

# **The impact of macroeconomic policy on investment, imported technical change and RTD in Greece**

**George Liagouras and Yannis Caloghirou with Artemis Koukounari,  
Laboratory of Industrial and Energy Economics,  
National Technical University of Athens**

The main objective of this paper is to study the impact of macroeconomic policy on technology in the small, middle-income and (now) open economy of Greece. The importance of macroeconomic policies on technological development will not be given particular attention because this is provided in other studies in the MACROTEC project (see Proposal and Theoretical Framework). Instead, the extended notion of technology used here must be clarified.

Sometimes, innovation is reduced to RTD and then to the more usual proxies of the latter, e.g. patents or R&D expenditure. Furthermore, RTD performance is often seen as the key factor shaping economic growth. This approach can hardly account for the existence of high-income nations or regions having relatively poor RTD performance. For example, as Lundvall, Johnson, Andersen and Dalum (2001) argue: “One of the interesting aspects of the Danish system is that its relative wealth has been built in spite of a specialization in low technology sectors and that most of its innovations are incremental and experience-based rather than radical and science based” (p. 16). Certainly, it is very difficult to quantify incremental, experience-based, or organizational innovations in order to proceed to international and inter-regional comparisons. Still, the socio-economic dimension of the above kinds of innovation frequently appears to be more important than technology in the narrow sense.

The narrow conception of technology becomes even more problematic when applied to intermediate and less developed countries (LDCs). Even though it can be argued that R&D is a critical condition not only for imitation but also for a successful transfer of technology, this is not at all evident for countries that are clear importers of technology. For these countries, technological development depends much more on the different forms of imported technology (FDI, capital goods imports, licensing) than on their (low) internal R&D capabilities. Thus, Franzen (2000) finds that for industrial countries, other than the G7, foreign R&D had a greater impact on productivity than domestic R&D. Molero (1998) shows the critical importance of MNCs for the technological development of a big intermediate economy like Spain. Finally, Mazumdar (2001) finds that in LDCs investment in domestically produced equipment reduces the growth rate while investment in imported equipment increases it.

Thus, especially for such countries, the study of the impact of macroeconomic policies on technology should give special importance to the different forms of technology transfer. The paper is structured as follows. The first part presents the macroeconomic policy and

performance of Greece from 1975 up to now. The second part analyses the impact of macroeconomic policy on investment and imported technology, whereas the third part focuses on the influence of macroeconomic policies on the RTD and innovation system.

## **I. Macroeconomic policy and performance in Greece from 1975 to the present**

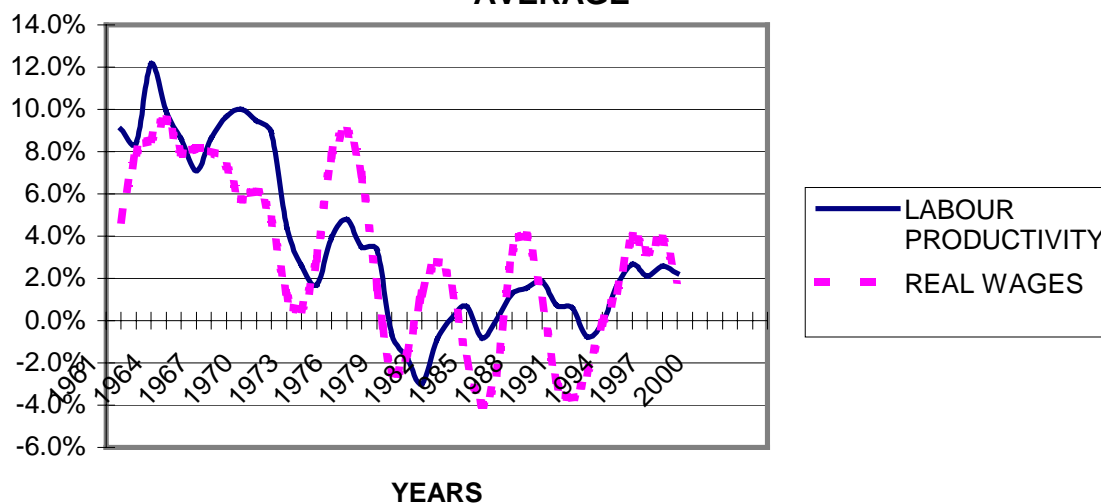
Macroeconomic policy in Greece from 1975 onwards can be divided into 4 regimes corresponding to the following periods: 1975-1989, 1981-1985, 1986-1990 and 1991-2000. Before explaining the main characteristics of each macroeconomic regime, and in order to better understand the latter, a brief introductory note on the development model of the Greek economy after World War II is presented.

### **1. Model of development and socio-political forces in post-war Greece**

In Greece the end of World War II was followed by a Civil War between the conservative and left alliances. The final defeat of the left-wing alliance (1949) inaugurated a semi-parliamentary regime where left parties and unions were outlawed. Besides, left-wing sympathisers suffered from systematic political discrimination and terrorist attacks from extra-military groups. This semi-parliamentary regime continued until 1967, when it was overthrown by a military junta (1967-1974).

The economic model, which was progressively established during the 1950s reflected the broader socio-political environment of this period. The state promoted the making of a domestic “entrepreneurial” class in the following possible ways: allocation of Marshall Plan financial assistance, low loans, low taxes and tax-evasion tolerance, subsidies, high protectionism, trade-union oppression, etc. At the same time, a special legal framework was established to provide additional incentives to attract Foreign Direct Investment either by foreign investors or by Greek entrepreneurs operating on an international scale (mainly ship-owners). The results appeared to be excellent. From the mid-1950s until the second oil crisis the Greek economy registered unprecedentedly high annual growth rates (6-7%). However, this “Greek miracle” demonstrated two basic structural deficiencies. First, the specialisation of Greek industry was in traditional (unskilled) labour-intensive and natural resource-intensive sectors (FDI had a dominant position in the latter sectors). Second, and much more importantly, the overall success of the Greek economy was based on an over-protected industry not only from abroad (high protectionism) but also from inside (union oppression). The tendency to the internationalisation in the world economy, but more substantively the entry of Greece into the EU (1981) and the establishment of a real democracy in 1974, rendered the post-war model of development obsolete.

**FIGURE 1: ANNUAL GROWTH RATES OF LABOUR PRODUCTIVITY AND REAL WAGES, 3-YEARS MOVING AVERAGE**



**2. 1975-1980: Maintenance of the status quo through loose monetary and credit policy**  
 During the period 1975-1980, Greek macroeconomic policy was expansionary. The principal objective was to support the existing model of development by very low (negative) real interest rates and sharp drachma devaluation. The important increases of real wages were the inevitable consequence for the legalisation of left unions and parties. This period was the only one in the post-war economic history of Greece when real wages increased faster than productivity of labour. However, this exception in the post-war model of development was not the result of a pro-labour income policy. It was rather the inevitable consequence of the legalisation of unions and communist parties.

The general macroeconomic performance up to 1979 was satisfactory. Of course the annual rate of growth had sharply slowed down (3-4 per cent) in comparison with the high scores registered during the 1960s (6-7 per cent). Nevertheless, it still remained high compared to the rates of growth of the western European countries. Similarly, even though inflation was high, its level too was near to those of the other economies of Western Europe. The coming of the second oil crisis in 1979 put an end to the hope that the post-war developmental path could be continued. In 1980 the growth rate and inflation jumped from 12 to 25 per cent. In order to confront stagflation an austerity program was adopted but a year after it was abandoned as the elections came closer. For the first time in the political history of Greece the coming to power of a socialist party seemed very likely.

**3. 1981-1985: Just at the wrong time - Socialists in power**

The victory of the socialist party in the elections of 1981 inaugurated a more active expansionary macroeconomic policy. During the period 1981-1985 the policy of drachma devaluation was continued. However the principal characteristic was the unprecedented increase of public expenditure, which was by no means compensated by an analogous increase of public resources. The spectacular increase of public expenditure served mainly to finance the realisation of the electoral promise of socialists for a social state. However, some structural features of the Greek economy and society, like the importance of the informal economy and of tax evasion, made the parallel increase of public resources impossible. At the same time, the already high level of inflation (25% in 1980) made impossible the financing of

public deficits via money creation. Thus, government borrowing seemed the only feasible solution.

