon,1996). PADS demand equations have a form with a multiplicative relation between the income term and the price term. The income term has a linear form with a constant, real income per capita, its first difference and a time trend. By use of adult equivalency weights, the effect of the age structure of the population on consumption is reflected in the forecasts. This age structure, in turn, is derived from a demographic submodel in INTIMO which computes population year-by-year in 100 one-year cohorts on the basis of fertility by age, net immigration by age, and survival rates from one age to the next.

The price term in PADS is nonlinear and designed to allow every product to have its own own-price elasticity and to exploit the idea of groups and subgroups of closely related commodities where within group complementarity or substitutability may be important. Not all commodities need be forced into a group; some of them, given the detail of the available statistics, do not find any group. Other commodities or services like Medical service and Education are recorded as household consumption expenditure but they are mainly Government expenditure so that they do not fall under the consumer's budget constraint. They can be given special treatment.

The PADS system in INTIMO models 40 categories of Personal Consumption Expenditure found in the National Accounts. The vector of a consumption in these categories is then multiplied by a "bridge matrix" to convert them into the 44 sectors of the input-output table. Though the number of sectors in the two classifications are nearly equal, the classifications are actually quite different.

Investment equations are base on capital stock gross investment data available for 21 sectors which are easily related to the 44 sectors of the input-output table. Gross investment is assumed to be composed of two parts: expansion investments and replacement investments. The latter are considered equal to the amount of investments required to maintain the level of capital stock constant; these investments are related to capital stock by means of a replacement rate implied by investments and ISTAT capital stock data. The capital stocks are, in fact, computed according to the perpetual inventory principle so that, given the investments and the stocks, the "average" replacement rate can be calculated. The expansion investments is dependent on changes in output with lags of up to three or four years. No other explanatory variables are used. We are, of course, aware that investment functions should consider the cost of capital, but we do not have such information at sectoral level and the use of aggregate measures has not been particularly successful.

These equations explain investment demanded by purchasing industry. As in the case of personal consumption expenditure, a bridge matrix is needed to convert investment by purchaser into investment by type of product purchased.

Imports are modeled by import- share equations. The share is the ratio of sectoral imports to sectoral output. These shares are not constant over time; they are modeled by a price term and a sort of time trend. The price term for each sector is a moving average of the ratio of import price to domestic price for that sector; the moving average covers the current and two previous years. The domestic price is computed inside the model while the import price is supplied by the Bilateral Trade Model. The "sort of time trend," known as a Nyhus's trend, is obtained by cumulating over time the variable 1 - s, where s is the import share. If the import share is close to zero, this variable grows by nearly 1 each year and is thus nearly a time trend. If, however, the import share rises, this "time" slows down. If the share reaches 1, this "time trend" stops growing altogether.

Exports are supplied by the Bilateral Trade Model.

Government expenditure, which is here represented in term of purchases for sectors, is treated as an exogenous variable; it belongs to the scenario variables and allows us to investigate the impact on the economy when level or the structure of the expenditure is changed. For example, it can be use to study the industrial effects of a shift of government expenses between defense and education.

In the model simulations reported in this paper, *labor productivity* for each sector is modeled with the rate of growth of output of the sector and either the level of output or a time trend.
This device is not our favorite theory. We outlined in the introduction the problems in connecting labor

productivity with investment. In the U.S., we are trying to estimate the connection between investment and productivity using cross-section across firms within an industry. At one time, INTIMO used an equation based on "Verdoorn's law" (Verdoorn,1949) which states that empirical evidence supports "a fairly constant relation over a long period between the growth of labour productivity and the [cumulated] volume of industrial production". That idea was abandoned in this study when it became clear that the equations were such that increasing outputs reduced employment in many industries.

We have investigated a number of other analytical forms for modeling labor productivity. We tried labor-capital ratios, that is to say, a step towards the Total Factor Productivity definition. In many cases, the estimation of the labor productivity equations seemed successful and gratifying. Unfortunately, good fitting and excellent statistical testing do not prevent the equation from giving most anomalous results in alternative scenarios. We consider the modeling labor productivity one of the most challenging topics in building an MM model.

Wages are modeled at sectoral level and at aggregated level. There are 42 sectoral equations and one macro equation. The macro equation is for wages in Industry -- the Energy, Manufacturing and Construction sectors. It explains the index of nominal wage as a function of the personal consumption deflator and labor productivity defined as the ratio of total output over employment. Both variables enter the equation with the current and one lagged value. The macro equation has been designed for long-term forecasting. The personal consumption deflator represents wage indexation, whether as a legal *scala mobile* or as just the working of labor markets. Labor productivity appears in the equation because productivity increased are often used as an argument for wage increases in labor negotiations.

Besides the macro equation, there are sectoral equations for each industry, except that the government sectors are aggregated into a single sector. The dependent variable of these equations is the ratio of the sectoral wage index over the aggregate wage index. There are two types of sectoral equations. One use the rates of growth of employment and output plus a trend. The other uses the ratios between the sectoral employment and sectoral out to employment and output of Industry as defined above.

Contributions for social security are computed at sectoral level. From the time series of (sectoral) wage and social security contributions, a time series of social securities rates is computed. These rates are exogenous variables which vary over time to reflect of policy actions. Contributions for social security are derived by applying such rates to sectoral wages.

Gross operating surplus, profits for short, are explained at the sectoral level, the same 42 sectors for which wages were computed. The profit equations work in terms of profits per unit of output and list among the explanatory variables sectoral price, change in sectoral output, sectoral foreign price for non-sheltered sectors, and a time trend.

Besides the many equations which explain a single cell in the input-output accounting scheme, INTIMO has a growing number of equations dealing with variables from the institutional accounts.

(Their number is growing because these accounts have only fairly recently been incorporated into INTIMO.) The institutional accounts properly belonging to the model are the Distribution of income and Current transactions accounts. In them, the institutions have been aggregated into threes: Enterprises, Government, and Households. The Households account has received special attention in order to model Household Disposable income (the balance line) which enters the Personal Consumption Expenditure demand system. Some items (which are macroeconomic variables) of this account are obtained by aggregation of sectoral flows; for example, Gross operating surplus, Compensation of employees and Actual social contribution. Other items need to be modeled. In some cases, a simple relationship among macroeconomic variables suffices. For example, Profits distributed to employees can be taken as a proportion of Gross operating surplus of the private sector. In other cases modeling the item may be more complex. For example, Social benefits and Current taxes on income and wealth both deserve special attention.

