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We apply the portfolio theory to assess the potential consequences in terms of risk sharing of the evolution of the industry mix of European Union countries between 1986 and 1997, and of the changes in the membership configurations of both economic and monetary unions. We compute a measure of risk-return performance for EU countries, by considering countries as collections of industries.

We observe that risk-return performance improved in most countries. We find that the EU9 is marginally more efficient than the other historical EU groupings, and that the Euro Zone might slightly benefit from the inclusion of the United Kingdom.

Keywords: European integration, risk sharing, regional specialization, portfolio diversification.
JEL Classification: F02, F15, F36.

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1. Introduction

Among the many motives for economic integration that have been put forward, stands the fact that an economic union benefits from the diversity of its member countries. The rationale behind that argument is that if one region of an economic union undergoes a slump while another experiences a boom, transfers from the latter to the former may help smooth their incomes. Income smoothing, or risk sharing, may thus be a sizeable benefit of economic integration.

Assessing the practical implications of that argument is particularly important in the case of the European Union. Namely, it is of great interest to know whether the loss of monetary independence may be at least partly compensated by greater income smoothing in the EMU. To answer that question, two sub-questions must be answered.

Firstly, one must determine the channels through which transfers among states may take place. Asdrubali, Sørensen and Yosha (1996) show that in the US 62% of shocks to gross state product are smoothed by capital and credit markets, and 13% by the federal budget. Using the same method, Sørensen and Yosha (1998) find that only 40% of shocks are

smoothed in Europe and the OECD. With a slightly different approach, Mélitz and Zumer (1999) conclude that 75 to 80% of idiosyncratic shocks go unsmoothed in the EU. These authors however also stress that monetary union may well increase smoothing through market channels, by fostering the integration of capital markets. This prediction is in line with Kalemli-Ozcan et al. (2001)'s finding that there is little risk sharing between countries but that a substantial degree of interregional risk sharing exists within federations. That literature therefore not only underlines that a sizeable proportion of consumption smoothing does not depend on public transfers, but also that risk sharing is positively influenced by economic integration.

Secondly, to the extent that some consumption smoothing may occur, its importance will depend on the characteristics of the countries that take part in the union, and in particular on the variances and covariances of their growth rates. One may then wonder which set of countries may provide the highest degree of risk sharing. With that end in view, Goldberg and Levi (2000) use the portfolio theory as a natural tool to answer that question in a recent and groundbreaking study.

The basic idea of their method is based on the analogy between countries and financial assets. Each country is accordingly described by the mean and the standard deviation of the growth rate of its GDP, which are the analogues to the expected return and risk of a financial asset. Their approach allows them to study the potential for risk sharing in the EU or alternative subsets of countries, analyzed as country portfolios. They observe in particular that few portfolio benefits have been realized by expansion of the EU beyond its original six members. In this paper, we probe more deeply into those results and the method from which they stem. However, our method differs from Goldberg and Levi (2000)'s in two important respects.

The first difference is that we do not consider countries as basic assets described by their own risk and return. Instead, we consider each country as a collection of industries. The analogy on which our study rests is therefore between industries and financial assets, where the growth rate of an industry and the standard deviation of its growth rate are the analogues to expected return and risk in financial portfolios. The same analogy was fruitfully used by Gunther and Robinson (1999) to study the industry diversification effect of interstate mergers among US banking groups. This modification of Goldberg and Levi (2000)'s method allows to study the evolution of the portfolio attributes of European countries as their sectoral composition evolves over time. By contrast, Goldberg and Levi (2000) could only study alternative groupings of countries but not the evolution of their portfolio attributes, because

these attributes were defined as means over the 1979-1994 period and were consequently time-invariant by construction.

The issue of the evolution of the portfolio attributes of countries comes nevertheless to the fore once one remembers that the very process of economic integration is likely to significantly alter the sectoral composition of the countries that take part in the process, hence their portfolio attributes. Thus, as European integration fosters trade integration, it is bound to affect the specialization of participating countries. The effect of trade integration is however ambiguous. If Krugman (1993) for instance argues that monetary integration may foster specialization, hence the resurgence of idiosyncratic shocks, empirical studies, such as Bayoumi and Eichengreen (1997) or Frankel and Rose (1998), reach the opposite conclusion.

