

**THE IMPACT OF THE EUROPEAN MONETARY UNION
ON THE STABILITY OF THE GREEK ECONOMY**

BY

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**A Thesis Submitted to the Faculty of Graduate Studies
in Partial Fulfilment of the Requirements
for the Degree of**

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The Impact of the European Monetary Union on the Stability of the Greek Economy

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As you set out for Ithaka
 hope your road is a long one,
 full of adventure, full of discovery.
 Laistrygonians, Cyclops,
 angry Poseidon – don't be afraid of them:
 you'll never find things like that on your way
 as long as you keep your thoughts raised high,
 as long as a rare excitement
 stirs your spirit and your body.
 Laistrygonians, Cyclops,
 wild Poseidon – you won't encounter them
 unless you bring them along inside your soul,
 unless your soul sets them up in front of you.

Hope your road is a long one.
 May there be many summer mornings when,
 with what pleasure, what joy,
 you enter harbors you're seeing for the first time:
 may you stop at Phoenician trading stations
 to buy fine things,
 mother of pearl and coral, amber and ebony,
 sensual perfume of every kind –
 as many sensual perfumes as you can;
 and may you visit many Egyptian cities
 to learn and go on learning from their scholars.

Keep Ithaka always in your mind.
 Arriving there is what you're destined for.
 But don't hurry the journey at all.
 Better if it lasts for years,
 so you're old by the time you reach the island,
 wealthy with all you've gained on the way,
 not expecting Ithaka to make you rich.

Ithaka gave you the marvelous journey.
 Without her you wouldn't have set out.
 She has nothing left to give you now.

And if you find her poor, Ithaka won't have fooled you.
 Wise as you will have become, so full of experience,
 you'll have understood by then what these Ithakas mean.

Costantine Cavafy
 (1863-1933)

Translated by E. Keeley and P. Sherrard

Σα βγεις στον πηγαιμό για την Ιθάκη,
 να εύχεται νάναι μακρύς ο δρόμος,
 γεμάτος περιπέτειες, γεμάτος γνώσεις.
 Τους Λαιστρυγόνας και τους Κύκλωπας,
 τον θυμωμένο Ποσειδώνα μη φοβάσαι,
 τέτοια στον δρόμο σου ποτέ σου δεν θα βρείς,
 αν μόν' η σκέψις σου υψηλή, αν εκλεκτή
 συγκίνησις το πνεύμα και το σώμα σου αγγίζει.
 Τους Λαιστρυγόνας και τους Κύκλωπας,
 τον άγριο Ποσειδώνα δεν θα συναντήσεις,
 αν δεν τους κουβανείς μες στην ψυχή σου,
 αν η ψυχή σου δεν τους στήνει εμπρός σου.

Να εύχεται νάναι μακρύς ο δρόμος.
 Πολλά τα καλοκαιρινά πρωϊά να είναι
 που με τι ευχαρίστησι, με τι χαρά
 θα μπαίνεις σε λιμένας πρωτοειδωμένους.
 Να σταματήσεις σ' εμπορεία Φοινικικά,
 και τές καλές πραγμάτειες ν' αποκτήσεις,
 σεντέφια και κοράλλια, κεχριμπάρια κι' έβενους,
 και ηδονκά μυρωδικά κάθε λογής,
 όσο μπορείς πιο άφθονα ηδονικά μυρωδικά.
 Σε πόλεις Αιγυπτιακές πολλές να πάς
 να μάθεις και να μάθεις απ' τους σπουδασμένους.

Πάντα στον νου σου νάχεις την Ιθάκη.
 Το φθάσιμον εκεί είν' ο προορισμός σου.
 Αλλά μη βιάζεις το ταξείδι διόλου.
 Καλλίτερα χρόνια πολλά να διαρκέσει.
 Και γέρος πιά ν' αράξεις στο νησί,
 πλούσιος με όσα κέρδισες στον δρόμο,
 μή προσδοκώντας πλούτη να σε δώσει η Ιθάκη.

Η Ιθάκη σ' έδωσε τ'ωραίο ταξείδι.
 Χωρίς αυτήν δεν θάβγαινες στον δρόμο.
 Άλλα δεν έχει να σε δώσει πια.

Κι αν πτωχική την βρείς, η Ιθάκη δεν σε γέλασε.
 Έτσι σοφός που έγινες, με τόση πείρα,
 ήδη θα το κατάλαβες οι Ιθάκες τι σημαίνουν.

Κωνσταντίνος Καβάφης
 (1863-1933)

Table of Contents

Acknowledgment	iv
List of Tables	v
List of Abbreviations	vi
Abstract	vii
Chapter One - Introduction	1
1. History of the EU	2
2. Statement of the Problem	6
3. Objective and Organisation of the Thesis	14
Chapter Two - The Theory of Optimum Currency Areas	16
1. The Traditional Approach	18
Price and wage flexibility	18
Factor mobility	19
Financial market integration	21
Goods market integration	22
Product diversification	23
2. The Alternative Approach	24
Benefits	25
Costs	27
3. The New Theory	29
Natural rate of unemployment and policy ineffectiveness	30
Time inconsistency and credibility	32
Labour mobility under uncertainty	34
The role of exchange rates	35
Formal models of OCA	36
4. Is Europe an optimum currency area?	38
Chapter Three - The Characteristics of the Greek Economy	48
1. Historical overview	49
2. The public sector	54
3. The private sector	57
4. The financial market	60
5. The labour market	61

Chapter Four - Specification of the Model	71
1. Behaviour of the household	73
2. Behaviour of the firm	79
Demand for capital	81
Labour demand	84
Energy demand	85
3. Government Budget Constraint	86
4. Prices and Wages	87
Domestic prices	87
Export Prices	87
Wage Rates	88
5. International Trade	93
6. Financial Markets	95
 Chapter Five - Experimental work and results	 99
1. Empirical adaptation of the model	99
2. Identification of structural disturbances	101
Specification of the VAR	101
The Blanchard and Quah Method	104
3. Stochastic Simulations	111
The effects of nominal and real disturbances	112
4. Results	114
 Chapter Six - Conclusion	 123
Limitations and Suggestions for future research	126
References	128

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List of Tables

Table 1.1: Landmarks in the development of the European Union	6
Table 3.1: Main indicators of the Greek economy	64
Table 3.2: Comparison of economic indicators between Greece and the EU .	65
Table 3.3: Public expenditure and current revenues	66
Table 3.4: Structure of GDP	66
Table 3.5: Firms with revealed comparative advantage in manufacturing	67
Table 3.6: Cross-country comparison of commercial bank indicators	68
Table 3.7: Cross-country comparison of the labour market	69
Table 4.1: Model parameter values	97
Table 5.1: Stationarity Test Results	101
Table 5.2: Stochastic Simulation Results	113

List of Abbreviations

CAP	Common Agricultural Policy
CFSP	Common Foreign and Security Policy
EC	European Community
ECB	European Central Bank
ECSC	European Coal and Steel Community
EEC	European Economic Community
EFTA	European Free Trade Association
EMS	European Monetary System
EMU	European Monetary Union
EU	European Union
EURATOM	European Atomic Energy Community
OCA	Optimum Currency Areas
OECD	Organisation for Economic Cooperation and Development
R&D	Research and Development
SEA	Single European Act
SGP	Stability and Growth Pact
TEU	Treaty on European Union

Abstract

The debate about the desirability and viability of a monetary union, particularly the European Economic and Monetary Union (EMU), has focussed either on the existence of the appropriate adjustment mechanisms necessary to counteract disturbances or on the benefits and costs of participation. The benefits include efficiency gains deriving from the increased integration while the costs are related mainly to the elimination of national monetary sovereignty.

The effects of the abandonment of national monetary independence on the stability of a small open economy, such as Greece, have attracted little attention. This study evaluates the impact of Greece's joining the EMU by examining how the economy reacts to disturbances, specific to this country, before and after giving up monetary policies as a means of adjustment. For this purpose, we use stochastic simulations of a macro-econometric multi-country model, QUEST II. We identify the structure of disturbances used in the stochastic simulations by imposing long-term restrictions to the coefficients of a structural Vector Autoregression.

The results from the stochastic simulations indicate that in the monetary union the stability of output will increase only slightly. The domestic price level will become more volatile. Also, the public sector deficit and debt as percentage of GDP, the (European) interest rates and the exchange rate with respect to the US Dollar will all be more stable in the monetary union.

Chapter One

Introduction

In May 2000 the European Central Bank and the European Commission issued their reports on the performance of the Greek economy in its effort to satisfy the criteria for membership in the European Economic and Monetary Union (EMU). The reports suggest that the European Council accept the Greek application for membership. The question that arises is how a small open economy is going to be affected by the transition to irrevocably fixed exchange rates and by the elimination of its monetary sovereignty.

During the past decade a great deal of debate has been initiated by the process in the European Union leading to the establishment of the EMU. Theoretical contributions to the literature have mainly dealt with the benefits and costs deriving from participating in such a union. The benefits are mostly efficiency gains arising from the increased integration while the costs arise from the abandonment of monetary independence. Empirical studies have concentrated on the incidence of shocks in the European countries to examine the desirability and viability of EMU. Very little attention has been given to the effects of the transition from flexible exchange rates to membership in the EMU for an individual country. This study sets out to evaluate how a small open economy, such as Greece, will react to country-specific disturbances having resigned from the ability to use monetary policies as a means of adjustment.

The remainder of this chapter is organised in the following way. The next section provides a brief account of the history of the European Union and its institutions. In the second section we summarise the issues related with participating in a monetary union, the benefits and costs arising for the country members and the adjustment mechanisms that must exist in order for the union to be viable. The final section describes the objective and organisation of this thesis.

1. History of the EU

With the agreements reached at Maastricht at the end of 1991, the Member States of the European Community (EC) came to the end of an unparalleled effort to think through the implications of a monetary union in Europe. The resultant Treaty on European Union (TEU) set out a constitution for the European Central Bank (ECB), a timetable for the approach to full union and a set of criteria for membership which individual countries would have to satisfy. This was the culmination of a process of intergovernmental discussion and negotiation inaugurated by the setting-up of the Delors Committee in June 1988, which was charged with setting out the requirements for a move to full monetary union in Europe. Such a project had been introduced before, in 1970, when the Werner Committee had set a date for monetary union, but it had never before been so carefully analysed (Artis and Lee, 1994, ch. 13).

The first practical step on the road to European integration was taken in 1951 with the signing of the Treaty of Paris, establishing the European Coal and

Steel Community (ECSC)¹. Then, in 1957, the Treaties of Rome were signed, the European Economic Community (EEC) Treaty which introduced common economic policies, especially in agriculture, and the EURATOM Treaty establishing the European Atomic Energy Community. In 1965, the signing of the Merger Treaty resulted in the creation of a single Commission for all three Communities (collectively referred to as EC), taking effect in 1967. The Single European Act (SEA, signed in 1986) was the first systematic revision to the founding Treaties and set the requirements for the completion of the internal market. The Treaty on European Union (TEU, or, Maastricht Treaty) was signed in 1991 and entered into force in 1993. It is usually described as resembling a temple. The roof sets out various broad objectives and rests on three pillars: the European Community activities (enhanced by TEU) comprise the first pillar, the Common Foreign and Security Policy (CFSP) the second and Justice and Home Affairs (JHA) the third. In 1997, the TEU was amended, at Amsterdam in order to address issues about consumer policy, employment, growth and the free movement of people.

In the Treaty of Rome (1957), there are no provisions for monetary arrangements, mainly because the international arrangements at the time fixed the national currencies at exchange rates as negotiated in Bretton Woods. In the late 1960s, the progress achieved in European integration – especially with the establishment of the Common Agricultural Policy – led to increasing awareness of

¹ See Table 1.1 for the landmarks in the history of the EU.

the interdependence of the country members and to attempts to plan and establish a European monetary identity.

More particularly, the history of monetary integration began in 1968 with the establishment of the Werner Committee, which was to set out a blueprint for the realisation of economic and monetary union. The Werner Plan, endorsed in 1971, suggested the achievement of economic and monetary union in stages with the final one involving fixed exchange rates and perfect capital mobility. The growing instability of the international monetary system and the disintegration and collapse of the Bretton Woods system led to the failure of the Werner Plan.

In 1979, the desire for closer monetary cooperation was expressed with the establishment of the European Monetary System (EMS), where bilateral rates were determined between all participating currencies and margins of currency fluctuation were set to ensure price stability in the EC. The completion of the single market at the end of 1992 and the integration of financial markets put the EMS under a great strain and led to its abandonment by many currencies within a few-month period. The reason for the failure of the EMS can be found in the so called 'inconsistent triangle', that is the impossibility of co-existence of economic integration (achieved through the free movement of goods, services, labour and capital), fixed exchange rates and independent national monetary policies. Given the former, the latter two are not simultaneously sustainable. Either independent monetary policies with flexible exchange rates will be implemented or the single market will be complemented by a monetary union (a common currency and a common monetary

policy) which is the most efficient alternative (as is discussed below).

In the meantime, the Delors Committee Report had identified the essential objectives and elements of a monetary union and proposed the framework and stages of the EMU. After years of negotiations, the Treaty of the European Union was signed in December 1991, opening the road to the twelve country members to proceed towards a political and economic union. After the EMU has been completed, the European continent will not be the same again.