5. The Bilateral Trade Model

The models of the INFORUM international system, such as the INTIMO model, are linked together with a model of bilateral trade flow in merchandise at the level of 120 products. This model was created and originally estimated by Qiang Ma [1996]. It has subsequently been revised and updated with more recent data. The following explanation of the model is taken directly, with only minor modification, from Ma's work. This model takes imports (from all sources) by product, prices by product, and capital investment by industry from the national models. From these data, it distributes the imports of each country among supplying countries. The crucial work of the model is therefore to calculate the movement in 120 import-share matrices. In any one of these matrices, which we denote by S (for share), the element S_{ijt} is the share of county *i* in the imports of country *j* of the product in question in year *t*. (This t is 0 in 1990.) The equation for this typical element is

$$S_{ijt} = \hat{a}_{ij0} \left(\frac{P_{eit}}{P_{\cdot}}\right)^{\hat{a}_{ij1}} \left(\frac{K_{eit}}{K_{\cdot}}\right)^{\hat{a}_{ij2}} \left(e^{\hat{a}_{ij3} T_t}\right) \qquad \textbf{(4)}$$

where,

P_{eit} = the effective price of the good in question in country i (exporter) in year t, defined as a moving average of domestic market prices for the last three years;

P_{wjt} = the world price of the good in question as seen from country j (importer) in year t (see fuller description below);

K_{eit} = an index of effective capital stock in the industry in question in country i in year t, defined as a moving average of the capital stock indices for the last three years;

K_{wjt} = an index of world average capital stock in the industry in question as seen from country j in year t (see fuller description below);

T_t = Nyhus trend variable, set to zero in the base year, 1990.

$\hat{a}_{ij0}$, $\hat{a}_{ij1}$, $\hat{a}_{ij2}$, $\hat{a}_{ij3}$ are estimated parameters.

The world price, P_{wjt}, is defined as a fixed-weighted average of effective prices in all exporting countries of the good in question in year t:

$$P_{wjt} = \sum_i S_{ij0} P_{eit} \quad ; \quad \sum_i S_{ij0} = 1 \qquad \textbf{(5)}$$

and the world average capital stock, K_{wjt}, is defined as a fixed-weighted average of capital stocks in all exporting countries of the sector in question in year t:

$$K_{wjt} = \sum_i S_{ij0} K_{eit} \qquad \textbf{(6)}$$

The fixed weights in Equations 5 and 6, the S_{ij0}, are the trade shares for the base year 1990. The use of the fixed weights ensures that the share equation satisfies the "homogeneity" condition as suggested by the demand theory. For example, if all effective domestic prices, P_{eit}, are doubled, then a doubling of the world prices as seen by each importing country (or its import prices) leaves the price ratio unchanged.

These parameters were estimated using Ordinary Least Squares (OLS) in the following specification:

$$\log S = \alpha + \hat{a}_1 \log P + \hat{a}_2 \log K + \hat{a}_3 T \qquad \textbf{(7)}$$

where, for simplicity, we have dropped the time and country subscripts (t, i, j) and let P and K denote the relative price ratio and relative capital stock ratio, respectively. Ma searched the parameter space for estimates of $\hat{a}_{ij0}$, $\hat{a}_{ij1}$, $\hat{a}_{ij2}$, and $\hat{a}_{ij3}$, and included only estimates with correct signs. The search procedure explored seven alternative functional forms as follows, beginning with the form in Eq. (4). If the estimated price parameter or capital parameter was of the wrong sign, various combinations of a subset of the three explanatory variables were then used in the regression. If either price parameter or capital parameter still had a wrong sign, then the share equation was regressed on the Nyhus trend variable alone, because there was no sign restriction on the Nyhus trend variable.

It should also be noted that in any forecast period each trade share must be non-negative, and that the sum of shares from all sources in a given market must add up to 1 (i.e. $\sum_i S_{ij} = 1$ for all j and t). The non-negativity condition is automatically satisfied through the use of the logarithmic functional form, but the adding-up condition is not. Methods must, therefore, be found for modifying the forecast trade shares so that the adding-up condition is met. Estimates of all of the n shares are made separately and then adjusted to meet the adding-up condition. In this way, the forecast shares in each market will satisfy both the adding-up condition and the non-negativity condition. In scaling the forecast shares to meet the adding-up condition in each import market, those with the best fits should be adjusted proportionally less than those with poor fits. There is a set of good weights at hand: the standard errors of the estimated equations. Thus, the adding-up condition in each import market is imposed by

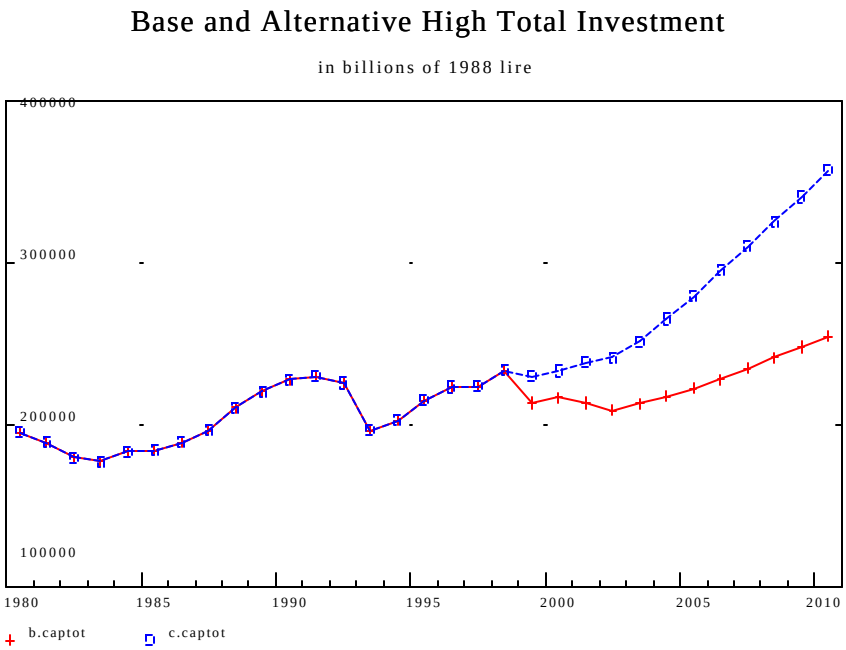
distributing the residual in proportion to the standard error of each estimated share equation.