The impact of European integration may also run through a subtler but less ambiguous channel that hinges on the relationship between risk and specialization. From a theoretical perspective, that relationship has attracted a lot of attention and spurred an extensive body of literature. Accordingly, risk is considered as an impediment to specialization according to comparative advantage, since the works of Brainard and Cooper (1968), Kemp and Liviatan (1973) or Ruffin (1974). That result may nevertheless not hold if trade in financial assets, i.e. the possibility to share risk, is made possible. This latter finding was first suggested in a seminal contribution by Helpman and Razin (1978), and extended by Anderson (1981). Subsequent contributions, such as Grossman and Razin (1984, 1985) or Helpman (1988), added credibility to that result by considering more realistic sources of uncertainty, such as country-specific shocks. The rationale of that result is that insurance through trade in financial assets may compensate the increased risk stemming from specialization. Its chief implication is that better risk sharing should result in greater specialization, which is precisely what Kalemli-Ozcan et al. (2003) observe in a recent and groundbreaking empirical study.

Moreover, increased risk sharing may also affect an economy's growth, in other words its return according to Goldberg and Levi (2000)'s analogy. Several channels have thus been described in the literature to account for this impact of risk sharing. Accordingly, risk sharing may increase the return on capital, thereby resulting in higher investment and faster growth as in Greenwood and Jovanovic (1990). However, as Obstfeld (1994) or Acemoglu and Zilibotti (1997) suggest, it may also affect investment qualitatively by giving agents the possibility to opt for riskier, but more profitable, investments or technologies. Finally, growth may also be affected through the positive effect of risk sharing on specialization, either because it allows a better exploitation of comparative advantage, as in Saint-Paul (1992), or because of the possibility of learning by doing, which is studied by Feeney (1999).

Our modification of Goldberg and Levi (2000)'s method stands therefore as a natural extension of that literature. Provided that European integration is bound to have affected the specialization of European countries, we assess how it may affect their capacity to share macroeconomic risk, either at the country or the Union level.

The second chief difference between our analysis and Goldberg and Levi (2000)'s is that, whereas they resort to graphical comparisons, we measure risk-return performance by the ratio of the portfolio return divided by its risk. We can then quantify the evolution of the risk-return performance of European countries and of the EU as a whole. It also allows us to study the risk-return performance of alternative groupings of the members of the EU.

To do so, the rest of the paper is organized as follows. Section 2 presents the evolution of the industry mix of European countries and of the European Union as a whole. Section 3 studies the evolution of the risk-return performance of individual member countries and the EU as a whole. Section 4 describes the portfolio attributes of alternative subsets of countries. Section 5 concludes.

2. Diversification in the European Union

We found a comprehensive description of the industry mix of the EU and its member countries over the 1986-97 period in the 1997 and 2000 issues of the Eurostat Statistical Yearbook. The nominal GDP of each country and of the EU as a whole are split between 6 industries.[1] In this section we measure the evolution of the diversification of European economies thanks to the Herfindahl index that we compute on the shares of each industry in each country. The Herfindahl index is calculated as the sum of the squared relative shares of industries in each country. It takes into account the relative size and distribution of the relative shares in a country, and it is lower the more diversified is the country. To obtain a more precise picture of the diversification of European economies, we complement the Herfindahl index with the share of the first industry in each country.

[1] Those industries are: agriculture, forestry and fishing; energy; manufacturing; construction; marketable services; non-marketable services.

Table 1: The evolution of diversification

	Herfindahl		Share of the first industry	
Country	**1986**	**1997**	**1986**	**1997**
Austria	29.26	34.27	44.8	52.3
Belgium	33.67	37.91	51	56.5
Denmark	29.53	31.38	45.3	47.1
Finland	25.40	28.51	38.1	41.4
France	30.47	34.28	47.1	51.9
Germany	30.69	36.66	43.3	53.9
Greece	23.92	36.78	38.3	56.9
Ireland	26.18	30.18	37.2	41.0
Italy	31.02	34.48	47.7	52.8
Lux	39.49	47.26	57	65.9
NL	32.66	31.74	51.7	48.8
Portugal	27.67	29.86	41.6	45.7
Spain	29.79	32.99	46.8	51.8
Sweden	27.16	30.24	38.3	43.3
UK	29.48	36.11	45.2	54.5
EU15	29.89	34.54	45.6	52.4

All figures are in percentage.

Lux: Luxembourg, NL: Netherlands, UK: United Kingdom, EU15: European Union (15 member countries).