Table 1.1: Landmarks in the development of the European Union²

1951	Treaty of Paris (in effect from July 23, 1952): Establishment of European Coal and Steel Community. Members: Belgium, the Federal Republic of Germany, France, Italy, Luxemburg and the Netherlands.
1957	Treaty of Rome (in effect from January 1, 1958): establishment of European Economic Community and European Atomic Energy Community.
1965	Merger Treaty (in effect from 1967): Merger of the principal institutions of the three communities, henceforth known as the European Community (EC).
1973	First Expansion: Denmark, the Irish Republic and the United Kingdom join the EC on January 1.
1981	Second Expansion: Greece joins the EC on January 1.
1986	Third Expansion: Portugal and Spain join the EC on January 1.
1986	The Single European Act (in effect from July 1, 1987): Introduction of systematic revisions of the founding treaties and expression of will for the completion of internal market.
1992	Treaty of European Union (in effect from November 1, 1993): Establishment of the framework for a European Economic and Political Union.
1995	Fourth Enlargement: Austria, Finland and Sweden become members of the EU on January 1.
1997	The Treaty of Amsterdam (in effect from May 1, 1999) was the third revision of the founding treaties after SEA and TEU.

2. Statement of the Problem

During the last decade, in light of the process to the EMU, a large volume of economic literature has discussed the feasibility and desirability of such undertaking. In reviewing this literature, one should consider the EMU as including two separate but complementary facets, a single currency and a stable currency. These two facets correspond to the two interrelated objectives of EMU, efficiency

² Adapted from Bulmer (1994)

and stability (European Commission, 1997).

First, the *efficiency* issues have been analysed by economists on the basis of the Optimum Currency Areas (OCA) theory by discussing the gains and losses associated with the replacement of the national currencies by a single currency.

Efficiency *gains* are linked with the smooth operation of the internal market:

- The establishment of a single currency eliminates the exchange rate risk and the conversion costs that accompany the use of national currencies.
- The 'inconsistent triangle', that is the pursuit of economic integration, fixed exchange rates and independent national monetary policies is impossible. Given the former, the latter two cannot coexist. Either independent monetary policies with flexible exchange rates will be implemented or a monetary union will complement the single market. Monetary union may not be the only alternative since a common monetary policy and fixed exchange rates (with occasional realignments) is also possible. However, as it will be argued in the following chapter, under the latter option the exchange rate risk still remains and efficiency gains are not fully exploited.
- From the political-economy point of view, a monetary union prevents currency fluctuations which affect competitive positions and which may give rise to political charges of competitive depreciation and exchange dumping. These, in turn, could trigger protectionist

responses.

As far as *costs* are concerned, the emphasis in the OCA literature is directed towards examining the effects of disturbances, especially asymmetric ones, on individual economies in light of the abandonment of monetary sovereignty.

- Research has focussed on the incidence of shocks in the EU. As the following chapter will show, empirical evidence suggests that the European country members are more likely to be affected by asymmetric shocks than European regions or American States. However, empirical findings also indicate that economic integration leads to greater correlation of business cycles.
- Another issue addressed in the literature is the existence of adjustment mechanisms that will take up the role of nominal exchange rate movements in restoring equilibrium. Given that the EMU is not as optimum a currency area as other unions are (especially regarding labour mobility) and in the absence of fiscal federalism, the existence of other adjustment mechanisms becomes more important.
 - The lack of sufficient flexibility in the product and labour markets is an issue raised by those who argue against the feasibility of EMU. However, as the internal market and the monetary union evolve, and firms and workers, being rational agents, adjust to the new constraints and opportunities, it is reasonable to expect that the rigidities that exist in these

markets will be eliminated.

- Greater controversy surrounds the automatic budgetary stabilisers. The Stability and Growth Pact (SGP) is an agreement reached by the European Council in 1997 requiring that country members avoid excessive general government deficits, i.e., deficits in excess of 3% of GDP. It is argued that, in the name of the Euro stability, the SGP imposes severe and unnecessary restrictions in the conduct of national fiscal policies, especially given the 'no bail-out' clause restricting the ECB. The counterargument is that the SGP will force the domestic economies to control the excessive deficits and debts accumulated during the 1980s and to correct the structural imbalances created during that decade. From this point of view, the SGP is a prevention not a cure for crises.

The second objective of EMU is the *stability* of the Euro expressed in the EU through price stability and abroad as a credible means of transactions and store of value. Currency stability is pursued through monetary and fiscal rules laid out by the TEU. The monetary rules affect the operation of the ECB and aim at preserving its independence and credibility, both necessary conditions for price stability. The fiscal rules concern the limitations that the national economies face and are aimed at further enhancing the credibility of the ECB. Both sets of rules are meant to prevent rather than correct disturbances and are expected to have positive effects

in the establishment of a stable macro-economic environment, manifested in the stability of prices and growth, and the formulation of such expectations that will allow the good functioning of the markets (European Commission, 1997).

In its steady state, the EMU should be characterised by price stability and sound fiscal policies. However, the question is what the situation will be for the individual country members in the presence of disturbances. How are the national economies expected to react after surrendering their monetary sovereignty?

Adjustment mechanisms

When comparing the two alternative exchange rate regimes, the basic argument in favour of floating exchange rates is that they ease the process of adjustment to external shocks in an open economy. Once a country has joined a single currency union and resigned from monetary policy independence, there are two alternative ways of adjustment through relative price movements and/or output changes and through fiscal policy. Leaving aside the issue of whether the EMU country members will have an adequate degree of fiscal autonomy, the prospect of asymmetric shocks requires the existence of alternative adjustment mechanisms. Even if shocks are symmetric, structural differences among the EMU members will give rise to asymmetric responses. Differences in institutions or preferences may explain why the EMU countries could be affected differently by movements in the Euro's real effective exchange rate, changes in the cyclical position of the EMU, or monetary policy mistakes.

It is, therefore, appropriate to discuss how adjustment can take place through

changes in factor quantities and/or factor and output prices, once an economy has lost control of the monetary instruments and assuming that adjustment can only partially be achieved by national fiscal policies. Consider the case of a country subject to a shock to its external sector, an increase in the trade deficit.

Adjustment through quantity changes in production factors

A decrease in net exports will result in the fall in the expected return to capital. With perfectly integrated financial markets, this will lead to an outflow of capital, lower investment and lower effective demand, thus reducing imports and restoring the external equilibrium.

Similarly, since the fall in net exports will bring about a fall in the degree of capacity utilisation, firms will fire workers to restore equilibrium, given the new demand conditions³. If labour is mobile, wages might not need to change in the long-run to adjust to the shock. The migration to countries where the probability of finding a job is higher will decrease domestic consumption depressing the effective demand and restoring the initial external equilibrium. This, however, can have a permanent effect on the growth rate of the economy.

It has been pointed out in the literature that the greater integration of the markets and higher factor mobility may result in increasing regional specialisation. In this context, regions are prone to instability caused by shifts in their exports and pro-cyclical movements of capital (and labour) which may contribute to divergent

³ Under the assumption of perfect competition, individual firms will take wages as given. Therefore, they will proceed to an adjustment through quantities.

long-run growth rates (Krugman, 1993). However, this is not an argument against capital mobility in the EMU. It simply highlights the need for alternative adjustment mechanisms to avoid the possibility of permanent capital outflows with significant adverse impact on a region's economy.

Adjustment through price changes

Apart from relative cyclical positions, the external balance of a country depends on the relative real effective exchange rate (REER). Given that the nominal effective exchange rate (of EURO) becomes exogenous to national governments within the EMU and that productivity is a rather long run phenomenon, the REER should adjust through real wages and output prices. A fall in real wages and/or output prices will improve the external position of the country and restore the equilibrium.

Since labour is rather immobile in the EU, the increased unemployment will put a downward pressure on wages. Under perfect competition and high capital mobility, flexible wages will help to keep the labour costs down and delay the capital outflow. If wages cannot adjust, the return to capital will be restored by reducing employment, which, in the absence of the appropriate income policies, will depress even more the effective demand. Therefore, immobile labour and sticky wages could, *ceteris paribus*, lead to higher unemployment and public spending, or lower growth. There is evidence of downward movement in real wages during the 1980's in European countries experiencing large negative shocks (de Grauwe, 1993).

If the assumption of perfect competition is abandoned, other adjustment

channels may come into effect. In imperfectly competitive markets, domestic producers may react to external shocks by reducing markups and profit margins to preserve their market shares at home or abroad. In both cases, this kind of reaction to external competitive pressures will soften the effects of adverse external shocks on growth and employment.

A recent economic assessment of the Single Market Programme (SMP) provides interesting empirical evidence on the effects of market integration: in sectors most likely to be affected by the integration of the markets, domestic firms have reacted to increasing competitive pressures of intra and extra-EU importers by reducing price margins in order to maintain domestic market shares. Studies examining the relationship between profitability and openness to trade, conclude that the ratio of imports to domestic consumption tends to be negatively correlated with the profitability of domestic sellers, especially when domestic concentration is high⁴ (European Commission, 1996).

To the extent that the integration of the markets enhances the adjustment mechanisms through prices and wages and EMU, in turn, promotes the efficient functioning of the Single Market, it can be expected that the effects of disturbances on growth and employment may be smoother in the future.

⁴ However, such a fall in profit margins has not reduced the capacity of the EU to attract investment. The share of the EU in the world FDI flows has almost doubled since the launching of the Single Market Programme (SMP) from 28.8% over 1982-87 to 44.4 over 1991-93 (European Commission, 1996) .

3. Objective and Organisation of the Thesis

How will a small open economy, such as Greece, react to country-specific disturbances having resigned from the ability to use monetary policies as a means of adjustment? Should disturbances occur, how will the stability of the Greek economy be affected compared to the alternative of flexible exchange rates? These are the questions this thesis sets out to answer. The main objective is to estimate the reaction of the Greek economy to disturbances both in a monetary union framework and under a flexible exchange rate regime. In order to achieve this, we compare the results of the stochastic simulations of the model used by the European Commission, QUEST II (Roeger and in't Veld, 1997), under both sets of assumptions about the exchange rate policies. QUEST II is a highly aggregated model which includes structural models for all EU country members, USA and Japan linked with trade-feedback equations. It combines the recent theoretical developments of macro-econometric model building: behavioural equations derived from inter-temporal optimisation processes, an explicitly modelled supply side, imperfectly competitive goods markets, adjustment costs, both for capital and labour markets and stock-flow interactions. We identify the disturbances used in the stochastic simulations by using a structural Vector Auto-Regression (VAR) and, following Blanchard and Quah (1989), by imposing restrictions on the long-run coefficients of the moving average representation.

The thesis is organised as follows. Chapter Two reviews the theory of optimum currency areas. This is the part of economic literature that is relevant for

the purpose of this study as it has attempted to identify the adjustment mechanisms alternative to flexible exchange rates for a monetary union to be optimal in terms of internal stability (real and nominal) and external equilibrium. It has also analysed the gains of joining a monetary union and the costs if the alternative adjustment mechanisms do not exist. In Chapter Three, we provide a brief history review of the Greek economy and describe the characteristics and structure of the public and private sector, focussing particularly on the financial and labour markets. Knowing the particular conditions of the Greek sectors is important for the discussion of the model used in the stochastic simulations as well as the discussion of the results from these simulations. Chapter Four presents the structure of QUEST II and its theoretical foundations. In Chapter Five, we describe the stochastic simulations performed with the QUEST II models and discuss our findings. Chapter Six concludes.

Chapter Two

The Theory of Optimum Currency Areas

The unification of Germany, the disintegration of the Soviet Union and, most importantly, the European monetary unification have increased interest in the theory of Optimum Currency Areas (OCA). The debate about the desirability and feasibility of the EMU focuses on the incidence of disturbances that may occur in specific country members and the existence of adjustment mechanisms alternative to flexible exchange rates. The theory of OCA offers insights on the conditions under which a currency union is desirable and the adjustment mechanisms that must exist for it to be viable. In that sense, it allows us to predict the kinds of changes in the stability of an economy caused by moving from flexible exchange rates to a monetary union. It is, therefore, appropriate to review the contributions to the theory of OCA before we investigate the impact of Greece's participation in the EMU on the stability of its economy.

An optimum currency area refers to the geographical domain having as a general means of payments either one single currency or several currencies. The exchange values of these currencies are irrevocably pegged to one another with unlimited convertibility for both current and capital transactions but their exchange rates fluctuate in unison against the rest of the world. 'Optimum' is defined in terms of the macroeconomic goal of maintaining internal and external balance. Internal balance refers to price and/or output stability and external balance involves both intra-area and inter-area balance of payments equilibrium (Kawai, 1987).

The origins of the concept of optimum currency areas can be found in the discussion about the optimum monetary arrangement among countries. Friedman (1953) argued in favour of a flexible exchange rate system, on the grounds that, in the absence of price and wage flexibility, after a disturbance in the trade balance has occurred, exchange rate movements can immediately change the terms of trade and restore equilibrium in the balance of payments. On the contrary, the proponents of fixed exchange rates argued that under this regime the adjustment process is more effective and that fixed exchange rates can be a more efficient policy than flexible exchange rates, under certain conditions. These conditions include mobile labour, financial or goods market integration and commodity diversification (Ishiyama, 1975; Kawai, 1987).

These are the early contributions ('the traditional approach') to the theory of OCA which, initially, attempted to answer the question: 'What is the appropriate domain of a currency area?' Each contribution to the literature singled out one characteristic which would, supposedly, indicate where the lines *should* be drawn. Subsequent contributions ('the alternative approach') focussed on the *rationale* of forming a currency union, the benefits and costs for a country participating in it. The most recent installments (the 'new' theories) incorporate recent developments in macroeconomic theory, such as policy ineffectiveness and time inconsistency theories, and in the theory of international economics, such as labour mobility under uncertainty and the role of the exchange rates.

In the following three sections we discuss the contributions to the theory of

OCA: first, the 'traditional', then the 'alternative' approach and third, the 'new' theories¹. Finally, in the fourth section, we present the empirical evidence of whether the EMU is an optimum currency area.