Ma estimated equations for over 19,000 trade flows. The capital term entered equations accounting for some sixty percent of total trade flow. It should be emphasized that the estimation uses time-series, not cross-section, data. Thus, the coefficients showing the effect of investment in Italy on Italian shares in the imports of other countries reflects only Italian experience. It is in no way based on, say, the effects of Japanese investment on Japanese exports.

Ma reports a variety of tests and experiments with the system in the work cited above. The best summary for Italy, however, is the experiment reported below.

6. The Base and Alternative Scenarios

The Baseline scenario is given by the models as they stand in the INFORUM International System. It represents a sort of business-as-usual, middle-of-the-road projection. The alternative stimulated investment in Italy so that it reached levels ever higher relative to the base. The ratio of total investment in the alternative to total investment in base increased roughly 4¼ percent every year. Figure 3 compares the base and the alternative in total investment. In the alternative, the investment in the individual industries were scaled so that the total reached the levels shown in this graph. Obviously, the alternative shows the results of a highly successful program of investment stimulation. It is not our purpose here to make proposals about how this level of investment could be reached, but only to look at its effects coming about through increases in the Italian share of other countries imports. It should also be emphasized that it takes a number of years of increased investment to change significantly the capital stock, and the capital stock works with a lag of up to three years on import shares.



7. The effects of investment stimulus

Table 3 shows the percentages by which Italian exports are increased in the high investment scenario. The largest effects are in Plastic and rubber products, 20.9 percent in 2010, followed by Non-metallic mineral products at 13.2 percent. Nine of the twenty mining and manufacturing industries have export increases of over five percent. In all but two of the industries, the effect is positive. The negative effects in Textiles and clothing about because Italy's capital investment has little or no effect on its shares in other countries imports in these products, but the increase in demand for these products has led to an increase in their prices, and this increase reduced the export shares. By contrast, in the other industries, with the exception of Dairy products, growing demand led to reduced prices.

Table 3. Percentage Increase in Exports from Investment Program

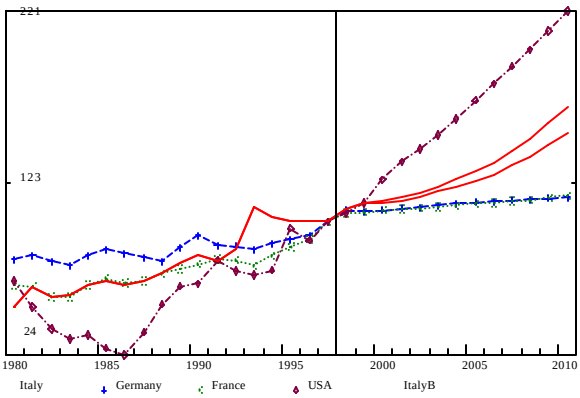
		2005	2010
7	Ferrous & Non ferrous ores	4.3	9.8
8	Non Metal Mineral Products	7.0	13.2
9	Chemical Products	2.2	3.8
10	Metal Products	3.7	8.5
11	Agric. & Indus. Machinery	2.5	5.0
12	Office, Precision, Optical Mach.	2.8	5.2
13	Electrical Goods	2.8	5.5
14	Motor Vehicles	2.5	4.9
15	Other Transport Equipment	1.9	2.2
16	Meat & Preserved Meat	0.9	1.8
17	Dairy Products	1.5	-1.8
18	Other Foods	1.7	3.2
19	Alcohol & Non Alcoh. Beverages	1.4	2.6
20	Tobacco	0.3	0.7
21	Textiles & Clothing	-1.5	-1.8
22	Leather, Shoes & Footwear	2.1	4.5
23	Timber, Wooden Product & Furniture	2.2	3.4
24	Paper & Printing Products	2.4	8.4
25	Plastic Products & Rubber	10.5	20.9
26	Other Manufacturing Industries	3.3	5.4

Given that the increase in investment reaches forty percent only in the last year, 2010, these increases in exports seem satisfying and certainly plausible. The course of investment and capital stocks are shown graphically at the end of this section.

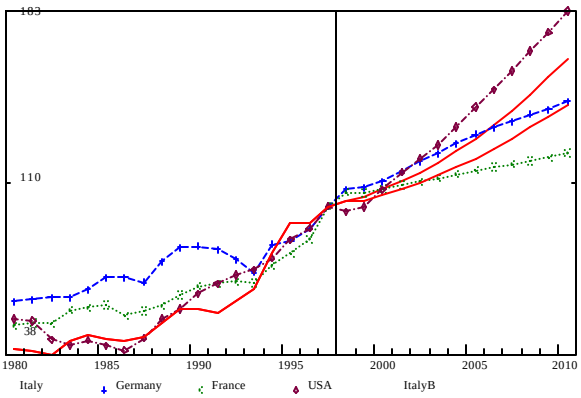
The following graphs show the export projections for the France, Germany, the USA and Italy both with and without the investment stimulus. The line for France is marked with x's, the line for Germany with +'s, the line for the USA with diamonds. The two lines for Italy have no marking of the points; the upper, slightly heavier line is with the investment stimulus. All lines are indexes with 1997 equal to 100. In general, the USA exports continue to grow faster than do the European countries. Relative to France and Germany, Italy has good prospects in Metals, Agricultural and industrial machinery, Wood and furniture, and Other manufacturing. It is weak in Chemicals, Motor vehicles, Paper, and Food industries. The investment program makes a noticeable difference in the comparisons with the European neighbors. The most striking case is Plastics and rubber, where it moves Italy from the slowest grower to the fastest among the Europeans.