Table 1 displays the results for the fifteen member countries for the years 1986 and 1997. It shows that the Herfindahl indices in general increased over the period of study. This first impression is confirmed by the evolution of the share of the first industry, which also rose between 1986 and 1997. For instance, Greece experienced the sharpest variation in diversification with an increase of 12.84 points of its Herfindahl index and of 18.6 points of the share of its first industry. As in all other countries, that industry was the marketable services sector both in 1986 and 1997. The evolution of the Herfindahl indices may then be explained by the growth of the share of this industry.

The Netherlands stands as the exception since it is the only country that grew more diversified, as both measures of diversification prove. More precisely, their Herfindahl index

declined from 32.66% to 31.74%, whereas the share of their first industry decreased from 51.7% to 48.8%. As regards international comparisons of Herfindahl indices, Greece was the most diversified economy in 1986, with a Herfindahl index of 23.92%, whereas Finland was in 1997, with a Herfindahl index of 28.51%. On the other hand, Luxembourg was the least diversified country both in 1986 (39.49%) and 1997 (47.26%). Our findings corroborate the results of previous studies. For instance, Midelfart-Knarvik et al. (2000) observe that the production of all EU countries but the Netherlands became more specialized between the periods 1980-83 and 1994-97.[2]

The evolution observed on individual member countries can similarly be observed at the European Union's level. Table 1 shows that the European Herfindahl index increased over our period of study and rose from 29.89% in 1986 to 34.54% in 1997. As a result, it appears that the European Union grew less diversified between 1986 and 1997, which is confirmed by the rise in the share of the marketable services industry over the same period.

The greater specialization depicted by table 1 may be a matter of concern insofar as it may result in a greater asymmetry of macroeconomic shocks, which would be costly in a monetary union.[3] This concern may be alleviated by two considerations. Firstly, the observed concentration results from the specialization of European economies in the same industry, namely the marketable services sector. Secondly, greater asymmetry as such may not be as harmful as it first seems, provided some risk sharing exists. More to the point, the risk sharing literature surveyed in the introduction implies that more risk taking is required to achieve more risk sharing.

Nevertheless, one may be tempted to deduct from table 1 that individual countries or the European Union may perform more poorly in risk-return terms as their diversification decreased, resulting in less risk sharing. This is not necessarily true and two possible evolutions may in particular contradict that simple intuition. European countries may thus have reallocated their activities towards more efficient industries, i.e. industries with a higher return and a lower risk. Alternatively, by concentrating their activities, European countries may have efficiently traded-off a higher return against a higher risk. In both situations, a

[2] For a survey of the literature devoted to the specialization of European economies, see Dierx et al. (2002).

[3] An anonymous referee suggested that this prediction could be tested by comparing the corelation of GDP's on two subperiods. Although this is feasible, it may also be misleading over our period of study. Indeed, the 1986-1997 period that we consider is marked by both an evolution of the structure of European economies and a convergence of national economic policies, implied by the general process of monetary integration. It would therefore be quite difficult to disentangle the relative impact of those two influences on the correlation of European countries' GDPs. However, such an exercise would make perfect sense over another period or within a country, at the regional level.

greater concentration of activities is consistent with a constant or increased risk-return performance.

To give a better account of the evolution of European countries and the European Union in risk-return terms, one has to describe more precisely their portfolio attributes, which is the aim of the next section.

3. An assessment of the risk-return performance of the industry mix in Europe

As our line of reasoning rests on the application of the portfolio method, we must firstly describe how we adapted that method to study the risk-return performance of the industry mix of a country. We subsequently apply that method to the case of individual countries and to the European Union as a whole.

3.1. Methodology

To apply the portfolio method one must describe the assets of which the portfolios under study consist and determine the weight of each asset in those portfolios. Accordingly, and following Gunther and Robinson (1999), we consider countries as a collection of industries. They can therefore be analyzed as portfolios whose basic assets are industries.

For the purpose of our analysis, we measure each industry's return by calculating the growth rate of each component of GDP at the European level. We subsequently interpret the average annual growth rate of an industry's production as the analogue to the expected return of a financial asset, whereas the variability of the annual growth rate of its production is the equivalent of the risk associated with a financial asset.