The macroeconomic performance of this period was really poor. GDP per capita stagnated, public debt exploded and the high inflation of the previous period only slightly decreased. Besides, a new macroeconomic puzzle appeared, the deterioration of the trade balance.<sup>1</sup> The main reason for such a poor performance of the Greek economy during this period, and in the 1980s in general, is still in debate. Some economists, especially the conservatives (Alogoskoufis, 1995), argued that exclusive responsibility can be given to the expansionary and pro-labour policy of the socialist government. There is no doubt that the social and economic policy of the socialists was totally inappropriate in the (new) context of a restrictive (monetarist) international environment. In the 1980s it was too late to implement the social modernisation of Greece, a plan that had been postponed from the end of the Civil War. However, the imputation of the poor performance to an inappropriate economic policy is problematic because it ignores the structural developmental problems of the Greek economy.

A second interpretation (Giannitsis, 1988), focused on the structural difficulties of the overprotected Greek industry to cope with the entry of the country into the EC (1981). So, after 1981 the lack of competitiveness of domestic goods become obvious and resulted in the growth of imports even in traditional industries (textiles, clothing, footwear, etc.). A third interpretation (Mitsos, 1989) in turn contested the view that the bad economic performance was due to the shock provoked by the entry to the EC. According to this view, the high non-tariff barriers, which had been raised in the previous decades in order to compensate for the fall of tariff barriers, were not suppressed during the period 1981-1985.<sup>2</sup> Given that the main source of protection was the non-tariff barriers, the entry into the EC was far from being responsible for the poor performance of the Greek economy. Furthermore, the existing data on imports show that the penetration of foreign products into the traditional sectors where Greek industry was specialised, mainly occurred two years before the entry of the country to the EC (in 1979 and 1980). Thus, the collapse of the post-war model of development took place before the Greek economy face intensified competition inside EC markets.

It is beyond the scope of this paper to choose between the second and third interpretations. What is more interesting is to keep in mind is that, according to both views, inappropriate macroeconomic policy was not the main cause of the bad performance of the Greek economy during the 1980s.

#### **4. 1986-1990: A political cycle in policy-making**

1986-1990 was a transition period in the history of Greek macroeconomic policy, which constitutes a good example of a political cycle in policy-making. Despite the difficult economic situation, socialists gained a second electoral victory in 1985. In the first two years they implemented a stability (austerity) programme combining a new drachma devaluation (15%) with tight wage policy, cuts of public expenditure and increases of taxes. The main

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<sup>1</sup> This was mainly due to two reasons. First, the expansionary policy of this period stimulated the demand for imported (and sophisticated) goods rather than for those that were locally produced. Second, the fall of oil prices during the 1980s and the transmission of the recession in the Soviet countries had a negative impact on the exports of Greece to the Middle-East and East-European markets.

<sup>2</sup> See also Katseli (1990) for a similar point of view. The differentiation in the taxation of imported goods, which was the main source of non-tariff barriers, was progressively suppressed between 1984 and 1989. Other forms of hidden protectionism such as public procurements were maintained. On the public procurement policy in Greece and its failure to constitute a developmental strategy, see Caloghirou and Papagiannakis (1991).

proponent of the austerity program was the then Minister of Economy, and now Prime Minister, C. Simitis. Even though the restrictive macroeconomic policy started to have a positive impact on the macroeconomic disequilibria building up in the period 1975-1985, it was abandoned as elections came closer. Thus, the macroeconomic policy of the years 1988 and 1989 restored the previous model of macroeconomic management. The macroeconomic performance in the second half of the 1980s was better than that of the first half, but it remained weak. GDP per capita was steady, the trade balance continued to deteriorate but at lower rates, and inflation continued to decrease slightly. The most serious problem was the creation of a vicious cycle between the increase of the public debt and the rise of public deficits. Thus, even though public expenditure without interest payments on the public debt was steady and public resources experienced a slight increase during this period, public deficits continued to increase year by year. Besides, macroeconomic disequilibria deteriorated further from the last trimester of 1989 to the third trimester of 1990, when two successive elections failed to give a winner. The political instability and the incapacity of the alliance governments of this period to take political decisions had negative effects on macroeconomic performance.

### **5. 1991-2000: Restrictive macroeconomic policies and (nominal) convergence with the EU**

The coming to power of the Conservative Party in 1990 opened a new period where continuous restrictive policies gave priority to the convergence of Greek macroeconomic indicators with those of the other members of the European Union. The return of socialists to government in the end of 1993 did not really change the main orientations of economic policy. High interest rates, a strong drachma, and a rapid increase of the tax burden were the main instruments to achieve the Maastricht criteria and participate to the EMU. However, the possible negative social impacts from the continuous austerity policies were more or less compensated by the financial assistance provided by the regional policy of the EU Community Support Frameworks of 1989-1993, 1994-1999 and, now, 2000-2006).

The macroeconomic performance of this period showed a contrast. The austerity programme of the conservatives (1991-1993) turned into failure. The hard measures of their programme had a marginal positive impact on inflation and public deficit whilst causing a recession to the economy as a whole. Some possible explanations for this failure were the influence of European recession during the same period, as well as the internal contradictions<sup>3</sup> and the excessively ideological blend of the implemented programme.

However, the period 1994-2000 has been characterised by the (unexpectedly?) excellent performance of the Greek economy. During this period, inflation has been reduced from 14.5% to 2.5%, the public deficit decreased from 13.6% of the GDP to 0.8%, the exchange rate of the drachma was stabilised, and GDP per capita increased faster than in the rest of the EU. Consequently, Greece succeeded in fulfilling the Maastricht criteria and joined the Economic and Monetary Union (EMU). It must be noted however that the nominal convergence with the EU and the return of relatively high rates of growth was not only due to the restrictive macroeconomic policy of this period. In order to have a more objective view about the prospects of the Greek economy in the future, two other factors must be considered:

- First, in recent years the financial assistance from the EU rose to 4 or 5% of GDP.

Regardless of the long-term impact of the Community Support Frameworks, their short-term demand effects have been important.

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<sup>3</sup> For example, "the reduction in direct tax rates led to tax revenues decreases which had to be counterbalanced by indirect tax increases that fuelled inflation" (Lolos, 1998, p. 8).

- Second, the overexploitation of a continuously increasing immigrant and illegal labour force (Lianos, Sarris and Katseli, 1996) had positive effects on inflation and probably on growth.

As the above two factors have obvious limits, one can pose the question of whether the recovery of the Greek economy will continue into the future. In other words, the important success regarding the nominal convergence with the EU is far from being a sufficient condition for long-term development.

## II. The impact of macroeconomic policy on investment and imported technology

Tables 1 and 2 summarise the discussion of macroeconomic policy and performance in Greece for the period 1975-2000. After presenting the evolution of investment and imported technology, this chapter analyses how they have been influenced by macroeconomic policy.

**Table 1: Macroeconomic policies in Greece: 1975-2000**

<b>Macroeconomic instruments</b>	<b>1975-1980</b>	<b>1981-1985</b>	<b>1986-1990</b>	<b>1991-2000</b>
<b>Interest rates</b>	Very low (negative)	Low (negative)	Low (positive)	High
<b>Public expenditure*</b>	Constant	Sharply Increasing	Constant	Slightly decreasing
<b>Public Resources</b>	Constant	Slightly Increasing	Slightly increasing	Sharply increasing
<b>Drachma devaluation</b>	Large and increasing	Large and Increasing	Large but decreasing	Small and decreasing
<b>Real wage growth rates</b>	High (Positive)	Low (Positive)	Steady	Negative (-94) Positive (95-)
<b>Macro policy regimes</b>	<b>Expansionary</b>	<b>Expansionary</b>	<b>Transitory</b>	<b>Restrictive</b>

\* Without interest payments

**Table 2: Macroeconomic performance of the Greek economy: 1975-2000**

<b>Macroeconomic performance</b>	<b>1976-1980</b>	<b>1981-1985</b>	<b>1986-1990</b>	<b>1991-2000</b>
<b>Inflation</b>	Sharply increasing	Slightly decreasing	Slightly decreasing	Sharply Decreasing
<b>Public deficit</b>	Zero	Sharply increasing	Sharply increasing	Sharply Decreasing
<b>Trade balance</b>	Improving	Sharply deteriorating	Deteriorating slightly	Deteriorating
<b>GDP / person employed</b>	Increasing (-78)	Steady	Steady	Steady (-94) Increasing (95-)

## **1. The evolution of investment and imported technology**

The evolution of investment (Gross Fixed Capital Formation) in equipment and imported technology (equipment imports, royalties, FDI) is characterised by the following features:

- Investment in equipment as a percentage of GDP decreased from 1972 to 1986, and increased from 1987 until today, with the exception of the recession years 1991-93.
- The imports of equipment as a percentage of GDP follow the same pattern as the rate of investment in equipment. Even though from 1983 to the present, equipment imports have grown faster than investment in equipment, their relations are rather stable in the long run. The former accounts for approximately 60% of the latter. Therefore, it is reasonable to suppose that the study of the latter also applies to the former.
- Royalties as a percentage of GDP decreased from 1975 to 1992, and then increased.
- FDI is perhaps the most powerful mechanism for upgrading the technological potential of intermediate or less developed economies.