Exports

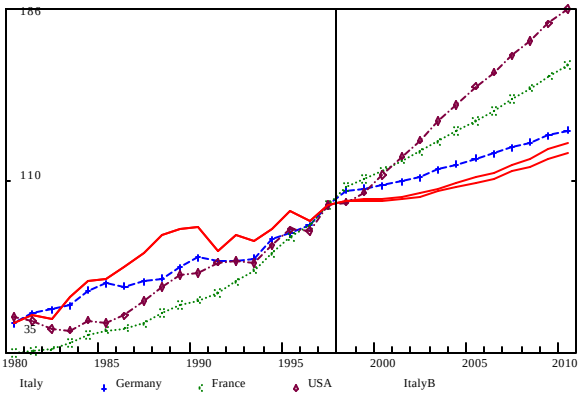
MIN.METAL.FER.E NON



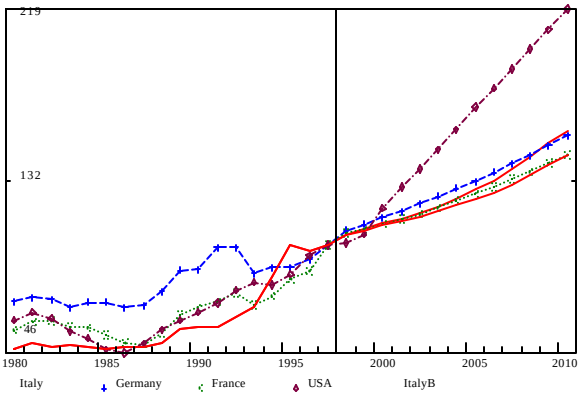
MIN.E PROD.NON METALLI



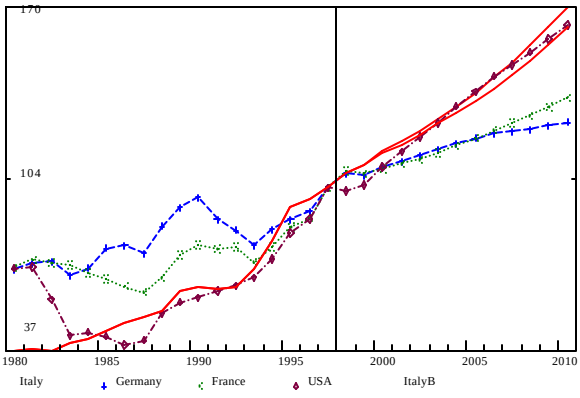
PROD.CHIMICI E FARMACEUTICI



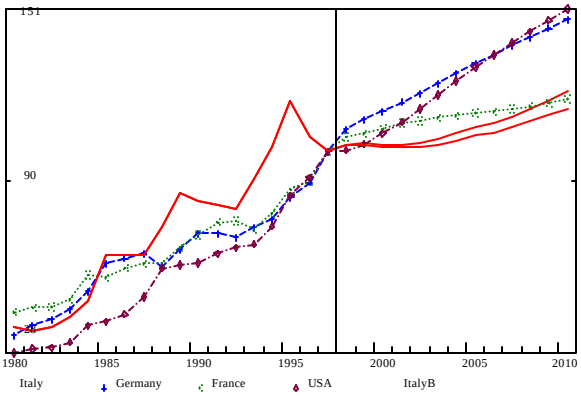
PROD.IN METALLO



MACCH.AGRIC.E INDUSTRIALI

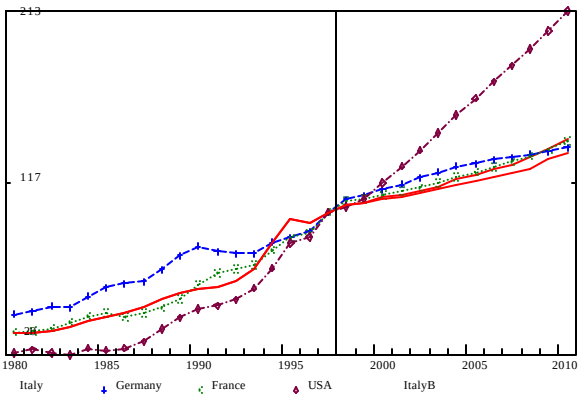


MACCH.UFF,PRECIS,OTTICA

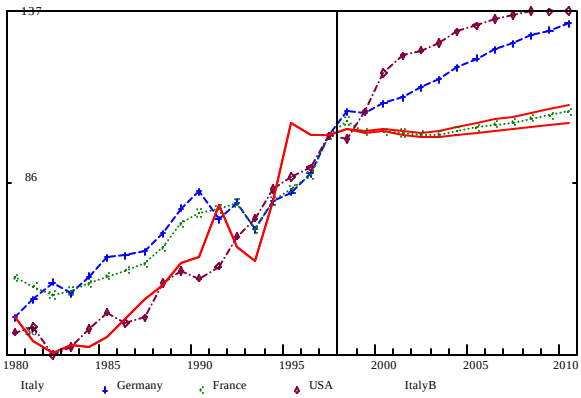


Exports

MATER.FORNITURE ELETTR.