More precisely, we used the Eurostat decomposition of nominal GDP to compute each industry's annual nominal production at the EU level and used the EU-wide consumer price index provided by Eurostat to calculate each industry's real production. We subsequently worked out each industry's growth rate and finally obtained the mean and the standard deviation of the growth rates of the six industries over our period of study. The results of our computations are displayed in table 2 below:

Table 2: Industries' return and risk

Variable	agri	energy	manu	cons	marc	nmar
Return	–2.143	0.971	0.878	1.267	3.713	2.297
Risk	4.312	2.986	2.294	3.143	0.611	1.529

All figures are in percentage.
agri: agriculture, forestry and fishing; energy: oil, gas, coal extraction, nuclear power, hydroelectricity; manu: manufacturing; cons: construction; marc: marketable services; nmar: non-marketable services.

The choice to employ the EU-wide consumer price index instead of the GDP deflator to compute real industry GDPs is motivated by a convincing argument put forward by Sørensen and Yosha (2002). These authors argue that using the GDP deflator to deflate nominal GDP in empirical measurement of risk sharing is inadequate because it neutralizes the variations of a region's income due to the variations of the price of its production. Using an area-wide (here an EU-wide) consumer price index precisely allows not to neutralize that part of the evolution of income.

Besides, the way we assess each industry's risk and return assumes the existence of single industries across Europe. Although this assumption may seem extreme at first sight, it makes sense in the context of our analysis. Thus, assuming the existence of industries at the European level allows us to neutralize the impact of national economic policies that European governments will not be able to use in the future. Therefore, our results rely on sectoral shocks that will not be affected by the loss of independence of economic policies implied by European integration. Moreover, and above all, there is recent evidence obtained by Ramos et al. (2003) that the importance of sectoral shocks is increasing relative to national shocks and now exceeds national shocks'. By assuming the existence of single European industries, we consequently focus on the shocks that have become prevalent.

As regards the weights of each asset in the portfolio, we suppose that the weight of an industry in a country's portfolio is simply the contribution of that industry to that country's GDP. Consequently, the share $\alpha_{i,j,t}$ of industry i ($i = 1,\ldots,6$) in country j's portfolio ($j = 1,\ldots,15$) during year t ($t = 1986,\ldots,1997$), which can be read in the Eurostat Statistical Yearbook, is simply given by:

$$\alpha_{i,j,t} = \frac{industry\ i's\ production}{GDP_{j,t}} \qquad (1)$$

Once each industry's risk and return and its share in a country's GDP have been defined, the overall return of a country's portfolio is readily obtained by weighting each industry's growth rate by the relative importance of that industry in the portfolio of the country. Accordingly, country j's return during year t, which we denote $G_{j,t}$, is given by:

$$G_{j,t} = \sum_{i=1}^{6} \alpha_{i,j,t} \cdot g_i \quad (2)$$

where g_i is industry i's average annual growth rate.

Similarly, the standard deviation of the return of a country's portfolio that is labeled $std_{j,t}$, is obtained thanks to the following formula:

$$std_{j,t} = \sqrt{\sum_{i=1}^{6}\sum_{k=1}^{6} \alpha_{i,j,t}\alpha_{k,j,t}\omega_{i,k}} \quad (3)$$

In the above expression, $\omega_{i,k}$ denotes the covariance of industry i's growth rate with industry k's. However, whenever $i = k$, $\omega_{i,k}$ simply denotes the variance of industry i's growth rate.

With these definitions in mind, the application of the portfolio method is straightforward. The final step of our analysis is to assess the risk-return performance of a country's industry portfolio. Therefore, following Gunther and Robinson (1999), we measure a country's risk-return performance by the ratio of its portfolio's average growth rate (its return) divided by the standard deviation of its portfolio (its risk). This is simply given by:

$$Performance_{j,t} = \frac{G_{j,t}}{std_{j,t}} \quad (4)$$

In the following sub-section, we use our method to study the evolution of the risk-return performance of the EU and its member countries.

3.2. The evolution of the risk-return performance of European countries' industry portfolios

As we emphasized before, the simple observation that countries have grown less diversified between 1986 and 1997 does not allow us to conclude that their industry mixes are inefficient. They may thus simply have either reallocated their activities towards more efficient industries or traded off a higher return against a higher risk. In the absence of a collective utility function that would allow us to rank countries in welfare terms we must resort to our measure of performance to assess the relevance of European countries' industry mixes. Table 3 displays the result of our computations.