1. The Traditional Approach

In the traditional approach, the optimality of a currency area is judged by the existence of a mechanism that can achieve standard economic objectives – full employment, price stability and balance of payments equilibrium. Nominal exchange rate movements invoke relative price changes which lead to adjustment after a disturbance has occurred. If nominal exchange rates are fixed, which mechanism restores equilibrium? This is the central question in the traditional approach of the theory of OCA. The starting point for most of the contributions presented in this section is an imbalance in the external trade caused by a decrease in the foreign demand for a country's exported goods which causes deflationary pressures and unemployment.

Price and wage flexibility

After a trade disturbance has occurred, if flexible prices and wages prevail in a currency area consisting of a group of countries, equilibrium can be restored through relative price changes: prices and wages decrease in the deficit country and increase in the surplus country. Under these circumstances, flexible exchange rates

¹ The terms 'traditional' and 'alternative' are used in Ishiyama (1975) to distinguish between the approach that singles out criteria for an optimum currency union and the approach that evaluates the costs and benefits of participating in a currency union from the point of view of a particular country. The term 'new' theory has been coined by De Grauwe (1992) and also used by Tavlas (1993). All these terms are used here for organizational reasons.

become unnecessary while fixed exchange rates (or a single currency) are beneficial for the entire currency area because they enhance the usefulness of money. External balance to the area is achieved by floating the area's currency with respect to the currencies in the rest of the world (Kawai, 1987).

Factor mobility

Mundell (1961) argued that factor mobility in the currency area can moderate the pressure on relative factor prices during adjustment. If a trade deficit occurs between regions, then flexible exchange rates between the *national* currencies will not serve to correct the imbalance. A flexible exchange rate system would be effective, if it were based on *regional*, instead of national, currencies, the region being characterised by a high degree of internal factor mobility.

“...the stabilization argument for flexible exchange rates is valid only if it is based on regional currency areas. If the world can be divided into regions within each of which there is factor mobility and between which there is factor immobility, then each of these regions should have a separate currency which fluctuates relative to all other countries” (Mundell, 1961, p.663).

Mundell recognises that national currencies are an expression of national sovereignty and he lays the conditions under which sovereign countries can form a union: either national boundaries are in flux or there is expressed political will for a union and, most importantly,

“...if (production) factors are mobile across national boundaries, then a flexible exchange system becomes unnecessary and may be even positively harmful” (Mundell, 1961, p.664).

Aizenman and Flood (1992) provide a formal model of labour mobility argument which indicates that Mundell may have understated the importance of

labour mobility. They show that strong efficiency gains can be reaped under a fixed-exchange-rate system with mobile labour and sticky prices .

The role of long-term capital movements in restoring equilibrium may not be equally effective. When a disturbance occurs and exchange rates are fixed, a country may experience deflationary pressures and unemployment. If the incentive to invest in this country decreases more than savings do, there will be long-term capital outflow and aggravation of unemployment (Fleming, 1971) .

Labour mobility may not be a necessary condition for adjustment – and the same is true for each criterion presented below, if it is examined separately. Portfolio adjustment and multiplier effects, by changing incomes and expenditures, can restore the equilibrium in the balance of payments (Scitovsky, 1969 ch. 8). Further, empirical evidence from Europe suggests that export-demand disturbances do not have a big impact on a country's employment (Gros, 1996). This could, indeed, imply that shocks to the balance of payment are counteracted by factors other than mobile labour.

Labour mobility is not a sufficient condition for adjustment, if assumptions are considered, such as economies of scale, different labour intensities in production, factor heterogeneity and adjustment costs².

² Onida (1972), Ishiyama (1975) and Tower and Willett (1976) offer detailed analysis of these characteristics.

Financial market integration

Ingram (1959, 1960) and Scitovsky (1969) considered the degree of integration in the financial markets as an important criterion of OCA. A large stock of short-term foreign securities that are held by domestic banks, readily marketable and internationally accepted ('generalized') can facilitate adjustment in the balance of payments. When a trade deficit is caused by a temporary disturbance, capital flows through the selling of short-term assets abroad can make the adjustment in incomes or output smaller or even unnecessary. If, however, the trade imbalance is caused by a persistent or permanent disturbance, short-term capital flows cannot sustain the deficit indefinitely. In the long-run, income and relative price changes will be necessary to restore equilibrium (Ingram, 1959, 1960; Pfister, 1960; Scitovsky, 1969).

Distinction has to be drawn between balance-of-payments financing and adjustment. The mechanism that Ingram suggests falls in the former category. Therefore, capital mobility may be effective in smoothing out the initial impact of trade imbalances, while other mechanisms such as labour mobility (which takes time) can be more effective in the medium-run (Tower and Willett, 1976; Corden, 1972; Onida, 1972).

Goods market integration

McKinnon (1963) argued that the choice of the exchange rate regime should be based on an economy's degree of openness as measured by the ratio of tradable to non-tradable goods in production or consumption, the ratio of exports plus imports to GDP or the marginal propensity to import. In a country that is highly open, exchange rate fluctuations are not effective in correcting trade imbalances and they are not compatible with domestic price stability. Assuming that a country depreciates its currency, the initial improvement in the terms of trade and the trade balance will be offset by the following changes. First, the appreciation of the domestically owned foreign assets in terms of domestic currency will tend to increase demand for imported consumption goods. Second, the increase of the domestic-currency value of imported investment goods will put upward pressure on capital costs. Finally, increases in nominal wages counteracting the domestic price increases may lead to rises in labour costs.

Another aspect of McKinnon's argument is that a large foreign sector may mean the lack of domestic substitutes. In this case, exchange rate changes will have a small effect on the quantity of imported goods. Expenditure-reducing policies will be more effective targeting trade balance and fixed exchange rates targeting price stability, provided that the prices of tradable goods in terms of foreign currency are stable.

The McKinnon criterion implicitly assumes that price stability prevails in the rest of the world. If the price level abroad fluctuates relative to the domestic price

level, then McKinnon's conclusion would be reversed: flexible exchange rates could offset the relative price variations and play an insulation role for the domestic economy. In other words, the openness criterion is not a general one (Corden, 1972). Corden and Ishiyama point out that, even assuming stability in the external environment, fixed exchange rates may be beneficial only for financially 'undisciplined' economies, because they may lead to sounder economic management.

Product diversification

Kenen (1969) proposed an alternative criterion based on the law of large numbers. In a well-diversified economy, the changes in the terms of trade do not have to either be as great or occur as often as in a single-product economy. When a disturbance in the demand for a specific exported good occurs, the interaction among the numerous sectors of the economy (such as inter-industry labour mobility) will make the adjustment process smoother.

Kenen's criterion seems to oppose this of McKinnon's: flexible exchange rates are ineffective or irrelevant both for an open economy and for a well-diversified economy (implying small external sector). This contradiction in conclusions is due to the different assumptions made regarding the nature of disturbances and their impact on the terms of trade. Kenen considers mainly external shocks that are industry-specific and, therefore, do not have a great impact on the terms of trade. However, when he discusses the impact of a generalised shock, such as an economy-wide increase in nominal wages relative to import prices, he arrives at the

same conclusion as McKinnon, namely that flexible exchange rates may be more beneficial for a diversified economy (i.e., a less open economy) than fixed exchange rates.

Other criteria have been proposed, such as policy compatibility (Tower and Willett, 1976), similarity of inflation rates (Haberler, 1970; Fleming, 1971) and the nature of shocks affecting the area (Vaubel, 1976 and 1978; Tower and Willett, 1976; Marston, 1984; Purvis, 1992). It is obvious that the successful and smooth operation of a currency area relies on the confidence in the permanence of fixed exchange rates and the unlimited convertibility of the participating currencies. This requires coordination of the monetary and fiscal policies and the political commitment of governments.

2. The Alternative Approach

The traditional approach of the OCA focuses on the cases where exchange rate movements are either ineffective (open economy) or unnecessary (labour mobility, product diversification) to argue in favour of a fixed exchange rate regime. In the cases where both systems are effective to correct trade imbalances, the costs of adjustment in terms of inflation and unemployment are used for the comparison of performance of the two systems. However, depending on the choice of assumptions about the underlying disturbances, the adjustment costs may be different. Moreover, very little is said about the benefits of a common currency (Ishiyama, 1975). Also, attention focuses mostly on microeconomic disturbances (shifts in demand for exports), while the impact of macroeconomic shocks (policy or

market-structure changes) as a source of external imbalances is mainly overlooked.

In light of these considerations, subsequent work by Corden (1972), Ishiyama (1975), Tower and Willett (1976), Hamada (1985) and others attempted to evaluate the benefits and costs of participating in a currency area.

Benefits

Removed transactions costs

A common currency eliminates the conversion costs of national currencies and other related transaction costs and enhances the value of money as a medium of exchange. The savings are greater, the greater are the transactions among country members. From this point of view, a common currency is conducive to efficiency and integration of the economy.

Eliminated speculative uncertainty

Exchange rate fluctuations may be aggravated by the actions of speculators who are trying to benefit from differences in the interest rates and the structures of economies. Fixing the exchange rate eliminates the uncertainty related to speculative capital movements and promotes efficiency by increasing the usefulness of money as a store of value (Grubel, 1970; Ishiyama, 1975; Gros and Thygessen, 1991 and 1992). Furthermore, the stability of exchange rates is important for the smooth operation of policies that rely on a common price system, such as the Common Agricultural Policy.

An example of the disruptive consequences of a speculative disturbance is what occurred in September 1992. Continuous capital flows out of the French Franc

into the Deutsche Mark created a dilemma for the respective central banks. They could either devalue the Franc against the Mark, or, sustain the interest rates at a higher level than was justified by purely domestic considerations. In the former case, the measures would result in a loss of confidence in the Franc and a further deterioration of the competitiveness for the German firms. In the latter case, which was chosen and implemented until mid-1993, the policy could (and did) lead to a recession in the French economy. In a single currency framework such disturbances cannot occur (Bofinger, 1994).

Exchange reserves

Economisations of foreign exchange reserves result from using a common reserve pool to accommodate the trade needs of the country members with third countries. This benefit is doubtful in the early stages of a process towards monetary unification – before a common monetary authority is established to manage these reserves – and the extent of savings will depend on the collaboration of the monetary authorities of the participants.

Policy coordination and fiscal discipline

Monetary unification intensifies the need for greater fiscal cooperation. As the integration of the markets in the union deepens, the competition increases among domestic fiscal authorities both in terms of imposing taxation and in terms of expenditure. For example, the fiscal authorities of a country that unilaterally increase the corporate income tax rates above the average rate prevailing in the currency area (or decrease transfers) may find the effectiveness of such policies

minimised by the flight of capital . Fiscal and monetary stability in the union requires discipline and coordination among the domestic authorities. The gains can take the following forms:

- A country that participates in a currency area will benefit from lower debt-servicing costs deriving from borrowing at the international markets in the common rather than the national currency. These gains may exceed the losses of seigniorage revenues.
- Fiscal federalism can enhance the effectiveness of stabilisation policies for the country members (Masson and Taylor, 1992).
- In a rational-expectations framework, the increased cooperation among authorities results in reduced confusion about shocks through the availability of more and better information and the complying with the same policy rules (Wihlborg and Willett, 1991).

Some of the benefits discussed in this section occur at the microeconomic level (to the extent that they derive from increased integration, e.g., eliminated transaction costs) and others at the macroeconomic level (deriving from increased policy cooperation). They all enhance economic efficiency and they exhibit non-rivalry, a characteristic of public goods. In this context, evaluating the benefits for one country joining a currency union is equivalent to evaluating the benefits for the whole union.

Costs

In contrast to the benefits of monetary union that are collective and

international, the costs are mostly national and refer to the macroeconomic policies.

Eliminated monetary sovereignty

Participation in a currency union means surrendering the control of money supply, integrating the capital markets and establishing a supra-national central bank. Monetary sovereignty takes the form of nominal exchange rate manipulation to affect real exchange rate adjustment between countries hit by asymmetric disturbances. The cost of surrendering monetary independence can be higher, if the need for real exchange rate adjustment arises more frequently and the economies that participate in the union are different. Differences may exist in the preferences about inflation and unemployment, in the market structures and in the growth rates (Corden, 1972).

Limited fiscal autonomy

By joining a monetary union, each country member may enjoy the benefit of lower debt-servicing costs by borrowing at the international markets in the common currency. As already mentioned, this beneficial consequence of the monetary union may become costly, if it leads to excessive borrowing by the domestic fiscal authorities. Rules may be imposed to protect the union against such contingencies, thus limiting fiscal autonomy. These rules also serve as a signal to the international markets. As any new institution, initially, faces disbelief, the country members have to show their commitment to fiscal and monetary discipline.

Regional divergence

Regional specialisation in specific production activities can occur because of the existence of increasing returns due to technological advantage, infrastructure and government policies (Ishiyama, 1975). Regions having these advantages attract financial and physical capital and skilled labour. Income differentials may arise and be maintained by the expansion of these prosperous regions relative to the poorer ones. Such an expansion may be further facilitated by the increased mobility of financial and physical capital within a monetary union (Abraham and van Rompuy, 1995). Moreover, the increased spatial concentration in production may result in greater vulnerability of regions to industry-specific shocks (Artis, 1991; Bayoumi and Eichengreen, 1992).