Unfortunately, in the Greek data (Bank of Greece) it is impossible to distinguish within long-term entrepreneurial capital inflows between Foreign Direct Investment and working capital. The spectacular take-off of long-term entrepreneurial capital from 1992/3 up to now has been mainly due to the financial liberalisation which permits Greek firms to get loans from abroad, and the acquisition of shares in Greek firms by foreign investors. Before 1992, i.e. the liberalisation of capital movements, the Bank of Greece collected data on FDI. But the time series were broken in 1992 and a new time series on FDI, based on a different methodology, has been used since 1998. If we take into account the dispersed information found in the press, FDI seems to follow the general pace of the Greek economy<sup>4</sup>. It was high in the 1960s, then it fell during the 1970s and 1980s, and started to rise again somewhere around the 1990s.

## **2. Is macroeconomic policy the main factor explaining changes in investment and technology imports?**

One could summarise the above ‘stylised facts’ by suggesting that during the 1990s, the good macroeconomic performance of Greece went together with its good performance in investment and imported technological progress; which was not the case for the period 1975-1990. Thus, two questions arise. First, can we assume that the inappropriate expansionary macroeconomic policies of the 70s and 80s are responsible for the poor macroeconomic and technological performance of this period? And second, is it not reasonable to suppose that the cause of the good macroeconomic and technological performance during the 1990s is due to the success of stability programmes implemented in the same period? The majority of Greek economists and all the national and international organisations (Bank of Greece, OECD, ...) tend to answer positively to both questions. Of course, this by no means excludes the existence or the possibility of different interpretations, but the main argument remains the same. Besides, the consensus is even stronger regarding the success of the macroeconomic stabilisation in the 1990s. According to this view, the tight macroeconomic policy headed an investment-led growth in two ways: first by increasing (or re-equilibrating) the share of capital and investment over the share of labour and consumption; and second by drastically limiting inflation, public deficits and drachma devaluations, and therefore by considerably ameliorating the business environment.

The positive answer to the first question clearly underestimates the structural developmental problems of the Greek economy, and especially of industry. Undoubtedly, the expansionary macroeconomic policies in the 1970s and 1980s caused a deterioration in the performance of the Greek economy, but the main problem was that the model of economic

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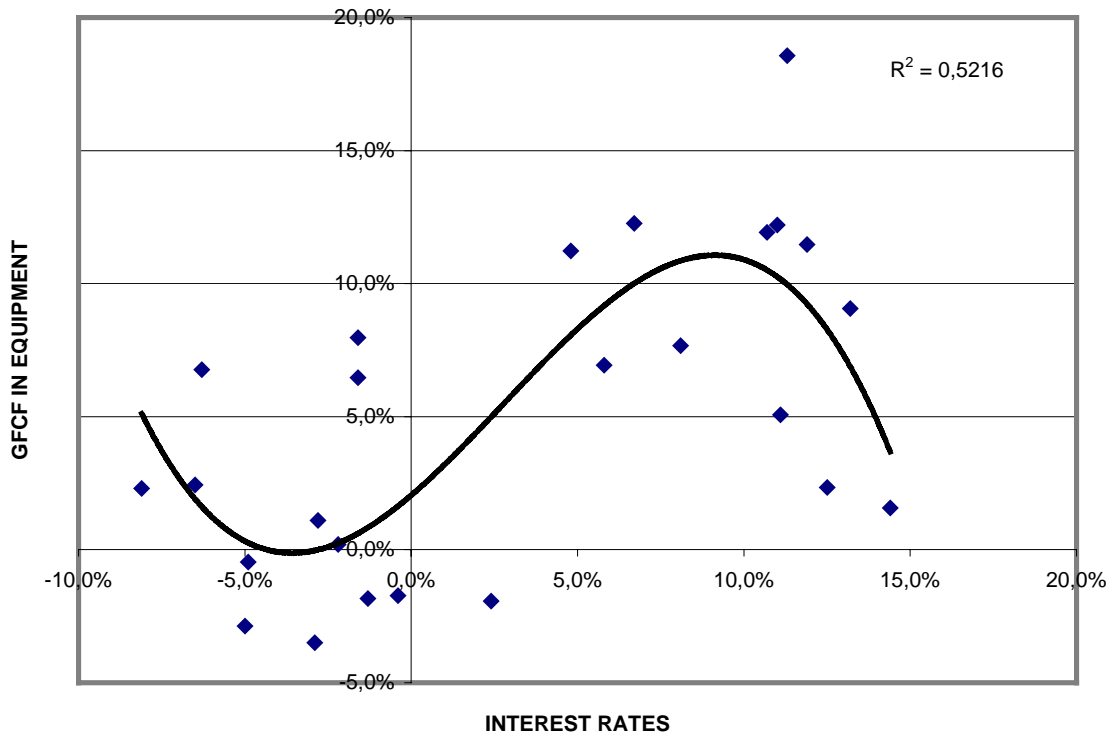
<sup>4</sup> Regarding especially the close relation between FDI and licensing, see Giannitsis (1991).

development of the 1960s had become obsolete in the new economic environment, as argued in the first part of the paper. *From this standpoint, the expansionary macroeconomic policy was the consequence rather than the cause of the bad macroeconomic and technological performance.* The Greek productive system was in such disarray during the late 1970s and the 1980s that it could hardly resist a really restrictive macroeconomic policy. Thus, if one compares the industrial and macroeconomic policies in Greece and Spain during the 1980s one can find an astonishing contrast between the political will of Spanish socialists to prepare their country to enter the EU and the “backwardness” of their Greek counterparts. However, Caloghirou, Voulgaris and Zambarloukos (2000), who have studied in detail the historical and political causes of the above contrast, admit that the different industrial capacities of the two countries also matter: “the difference in outlook between Greek and Spanish socialists also reflects the industrial capacity of each country and the structure of its enterprises. Spain is a large country compared to Greece and, despite the problems facing its manufacturing base, it had several large industrial enterprises that could potentially become competitive at the European level. In addition it had a strong private bank sector. Greece, on the other hand, feared that a more open market approach would lead to a radical reduction of its manufacturing base, given the small and uncompetitive nature of its enterprises and of its domestic market” (p. 91).

Another hint in this direction is the existence of important similarities between the economic policy of the conservatives in the second half of the 1970s and that of the socialists in the 1980s. Despite their opposite ideologies and political intentions, both policies focused on minimising the costs of the deep crisis of the post-war model of development (Lyberaki and Travlos, 1993). For example, when the socialists came to power in 1981 they insisted on the need to make massive investments in new technologies in order to foster the competitiveness of the Greek economy. In the first half of the 1980s, their leader, Andreas Papandreou, clearly disappointed by the performance of the domestic economy, declared that if the Greek entrepreneurs were still not willing to invest, his government would promote the rise of a new entrepreneurial class. Some years later, in 1989, the socialist party lost power by the unveiling of a major economic and political scandal, this being one of the new “entrepreneurs”, G. Koskotas.

Regarding the 1990s, it seems also reasonable to suppose that the stability effect on the business environment was positive. To our knowledge, there is no clear evidence that the good performance in terms of inflation, public deficits and exchange rate has really promoted investments and subsequently growth. It can be suggested however that the increase in real interest rates did not have negative influence on investment.