AUTOVEICOLI E MOTORI



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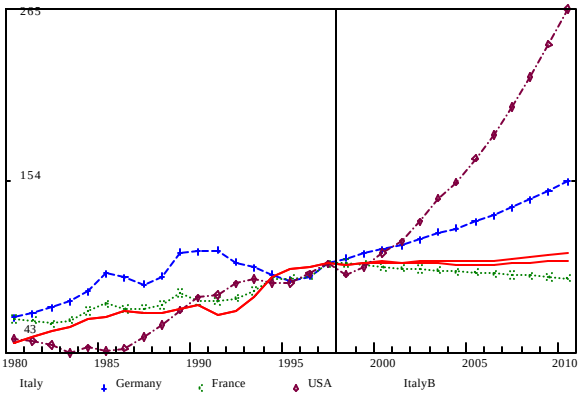
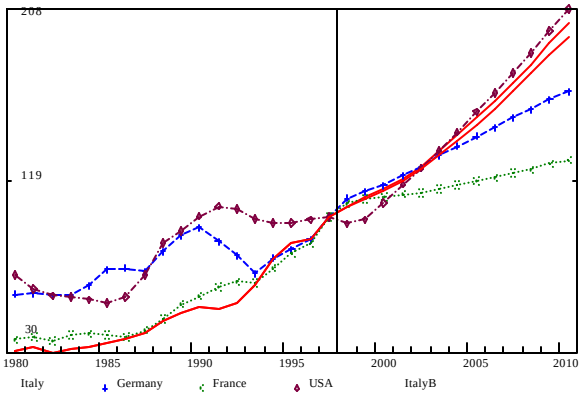
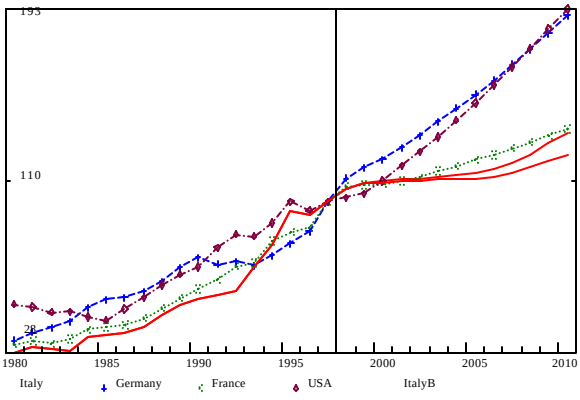


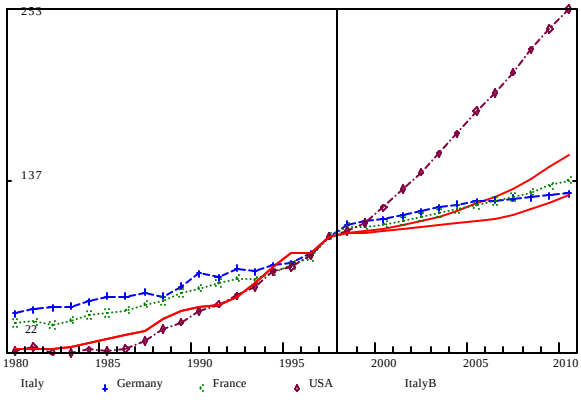
LEGNO&MOBILI IN LEGNO

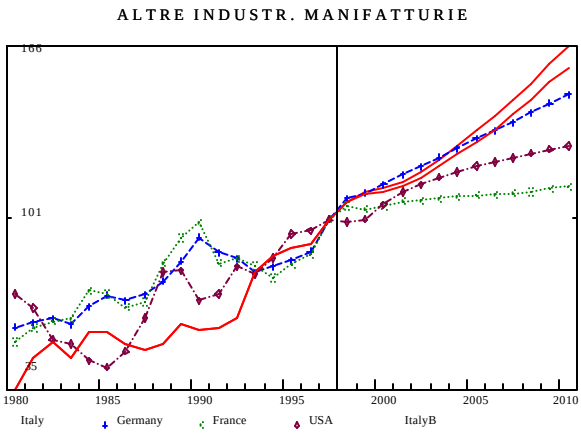


CARTA,CARTOTECN,EDITORIA



GOMMA&MAT.PLASTICHE





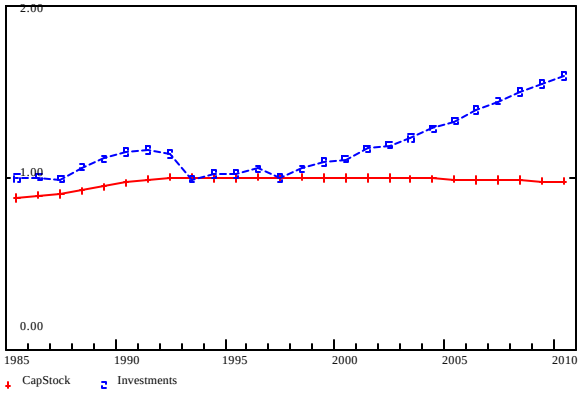
The positive effects of the investment program show up in the following changes in the rates of change of the shares of employment, as read from Table 2.

Ores		0.54
Non-metallic mineral products	1.11	
Metals		0.37
Agricultural and industrial machinery		0.37
Wood and furniture		0.26
Paper		0.08
Plastics		0.35
Other manufacturing		0.28
Building		1.78
Trade		0.06
Inland transport	0.02	
Private education		0.68

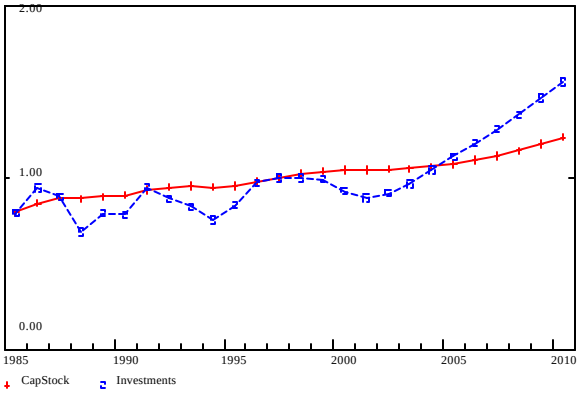
These beneficiaries are, with perhaps the exception of the last, the expected ones. Since the total shares must add to 100, increases in these shares must necessarily reduce other shares. That does not mean that those industries losing share would considered themselves hurt by the increase in investment.

It may be felt that the effect on exports was fairly small given the size of the increase in investment, but it should be pointed out that the increased investment lifts Italian capital stocks on slightly. The following graphs show Italian investment and capital stocks as calculated and used in the bilateral trade model -- both indexed so that 1997 is 100. These stocks are computed by assuming 8 percent per year wearout. They show remarkably little growth. In other words, in a number of industries, the increase in investment, relative to the base forecast, is necessary just to keep capital constant. In others, it produces a slight rise only in the last years of the forecast.