Table 3: The evolution of return, risk and performance

	Return		Risk		Performance	
Country	1986	1997	1986	1997	1986	1997
Austria	2.31	2.55	0.99	0.92	2.34	2.77
Belgium	2.49	2.66	0.91	0.84	2.74	3.16
Denmark	2.33	2.46	1.00	0.94	2.33	2.62
Finland	2.03	2.24	1.15	1.07	1.76	2.09
France	2.37	2.56	0.94	0.87	2.52	2.94
Germany	2.28	2.59	1.05	0.89	2.17	2.89
Greece	1.72	2.45	1.28	0.95	1.35	2.56
Ireland	1.94	2.12	1.20	1.16	1.61	1.82
Italy	2.31	2.51	0.99	0.87	2.34	2.89
Lux	2.61	2.93	0.94	0.80	2.77	3.69
NL	2.41	2.48	0.84	0.89	2.87	2.78
Portugal	2.05	2.31	1.10	0.99	1.87	2.32
Spain	2.24	2.47	1.00	0.90	2.24	2.74
Sweden	2.26	2.44	1.01	0.95	2.23	2.58
UK	2.36	2.58	0.90	0.85	2.62	3.05
EU15	2.31	2.54	0.98	0.88	2.37	2.88

Return and risk are in percentage.

Lux: Luxembourg, NL: Netherlands, UK: United Kingdom, EU15: European Union (15 member countries).

Casual observation of table 3 suggests that the risk-return performance of European countries in general tended to improve. Thus, the performance of fourteen member countries out of fifteen increased. That first impression is confirmed by the evolution of the return and risk associated with these countries. Namely, it appears that return systematically increased whereas risk decreased for those countries between 1986 and 1997. In other words, the 1997 industry mixes of these European countries strictly dominates their 1986 industry mixes in first-order stochastic terms – meaning a higher return and a lower risk.[4]

As before, the only exception is the Netherlands, whose performance decreased over the period of study from 2.87 to 2.78. However, this country's evolution is not as straightforward as the evolution of the other EU countries. Specifically, the Netherlands has experienced a surge in its return but that surge is more than compensated by an increase in their risk, which accounts for the evolution of their performance.

The rationale behind those results must be found in the evolution of the industry mixes of European countries. It may be driven by two trends, which are respectively the shrinking of

[4] A noteworthy implication of this result is that it implies a welfare gain for each country's representative consumer, regardless of her risk aversion. Our findings therefore do not rest on the definition of our measure of performance. This will also hold true for the ranking of country groupings in the next section.

the agricultural sector and the expansion of the marketable services industry. In risk-return terms, these sectors are respectively the least and the most efficient one, as shown in table 2. Consequently both trends concur to the improvement of the risk-return performance of EU countries. The special case of the Netherlands can also be accounted for by the same intuition, as it is the only country where the share of the marketable services industry decreased along the period.

Finally, an international comparison of performance scores reveals cross-country differences. In 1997, performance ranged from a low 1.82 for Ireland to a high 3.69 for Luxembourg. This ranking may result from the fact that these countries have respectively the smallest and the largest marketable services industry among European countries, which is as above-mentioned the most efficient industry in risk-return terms.

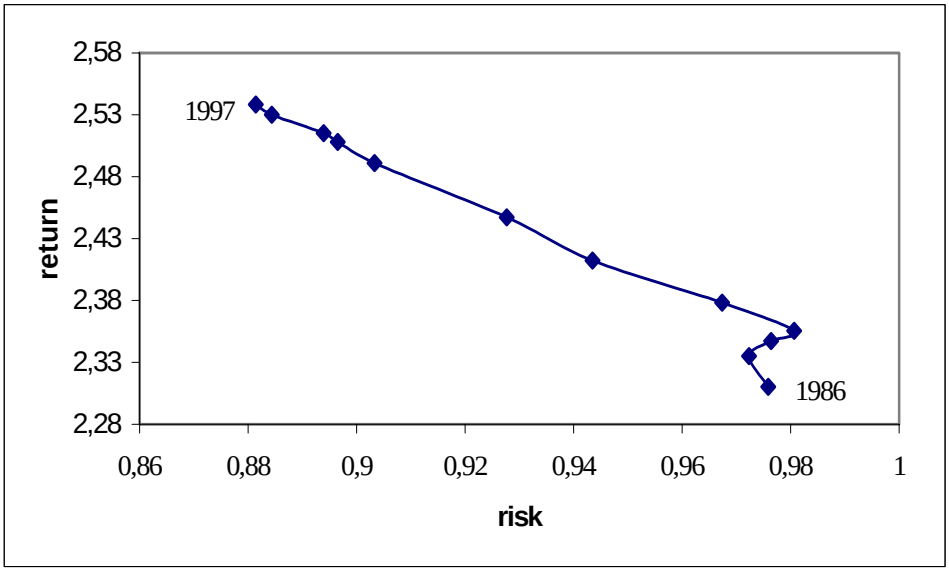
3.3. The evolution of the risk-return performance of Europe as a whole