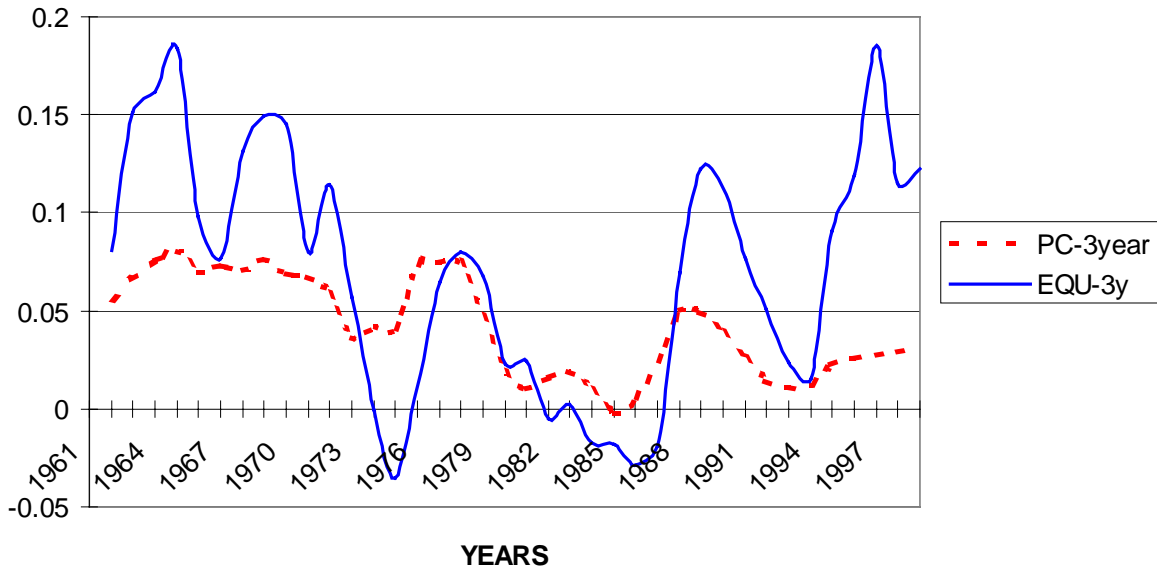
**FIGURE 2: REAL INTEREST RATES AND ANNUAL CHANGES OF GFCF IN EQUIPMENT  
(3-years moving averages)**



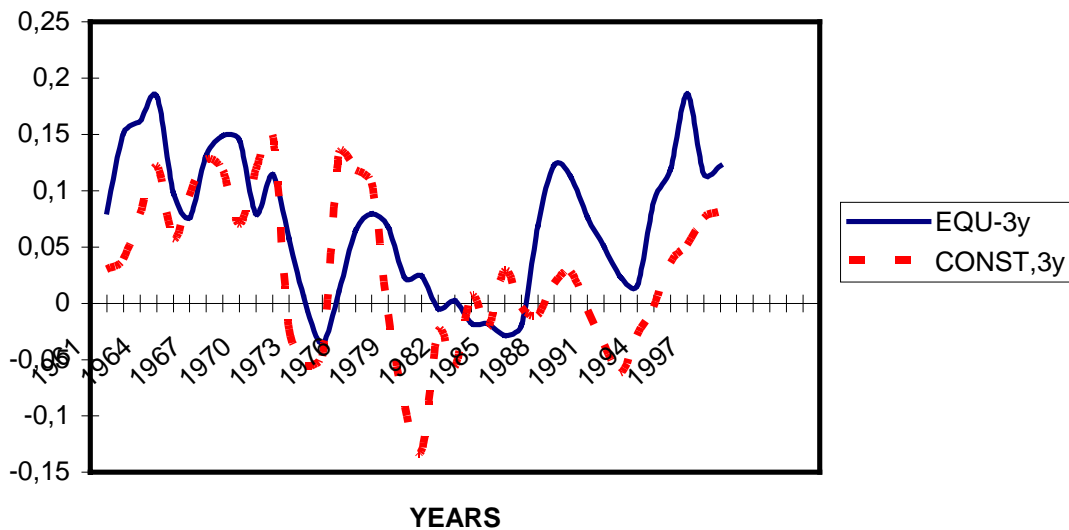
As can be observed in Figure 2, in the period 1980-2000 there were two successive regimes: a first one of negative real interest rates and low investment annual changes, and a second one with high interest rates and high investment annual changes. A possible explanation is that investment is influenced in the short run by the general macro-economic environment and not only by the cost of capital borrowing. Thus even though a negative relation between investment and interest rates can be observed for each regime (period), the macroeconomic stabilisation shifted the negative slope curve upwards.

Yet, as Figure 3 shows, investment growth rates started rising faster than consumption growth rates during the last expansionary period of earlier decades (1987-1989 or 1990)! Furthermore, the implementation of the conservative austerity policy of the years 1990-1993, instead of boosting investment at the expense of private consumption, produced the opposite result. It also must be noted that during the period 1989-1993 Greece benefited from the First Community Support Framework, which represented 2.6% of GDP (Lolos, 2001) and primarily concerned investment in physical and human capital. If this considerable financial assistance to investment had been lacking, the growth rates of investment would have been very much lower than those of consumption.

**FIGURE 3: ANNUAL GROWTH RATES OF CONSUMPTION AND INVESTMENT IN EQUIPMENT (3-years moving averages)**



**FIGURE 4: GROWTH RATES OF GFCF IN CONSTRUCTION AND IN EQUIPMENT IN GREECE ( 3- years moving averages)**



### 3. Is a new model of development emerging?: some initial hints

The above evidence questions the view that attributes the good performance of the Greek economy in the 1990s exclusively to the “good” (austerity) macroeconomic policy of this period. At the same time it points, as was the case for the decades of the 1970s and 1980s, to the importance of structural causes, which have been put forward by non-mainstream scholars of development. There is very interesting work on the structural deficiencies of the

previous model of development (Giannitsis, 1985; Vaitsos and Giannitsis, 1987; Mitsos, 1989). What is lacking is assessing the possibility for a new model of development. In what follows, some hints about this issue are discussed at a very aggregate level.

As can be seen in Figure 3 and Table 3, during the period 1969-1973 investment grew almost twice as fast as consumption. This reflected the fact that real wages grew much slower than labour productivity. During the same period, investment in construction, and especially in housing, was leading investment in equipment. From 1988 to 2000, investment in equipment again grew much faster than consumption, but this was not due to important differences in the growth of real wages and labour productivity (as was the case for the period before 1975). Furthermore, investment in equipment was far more important than investment in construction (Figure 4); and this, in spite of the programme of public investments in infrastructure (airports, ports, highways, etc.).

**Table 3: Average growth rates of private consumption, and of GFCF in equipment, construction and housing, Greece: 1961-2000.**

Period	A) Private Consumption	B) GFCF in Equipment	C) GFCF in Construction	D) GFCF in Housing	A/B	C/B	D/B
1961-73	6.8%	12.5%	9.5%	11.2%	0.54	0.76	0.90
1974-87	3.3%	0.7%	1.4%	5.1%	4.71	2.00	7.29
1988-00	2.9%	9.5%	1.9%	-0.4%	0.31	0.20	-0.04

Still, the above considerations are too weak to support the idea of the rise of a new growth regime in the Greek economy. The coming of the Olympic Games to Athens (2004), and above all the ending of the Third Community Support Framework (2008), will show whether the existing dynamics of the Greek economy could be maintained in the long run. Besides, the hypothesis of a new model of development needs to be tested in a less aggregated and more qualitative level than that of this study. To our knowledge, it is rather difficult to find comprehensive studies about the structural transformations of the Greek economy during the last 10-15 years. This is probably due to the domination in the 1990s of a new economic and political discourse, which privileges the nominal convergence of Greece with the EU and limits the structural reforms to the liberalisation of markets. From this point of view, Greece today faces a similar challenge to most of the CEECs (Dyker and Radosevic, 1999). That is, inasmuch as stabilisation policies in the 1990s were successful, there are far from sufficient conditions for the rise of a new and viable model of development.

### **III. The impact of macroeconomic policy on RTD and the innovation system**

#### **1. The Greek system of non-innovation**

As said in the first part of this paper, the post-war model of development in Greece was characterised by the prominent role of construction and trade activities relative to manufacturing, and by the specialisation of manufacturing firms in traditional industries (unskilled labour intensive or natural resource intensive sectors). Therefore, the technological base of the Greek economy was exclusively dependent on technology transfer from abroad (FDI, capital goods, imports and licensing). The lack of endogenous technological development coincided with the reluctance of the business sector to invest in innovative activities. Even though the post-war model of development is now over, some of its negative

features still persist. In the following section we present briefly the Greek context in RTD and innovation. For further studies on this subject (published in English) one should look at Deniozos (1996, 1997), Katsoulacos et al. (1996), Vernardakis (1996), Kastelli (2000), Kastelli and Tsakanikas (2001), and Bakouros, Mardas and Vaskarelis (2002).

**Table 4: GERD, BERD and BRDP (Business R&D Personnel) in Southern Europe and in Ireland (1997)**

	<b>GERD/GDP</b>	<b>BERD/GDP</b>	<b>BERD/GERD</b>	<b>BRDP (per 1000 in labour force)</b>
<b>GREECE</b>	0.51%	0.13%	25.6%	0.77
<b>PORTUGAL</b>	0.65%	0.14%	22.5%	0.40
<b>SPAIN</b>	0.86%	0.40%	48.8%	1.84
<b>ITALY</b>	1.00%	0.53%	53.2%	--
<b>IRELAND</b>	1.43%	1.03%	73.3%	5.31
<b>EU-15</b>	1.82%	1.13%	62.9%	5.07

Source: OECD (2000), GSRT (2001)

As can be observed in Table 4, in 1997 Greece shared with Portugal the last position in all indicators concerning GERD, BERD and BRDP (Business R&D Personnel). Both countries clearly lag behind not only the EU-15 average but also Italy and Spain. Besides, it is a matter of concern that the lag of the two countries is even greater in the case of BERD. The ratios of BERD to GDP are so low (0.13%) that even the study of their evolution over time becomes problematic.