3. The New Theory

Depending on one's point of view, theories evolve either to reflect the development of contemporary conditions in the economy or independently of their economic environment. The New Theory of OCA is an example of the combination of the two. The interest in the theory of OCA has been recently revived because of two factors. First, in light of the unification of Germany, the disintegration of the Soviet Union and, especially, the European monetary unification, the theory of OCA has been the cornerstone of the debate about these international monetary developments because it provides useful and relevant insights. Second, developments in the macroeconomic theory, such as expectation formation and time-inconsistency theories, have allowed the original theory of OCA to be cast in

a new light.

Natural rate of unemployment and policy ineffectiveness

During the 1970s and early 1980s, many countries experienced rising unemployment combined with increasing inflation rate. In that period, Lucas' work was developed based on the assumption that agents make optimal use of the available information and understand the ongoing government policy rules. In this sense, under certain conditions (costless information and flexible prices) even in the short-run, anticipated policy changes have no effect on output and employment. Further, the Friedman-Phelps hypothesis, that the steady-state unemployment rate is not related to the steady-state inflation rate when the Phillips relationship is augmented by expectations of inflation, has undermined the view of a permanent trade-off between inflation and unemployment rates. The view that flexible exchange rates would allow an economy to pursue an independent monetary policy in order to choose an optimum point along the Phillips curve has weakened in light of these developments. Since nominal variables have no permanent effects on real variables, a devaluation in nominal exchange rates cannot have sustained effects and is offset by price increases that tend to make the real exchange rate fixed. In this view, following a flexible exchange rate policy is not beneficial (Tavlas, 1993).

While the validity of long-run monetary neutrality is acknowledged by the theory of OCA, several issues should be addressed. First, the commitment to monetary policy cooperation and to a fixed exchange rate regime may not be sustainable when an asymmetric shock occurs. A common monetary policy can

lead to the exacerbation of the domestic business cycle and to pressures to adopt independent national policies. An example of the consequences of high currency competition was the ordeal of ERM in late 1992 and 1993 (Frenkel and Goldstein, 1986; de Grauwe, 1991; Tavlas, 1993). Even if a disturbance is symmetric, structural differences may give rise to different policy preferences. This is the 'free rider' problem (Hamada, 1985) where each participant in a convention has an incentive to unilaterally abandon it (Tavlas, 1993).

Second, concern has been expressed that in a single currency area industries will become spatially concentrated and regions will be increasingly vulnerable to asymmetric shocks. The underlying argument is that, in a flexible exchange rate system, long-term decisions about location and unit operation scale must take account of the exchange rate risks. Therefore, firms may prefer to scatter their production activities across markets. This response is not necessary under fixed exchange rates leading to more geographic concentration of production facilities. (Artis, 1991; de Grauwe, 1991; Krugman, 1993).

Finally, the loss of seigniorage revenue at the national level may be particularly severe for countries with an under-developed tax system which may find less costly to increase their revenues through inflation than by increasing taxes (Artis, 1991; de Grauwe, 1991).

Time inconsistency and credibility

As with all other benefits arising from the forming of a currency area, credibility is an externality shared by all members of a monetary union. The benefit is produced as follows. If the authorities of a country have a reputation of implementing inflationary policies, they will need to follow long and costly deflationary programmes and abide by a policy rule that is time consistent (Barro and Gordon, 1983). However, they can benefit immediately in terms of credibility by 'tying their own hands' and making drastic institutional changes, such as resigning from monetary sovereignty, when they join a currency area with low inflation countries (Commission of European Communities, 1990; de Grauwe, 1992). Unless a common monetary policy is implemented, there may exist occasions where, despite their commitment, national governments will want to resort to independent policies to deal with shocks specifically affecting their own economies – and economic agents are assumed to be aware of this. This is the basis of the time-inconsistency argument. A common currency is one way of increasing the credibility and ensuring the commitment of the country members³. While in the traditional approach similarity in inflation rates is a criterion of OCA, in the new theory it is a consequence (Gandolfo, 1992).

Again, there are issues that need further discussion. First, there is the

³ Monetary discipline and reputation have an interesting political aspect, as well. It has to do with what Gandolfo (1992) calls 'economic policy illusion'. While societies are not willing to accept certain economic policies as a result of exercising national sovereignty, they are willing to accept them as a requirement of participating in a monetary union. This is especially so if there exists an independent central bank in the 'dominant country', in which case the country members are considered to 'import discipline'.

question of how the common monetary policy is formulated and conducted (the 'nominal anchor' issue). There are two kinds of arrangements: symmetric systems in which the member-countries co-operate in the policy-making process and asymmetric systems in which one country takes the leadership in policy implementation.

Second, the literature of time-inconsistency points out the benefits of monetary unification for high inflation countries but it is not clear, in asymmetric systems, what the incentive for the leader-country would be to join such an arrangement. The benefits for the dominant country could include promoting its monetary leadership and enhancing control over domestic monetary conditions by controlling speculative capital flows (Tavlas, 1993). The costs may include reduction in reputation as long as the anchor country takes into account the economic conditions of the peripheral countries (de Grauwe, 1992; Krugman, 1990).

Third, short-run costs of transition to the new framework may include higher unemployment rates as the candidate economy implements policies to decrease its inflation rate and enhance its credibility. Wihlborg and Willett (1991) suggest an alternative transition path to a currency union: the use of flexible exchange rates while the institutional arrangements for policy coordination and common central bank are worked out. This is because countries with low tolerance for unemployment may be tempted to follow expansionary monetary policy, especially if the short-run costs in terms of inflation are low.

Finally,

“(t)he expression ‘irrevocably fixed exchange rates’ has no practical significance ... History is full of irrevocable commitments to fixed exchange rates that have broken down” (Gandolfo, 1992).

A single currency is not the same as irrevocably fixed exchange rates. In order for the latter to be equivalent to the former, the national monetary authorities have to guarantee the fixed price of foreign exchange and be able to buy and sell unlimited quantities of exchange at this fixed price. If speculative runs occur, there will be pressure to abandon either of these obligations.

Labour mobility under uncertainty

The size of the adjustment costs and the degree of uncertainty about the future are important determinants of resource-reallocation decisions in response to disturbances. The more uncertain is their environment, the less will be the willingness of rational economic agents to undertake adjustment that may ex-post be regretted (Bertola, 1989). Bertola applies a model with microeconomic foundations under conditions of costly reallocation and uncertainty to Mundell's factor flexibility criterion. Specifically, he models an agent who faces the choice between remaining in his current occupation (or location) or moving to another, with income being uncertain in both locations and with fixed costs of moving. The agent will move, if the expected income differential exceeds the fixed moving cost by an amount related to the probability that the agent may want to reverse the movement in the future. In this framework, Bertola shows that within a range of expected income differentials, there is no movement and the width of this range depends positively on the degree of uncertainty.

The implication of Bertola's analysis is that, in a fixed exchange rate regime, asymmetric disturbances, by increasing income variability, lead to lower labour mobility. However, Branson (1989) argues that Bertola's results are based on a restrictive version of the Mundell-Fleming model which biases the results in favour of exchange rate flexibility. An alternative formulation would be to use monetary policy to stabilise the exchange rate and fiscal policy to stabilise income. Then, in the Mundell-Fleming model, stability of the exchange rate makes fiscal policy more effective.

The role of exchange rates

External adjustment.

In the earlier literature on optimum currency theory, exchange rate movements were considered an effective adjustment mechanism for external imbalances as they were perceived as being primarily influenced by trade flows. However, as international capital movements became larger and the world moved towards variable exchange rates, economists focussed their attention on the importance of the capital account on the exchange rate determination and also stressed that there may be lags involved in this adjustment process, considerably longer than implied by the flow model (Krueger, 1983; Tavlas, 1993). For example, in the context of the portfolio balance model, in which non-money assets are imperfect substitutes, asset shocks can result in exchange rate overshooting which may be reversed by accumulation of foreign assets via the current account. Therefore, exchange rate adjustment may be an insufficient tool for restoring

equilibrium in the balance of payments.

Economic activity.

Since the breakdown of the Bretton-Woods agreement, a debate emerged as to the desirability of subjecting the rate at which currencies are traded to the forces of supply and demand. The laissez-faire economists embraced the transition to flexible exchange rates, while those who were against it argued that exchange rate volatility may hamper trade and investment activities. If exchange rate movements are not anticipated, then they result in higher risk which, in turn, leads risk-averse agents to redirect their trade and investment activities towards domestic markets. However, the theoretical work and empirical evidence are inconclusive as of whether this argument is true. In general, the theoretical models show how exchange rate volatility may impact in a positive or negative fashion the trade flows depending on the assumptions employed with respect to the nature of the response to risk, the availability of capital, the time horizon of the trader and whether the firm is a manufacturer or a trader. The same ambiguity exists among the empirical contributions to this discussion (McKenzie, 1999).

Formal models of OCA

It has been argued that if the only visible advance in the theory of OCA is the proposal of new criteria for determining the optimal size of a currency area, then the profession is at fault for its unwillingness to adopt a formal analysis of the subject divorced from the policy aspects (Melitz, 1995a). Recently, there has been an effort to formalise the theory of OCA and relate it more closely to other aspects of

international economics.

Melitz (1993) suggests that the benefits be represented by the decrease in transportation costs, the costs by the decrease in the adjustment speed of the terms of trade and the size of the currency area be treated as a continuous variable going from zero to one, depending on the degree of integration ('percentage of trade'). Marginal analysis is performed to determine the optimal size of the monetary union from the view-point of aggregate trade rather than trade within the area. As the area expands, marginal benefits decrease, marginal costs increase and the optimum size can be determined. However, this size is affected by the composition of the monetary union.

Following the same line of argument, that the choice of union partners becomes a vital component in the determination of the optimal size of the union. Melitz suggests that this choice can be optimal by minimising the covariance in the terms of trade with the aspiring partners (Melitz, 1995b).

Bayoumi (1994) proposes a general equilibrium approach to the optimum currency areas. He sets out to combine many of the insights from the earlier, less technical, literature in a well-specified model with a stronger basis in the microeconomic theory. In this framework, the decision to form a currency union depends on fundamental factors such as the size of and the correlation between the underlying disturbances, the cost of transactions between different currencies, the mobility of labour, the degree of openness and industrial diversification. The model provides insights on the welfare effects of a currency union both for the country

members and the countries outside the union. Two conclusions are drawn from this analysis. First, while a currency union can raise the welfare of the countries within the union, it unambiguously lowers the welfare of the countries outside the union. Second, the incentives for a country to join a currency union are different from the incentives to admit a country into a union.

4. Is Europe an optimum currency area?

In their attempts to evaluate the costs involved with EMU, recent contributions have concentrated on the incidence of shocks. Because the EMU involves the sacrifice of monetary and, to some extent, fiscal autonomy, if disturbances are symmetric and the economies of the member-countries similar, then common policy responses should suffice and the cost of relinquishing the national policy sovereignty will not be very high. On the contrary, if disturbances are asymmetric, then adjustment will take place either through *relative price* or *quantity* movements⁴.

The variability of real exchange rates is one measure of the extent of asymmetric shocks, since changes in relative prices reflect disturbances in demand or supply or responses to them that are greater in one country than another. Poloz (1990) found that relative prices within Canada are more variable than real exchange rates between four EU countries (France, Italy, the UK and Germany). The implication is that Europe should be as successful in functioning as a monetary

⁴ As a result of the increased interest in issues of currency unions, a large volume of literature has been developed, especially during the last decade, discussing the feasibility of EMU and comparing the results with the US. Eichengreen (1990) and Masson and Taylor (1992) provide a survey of the early literature while, since then, contributions have taken great proportions.

union as Canada is (except for the Quebecois nationalists, few would argue that Canada is not an OCA). However, it is not surprising that relative prices between Canadian provinces are highly variable, since they are highly specialised in their production, while the four EU countries examined are all diversified economies with similar characteristics.

Eichengreen (1991) found that relative prices between four US regions (North East, North Central, South and West) have been less variable than real exchange rates between 10 EU countries (Belgium, France, Germany, Greece, Ireland, Italy Netherlands, Portugal, Spain, the UK). Also, real securities prices, a measure of the incentive to reallocate productive capital across regions in response to asymmetric shocks, appear considerably more variable between Paris and Dusseldorf than between Toronto and Montreal.

Von Hagen and Neumann (1994) compare the conditional real exchange rate (RER) variance (i.e., the variance of unexpected RER fluctuations instead of the observed variance) within Germany (regional relative prices among six West German Länder) with the conditional real exchange rate variance of the same six Länder with other European countries. They find that the variability of real exchange rates has decreased dramatically both within Germany and between Germany and other European countries during the 1980s. However, the conditional real exchange rate variance between Germany and certain countries (Austria, Belgium, France, Luxembourg and the Netherlands) is lower than the variance between Germany and other countries (Denmark, Italy and the U.K.). This

difference is due to asymmetric real supply and demand shocks, not lack of monetary coordination. This finding favours the forming of a monetary union of 'two speeds' in Europe.

Evidence on the responsiveness of the markets to disturbances could provide information on the feasibility of EMU. Eichengreen (1990) finds that the speed of adjustment to country specific labour-market shocks is nearly 25% higher in the US than in the EC and that unemployment differentials are smaller in the US regions. These findings indicate that *labour mobility* in Europe is lower than in the US where there exist greater cultural and linguistic homogeneity and fiscal federalism.

Caporale (1993) applies a statistical technique known as 'principle components analysis' to distinguish between common and country-specific shocks. He concludes that a sizeable percentage of GDP fluctuations in the EC are due to asymmetric disturbances, making the operation of a currency union difficult. He suggests the establishment of fiscal federalism to deal with the asymmetries in shocks.