As the Eurostat Statistical Yearbook not only provides the share of each industry in European countries' GDPs but also in the European Union's GDP, the application of the portfolio method to the EU is straightforward.

The same trend can be observed for the Union as a whole as for most of its member countries taken separately, in table 2. Thus, the EU's performance increased from 2.37 to 2.88 between 1986 and 1997. More precisely, its return rose from 2.31% to 2.54% whereas its risk decreased from 0.98% to 0.88%. There again, the 1997 version of the EU strictly dominates its 1986 version in stochastic terms.

Graph 1 sketches a richer picture of the evolution of the EU in risk-return terms. Each year's risk is measured on the horizontal axis and each year's return is measured on the vertical axis. It reveals that the Union's return generally steadily increased while its risk decreased from one year to another over the whole period, resulting in a year to year improvement of risk-return performance. The only exception is the 1987-1989 period, during which risk and return increased. Nevertheless, performance still improved between 1987 and 1988. It only deteriorated between 1988 and 1989.

Graph 1: the evolution of the EU's risk and return



To explain those results, both at the country and Union levels, one must bear in mind that there is no simple relation between concentration and performance. However they are probably due to two auspicious evolutions. On the one hand, the share of the marketable services industry, which provides the highest return for the lowest risk, as table 2 shows, increased in almost all countries as well as in Europe as a whole. On the other hand, the share of the industry exhibiting the lowest return and the highest risk, namely the agriculture forestry and fishing industry, persistently decreased. By the same token, the special case of the Netherlands can be accounted for by the decrease in the share of the marketable services industry in that country, which both enhanced its diversification and lowered its performance.

The finding that the potential for risk sharing increased with specialization may seem at odds with the findings of Kim (1995) and Asdrubali et al. (1996). Namely, Kim (1995) reports that specialization has decreased over time in the United States at the state level while Asdrubali et al. (1996) find that risk sharing among US states has increased over time. Kalemli-Ozcan et al. (2003) confirm those two trends.

The contradiction of those results with ours is only apparent. Indeed, our paper does not exactly measure the same phenomenon as Asdrubali et al. (1996) and Kalemli-Ozcan et al. (2003). Namely, whereas they are concerned with observed risk sharing, we measure potential risk-sharing. Therefore, our results are not directly comparable. What accounts for

their results is both the evolution of the specialization of US states and the evolution of the channels through which risk sharing occurs. The present paper only deals with the former.

4. Comparing the performance of alternative EU configurations

The composition of an economic union may always be subject to alterations. For instance, the composition of the EU evolved in several instances in the past, with the admission of new member countries. One may therefore wonder whether those successive enlargements were associated with improvements in risk-return performance. Moreover, and as monetary integration is about to foster risk sharing, one may also wonder whether the current Euro Zone may benefit from the inclusion of new member countries.

In this section, we consider the situation of the current European Union with the situations of alternative arrangements among subsets of its member countries. We must therefore complement our method so as to describe the portfolio attributes of imaginary unions. The next sub-section describes how we perform that analysis and the following two display our results pertaining to past and future enlargements, respectively.

4.1. Methodology

To apply the portfolio method to an imaginary economic union, we consider that union as a portfolio of countries that are themselves portfolios of industries. We must therefore define each country's weight in the union's portfolio. Following Goldberg and Levi (2000), we assume that the weight of each country is given by the relative GDP of that country versus that of the group.