Anyway, there was no significant evolution in any of the above indicators during the 1990s. In the case of Greece a limited improvement can be observed between 1985 and 1991, but it is likely that this was due to improvements in the measurement of the corresponding variables, which took place in the mid 1980s.

**Table 5: Scientific performance in Southern Europe and in Ireland**

	<b>Publications</b>			<b>Citations</b>		
	World share (adjusted)* 1998	Av. growth of share		World share (adjusted)* 1996	Av. growth of share	
		1990-95	1995-98		1990-93	1993-96
<b>GR</b>	0.60%	6.6%	7.6%	0.40%	2.8%	13.9%
<b>P</b>	0.32%	9.0%	11.6%	0.21%	7.2%	10.5%
<b>SP</b>	0.77%	8.9%	5.6%	0.61%	12.4%	8.6%
<b>I</b>	0.79%	4.8%	3.4%	0.77%	5.8%	7.4%
<b>IRL</b>	0.84%	4.0%	5.9%	0.56%	-1.4%	6.1%
<b>EU-15</b>	1.05%	2.8%	1.7%	1.07%	2.8%	2.1%

Source: European Commission (2000)

Theoretically, the underdevelopment of R&D activities in the Greek economy could also result from the inability of higher education mechanisms to supply the required quantity and quality of researchers. Still, there is no such lack of human capital in Greece for R&D activities. Not only does Greece have an excess of PhDs, but also most of them come from well-known European and American universities and technical institutes. The fact that many PhD holders have no alternative but to wait for a long time to be employed by universities or public research institutes cannot be attributed to the quality of their knowledge and skills. In

other words, the missing link is not the supply of high-quality researchers but the capacity of the business sector to absorb them. Furthermore, the poor prospects for being employed as a researcher in Greece is one of the reasons that many young Greeks after completing their PhDs abroad prefer to start a career there<sup>5</sup>.

The divergence in the performance of the scientific and techno-economic system in Greece can be shown by comparing Tables 4, 5, 6 and 7. Compared to the resources Greece devotes to R&D (GERD/GDP), its scientific performance measured by publications is very satisfactory. Concerning its world share in publications, adjusted by population (Table 5), Greece's position is close to Italy and Spain and above Portugal.

The scientific performance of Greek researchers is less remarkable when we are using citations as an indicator. But even in this case its position remains satisfactory relative to its investments in R&D.

**Table 6: Patent applications to the EPO per million inhabitants, Southern Europe and Ireland**

	Number of patent applications per million inhabitants, 1999	Average annual growth rates (1991-1999)
<b>GREECE</b>	8.1	18.2%
<b>PORTUGAL</b>	4.7	52.8%
<b>SPAIN</b>	23.4	21.9%
<b>ITALY</b>	68.1	8.7%
<b>IRELAND</b>	69.9	32.3%
<b>EU-15</b>	140.9	3.0%

Source: Eurostat (2001)

**Table 7: Exports (X) and Imports (M) in High-Tech Products\* in Southern Europe and Ireland**

	X / M	X-M / X+M	Average annual growth (X)	
			1990-1994	1995-1998
<b>GREECE</b>	15.7%	-72.9%	15.3%	15.8%
<b>PORTUGAL</b>	23.6%	-61.8%	1.3%	-1.8%
<b>SPAIN</b>	44.9%	-38.0%	15.8%	9.3%
<b>ITALY</b>	67.9%	-19.1%	6.8%	6.4%
<b>IRELAND</b>	157.5%	22.3%	11.8%	24.1%
<b>EU-15</b>	81.3%	-10.3%	10.8%	12.0%

Source: European Commission (2000)

\*High-tech products: Aerospace, computers and office machinery, electronics and communications, pharmaceuticals, scientific instruments, electrical machinery, chemicals, non-electrical machinery, armaments.

When we pass from scientific to technological output the gap between Greece and the EU-15 average widens considerably. The proxy for technological output used here is the number of patent applications per million inhabitants deposited by residents at the national patent office and the European Patent Office (EPO). In both indicators, Greece is performing much better than Portugal, but this simply reflects the important differences in FDI inflows between the two countries. Thus, in 1999 the dependency ratio (non-resident/ resident patent applications) was approximately 100/1 for Greece against 400/1 for Portugal.

<sup>5</sup> For more on the relation between higher education and labour markets in Greece, see Caloghirou, Liagouras and Protogerou (2001).

The weak position of Greece (and the illusion of its precedence over Portugal) becomes evident when one takes into account indicators that combine technological and economic performance, such as the trade in high-tech products. Irrespective of which indicator is used – exports/imports ratio, Balassa index  $(X - M)/(X+M)$ , high-tech exports to total exports or to GDP ratios, etc. – Greece occupies the last position among EU countries.

**Table 8: Some indicators of the technological gap between Southern Europe, Ireland and EU-15 (base: EU-15 = 100)**

	<b>GERD/GDP</b>	<b>BERD/GDP</b>	<b>Publications</b>	<b>Patents appl. (EPO)</b>	<b>(X/M) in high-tech</b>
<b>GR</b>	28	12	57	6	19
<b>P</b>	36	12	30	3	29
<b>SP</b>	47	35	73	17	55
<b>I</b>	55	47	75	48	84
<b>IRL</b>	79	91	80	50	194
<b>EU-15</b>	100	100	100	100	100

Table 8 summarises the above discussion of the RTD system in Greece. It seeks to make comparable some basic indicators used here by recalculating them using as a base the performance of the EU-15 (=100). This makes it easier to locate the major problem of the Greek RTD system, i.e., a relatively important scientific base that can hardly be exploited by the business sector.

Still, as stated already in the Introduction, a strong RTD system or a specialisation in high-tech sectors is not the only way to long-run development, especially for small economies. From this point of view, studies or surveys on innovation like the CIS are far more important than R&D indicators. Nevertheless, according to the two CISs (GRST, 1996; Logotech, 2001a,b) the position of Greece is not at all enviable, even though an improvement can be observed from CIS I to CIS II, i.e. a fourfold increase in the number of innovative firms from the 1989-91 to the 1998-99 period. Such a fast change should be attributed to problems of measurement, especially in the realisation of CIS I, rather than to real improvements in the propensity of Greek firms to innovate. Thus, in a comparative study of the OECD (1999) on innovation performance (percentage of innovative firms) based on the CIS II data (1994-1996), Greece still occupies the last position among EU countries.

Two structural features of the Greek system of innovation are of great concern. First, the majority of non-innovative firms face fewer obstacles to develop innovations than the innovative enterprises! This paradox means that the reasons behind the lack of innovative performance should be found outside the innovation process itself. The more reasonable hypothesis in this case is that for some reasons (business culture, relative lack of competition, ...) the majority of Greek firms simply do not seek to innovate. Second, the CIS data for the periods 1994-96 and 1997-98 show that the degree of cooperation in the process of innovation is very low among the Greek (manufacturing) firms: "The majority of the Greek enterprises (77% in the first period and 65% in the second period) have limited or no interaction with other organisations during the innovation process. Information necessary for the development of innovation is derived mainly from within the firms showing an isolation of the firms from their environment. This is actually obvious in both SMEs and large companies. In addition the percentage having contacts and deriving ideas and information from a wide range of organisations (customers, suppliers, research and technological institutions) in order to develop their innovation is as low as 11%-13%. This is too low, in

comparison to other small-medium countries such as Ireland, Belgium, Holland, and Norway where the respective shares are between 33% and 35%” (Logotech, 2001b).

## **2. Technology policy in Greece: searching to establish the missing link between science, technology and economy.**

According Deniozos (1993), technology policy in Greece can be divided into three periods. During the first period, that is before 1983, relatively little attention was paid to endogenous technological development. The main concern of industrial policy was to improve the technological base of the Greek economy via technology transfer from abroad. Significantly, the Ministry responsible for R&D issues was the Ministry of Culture.

The second period, 1983-1989, marked a turning point in Greek technology policy. Efforts for endogenous technological development clearly took over technology transfer policies. The *General Secretariat of Research and Technology* (GSRT), attached to the Ministry of Industry, Energy and Natural Resources, played a very active role in the promotion of internal RTD capabilities of the Greek economy, and especially of the manufacturing firms which were seriously threatened by foreign competition. It is beyond the scope of this study to present the whole spectrum of specific policy actions taken during this period. Instead, reference will be made only to the measures that were directly related to the main objective or the basic philosophy of public action, i.e. the integration between research and industrial (economic) activities.