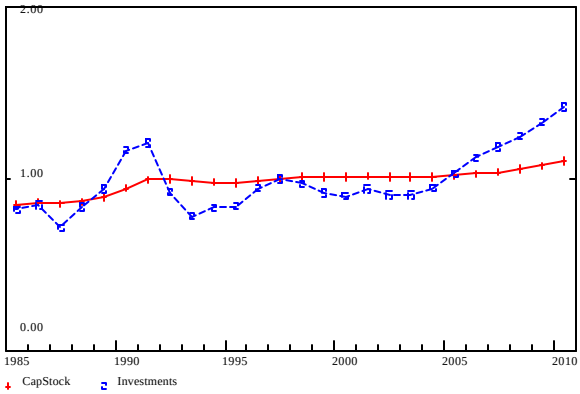
Agriculture



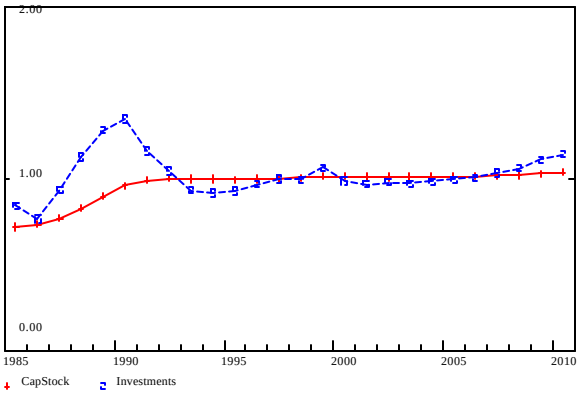
Energy Sectors



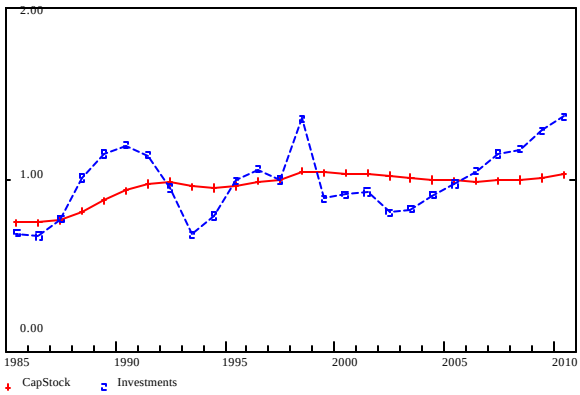
Ferrous & Non Ferrous Minerals



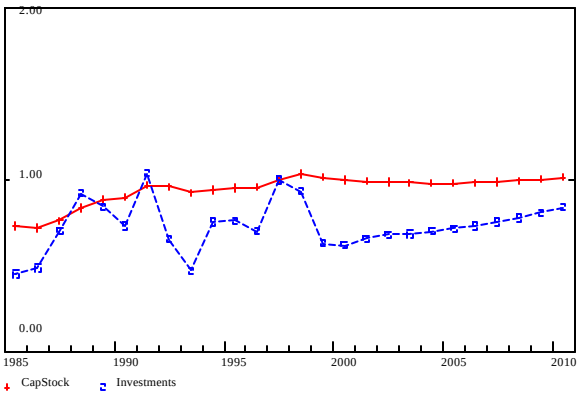
Chemical Products



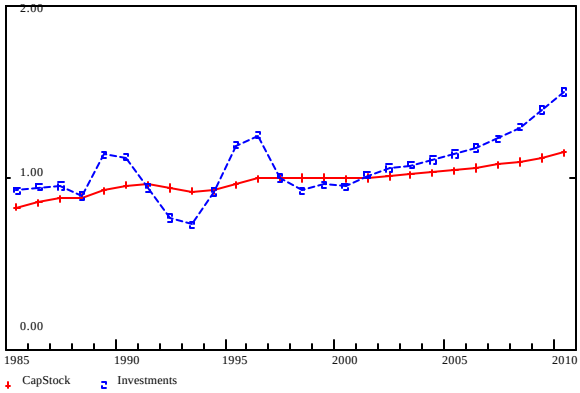
Electrical Goods



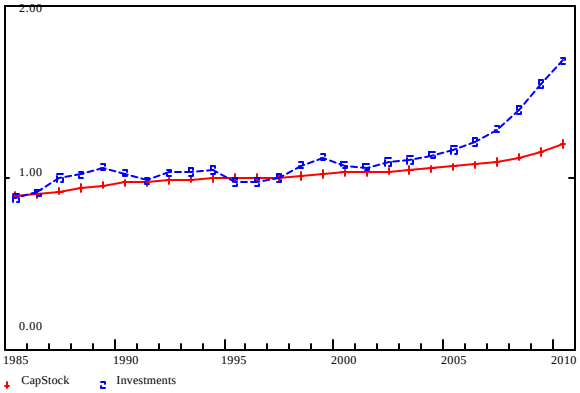
Motor Vehicles



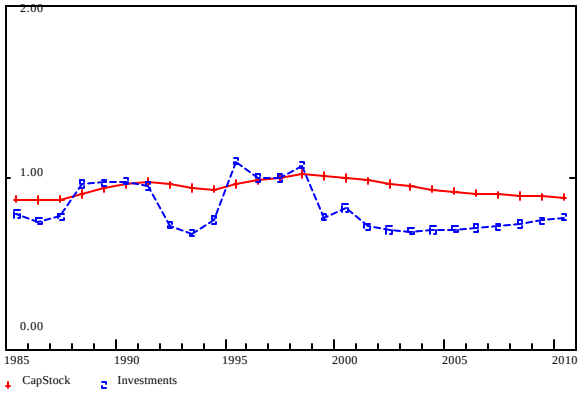
Office & Precision Products



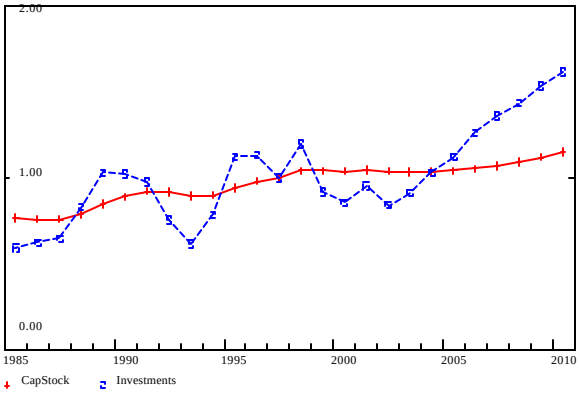
Food & Tobacco Industry



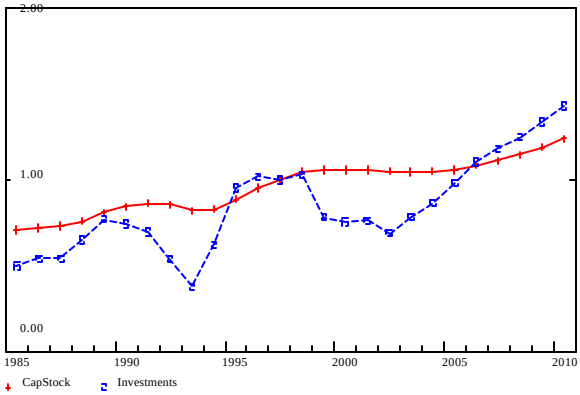
Textile & Leather Goods



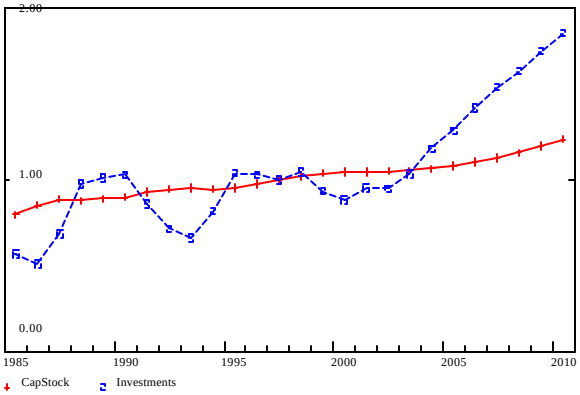
Metal Products

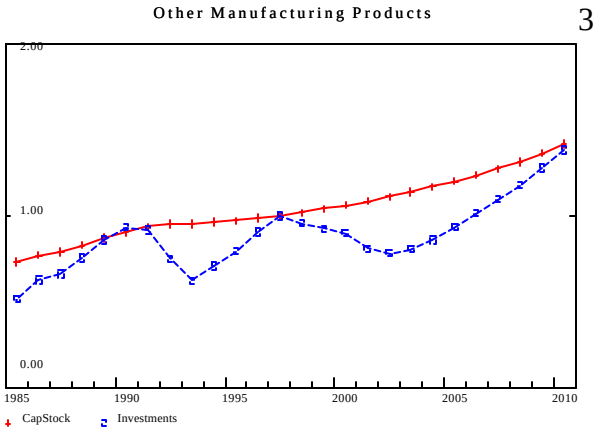


Agriculture & Industrial Machinery



Non-Metallic Mineral Products





8. Conclusions

The appearance of convergence in economic structure disappears when the reduction in the agricultural sector is removed from consideration. Increasing diversity seems to be the rule in the non-agricultural part of the economies of the seven countries considered here. Italy appears to be specializing in Textiles and clothing and Leather and shoes. The loss of share in the industries more associated with high technology may be a consequence of low investment rates in Italy. An experiment in increasing investment spending uniformly leads to some strengthening of exports and some increase the employment shares of industries associated with investment. In the undifferentiated form in which we have used it, the higher investment did not increase the share of employment in some of the high-tech sectors such as Office machinery and Chemicals.

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Appendix

Table A. The Changing Structure of Employment in Seven Countries, 1980, 1995, 2010

In Percent

	Italy	Germany	France	Spain	USA	Japan	China
1 Agriculture, Forestry, Fishery							
1980	13.57	1.07	9.02	19.26	3.29	12.93	67.82
1995	8.14	0.76	5.43	7.80	2.77	7.36	55.05