To avoid the distortions that may be caused by the volatility of exchange rates, we base our calculations on GDPs expressed in US dollar converted thanks to an exchange rate computed at purchasing power parity values. Those data stem from the Growth Development Network database of the World Bank. Once each country's weight has been computed, the weight of an industry in the union's portfolio is simply given by the sum of the shares of that industry in the member countries of the imaginary union weighted by the weights of the member countries in the union. The weight of an industry is therefore given by:

$$\beta_{i,t} = \sum_{j=1}^{n} \alpha_{i,j,t} \cdot \frac{GDP_{j,t}}{\sum_{j=1}^{n} GDP_{j,t}} \quad (5)$$

Where *n* is the number of countries in the imaginary union.

Once these shares are defined, the imaginary union's portfolio attributes are readily obtained following the same method as in the previous section. We can therefore compute its performance score and compare it with that of the current EU or those of other imaginary unions.

As Goldberg and Levi (2000) appropriately underline, a limitation of that application of portfolio analysis is that it is based on past data. Thus, the risk-return characteristics of the industries we study are considered constant whereas they might have been different, had the composition of the union been different. In other words, we consider that an industry's average growth rate and the covariances between industries' growth rates are constant. We acknowledge that limitation of our method which is unfortunately inevitable.[5] We must however stress that, unlike Goldberg and Levi (2000)'s method, ours allows us to take into account the modifications in the countries' structures over time, which partly addresses that criticism.

Moreover, our method permits another improvement of Goldberg and Levi (2000)'s method. As their analysis is based on average size over their period of study, it cannot take into account the fact that faster growing countries tend to become relatively more important in the portfolio over time. By contrast, our method allows us to compute a different weight every year and cannot raise the same criticism. With these considerations in mind, the next sub-section presents the outcome of our calculations.

4.2. The consequences of EU enlargement in portfolio terms

In this sub-section, we concentrate on the last year of our period of study and compare the portfolio attributes of the current EU with those of the previous EU groupings that would have occurred if they had been left unchanged. We therefore compare the imaginary 1997

[5] A possibility would have been to compute variances and covariances over sub-periods, as is common in the empirical finance literature, but the time series at our disposal are too short to allow us to perform such an exercise.

portfolio attributes of the EU6, of the EU9, of the EU12 and of the Euro Zone (Greece included) with those of the current EU15.[6] Table 4 displays the results.

Table 4: The 1997 portfolio attributes of previous EU groupings

	Return	Risk	Performance
EU6	2.556	0.877	2.915
EU9	2.553	0.874	2.920
EU12	2.539	0.880	2.887
Euro Zone (12)	2.528	0.890	2.841
EU15	2.538	0.881	2.880

Return and risk are in percentage.

That table allows us to draw a few conclusions regarding the impact in terms of risk-return performance of the successive enlargements of the EU. Thus it appears that if the EU9 had lasted until 1997, it would have exhibited a better performance than all the other historical groupings. The first move from six to nine members would therefore have led to an optimal situation in 1997, which contrasts with Goldberg and Levi (2000)'s finding. Nonetheless, the EU9 does not strictly dominate the EU6 in stochastic terms. Thus, although the EU9 provides a lower risk than the EU6, its return is also lower.

However the EU6 and the EU9 both dominate the other groupings, in stochastic terms. In particular, a move from the EU9 to the EU12 in 1997 would have had adverse consequences in terms of risk and return: the performance measure would have fallen from 2.920 to 2.887. Besides, the impact of the last enlargement from the EU12 to the EU15 would have been more limited (from 2.887 to 2.880).

What explains the drop in performance between the EU9 and the EU12 is the industry composition of the EU members. In 1997, the share of the agriculture industry was more important in Greece, Portugal and Spain than in the EU9. On the other hand, the industry mixes of Austria, Finland and Sweden were closer to the EU12's, which accounts for the limited effect of the last enlargement.

[6] The EU6 includes Belgium, France, Germany, Italy, Luxembourg and the Netherlands. The EU9 consists of the EU6 plus Denmark, Ireland and the United Kingdom. The EU12 consists of the EU9 plus Greece, Portugal and Spain. The EU15 consists of the EU12 plus Austria, Finland and Sweden. The euro zone includes Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.

These results should however be qualified. It indeed appears that the differences observed between the historical groupings are quite limited and may not be significant. More precisely, the range between the best and the worst country grouping, in terms of either risk, return, or performance, is an order of magnitude smaller than the variations observed in individual countries' performances over the period of study. If we for instance focus on our measure of performance, we find that the difference between the best and the worst country groupings (i.e. the EU9 and the Euro Zone) is equal to 0.079, whereas the average variation of a country's performance between 1986 and 1997 amounts to 0.48.