Fatas (1997) analyses country and regional business cycles in the European Union and their evolution overtime using *employment growth rates*. The main finding is that the correlation across national borders has been increasing while the regional correlation within countries has decreased. This result supports the hypothesis that increased integration has favoured regional specialisation and the discipline of the EMS has reduced the national components of the business cycles. The same conclusion, with respect to increased regional specialisation, is reached

by de Nardis et al. (1996) using output dispersion data for European countries and regions in the major manufacturing sectors.

Taking a more general approach, other papers examine the movement of more than one macroeconomic variable as an indication of the nature of shocks. Cohen and Wyplosz (1989) consider three variables for France and Germany – real GDP, real wage rates and the price level. They find that symmetric shocks are much larger than asymmetric ones and they tend to be more permanent than transitory. Their findings are consistent with Poloz' which could be explained by the fact that both compare economies with similar characteristics.

Weber (1991) shows that the behaviour of nominal and real exchange rates, nominal interest rates, relative inflation rates and current accounts displays considerable symmetry during the EMS period and so do demand and supply shocks, which is consistent with the general decline of output growth rates and the increased synchronization of business cycles. On the contrary, shocks to external balances, real wages, relative money supply and demand are predominantly asymmetric.

De Grauwe and Vanhaverbeke (1991) compare the movements of regional and national relative prices, the mobility of labour, the unemployment rates and the growth rates of output and employment in ten European countries, Japan and the USA. Their findings are summarised as follows. First, labour mobility across regions (in the same country) plays an important role in the adjustment process. At the national level, there is almost no labour mobility but significantly more real

exchange rate variability than at the regional level. Second, they find larger and more sustained divergencies of output and employment growth rates at the regional than at the national level. Finally, they distinguish two country groups in Europe with different regional development characteristics. On the one hand, the 'Northern' group has greater regional labour mobility, low divergences in output and employment and relatively uniform regional unemployment rates. On the other hand, the 'Southern' group involves relatively immobile labour, pronounced divergences in output and employment and regional concentrations of unemployment.

Bayoumi and Eichengreen (1992) analyse data on output and prices for 11 EC country members using a structural VAR approach in order to distinguish between pure aggregate demand and supply shocks and different speeds of adjustment. They find, first, that disturbances are significantly larger and less correlated across countries in Europe compared with the US. Second, EU members can be distinguished in two groups according to the nature of shocks. There is the 'core' of members that experience smaller and more correlated shocks and the 'periphery' characterised by larger and less correlated disturbances. This distinction argues for the advancement of a 'two speed' monetary union.

These results are consistent with Bayoumi and Thomas (1995) who also use the structural VAR approach and find that economic integration in the US is significantly greater than the integration in the EU. As a result, relative prices are more important for adjustment in the EU than in the US. Their findings are also

consistent with the theory that, in the long run, increased economic integration will reduce the need for large movements in relative prices. Similarly, Chamie et al. (1994) use an extension of the structural VAR approach to decompose supply and real and nominal demand shocks into unobservable common and specific components. The results show that both supply and real demand shocks affecting the US regions are much more symmetric than those affecting the European countries.

The structural VAR approach is also used by Funke (1997) who compares data for European countries and West German Länder and shows that the correlation of demand and supply shocks is lower among the former than the latter.

Christodoulakis et al. (1995) study the business cycle features of key macroeconomic variables of the EC and examine the similarity of these characteristics across the countries involved in the EMU. They find that the behaviour of GDP, consumption, investment, prices and, to a smaller degree, net exports are quite similar, while the behaviour of government purchases, money and terms of trade vary substantially across countries. They interpret these results as implying that only variables under the direct control of the government behave differently and that the type of shocks and the propagation mechanism are fairly similar across the EU countries.

Frankel and Rose (1997, 1998) also show that countries with closer trade links have more tightly correlated business cycles, implying the inter-relation and endogeneity of these two criteria of OCA. They argue that a country is more likely

to satisfy the criteria for entry into a currency union ex post than ex ante.

Bayoumi and Eichengreen (1997a) construct an OCA index based on a particular empirical specification that summarises countries' readiness for EMU, as predicted by output disturbances, the commodity composition, the importance of trade and the size of the economy. The results show the prospective EU members divided into three groups, ranging from those with a great degree of readiness to those with little or no convergence. The make-up of the grouping coincides with what would be widely expected with the notable exception of France. France's OCA index indicates that the structural characteristics and the cyclical performance of this country are not consistent with an easy transition to monetary union. Another finding is that economic integration has increased the readiness for monetary integration which supports the notion that the EMU and the Single Market can constitute a virtuous, self-reinforcing circle.

The results of some of the empirical studies appear conflicting but this is due to the different methods used. The major conclusions can be summarised as follows:

- Labour mobility among EU countries is lower than across regions in the same country, leading to greater reliance on relative price movements for adjustment. However, increasing integration among EU countries leads to greater correlation in business cycles but also to higher regional specialisation (therefore, lower correlation of disturbances among regions).

- European countries can be grouped in at least two categories, the 'core' and the 'periphery', depending on their degree of convergence, measured by labour mobility, relative price movements, output and employment growth rates.
- There exists greater asymmetry, as far as relative price fluctuations are concerned, among European countries than among regions in the EU or the USA. The level of integration and the speed of adjustment are lower at the national level in Europe than at the regional level in Europe or the USA.

In conclusion, the choice of the optimal exchange rate regime and, especially, the desirability and viability of a monetary union created a great deal of discussion among economists, especially during the last decade. In comparing the two alternatives, the main criterion is how each facilitates adjustment after a disturbance has occurred in an economy. Flexible exchange rates provide a useful tool for immediate change in the relative prices (real effective exchange rates) while under fixed exchange rates (or a common currency) other adjustment mechanisms are required.

The theory of Optimum Currency Areas provides useful insights about these adjustment mechanisms, the benefits of joining a monetary union and the costs from joining in the absence of such mechanisms. Each of the earlier contributions to this theory singled out one characteristic that would make the currency area viable. Factor mobility, market integration and product diversification were among

the criteria put forward.

More recent contributions focussed on the rationale of forming a currency union, the benefits and costs for a country participating in it. The benefits can take the form of enhanced efficiency because of eliminated transaction costs and exchange rate risk, exchange reserve pooling and greater policy coordination. The costs include eliminated monetary sovereignty, limited fiscal autonomy and greater regional vulnerability to disturbances if regional specialisation occurs.

The most recent contributions have incorporated the developments in macroeconomic theory, such as policy ineffectiveness and time inconsistency theories, and in the theory of international economics, such as labour mobility under uncertainty and the role of the exchange rates.

The insights provided by the theory of OCA predict the following changes in the stability of components of the Greek economy from participating in the EMU. The nominal interest rate and, consequently, the exchange rate will become more stable as the Greek economy participates in a union where the monetary authority is committed and able to implement policies protecting the stability of the EURO both in the EMU area and internationally.

The fiscal authorities may benefit from the increased credibility and lower volatility in debt-servicing costs (due to the increased stability of both the interest rate and the exchange rate). As a consequence, the deficit and debt as percentage to GDP may become more stable in the EMU framework. On the other hand, these benefits may be offset by the fact that the public sector budget will be the only

stabilisation tool available to the government, particularly because the SGP constraints are not explicitly included in the stochastic simulations.

In the occurrence of disturbances, the theory of OCA predicts that adjustment will be achieved through the increased volatility either of output and employment (if the domestic price level and wages are fixed) or of prices or a combination of the two. These particular features of the economy will be discussed in chapter four and the issue of which adjustment mechanism is at work in the Greek economy will be more decisively addressed through the stochastic simulation process.

Chapter Three

The Characteristics of the Greek Economy

This chapter discusses the main characteristics of the Greek economy and presents the recent reforms that have been implemented. The objective is double. First, to provide information about the structure of the Greek economy and the interaction of its different sectors. This information will be useful for the discussion of the policy implications of the results of the stochastic simulations in chapter five. Second, to describe the nature of shocks that the Greek economy has experienced since the mid-sixties because the structural shocks used in the stochastic simulations are derived from the historical data during this period.

The chapter is organised as follows. The first section provides a survey of the recent economic history of Greece to show how the Greek economy has responded to disturbances and government policies during the post-war period. The second section presents the main features of the public sector. Discussing the structure of the government expenditure and revenues aims at understanding the constraints of the public sector in the implementation of stabilisation policies. The third section describes the characteristics of the private sector and discusses the effects of the interaction between the public and the private sector. In the last two sections, we present the structure of the financial and the labour market. These two sections provide more detailed information about these markets which serves in better understanding the limitations of the public and private sector and will also serve in the analysis of the stochastic simulation results.

1. Historical overview

The Greek independent state was consolidated in its present frontiers in 1945 after a liberation process from the Ottoman Empire that essentially lasted for over a century. Between 1939 and 1949, Greece experienced two major and devastating wars, World War II and a civil war. These historical pressures delayed Greece's economic development. After 1950, the political and institutional environment of the economy provided the private sector with safety and stability, albeit based on strict labour policies. During the 1950s and 60s, the Greek economy had an abundance of unskilled labour (originating from the overcrowded primary sector) and low capital accumulation. These favourable conditions were combined with a very close state control of labour unions¹ and government policies aiming at protecting the domestic manufacturing sector from international competition. This environment produced high returns to investment, especially in labour-intensive industries, and attracted international investors. Until 1975, the Greek economy achieved high growth and low inflation rates because of these positive domestic and international conditions (world output grew, inflation rates were low internationally, exchange rates were stable because of the Bretton Woods agreement). During the period 1961-73, the main characteristics of the Greek economy were as follows²:

- High GDP growth rate: the average annual real GDP growth rate was 8.5% in Greece and 4.8% in the EU countries.

¹ For a description of the evolution of labour law in Greece, see Gallant (1995).

² Table 3.1, at the end of this chapter, shows the development of the main economic indicators of the Greek economy during the past four decades. Table 3.2 compares some of these indicators between Greece and the EU.

- High savings and investment rates: gross capital formation represented 28% of GDP on average and national savings 26%, in Greece and in the EU the percentages were 25% and 25.8%, respectively.
- Very high labour productivity growth rate – more than double the one in the EU countries: the average annual labour productivity growth rate was 9% in Greece and 4.4% in the EU countries.
- Increases in real wages were much less than productivity growth. Real wages increased annually by 6.4% on average in Greece and by 5% in the EU countries.
- Lower inflation rate: the average annual private consumption inflation was 3.5% in Greece and 4.6% in the EU countries.
- Fiscal discipline: the general government budget surplus was on average 0.5% of GDP.

The good performance of the Greek economy in the 1960s and early 1970s was hampered by the two oil-price crises, the collapse of the Bretton Woods agreement and by domestic political factors during the seventies. The re-establishment of democracy (in 1974, after a seven-year dictatorship) was followed by pressing demands for income increases and redistribution. By the late seventies, the government proved incapable (and/or unwilling) to follow a plan of gradual wage increases in accordance with productivity growth rates. A series of expansionary measures was implemented: increased public expenditure, credit expansion,

reduction of labour income taxation, introduction of wage indexation and increase in minimum wages (up to 46%). The implementation of these policies (apart from being induced by political pressures) was based on the misconception that demand-push policies would be the remedy to the stagnation of economic activity at the time. These measures were not combined with any supply-side policies that would help the private sector overcome the oil-price disturbance and adjust to the new international conditions (increased competition, new technologies). For this reason, the main economic indicators deteriorated and diverged from the OECD averages. In 1982, the inflation rate was 21.1% while the real GDP growth rate was negative.

In 1981, Greece became a full member of the EC. Faced with the decreased protection from the international competition, in addition to the sharp increase in labour costs (due to the expansionary policies described above), many firms closed down. In an attempt to control the rising unemployment rate (from 2.8% in 1980 to 7.2% in 1984) the government increased the employment in the public sector and took over the ownership and management of some of these 'problematic' firms, with the mandate to return them viable to the private sector. As a result, the public sector expanded sharply and permanently, the deficit increased to 11.7% of GDP in 1984 and the public sector debt mounted from 27.4% of GDP in 1979 to 51.5% in 1984.

The intervention of the government by taking over bankrupt firms combined with the attempts to control inflation through price administration, weakened the role of the markets. The increased operating costs delayed the introduction of new

technologies in the private sector. The increases in minimum wages disconnected from the labour productivity growth and independently of skills created a notion of 'levelling up' labour incomes and decreased the incentive for labour differentiation, especially in the public sector. These developments reversed the good performance of the Greek economy relative to other EC and OECD countries. The absence of an adequate strategy to promote investment in new technologies and retraining of the labour force, combined with the demand-push policies, led the economy to stagflation, inefficiency in the product and labour markets and low productivity in the public sector.

Another consequence of the crowding-out effects of the high government deficits was the expansion of the 'underground' economy (mainly in the form of undeclared legal economic activity). This allowed some inefficient firms to avoid restructuring and adjustment to the more competitive conditions while it sustained household incomes at higher levels than warranted by the government income policies. The size of the 'underground' activity was estimated at 25-30% of GDP during the 1980s and it was traced in all the sectors of the economy (primary, secondary and tertiary). Apart from the reduced revenues for the government, the existence of a sizeable 'unofficial' sector implies reduced effectiveness of stabilisation policies (Pavlopoulos, 1996).

In 1983, the government introduced an 'austerity programme' that included wage 'freezing', a Drachma devaluation by 10%, policies to control the public sector variables and incentives to promote private investment in remote areas. The results

of the programme were limited for two reasons. First, it did not contain the appropriate measures for the correction of the problems discussed above. Second, it was a short-lived programme because 1984 and 1985 were election years – political business cycles seem to be very pronounced in Greece.