The realisation of the above objective involved two basic axes of intervention. First was by the launch of national programmes aiming to foster the industrial research of firms and of networks of firms (*Programme for Developing Industrial Research*, PAVE) and the cooperation of Universities or Research Institutes with industries/users (*Programme of Co-Financing*, SYN). Second was by the creation of intermediate organisations – joint ventures between the State, universities and firms – aiming to provide technological assistance to SMEs in specific industrial sectors (*Industrial Research and Technological Development Companies*, EBETA).

The third period from 1990 until today coincides with stability (austerity) policies at the macroeconomic level and the (nominal) convergence constraints set up by the Maastricht criteria. This period is characterised by the effort to preserve and deepen the policy priorities of the previous decade by using financial assistance from the Community (EU) Support Frameworks, and especially from the Structural Funds. In the new context of the European Support Frameworks I and II, the GSRT launched two comprehensive programs, the *Business Program for Research and Technology I* (1989-1993) and *II* (1994-1999) (EPET I and II).<sup>6</sup> Again the basic objective of the S&T policy was to strengthen the linkages between research and productive activities either by giving aid and incentives or by creating intermediate organisations. An example of the first case is the sub-programme of EPET II, *Research Joint Ventures for Improvement of Competitiveness* (EKBAN), which seeks to establish cooperative R&D activities in strategic sectors. Examples of the second case are the *Technological Parks* and the *Business Innovation Centres*, which provide various types of consultancy and training especially for SMEs.

During this period the Greek RTD system has also benefited from European technological policy, i.e. the Framework Programmes. The financial participation in Framework programmes rose from 2.1% in 1986 to 12.4% in 1997 of the GERD of Greece.

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<sup>6</sup> The programmes of the previous period (PAVE, SYN) were integrated into EPET. Another programme of this period was STRIDE HELLAS (1991-93), integrated into the European initiative STRIDE (Science and Technology for Regional Innovation and Development), concerning the less-favoured regions of Europe.

From a financial point of view, the EU Framework Programmes have the same importance for Greece as the EU Support Frameworks (Structural Funds).

### **3. The impact of macroeconomic policy on the RTD system**

As mentioned in the proposal of MACROTEC and in the Guidelines of WP4, the main direct effects of macroeconomic policies on the S&T system concern the supply side (interest rates, bank credit, taxation of firms, ...), the demand side (the derived demand for technology), and the stability of the macroeconomic environment (inflation, exchange rates). Indirect effects of macroeconomic policies, taking place principally via the funding of S&T policies and the promotion (or the undermining) of a model of development, are also very important.

Let us start from the funding of S&T policy. Data show that government participation in the financing of R&D remains rather stable as a percentage of GDP and falls as a percentage of GERD (74.4% in 1986, 49.3% in 1993, and 55% in 1997). Still, as in the 1990s the inflows from the EU (Framework programmes and Structural Funds) range from 20% to 25% of GERD, and broad public participation in the financing of R&D remains stable, i.e. approximately 80% of the GERD. *This means that the EU research and regional policy was very successful in enabling the Greek government to fulfil the Maastricht criteria by means of a tight macroeconomic policy without at the same time reducing its financial support for R&D.*

Nonetheless, it remains questionable whether the conditions required to have access to European financial resources correspond to the specific needs of the Greek economy. It is likely that EU funding has a more positive impact on the employment and training of Greek researchers than on technology performance or the innovative capabilities of the economy. Deniozos (1997), who now is and has also been in the past Head of GSRT, summarised the problems of S&T policies for less-favoured regions in the following way: "The practice in these regions proves that it is much easier to implement science policy measures (create research laboratories, train new researchers), than to encourage industry to undertake R&D projects, use R&D results or even use technological services and participate in the development of S&T parks... The relevance of the research implemented in these countries for the local or national economies and societies attracts fewer discussions than the issue of funding. Several assessment studies have been drafted ... The conclusions range from absolutely enthusiastic, when dealing exclusively with the impact on the national science systems, to moderate positive when taking into account the socio-economic improvements due to the potential exploitation of research results"(p. 184).

All the new evidence accumulating from 1997 till now supports and even accentuates the hypothesis of serious missing links between the scientific system and the economic system. Thus, the main point of the assessment of the national programmes PAVE and SYN (BPM, 1999) is the inability of Greek firms to exploit the results of their research. Similar results can be found in the assessment of such intermediate organisations as the Industrial Research and Technological Companies (Logotech, 1997). Besides, recent assessments of the impact of EU RTD and regional policy on technological and economic cohesion are rather disappointing for Greece (Clarysse and Muldur, 2001; European Commission, 2001).

Most importantly, recent research (Tsakanikas, 2002) has shown that Greek participation in the EU-RTD Framework Programmes was mainly expressed by the universities and the research centres until the beginning of the 90s. A sharp increase was established in the next period, as the Greek firms increased their participation in the 4<sup>th</sup> Framework Programme (1994-1998). An average annual growth of 37% was established compared to the overall 32% increase of European firms in general. However field research in the participant firms shows that this significant participation in these research partnerships has not been translated into any serious outcome in the product development area. Greek firms mainly participate in order

to have access to complementary knowledge resources and skills and keep up with technological developments, not to reduce R&D costs (since it usually represents their only activity in that area) or gain some market advantages. They benefit mostly by upgrading their knowledge base, whereas their European counterparts seem to have an eye on the market, despite the fact that these partnerships are precompetitive and do not directly aim at the market area. Therefore, European firms, contrary to the Greek ones, seem to be in a better position to exploit these activities in the market area, even in the long term.

Our hypothesis is that the above ‘disappointing’ results are due to the fact (among others) that the conditions required to have access to EU funds hardly correspond to the socio-economic specificities of Greece, and of less-favoured regions in general. In the cases of Greece and of other related countries, S&T policy should find its own way to be efficient instead of imitating the model of the leading economies of the EU.<sup>7</sup> More concretely, privileging innovation over R&D (Logotech, 2001), technology transfer and diffusion over internal production of technology (Vernardakis, 1995), and comprehensive industrial modernisation over strengthening of the RTD system, could perhaps yield better results. From this standpoint, perhaps the more positive impact of the EU on the Greek innovation system is the pressure for modernisation it puts on domestic firms. It is very likely that the change in the entrepreneurship patterns of the most dynamic part of the business sector will promote the Greek innovation system more than the EU and national RTD policies all put together.

Still, a detailed discussion of the need to reform the Greek S&T policy is beyond the scope of this study. It is mentioned here in order to give a better introduction to the discussion about the direct (supply, demand and stability) effects of macroeconomic policy on technology. There is an interesting empirical literature on the supply and demand effects. From the *supply* side, interest rates are perhaps the most important variable. Guellec and Ioannidis (1997) found evidence that business sector R&D spending is sensitive to interest rate fluctuations. The *demand* effect of macroeconomic policies on technology can hardly be studied directly. What has been studied at length is the impact of demand fluctuations on technology, in the context of the “technology-push vs. demand-pull” debate. It is worth noting that most empirical studies published in the 90s found that there was a significant impact of demand changes on different proxies for technology, like R&D spending, patenting, or number of innovations (Kleinknecht and Verspagen, 1990; Geroski and Walters, 1995; Guellec and Ioannidis, 1997; Brouwer and Kleinknecht, 1999; von Tunzelmann and Efendioglu, 2001; Lebas, 2001).

Nevertheless, the above empirical literature is based on data referring to developed or leading economies having more or less high ratios of GERD and BERD to GDP. Given the structural deficiencies of the Greek innovation system presented above, similar tests would be of very little relevance, even in the hypothetical case of reliable time series on RTD and innovation variables. Fluctuations of interest rates could hardly have any effect on the decision of firms to invest in endogenous technological development in underdeveloped RTD and innovation systems. By the same token, where there is neither a *critical mass* of resources devoted by business sector to RTD and innovation nor even enough consciousness about the importance of innovation, the whole system is rather insensitive to demand fluctuations.

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<sup>7</sup> Theoretically this is also the position of European Commission. According to the Green Paper on Innovation, innovation “is a means by which less favoured regions can move immediately alongside the developed regions, not by attempting to imitate what the latter have already achieved but by trying to lay the groundwork, in accordance with their own features and requirements”.

#### 4. Concluding remarks

For small intermediate countries like Greece, imported technology (FDI, capital goods imports, royalties) and investment in general are equally or even more important for techno-economic performance than the domestic production of technology. This is why both factors have been given equal importance in the study of the impact of macroeconomic policy on technology in Greece.