Consequently, our results lend themselves to two opposite interpretations. Thus, whereas a euro-phile could use them as an argument in favor of past enlargements, a euro-skeptic could argue that not much has been gained or lost with these enlargements in terms of risk sharing.

4.3. Who's next?

In this sub-section, we assess the consequences of the inclusion of new countries in the Euro Zone. More precisely, we study three fictitious Euro Zones, each consisting of the current Euro Zone plus another EU country which does not yet take part in the current monetary union. We therefore compare the portfolio attributes of the Euro Zone plus Denmark, of the Euro Zone plus Sweden, of the Euro Zone plus the United Kingdom, and of the current Euro Zone. The results are displayed in table 5.

Table 5: The 1997 portfolio attributes of alternative Euro Zones

	Return	**Risk**	**Performance**
Euro Zone (12)	2.528	0.890	2.841
Euro Zone + Denmark	2.527	0.891	2.836
Euro Zone + Sweden	2.526	0.891	2.834
Euro Zone + UK	2.537	0.882	2.875

Return and risk are in percentage.

It appears that the inclusion of Denmark or Sweden would slightly reduce the risk-return performance of the Euro Zone. Indeed a Euro Zone including Denmark or Sweden

would face a weak decrease of its performance from 2.841 to 2.836 and 2.834, respectively. More to the point, table 5 reveals that the current Euro Zone would dominate the new alternative zones in stochastic terms. The similarity of the consequences of both inclusions may hinge on the closeness of the industry mixes of Denmark and Sweden. On the contrary, the taking part of the United Kingdom in the Euro Zone would improve the zone's stochastic attributes. Namely, the performance would then rise from 2.841 to 2.875.

Next to the sign of the variations in performance that would result from the inclusion of an additional country, the differences in the magnitude of the variations may raise attention. What accounts for these differences is chiefly the entrant's size, besides its industry mix. Indeed the UK is the only economy that is large enough to significantly affect the industry composition of the zone.

As before, these results must be considered with caution. The changes induced by the entry of a new country in the Euro Zone result in limited evolutions, compared to the observed variations in the performance of individual countries between 1986 and 1997. Therefore those results may also lend themselves to contradictory interpretations.

5. Conclusion

In this paper, we apply the portfolio theory to judge whether the evolution of their sectoral composition has resulted in portfolio benefits for the members of the European Union during the 1986-1997 period. In this aim, we compute a measure of risk-return performance for EU countries, based on growth rates and growth rate volatilities of industries, by considering countries as collections of industries. We find several important results.

Firstly, while diversification slightly declined over the period, risk-return performance improved in all countries but the Netherlands. Our findings suggest that European countries concentrated their activities on more efficient industries.

Secondly, the evolution of the European Union as a whole is similar to the evolution of individual countries. If we except the 1988-89 period, its performance constantly improved over time.

Thirdly, when comparing the portfolio attributes of the current European Union with those of the previous EU groupings (EU6, EU9, EU12) and the Euro Zone, we observe that if the EU9 had lasted until 1997, it would have dominated all the other historical groupings. It is also of interest to notice that the EU15 is more efficient than the Euro Zone, which may plead in favor of an enlargement of the Euro Zone.

Fourthly, we also investigate the consequences of the enlargement of the Euro Zone to either Denmark, Sweden or the United Kingdom, i.e. the three EU members that do not participate in monetary union. We find that, while Denmark and Sweden would marginally reduce the risk-return performance of the zone, the taking part of the United Kingdom in the Euro Zone would slightly benefit the zone. It has however to be stressed that the differences between the various country groupings are fairly limited.

Besides, our paper lends itself to several extensions in space and time that all depend on the availability of fresh data. An obvious prolongation will be to resume the analysis on a regular basis to keep up with the consequences of the future evolution of the European Union's industry mix. Another application would be to investigate the consequences of EU enlargement beyond its present members, Eastern European countries being the most evident candidates.

It must finally be underlined that our study focuses on the possibilities of risk sharing among European countries, as opposed to the effective extent of risk sharing. Whether those possibilities will be exploited in the future crucially depends on the magnitude of transfers among states and therefore on the evolution of the European institutional framework. The definitive answer to the questions we addressed in this paper consequently rests on politics rather than empirics.

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