In 1987, another austerity programme was launched aiming at lowering the inflation rate and correcting the severe imbalances in the government budget and the balance of payments. It involved a devaluation of the drachma by 15%, strict income guidelines and restrictive fiscal and monetary policy. This stabilisation programme was effective partly because of favourable international conditions, such as lower oil prices, lower interest rates and recovery of economic activity. The inflation rate decreased and output grew. However, these achievements were accompanied by falling real per capita income and declining infrastructure investment. The programme was abandoned in 1989 (the next election year).

During the early 1990s, successive governments formulated different stabilisation programmes none of which was in place for long enough time to be effective because of political instability. During the last half of the nineties, considerable progress has been made in correcting imbalances and achieving the requirements for participating in the EU. In 1997, the public deficit declined to 4% of GDP and the inflation rate decreased to 5.6%. Forecasts for the deficit/GDP ratio and the inflation rate in 1999 are 2.1% and 2.5%, respectively. Output growth rates have been consistently positive. Between 1994-1998, the annual real GDP growth rate was 2.7% on average and the equivalent EU rate was 2.6%. However, the

challenges for macroeconomic policies remain large because the unemployment rate has been increasing (9.6% in 1998) and convergence of per capita income towards the EU average will require additional effort (in 1991, GDP per capita in Greece was 47.3% of the EU average).

In summary, during the last three decades, the Greek economy was affected by four major events: two oil-price crises, the collapse of the Bretton Woods agreement, the expansion of the public sector and becoming a member of the EC. The main consequence of these shocks was the delay of output growth (the average annual percentage change was 2% during the period 1975-95 compared to 7% for 1960-1974) and the acceleration of inflation (the annual rate averaged 18% compared to 4% for the respective periods). Another effect was the deterioration of the public sector debt during the 1980s. Earlier efforts to correct these problems had only temporary success partly because they dealt with the symptoms instead of addressing the underlying causes: the weaknesses in the structure of the government budget and the inefficient operation of the product and factor markets. These problems will be discussed in the following sections in greater detail.

2. The public sector

During the 1980s, the financial position of the public sector deteriorated significantly as a result both of a rapid increase in certain types of expenditure and of a rather modest increase in tax revenue.

Public expenditure has been in excess of revenues since the late seventies. It increased from about 23% of GDP in the 1960s to 40% in 1988 and to about 46%

in 1995. The growth has been rather uneven between the major components as Table 3.3 shows:

- During the 1980s the public sector wage bill increased while labour efficiency and quality of public services decreased³. In addition, public pension payments rose. In relation to GDP, pension expenditure doubled (15% in 1989) following a phase of being nearly stable at 7% during the 1970s. On the other hand, expenditure on human capital development, research and technology, health and welfare is of the lowest while expenditure on military equipment is of the highest among the EU countries⁴.
- Debt servicing costs increased not only because of the increase in public debt itself, but because of the increase in interest rates (as a result of the financial market reform described below and the introduction of deficit financing through bonds sold to the non-bank sector in the mid-1980s) (OECD, 1990).
- Transfer payments to households accounted for more than 60% of total transfer payments in the 1970s and 80s. Total transfer payments

³ This is the result of three factors. First, there was overstaffing in almost every public administration department. Second, new recruitment criteria were applied concentrating on unskilled and general-education labour. Recruitment of skilled and qualified personnel was limited. Third, motivation has suffered from the implementation of a 'unified civil service pay scheme' which compresses the earnings of qualified personnel and provides automatic annual increases in wages irrespective of qualifications and performance (OECD, 1991).

⁴ During 1989-92, Greece had the lowest allocation of funds to the training of the workforce to new skills: 19% compared with 60% in Ireland, 47% in Spain and more than 40% in Portugal (Christodoulakis, 1994). Also, health expenditure represents 5.8% of GDP while it is 10.4 in Germany, 6.4 in Ireland, 8.2 in Portugal, 7.6 in Spain (OECD, 1992).

were subject to cyclical variations, reaching their peaks at election years.

- While the share of transfer payments in total public expenditure increased, the share of public investment decreased during 1980s. This is an indication of the preference of the government for present rather than future consumption and had serious consequences for the infrastructure of the country.

The tax system yields weak revenues mainly because of the following factors (OECD, 1990):

- The personal income tax system produces the following distortions. First, it discriminates against wage and pension earners. Given the exemptions from taxation of the agricultural income and the difficulties in tax collection among the self-employed and small businesses, the greatest share of tax weight is borne by employees and pensioners. Second, the system is extremely progressive by OECD standards.
- While the overall income tax burden and the tax elasticity with respect to income are extremely low, indirect taxes as a share of GDP are of the highest in OECD. Indirect taxes have traditionally been the source of about half of total public revenues, with a slight tendency to decrease recently as a result of fiscal harmonisation with the EU.
- The rates of social security contributions, at 35–40% of income, are also high by international comparison. However, the application of

ceilings on the total amount of contributions, exemptions and tax evasion make the effective rate somewhat below the OECD average.

- The relatively high tax rates contrast with the comparatively low tax yields and tax elasticities. This is partly due to the inefficient operation of the tax filing system which does not allow the tax authorities to fight tax evasion. Corporate taxes in proportion to total corporate profits are of the lowest internationally, reflecting revenue foregone due to tax deductions, exemptions and tax avoidance. Similarly, the value-added tax (VAT) rates are among the highest in the EU but revenues in proportion to private consumption are only slightly above the EU average, suggesting serious problems in tax collection.

3. The private sector

The structural problems of the private sector contributed to the reversal of the position of the Greek economy relative to other EU and OECD countries. These problems resulted from the particular relationship between the government and the private sector in Greece, that has existed for the biggest part of the post-war history of the economy.

On the one hand, the government controlled all the aspects of business conduct: hiring and investment regulations, price and profit-margin controls, quotas and licence granting. On the other hand, a system of exceptions and financial support reflected the preferential treatment reserved for certain firms, usually larger ones with affiliations to the government. This framework of selective sectoral

protection aiming at offsetting the effects of trade liberalisation fostered an environment where financial constraints were weak for specific firms (OECD, 1991; Kornai, 1986).

The structural problems of the private sector are summarised as follows (OECD, 1993):

- The high degree of government intervention and the crowding-out effect of the high public sector deficit during the 1980s affected the activities of the private sector. By regulating almost every aspect of business conduct and nationalising bankrupt firms in the early eighties, the government policies distorted the operation of the product and factor markets and prevented them from performing their role of efficient resource allocation. It is not surprising that institutions, such as the stock market, which rely on information about quality and risk, were only recently developed in Greece.
- The Greek manufacturing firms are characterised by a great degree of duality. On the one hand, there exist a few large firms. Some of these firms had been protected against international competition and had considerable negotiation power and access to credit. Of these, some came under state control when they became bankrupt, during the 1980s and others are struggling with low capacity utilisation rates and losses. On the other hand, there are small, usually family run, firms with limited market power and limited access to the financial

markets. The small size of enterprises creates a disadvantage for two reasons: first, small firms lack the necessary financial resources to fund research and development and second, their access to capital markets is limited (Katseli, 1990; Sarris, 1992; OECD, 1993).

- The private sector of the Greek economy has a narrow industrial base and a large inefficient agricultural sector (see Table 3.4). Most of the Greek manufacturing firms are concentrated in low and medium technology sectors, producing low value-added products (see Table 3.5). These products are mainly consumption goods with low price and income elasticity while competing imported goods have higher income elasticities⁵. Most of the firms are located close to the two big urban centres where congestion problems arise while firms located elsewhere face problems related to the lack of infrastructure, skilled labour and other external economies.
- The frequent policy changes and the shortcomings of the Greek bureaucracy (both in terms of low productivity and corruption) contribute to the creation of an ever-changing and uncertain business environment.

⁵ Between 1950-70 income elasticities for domestic and imported goods were not as different (1.45 and 1.76, respectively) as they were for 1980-88 (0.3 and 2.7, respectively). Even for some 'traditional' industries (food and beverages, tobacco, clothing and footwear, leather, textiles) income elasticities of imports are over 5 while they are negative for the domestic production for 1980-88 (Hassid and Katsos, 1992).

4. The financial market

After the Second World War, the economy was in a very disorganised state which necessitated the close co-operation between the Bank of Greece and the government. In 1946, the Currency Committee was established with the mandate to formulate the monetary policy and manage the banking system. The committee members included Bank of Greece and government officials. A complicated system of direct controls and regulations of bank credit was designed to channel funds to selected sectors. A large part of the public sector deficit was financed either directly by the Bank of Greece or by earmarking the commercial bank funds to be invested in treasury bills. The loan rates were often set at levels lower than the market-clearing ones. Therefore, credit was rationed and preferential treatment was offered to 'traditional' customers (usually large corporations with personal connections to the government). This system remained unchanged until the mid-1980s and it was inefficient for two reasons. First, it distorted the allocation of credit in the economy. Second, it delayed the growth and development of the financial sector (Chalikias, 1987, 1990).

Since the reform policies took effect in mid-1980s, the financial sector has been the area of the Greek economy where the deepest structural changes have been occurring. State-controlled banks have expanded their capital base and are improving their efficiency. Nonetheless, the financial sector still exhibits the following weaknesses (see Table 3.6):

- Limited competition: the banking system in Greece is dominated by

two state-controlled banks (the National Bank of Greece and the Commercial Bank of Greece) conducting around one half of total banking business and holding about two thirds of total assets of commercial banks.

- High labour costs and wage rigidities due to overstaffing and powerful labour unions.
- Low profitability due to inefficient operation, especially of the state-controlled banks. The large allocation of financial resources in treasury bills and the ownership of indebted firms by some of the banks slows down their adjustment in a more liberalised environment with new financial products (Katseli, 1990).

5. The labour market

The characteristics of the labour market reflect the impact of government policies. The high degree of intervention and control has led to rigidities in the structure of employment and the wage formation (OECD, 1996).

- Although the agricultural labour force decreased from about 30% in 1981 to 20.8% in 1995, it is still almost four times higher than the EU average. The proportion of self-employment is much higher than the EU average both in the agricultural and non-agricultural sectors (see Table 3.7).
- There are significant barriers to entry and exit in the public and the private sector. A system of quotas, selective educational and social

requirements restrict the entry in the public sector where, once hired, employment and promotion are guaranteed. Strict firing regulations (among the strictest in the OECD) limit the exit from the private sector, especially in manufacturing. Another indication of market segmentation in favour of insiders is the difference between the unemployment rate of household heads which stands at 2% and this for youth which is 29% (see Table 3.7). Also, OECD studies indicate that Greece has the lowest rates of both inflow to and outflow from the ranks of unemployed among the OECD member countries as well as the lowest shares of dismissed workers in total unemployment (OECD, 1996).

- The ratio of the minimum to the average wage is high in Greece compared with the ratio in other European countries⁶. Moreover, empirical evidence indicates the narrowing of wage differentials⁷. The wage formation system⁸ and the presence of regulation about firing and hiring have fostered a loose relation between wages and

⁶ Following an increase in entry-level minimum wage of more than 40% in the early eighties, the ratio of minimum to average wage jumped to 60% and more than 40%, respectively, for blue-collar and white-collar workers in manufacturing. In 1995, this ratio for a married worker with 10 years of experience (adjusted for legislated bonuses) was about 60% compared with 50% in France, 30% in Portugal and 35% in Spain (OECD, 1996).

⁷ The ratio of average white- to blue-collar wage declined from about 1.7 in 1974 to about 1.2 for the period 1982-88 and increased to 1.35 in 1995 (OECD, 1996).

⁸ The government income policy plays an important role in the private sector wage formation process. Wage changes for the public sector are usually announced before private sector negotiations and are considered a minimum benchmark for the national collective agreement.

productivity⁹.

- There are several indications of the existence of structural unemployment in the Greek economy. The high unemployment rate among university graduates (10% in 1994), the low use of vocational training and frequently cited demands from the business sector for more highly qualified labour are signals of a problem in matching the skills supplied by the educational system with the needs of the economy¹⁰. The broader public sector is the largest employer of university graduates (60 to 80%) which may be biasing the choice of degree made by students (humanities have increased to 45% of total degrees in the last twenty years).
- Multiple job holdings are another characteristic of the Greek labour market. Many employees in the 'official' sector have sources of income in the 'unofficial' sector, a pattern which maintains demand and living standards higher than government income policies would justify.

In conclusion, during the period 1975-95 the slowing down of output growth

⁹ Regression analysis across 19 manufacturing industries has shown that average change in hourly wage is not correlated with changes in average productivity, value of sales or composition of employment (Katseli, 1990). Further, evidence shows that in the period 1966-88 wage variation was limited which suggests that, with different labour productivity growth rates among industries, wages in industries with relatively poor productivity performance were insulated, with adverse effects on employment (Ioannou, 1995).

¹⁰ Empirical evidence also supports the mismatching of labour demand and supply. The Okun curve – which shows the relation between the unemployment rate and the rate of industrial capacity utilisation – and the Beveridge curve – which links the unemployment rate with the vacancy rate – have shifted outwards (OECD, 1996).

and the acceleration of the inflation rate were the main consequences of four major disturbances that occurred in the seventies and early eighties: the two oil-price crises, the collapse of the Bretton Woods agreement, the expansion of the public sector and the membership in the EC. The high degree of intervention of the government distorted the operation of the product and production-factor markets. In the last half of 1990s, progress has been made in reforming structural weaknesses in those markets and reversing the deterioration of certain variables (output growth, inflation rate and public deficit). Despite the progress, there are still major challenges for the Greek economy. First, there are more rigidities to be corrected (in the labour market, in the operation of private firms and in the structure of the government budget). Second, the unemployment rate has been increasing. Finally, less progress has occurred as far as the convergence of per capita income to the EU average is concerned. Some of these issues will be addressed in the discussion of the stochastic simulation results.