2010	4.62	0.59	3.06	3.72	2.03	5.20	43.59
2 Coal, Lignite, and Briquettes							
1980	0.02	0.97	0.28	0.44	0.23	0.07	1.19
1995	0.00	0.58	0.07	0.23	0.08	0.03	1.21
2010	0.00	0.46	0.02	0.15	0.03	0.01	1.36
4 Oil, Petroleum Refining Products							
1980	0.14	0.17	0.29	0.13	0.74	0.07	0.19
1995	0.12	0.09	0.19	0.10	0.36	0.05	0.33
2010	0.19	0.06	0.21	0.06	0.28	0.04	0.78
5 Electricity, Gas, Water							
1980	0.70	1.10	0.71	0.71	0.80	1.07	0.31
1995	0.64	1.11	0.86	0.62	0.70	1.24	0.47
2010	0.53	1.20	1.14	0.53	0.65	1.11	0.48
7 Ferrous & Non ferrous ores							
1980	1.04	2.15	1.14	0.84	1.23	0.74	0.90
1995	0.57	1.18	0.62	0.48	0.61	0.64	1.30
2010	0.38	0.73	0.40	0.33	0.48	0.46	1.36
8 Non-Metalic Mineral Products							
1980	1.72	1.54	1.26	2.04	0.74	1.41	2.47
1995	1.41	1.08	0.79	1.64	0.50	1.00	3.02
2010	1.28	0.75	0.57	1.76	0.46	0.82	3.51
9 Chemical Products							
1980	1.41	2.61	1.55	1.48	1.06	0.83	0.91
1995	1.13	2.37	1.45	1.19	0.79	0.77	1.29
2010	0.59	2.09	1.26	0.80	0.67	0.75	1.69
10 Metal Products							
1980	2.98	1.88	2.51	2.82	1.49	2.25	0.66
1995	2.14	1.66	1.99	2.57	1.08	1.94	0.82
2010	1.43	1.44	1.93	3.13	1.01	1.89	1.05
11 Agricultural and Industrial Machinery							
1980	2.32	4.69	2.57	1.08	2.03	2.28	2.00
1995	1.85	4.12	1.76	0.92	1.32	2.22	1.55
2010	1.63	3.55	1.60	0.88	1.42	2.79	0.46
12 Office, Precision, and Optical Instruments							
1980	0.50	1.30	2.28	0.19	1.37	0.88	0.16
1995	0.39	1.18	2.03	0.22	0.91	0.68	0.19
2010	0.20	1.18	1.40	0.20	0.74	0.79	0.12
13 Electrical Goods							
1980	1.92	4.64	0.39	1.53	1.69	2.77	0.50
1995	1.40	4.15	0.24	1.25	1.24	3.44	0.68
2010	0.85	3.41	0.10	1.19	0.98	3.44	0.59
14 Motor Vehicles							
1980	1.36	3.94	2.44	1.36	0.75	1.96	0.59
1995	0.80	3.43	1.48	1.27	0.74	1.85	0.77
2010	0.39	3.13	0.95	0.97	0.56	2.54	0.77
15 Other Transport Equipment							
1980	0.70	0.47	0.98	1.01	1.04	0.46	0.00
1995	0.51	0.35	0.70	0.44	0.63	0.34	0.00
2010	0.21	0.30	0.56	0.36	0.69	0.34	0.00