The macroeconomic policy of Greece was expansionary for the period 1975-1990, and restrictive from 1990 until today. Expansionary macroeconomic policy coincided with poor performance in basic macroeconomic indicators, investment and imported technology. Instead, restrictive macroeconomic policy coincided with good performance in the above variables. The positive (negative) impact of restrictive (expansionary) macroeconomic policy on investment, and indirectly on imported technology, is clearly overestimated by scholars who do not take into account the structural problems of the post-war model of development in Greece.

In most RTD indicators Greece shares with Portugal the last position in EU-15. The basic problem of the Greek RTD system is that its relatively important scientific base cannot be exploited by the business sector. EU research and regional policy was very successful in enabling the Greek government to implement a restrictive macroeconomic policy without reducing its financial support for RTD. However, the conditions required to have access to EU funds did not seem to correspond to the specificities of the Greek economy. Thus, EU funding had a more positive impact on the employment and training of Greek researchers than on the country's overall techno-economic performance. On the other hand, fluctuations of demand and interest rates have little or no impact on underdeveloped RTD and innovation systems, like that of Greece.

From the above, two policy directions can be derived. The first is that the success of stabilisation policies in the 1990s forms a necessary but not sufficient condition for inaugurating a new development regime. There is now need for a more active development policy. The latter can hardly be fulfilled by the dominant paradigm in the economic policy of the last decade that reduces structural reforms to privatisation and liberalisation of markets. Still, such developmental policy, instead of simply imitating the "best practices" followed by the leader nations of EU, should correspond to the specificities of the Greek economy. The impact of EU research and regional policy on the Greek RTD system is a good example for the possibility of a *crowding out effect* of European policies on the domestic ones. As said above, Greece could not combine restrictive macroeconomic policies with a more active RTD policy without the support provided by EU policies. However, the moderate or even disappointing results of the Greek RTD system point to the need to re-elaborate the overall concept of technology policy by adapting it to the specificities of the Greek economy. For example, privileging "soft" forms of innovation over the "hard" ones (R&D), technology diffusion over technology production, and comprehensive industrial modernisation over strengthening of the RTD system, could perhaps give better results than have been observed so far. From this point of view, the more positive impact of EU integration on the Greek innovation system is the pressure for modernisation it puts on domestic firms.

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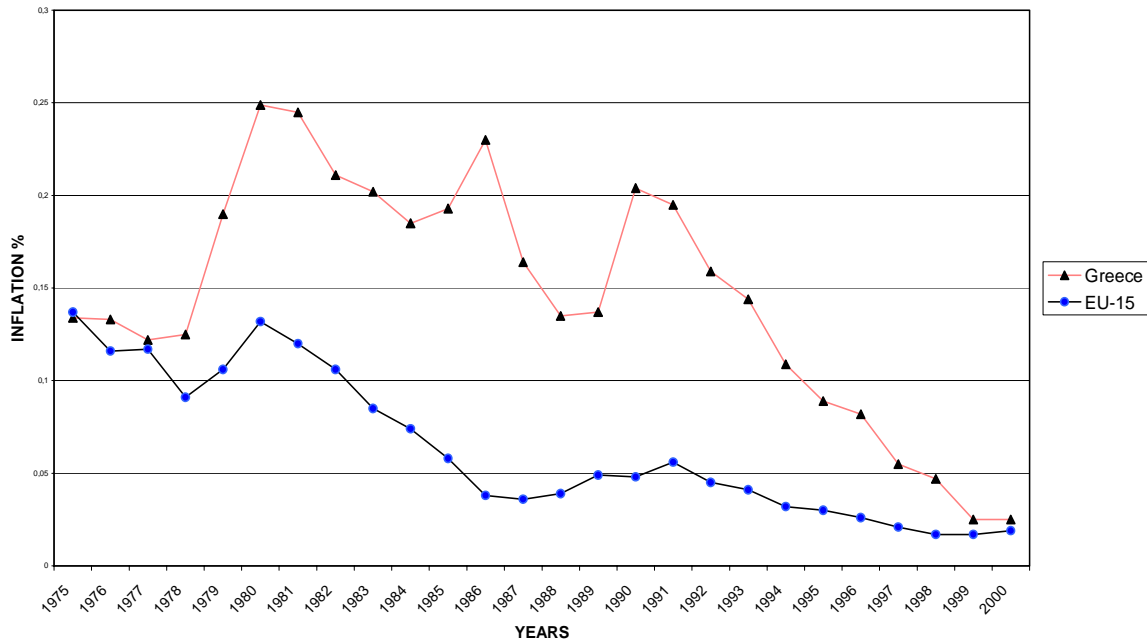
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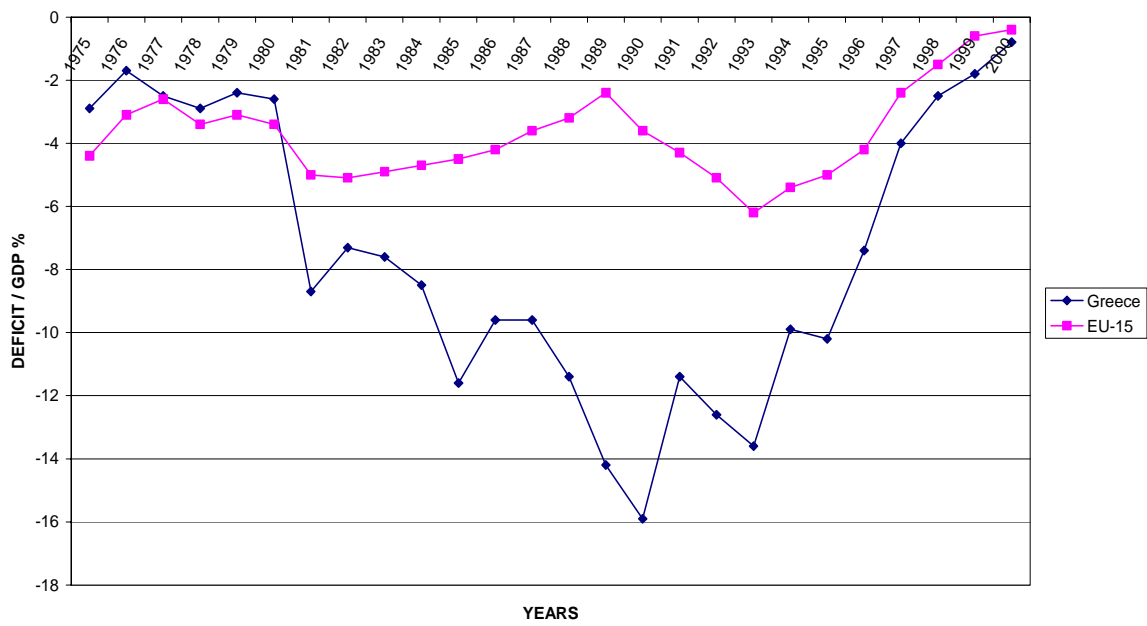
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# ANNEX: BASIC MACROECONOMIC INDICATORS OF GREECE, 1975-2000

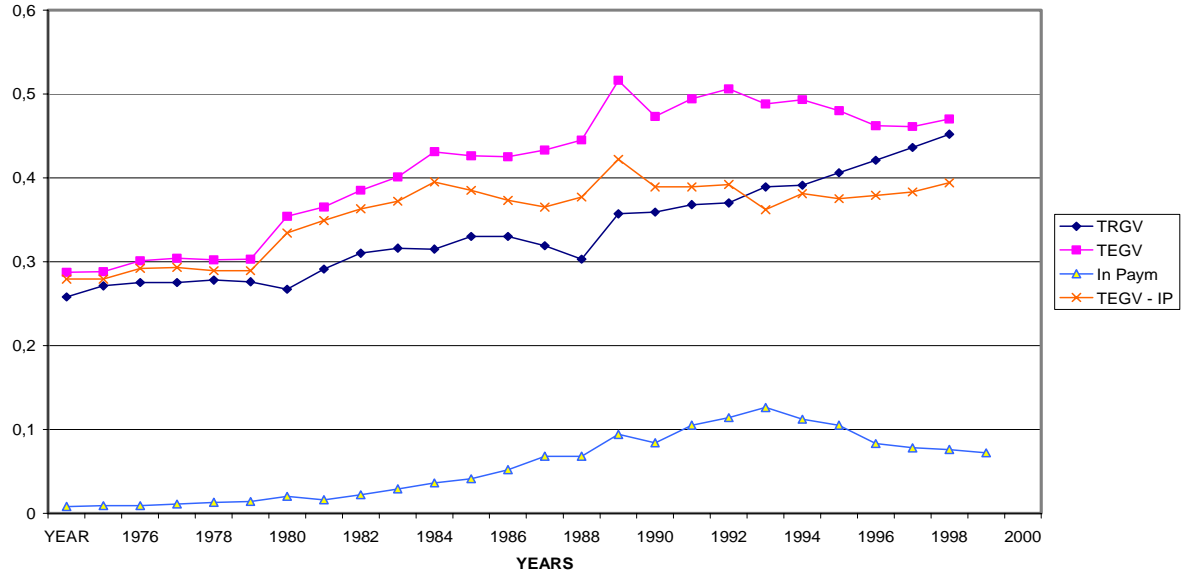
**FIGURE 1: INFLATION IN GREECE AND EU-15 (1975-2000)**