Table 3.1: Main indicators of the Greek economy (annual percentage change, unless otherwise stated)											
	1961-70	1971-80	1981-85	1986-90	1991	1992	1993	1994	1995	1996	1997
Real GDP¹	8.5	4.6	0.1	1.2	3.1	0.7	-1.6	2.0	2.1	2.4	3.2
Private Consumption¹	7.1	5.3	1.1	3.1	2.8	2.4	-0.8	2.0	2.7	1.9	2.5
Public Consumption¹	6.3	6.2	3.0	-0.1	-1.5	-3.0	2.6	-1.1	5.6	1.0	-0.4
Gross Fixed Capital Formation²	8.4	2.8	-2.7	2.3	4.8	-3.2	-3.5	-2.8	4.2	8.8	9.6
Exports of goods and services¹	8.1	14.4	-0.5	3.9	3.7	10.4	-3.3	6.6	0.5	3.0	5.3
Imports of goods and services¹	11.3	8.0	1.6	8.5	6.0	1.3	0.2	1.3	9.2	4.9	5.4
Unemployment rate³	5.1	2.2	6.2	6.6	7.0	8.6	8.9	9.2	9.6	9.6	9.6
Private consumption deflator	2.4	13.9	20.5	17.6	19.7	15.6	14.2	11.1	8.9	8.3	5.6
Real Compensation per Employee⁴	6.9	3.8	1.6	-0.7	-3.7	-3.3	-3.8	-0.2	3.7	3.2	5.1
Government Expenditure⁵		23.7	34.3	44.0	40.3	41.7	43.9	44.6	45.7	43.8	41.3
Government Current Receipts⁵		25.3	29.2	31.8	33.8	34.6	35.9	37.4	38.5	38.8	39.5
Net lending (+) or borrowing (-)⁵		-1.7	-8.7	-12.1	-11.5	-12.8	-13.8	-10.0	-10.3	-7.5	-3.9
Debt⁶		20.7	38.6	90.1	92.3	98.8	111.6	109.3	110.1	112.2	109.4
Money supply⁷	17.6	22.6	28.0	21.1	12.3	14.4	15.0	8.9	10.3	9.4	9.5
Nominal Effective Exchange Rate⁸	758.8	572.6	280.9	134.0	100.0	92.4	85.3	79.6	77.6	76.2	74.1

1. 1990 market prices.

2. 1990 prices; total economy.

3. Percentage of civilian labour force.

4. Total economy; deflator private consumption.

5. General government; % of GDP at market prices.

6. General government; % of GDP at market prices. Maastricht and former definition (1970-89: not consolidated; direct advances by the central bank not included).

7. End of period.

8. Performance relative to 22 industrial countries; 1991=100.

Source: European Commission (1999) Broad Economic Policy Guidelines, *European Economy*, #68.

Table 3.2: Comparison of economic indicators between Greece and the EU (annual percentage change, unless otherwise stated)								
	1961-73		1974-85		1986-90		1991-96	
	EU*	GR	EU	GR	EU	GR	EU	GR
Real GDP	4.8	8.5	2.0	1.7	3.3	1.2	1.5	1.4
GDP per head of population ¹	100	49.4	100	53.6	100	42.7	100	47.3
Gross Capital Formation ²	25	28	22.1	27.3	21.1	22.5	19.6	20.1
Profitability index ³	100	100	73.3	80.2	88.9	59.8	95.8	80.2
Unemployment Rate ⁴	2.3	4.5	6.4	3.8	8.9	6.6	10.2	8.5
Labour Productivity Growth	4.4	9	2.0	0.7	1.9	0.5	1.9	0.8
Private Consumption Deflator	4.6	3.5	10.7	18.2	4.4	17.6	3.9	12.9
Real Wage	5	6.4	1.5	2.7	1.8	-0.7	0.8	-0.7

• EU=EU-15 (all member countries).
 1. EUROS; EU-15=100.
 2. Percent of GDP at current prices.
 3. 1961-73=100.
 4. Percent of civilian labour force.

Source: European Commission (1999) Broad Economic Policy Guidelines, *European Economy*, #68.

Table 3.3: Public expenditure and current revenues (General Government; % of GDP at market prices)			
	1970-79	1980-89	1990-96
<i>Total Expenditure</i>	26.5	39	47.7
Compensation of Employees	8.3	10.9	11.4
Public Investment	2.8	2.9	3.2
Transfer Payments	9.9	15.7	16.7
Interest Payments	1.1	4.7	11.9
<i>Total Current Revenues</i>	25.1	27.2	36
Direct Taxes	3.6	4.7	6.2
Indirect Taxes	11.7	12.6	14.7
Social Security Contributions	8.1	11	12

Source: European Commission (1999) Broad Economic Policy Guidelines, *European Economy*, #68.

Table 3.4: Structure of GDP			
	1970	1980	1989
Primary Sector	18.2	14.5	13.3
Secondary Sector	31.3	32.4	29.8
Manufacturing	19.1	21.3	19.1
Services	50.4	53.1	56.9

Source: National Accounts of Greece

Table 3.5: Firms with revealed comparative advantage in manufacturing¹

	1970	1979-1981	1990
<i>Industries classified by product</i>			
Food, drink and tobacco	298	255	310
Textiles, footwear and leather	230	403	574
Petroleum refining	81	368	352
Stone, clay and glass	118	379	289
Basic metal industries	295	151	207
Ferrous metals	286	122	167
Non-ferrous metals	313	218	271
<i>Industries classified by technology</i>			
Low-technology industries	174	210	252
Medium-technology industries	60	37	33
High-technology industries	15	21	18
<i>Industries classified by production intensity</i>			
Resource-intensive industries	221	251	250
Labour-intensive industries	115	198	294
Scale-intensive industries	96	42	39
Specialised-supplier industries	10	18	18
Science-based industries	35	26	18

1. Only commodity groups with above average comparative advantage are shown.

Note: Revealed comparative advantage is calculated by taking the ratio of product *i* to the country's total manufactured exports and dividing it by the ratio of total OECD exports of product *i* to the total OECD manufactured exports.

Source: OECD, *Economic Surveys: Greece*, 1993.

	Intermediation spread ¹ (%)	Required reserve ratio (%)	Staff costs ³	Loans ⁴	Non-bank deposits ⁵	Capital, reserves and bonds ⁵	Net income ⁶
<i>Greece</i>	7.9	12.0	47.0	31.5	75.2	4.6	27.4
<i>Spain</i>	4.4	2.0	39.3	42.3	44.7	12.0	9.5
<i>Portugal</i>	4.3	2.0	35.0	32.7	49.0	9.8	10.1
<i>Italy</i>	5.6	6.0 ²	43.4	40.2	35.4	19.5	5.7
<i>France</i>	2.8	0.5-1.0	45.9	32.0	23.8	21.2	1.6
<i>UK</i>	4.5	0.35	34.0	55.3	54.0	17.1	7.4
<i>USA</i>	1.3	3.0	26.1	63.8	68.5	9.4	22.8

1. The difference between the short-term bank lending rate and the one-month time deposit rate. Period average for 1997.
2. In August 1998, having undergone drastic reduction towards the level of the EU average.
3. Percent of total gross income.
4. Percent of assets.
5. Percent of liabilities.
6. Percent of capital, reserves and bonds.

Source: OECD, *Economic Surveys: Greece*, 1998.

Table 3.7: Cross-country comparison of the labour markets (Percentages)								
	EU-15		Greece		Portugal		Spain	
	1985	1994	1985	1994	1985	1994	1985	1994
<i>Unemployment rate</i>								
Total	10.9	11.3	7.8	9.6	8.1	6.7	21.2	23.9
Males	9.6	10.1	5.6	6.5	6.1	5.8	19.6	19.5
Females	12.9	13.0	11.7	14.9	11.0	7.8	25.0	31.4
<i>Youth unemployment rate</i>								
Total	23.2	21.6	23.9	29.1	19.5	14.1	43.8	42.8
Males	21.3	20.9	17.4	20.6	15.3	12.0	39.3	37.4
Females	25.4	22.6	31.7	38.8	24.6	16.7	51.0	50.1
<i>Long-term unemployment rate</i>								
Total	54.0	49.0	44.6	52.1	53.7	43.3	56.7	56.1
Males	53.7	47.4	34.8	42.5	48.3	42.3	53.9	49.6
Females	54.3	50.7	53.2	59.0	58.1	44.4	62.0	62.9
<i>Participation rate</i>								
Total	65.6	67.6	62.0	61.4	71.8	70.8	58.8	61.8
Males	81.6	78.9	83.5	79.7	85.8	81.3	83.0	78.0
Females	50.0	56.3	42.2	44.2	58.8	61.0	34.8	45.8
Youth (15-24) ¹	54.8	48.2	40.6	37.0	63.8	46.1	55.0	49.1
Old (55-64)	40.5	38.9	46.1	40.7	47.7	47.8	42.7	36.8
<i>Employment structure</i>								
Agriculture	8.6	5.6	28.9	20.8	23.9	11.5	18.3	9.8
Industry	33.8	31.3	27.4	23.6	33.9	32.8	31.7	30.1
Services	57.6	63.1	43.7	55.5	42.2	55.7	49.9	60.2
<i>Professional status</i>								
Wage earners	80.7	82.6	49.3	53.2	67.7	72.2	68.3	73.3
Self-employed in agriculture	6.4	3.8	27.7	20.1	19.7	10.2	12.9	6.7
Other self employed	12.9	13.5	23.0	26.7	12.6	17.5	18.8	20.0

1. Except Greece: 14-24.

2. 1993.

Source: OECD, *Economic Surveys: Greece*, 1996.

Chapter Four

Specification of the Model¹

The QUEST II is a quarterly model designed to analyse the economies of member countries in the European Union and their interaction with each other and the rest of the world, especially the United States and Japan. The focus of the model is on the transmission of the effects of economic policy both on the domestic and the international economy. The high degree of aggregation allows for a wide coverage of the model and reduces the computer time and memory requirements for the simulations.

The traditional Keynesian macroeconomic models and rational-expectations models have been criticised on the grounds that the behavioural relations are arbitrarily specified. Given this criticism, the dominant macroeconomic framework of the recent past is the representative agent model which is based on strong microeconomic foundations. Following these lines, the behavioural equations of the QUEST II model are derived from the intertemporal maximisation process of households' utility and firms' profits, which also makes the model forward-looking. The supply side is explicitly modelled with a neoclassical production function. This feature of the model ensures that the long-run behaviour of the model resembles the standard neoclassical growth model in that the model reaches a steady-state growth path with the growth rate essentially determined by the (exogenous) rate of

¹ This chapter follows Roeger and in't Veld (1997).

technical progress and the growth rate of the population. The real interest rate is determined by private savings behaviour in the long-run. Similarly, the real exchange rate is determined by demand for and supply of domestic and foreign output. This implies that economic policy will not affect the long-run steady-state growth rate² – unless it changes the rate of time preference, technical progress or population growth. However, it can affect the level of output and, thereby, the growth rate of the economy in the medium-term until the new steady-state income level is reached.

Stock-flow interactions are taken into consideration explicitly. The stock variables (such as physical capital, net foreign assets or government debt) are endogenously determined and adjustment takes place through wealth effects which influence the savings and investment decisions of the households, firms and government.

The financial linkages at the international level are strong. Assets (short and long term private and government bonds) are assumed to be perfect substitutes across countries. Consistent modelling of international trade and financial linkages also requires that two adding-up constraints hold across all countries in the model at each instant. Both trade balances and net foreign asset positions must sum to zero.

There are two major departures from the neoclassical model. First, the firms are not perfectly competitive, so they charge markups over marginal cost. Second,

² The long-run steady-state growth rate is set at 2.5% per annum.

adjustment in the labour market is sluggish because hiring and job-searching are costly and wages are determined through bargaining. Because of these rigidities, involuntary unemployment persists even in the long-run. There are standard Keynesian features in the model: imperfectly flexible wages and prices, adjustment costs for investment and labour hoarding.

The chapter is organised in the following way. In the first three sections, we specify the behaviour of the three sectors of the economy. In the fourth section, we discuss the determination of prices and wages. The fifth section presents the international trade relations and in the final section, we present the functioning of the financial market.

1. Behaviour of the household

The behaviour of households is modelled using the Life Cycle Hypothesis as formalised by Yaari (1965), Blanchard (1984, 1995) and Buiter (1988). It analyses the consumption and saving behaviour of households when agents have finite horizons. This assumption has an important theoretical implication, in that the Ricardian Equivalence Theorem does not hold. Life-cycle consumers usually underestimate the tax burden associated with government debt and regard government debt at least partially as net wealth of households.

The derivation of the aggregate consumption function from individual life cycle behaviour is not a simple matter because individuals differ in two relevant respects: in the level and composition of wealth and in the propensity to consume out of wealth. The following model is based on two assumptions which allow us to

preserve the hypothesis of finite horizons and make the derivation of a tractable aggregate consumption function possible. First, each consumer faces a common and constant instantaneous probability of death, $0 \leq p \leq 1$. For simplicity, it is assumed that there is no population growth so, at every point, a group of people ('cohort') of size p is born (or, equivalently, enters the labour market). With constant probability of death, the expected life for an agent is p^{-1} . Each group born at time zero has a size, as of time t , of pe^{-pt} and the size of the population at any time t is $\int_{-\infty}^t pe^{-p(t-s)} ds$.