16 Food industries & Tobacco							
1980	2.01	3.48	2.81	3.19	1.71	2.40	1.10
1995	1.61	2.81	2.81	2.79	1.33	2.70	1.36
2010	1.22	2.49	3.01	2.48	0.93	2.30	1.31
21 Textiles and Clothing							
1980	4.85	2.66	2.71	3.81	2.03	2.08	2.14
1995	3.90	1.15	1.36	2.52	1.24	1.00	2.19
2010	2.62	0.59	0.81	2.76	0.76	0.35	2.29
22 Leather, Shoes and Footwear							
1980	1.34	0.44	0.53	1.10	0.23	0.26	0.23
1995	1.03	0.15	0.28	0.51	0.08	0.18	0.28
2010	0.55	0.07	0.27	0.59	0.07	0.12	0.35
23 Timber, Wooden Products, and Furniture							
1980	2.18	1.73	1.83	2.17	1.22	1.41	0.44
1995	1.57	1.44	1.43	1.54	1.06	1.23	0.47
2010	1.25	1.14	1.31	2.20	0.92	0.82	0.76
24 Paper and Printing Products							
1980	1.32	1.71	1.64	1.39	1.91	2.14	0.53
1995	1.08	1.50	1.59	1.44	1.78	2.15	0.66
2010	0.71	1.14	1.39	2.23	1.58	1.87	0.72
25 Plastic Products and Rubber							
1980	0.99	1.44	1.07	0.97	0.73	1.31	0.52
1995	0.87	1.72	0.98	0.82	0.75	1.74	0.60
2010	0.56	1.71	0.83	0.53	0.62	1.63	0.68
26 Other Manufacturing Industry							
1980	0.40	1.74	0.00	0.55	0.42	0.88	0.65
1995	0.31	1.59	0.00	0.27	0.33	0.66	0.88
2010	0.23	1.15	0.00	0.38	0.23	0.86	0.81
27 Building and Construction							
1980	7.99	8.15	8.94	9.01	5.28	10.08	2.36
1995	7.16	6.78	7.17	9.37	5.02	10.55	5.65
2010	10.36	6.75	5.66	11.64	5.20	12.32	5.73
28 Recovery and Repair Services							
1980	2.33	0.00	2.01	1.88	0.80	1.02	0.00
1995	2.32	0.00	1.89	2.13	1.01	1.39	0.00
2010	1.59	0.00	2.14	2.03	1.06	1.35	0.00
29 Wholesale and Retail Trade							
1980	12.63	12.17	12.68	13.41	16.59	17.79	3.10
1995	15.11	11.35	13.05	15.63	16.50	16.66	6.85
2010	13.02	11.97	12.97	12.38	15.38	16.29	14.16
30 Hotels and Restaurants							
1980	3.90	1.85	2.79	3.95	7.23	4.01	0.42
1995	4.49	2.50	3.63	6.27	8.58	5.48	1.07
2010	5.13	2.44	4.19	6.97	8.80	6.20	1.00
31 Inland Transport Services							
1980	3.35	1.48	3.69	3.72	0.73	3.45	1.22
1995	4.07	0.85	4.39	3.97	0.33	3.42	2.06
2010	3.50	0.47	4.81	3.49	0.23	4.09	3.03
32 Sea and Air Transport Services							
1980	0.36	0.24	0.00	0.54	0.58	0.41	0.00
1995	0.30	0.13	0.00	0.50	0.81	0.40	0.00
2010	0.28	0.08	0.00	0.36	0.88	0.28	0.00
33 Auxiliary Transport Services							
1980	0.83	2.16	0.00	0.65	1.76	0.83	0.00
1995	0.72	2.86	0.00	0.73	2.08	0.82	0.00
2010	0.63	3.74	0.00	0.69	2.08	0.47	0.00
34 Communication							
1980	1.15	2.15	1.98	0.86	1.29	1.00	0.21

1995	1.22	2.02	2.11	1.31	1.02	0.99	0.22
2010	0.84	2.03	1.45	0.98	0.55	0.55	0.29
35 Banking and Insurance							
1980	1.59	3.17	2.67	2.26	4.10	3.02	0.64
1995	1.96	3.74	5.58	3.00	4.34	3.14	1.27
2010	1.96	4.41	5.76	3.59	4.68	3.84	1.72
36 Other Private Services							
1980	3.29	0.00	6.22	1.25	6.67	5.91	0.89
1995	7.28	0.00	9.29	4.07	10.78	8.22	1.60
2010	13.78	0.00	14.65	5.50	14.03	9.22	3.19
37 Private Education Services							
1980	0.68	1.34	0.02	0.99	4.03	2.27	0.00
1995	0.65	1.66	0.00	1.23	5.45	3.11	0.00
2010	0.30	2.41	0.00	1.30	5.69	3.43	0.00
38 Private Health Services							
1980	1.08	1.68	0.00	0.90	5.37	2.92	0.00
1995	1.60	2.66	0.00	1.07	7.30	4.00	0.00
2010	2.85	3.37	0.00	0.85	8.44	3.53	0.00
39 Recreation and Culture							
1980	2.82	5.50	0.00	1.94	1.14	3.46	0.00
1995	4.37	8.18	0.00	2.73	1.62	4.73	0.00
2010	4.81	10.41	0.00	3.07	1.92	4.80	0.00
40 Government and Non-profit Institutions							
1980	16.53	20.38	22.96	12.57	19.70	5.63	7.86
1995	19.30	24.84	26.83	19.36	16.87	5.87	8.14
2010	21.45	24.73	27.54	21.90	15.92	5.49	8.19