**FIGURE 2: PUBLIC DEFICIT AS PERCENTAGE OF GDP IN GREECE AND EU-15**



**FIGURE 3: RESOURCES, EXPENDITURE, INTEREST PAYMENTS AND EXPENDITURE WITHOUT INTEREST PAYMENTS OF GENERAL GOVERNMENT AS % OF GDP (GREECE)**



**FIGURE 4: REAL (SHORT-TERM) INTEREST RATES IN GREECE AND IN EU-15**

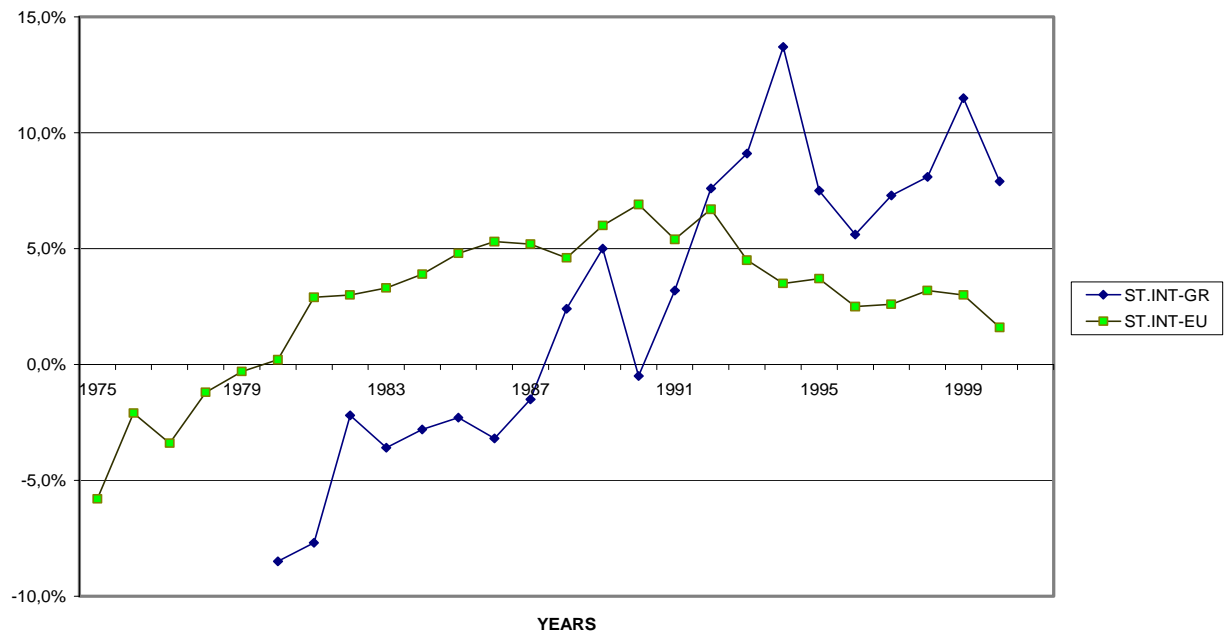


FIGURE 5: NOMINAL DEVALUATION, EFFECTIVE DEVALUATION AND IMPORTS / EXPORTS RATIO

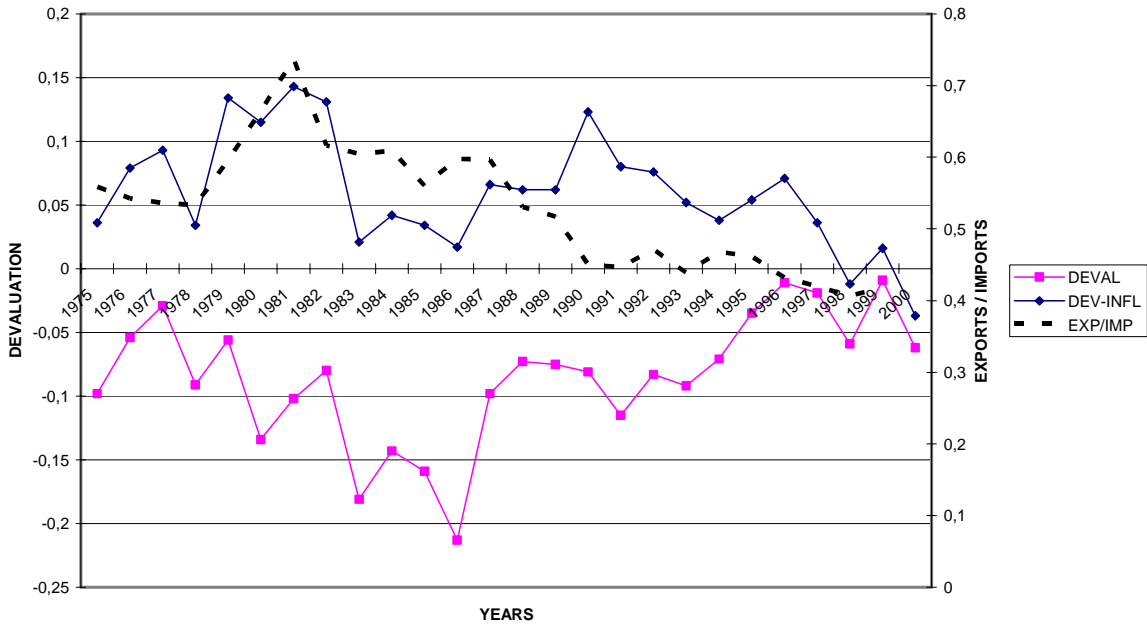


FIGURE 6: INVESTMENT IN EQUIPMENT AND IMPORTS IN EQUIPMENT AS % OF GDP

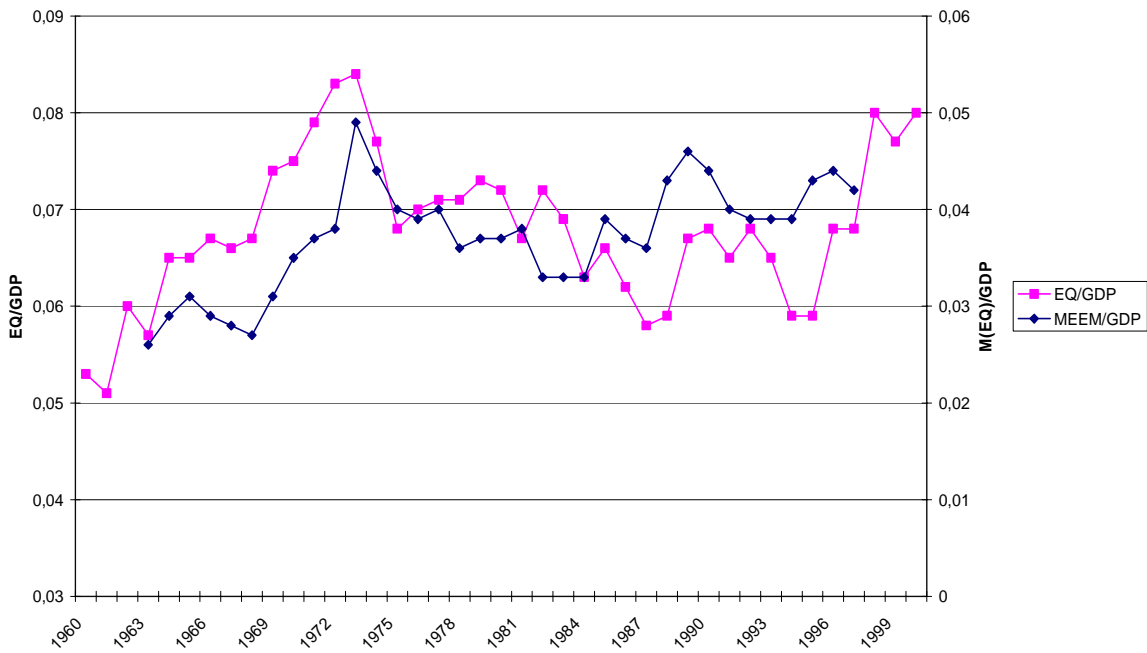


FIGURE 7: MACHINERY IMPORTS AND ROYALTIES AS % OF GNP