The second assumption is that there exists a mutual life insurance system which ensures that no unanticipated bequest (or debt) is left when a person dies. Agents make the following contract with the insurance company. As long as they live, they receive (pay) a rate of return p on their total financial asset holdings (liabilities) at every point in time. Upon their death, their wealth accrues to the life insurance company (or their debt is cancelled).

Each consumer maximises his expected lifetime utility as of time t . Instantaneous utility is a logarithmic function of consumption:

$$\max U_t = \max E_t \int_t^{\infty} \ln c(s, v) e^{-\theta(v-t)} dv \quad (1)$$

where $c(s, v)$ is consumption of the single good at time v by an individual born at time s and $\theta \geq 0$ is the subjective discount rate. Given the constant probability of death p , the probability at time t of surviving until time $v \geq t$ is $e^{-p(v-t)}$ and the consumer's optimisation problem is equivalent to:

$$\max U_t = \max \int_t^{\infty} \ln c(s, v) e^{-(\theta+p)(v-t)} dv \quad (2)$$

The consumer's intertemporal budget constraint is

$$f\dot{w} = \frac{d}{dt} fw(s, t) = [r_t + p]fw(s, t) + (1 - tl)w(s, t) - c(s, t) \quad (3)$$

where $fw(s, t)$ is non-human wealth, $w(s, t)$ is non-interest income as of time t of a consumer born at time s , tl is the labour income tax rate and r_t is the interest rate at time t . The term pfw on the right-hand side reflects the return to the consumer from the operation of the life annuity programme³.

A transversality condition is necessary to prevent consumers from going into debt infinitely: the solution to the optimisation problem must be such that at time v , if the consumer is alive, the value of his non-human wealth, discounted by the rate $r_t + p$, is zero:

$$\lim_{v \rightarrow \infty} fw(s, v) e^{-\int_t^v [r(j) + p] dj} = 0 \quad (4)$$

The budget constraint can be then rewritten⁴

$$\int_t^{\infty} c(s, v) e^{-\int_t^v [r(j) + p] dj} dv = fw(s, t) + \int_t^{\infty} (1 - tl)w(s, v) e^{-\int_t^v [r(j) + p] dj} dv \quad (5)$$

The lifetime consumption should equal the sum of the lifetime human and

³ An equivalent assumption is that there exist actuarial bonds. Lenders lend to and borrowers borrow from intermediaries. These claims are cancelled by the death of the lender or borrower (Yaari, 1965).

⁴ Yaari, 1965; p.146.

non-human wealth. In other words, the lifetime human wealth is exhausted between the lifetime consumption and savings.

The consumer maximises (2) subject to (5) and the solution to this problem is:

$$c(s,t) = (\theta + p)[fw(s,t) + lci(s,t)] \quad (6)$$

where $lci(s,t) = \int_t^{\infty} (1-tl)w(s,v)e^{-\int_t^v (r(u)+p)du} dv$ is the life cycle (non-interest) income as of time t of a consumer born at time s . Individual consumption is proportional to total individual wealth with propensity $(\theta+p)$. The rate used to discount non-interest income is $(r+p)$, the same as the rate at which non-human wealth accumulates. At every point in time, the consumer maximises his utility by allocating his total wealth, defined as the sum of lifetime earnings from labour, accumulated assets and other transfers, in an optimal pattern of consumption. This pattern is determined by the individual's time preference and the probability of his death.

Assuming that consumers have the same life expectancy and the same propensity to consume allows for aggregation. Denoting aggregate values by upper-case letters, the relation between an individual variable $x(s,t)$ and its aggregate equivalent $X(t)$ is described as

$$X(t) = \int_{-\infty}^t x(s,t)pe^{-p(t-s)} ds \quad (7)$$

The equivalent equations characterising aggregate consumption are as

follows:

$$\begin{aligned}
 C &= (\theta + p)(FW + LCI) \\
 \dot{LCI} &= (r + p)LCI - (1 - tl)W \\
 \dot{FW} &= rFW + (1 - tl)W - C
 \end{aligned} \tag{8}$$

Human wealth (LCI) is the present value of future labour income accruing to those currently alive. It is assumed that labour income (W) is equally distributed (all individuals work and have the same productivity and they pay the same taxes). Thus, all agents have the same human wealth which is aggregated using the notation in (7).

The empirical specification of the model allows for a modification of the above formulation of the consumption function in order to reflect findings (Campbell and Mankiw, 1991) that indicate that liquidity constraints are important in the decision-making of some households:

$$C_t = (1 - \lambda)(\theta + p)[LCI_t + FW_t] \frac{P_t}{PC_t} + \lambda YDIS_t \tag{9}$$

where λ is a parameter⁵ denoting the share of liquidity constrained consumers in the economy, LCI_t is the Life Cycle Income, FW_t is the financial wealth and $YDIS_t$ is the real current disposable income. The rate of time preference, θ , takes higher values, the higher is the preference for present consumption in a country. It is estimated from the relationship between wealth and consumption implied by the Life

⁵ The values of the parameters of the model are shown in Table 4.1 at the end of this chapter and they are taken from data files received from the builders of the model.

Cycle Model⁶. In the Greek model θ has the value of 0.0025.

LCI_t is defined as the present value of expected net-of-tax real income. It consists of real labour income in the private sector ($W_t N_t / P_t$), the public sector ($WG_t NG_t / P_t$), unemployment benefits (BEN_t) and all other transfers to households (TR_t). FW_t is the current stock of financial wealth and it consists of domestic share holdings ($Q_t K_t$), the net foreign asset position (F_t), and the real government debt (B_t / P_t):

$$LCI_t = \int_t^{\infty} \left[(1 - tl) \left(\frac{W_t N_t}{P_t} + \frac{WG_t NG_t}{P_t} \right) + BEN_t + TR_t \right] e^{-\int_t^s (r(j) + p) dj} ds \quad (10)$$

$$FW_t = Q_t K_t + F_t + \frac{B_t}{P_t}$$

where W_t is the nominal wage rate in the private sector, N_t is employment in the private sector, P_t is the price level, WG_t is the nominal wage rate in the public sector, NG_t is employment in the public sector, Q_t is the shadow price of capital and K_t is the fixed capital stock in the economy. As already mentioned, government debt appears in the financial wealth equation of households to indicate that the Ricardian Equivalence Theorem does not hold when consumers face finite life horizons.

⁶ The path of consumption can be written as $\dot{C} = (r - (\theta - \pi))C - (\theta + p)nFW$ where π is the productivity growth rate and n is the birth rate (Buiter, 1988). It follows that, along the steady-state growth path, $\theta = ((r - \pi)C - pnFW) / (C + nFW)$. The value of θ is the mean value of this expression over the 1990s.

2. Behaviour of the firm

Firms operate in a monopolistically competitive environment. Potential output in the private sector ($YPOT_t$) is determined by a nested CES and Cobb-Douglas function, with capital (K_t), energy (E_t) and labour (N_t) as inputs.

$$YPOT_t = \left(\left(\gamma K_t^{-\rho} + (1 - \gamma) E_t^{-\rho} \right)^{-\frac{1}{\rho}} T_{Kt} \right)^{1-\alpha} \left(N_t T_{Nt} \right)^\alpha \quad (11)$$

where T_{Nt} represents labour-augmenting technology which grows at an exogenously-given rate. T_{Kt} is an efficiency index for capital capturing embodiment effects resulting from current and past investment. It is a function of the mean age of capital (AGE_t), defined as the ratio of the sum of current and non-depreciated past investment (J_t) to the current stock of fixed capital:

$$\begin{aligned} T_{Kt} &= e^{-\tau AGE_t} \\ \text{with} & \\ AGE_t &= \frac{1}{K_t} \left(\sum_{i=0}^{\infty} (i+1)(1-\delta)^i J_{t-i} \right) \end{aligned} \quad (12)$$

where τ is the embodiment parameter with value 0.05. As less than full-capacity operations are possible, the relation between actual and potential output is defined as $Y_t = UC_t YPOT_t$, where UC_t is the capacity utilisation rate.

Changes in capital stock (\dot{K}) are determined by investment (J_t) and by the quantity of fixed capital necessary to replace depreciated capital (δK_t):

$$\dot{K} = J_t - \delta K_t \quad (13)$$

It is assumed that the investment process involves installation costs⁷. These may take the form of lost output from disruptions to the existing production process (as new capital goods are installed and workers retrained), of additional labour hired for the installation of new capital, or of a wedge between the quantities of purchased and installed capital. In this model, unit installation costs, $\varphi(J,K;t)$, are assumed to be a linear function of the investment-to-capital ratio. Investment expenditure is the sum of the firm's expenditure on actual capital goods plus the installation costs:

$$I_t = J_t \left(1 + \frac{\phi}{2} \left(\frac{J_t}{K_t} \right) \right) \frac{PI_t}{P_t} \quad (14)$$

where PI_t/P_t is the relative price of capital goods. The firm pays $(PI_t/P_t)J_t$ to acquire capital goods: $\left(\frac{PI_t}{P_t} \right) \dot{K}$ to increase its capital stock and $(PI_t/P_t)\delta K_t$ to maintain its capital stock intact. It pays $\frac{\phi}{2} \left(\frac{J_t^2}{K_t} \right) \left(\frac{PI_t}{P_t} \right)$ to install these capital goods.

The objective of the firm is to maximise the sum of present and discounted expected future after-tax gross operating surpluses (GOS_t) subject to the capital accumulation constraint (13). GOS_t is defined as revenue ($P_t Y_t$) minus labour costs $((1+scc)W_t N_t/P_t)$, energy costs $((1+te)PE_t E_t/P_t)$, vacancy costs $(vc_t W_t/P_t)$ and investment expenditure, (I_t):

$$\max GOS_t = \int_t^{\infty} \left((1-tc) \left(P_s Y_s - (1+scc) \frac{W_s N_s}{P_s} - (1+te) \frac{PE_s E_s}{P_s} - vc_s \frac{W_s}{P_s} \right) - I_s \right) e^{-\int_t^s r(s) ds} ds \quad (15)$$

⁷ This model of the firm is a generalisation of Hayashi's (1982) extension of the neoclassical theory of investment.

where tc is the corporate income tax rate, scc is the rate of social security contributions by the employer, te is the rate of energy taxes and vc_f is the cost of a vacancy to the firm expressed as a percentage of the real wage. The importance of vc_f in the wage rate determination is discussed in greater detail in section four.

The value of the share of labour in equation (11) for output (a) was estimated to be 0.6 using annual data for the period 1974-95. The parameter ρ is calibrated to yield an elasticity of substitution between capital and energy slightly smaller than one. The installment cost parameter (ϕ) was estimated on annual data for Greece and has a value of 22⁸.

The solution of the maximisation problem produces the following demand equations for capital, labour and energy.

Demand for capital

Investment is a function of Tobin's 'marginal q', the ratio of the market value of an additional unit of capital to its replacement cost:

$$\frac{J_t}{K_t} = \frac{1}{\phi} \left(\frac{Q_t}{\left(\frac{PI_t}{P_t} \right)} - 1 \right) \quad (16)$$

Q_t is the shadow price of capital which, because of capital's durability, is the present discounted value of the 'spot' marginal revenue products over the life of the *additional* capital good. In practice, marginal revenue product is not directly

⁸ Its estimation was based on the assumption that the share of adjustment costs is unlikely to be less than 5% of total investment expenditure.

observable, so the 'average q ' is used instead, defined as the ratio of the market value of *existing* capital to its replacement cost. Q_t is then expressed as a function of profitability, represented by the ratio of gross operating surplus to capital stock (GOS_t/K_t), and of installation costs:

$$Q_t = \int_t^{\infty} \left[(1 - tc)(1 - \eta) \frac{GOS_s}{K_s} + \frac{\phi}{2} \frac{PI_s}{P_s} \left(\frac{J_s}{K_s} \right)^2 \right] e^{-\int_t^s (r_t) + \delta) ds} \quad (17)$$

The shadow price of capital depends on the corporate tax rate (tc), the degree of monopoly (η), the current and future real interest rates (r_t) and the depreciation rate (δ). The exchange rate can also affect investment by changing the relative price between imported capital goods and domestic output. The assumption that firms operate in a monopolistically competitive environment implies that they set output prices by marking-up above their marginal cost according to demand conditions, indicated by the level of η .

Being derived from the profit maximisation process of the firm, Q_t summarises all the relevant information about the demand for the firm's output and the production function. Once Q_t is known, the firm can decide the optimal rate of investment. By explicitly introducing the elements of imperfect competition, the model can differentiate between the effects of profitability on investment due to improved cost conditions and those derived from a higher markup. The former will

generally stimulate investment while the latter will decrease it⁹.

By determining the demand for capital through the profit-maximisation process, the model takes account of the conditions affecting the firm's production function and the characteristics of the demand for the firm's output. This specification assumes perfect financial-capital markets so that funds are always available for investment at a price. Credit rationing is not assumed to take place, so that only the prices of financial variables play a role as factor prices in such models. However, where the market for funds is imperfect, the availability of finance may act as a constraint on the rate of investment. The importance of the availability of credit depends on the financing policies of the firms which determine the extent to which their capital requirements are met by retaining earnings, by borrowing or through the sale of new shares in the stock market. Where firms have inadequate access to equity capital or internal financing of investment is not used, credit rationing may constitute a serious limitation on investment. In Greece, for example, limited credit availability may have arisen either because some form of non-price rationing existed in the system or because quantitative restrictions were explicitly introduced by the monetary authorities in periods of increased demand for funds. In an environment where credit-rationing was common place until the early 1990s and the overwhelming majority of Greek enterprises relied heavily on bank

⁹ Because of liquidity constraints, the empirical specification of an aggregate investment equation would emphasise more heavily the importance of current rather than future profitability. However, such a specification made the solution of the model less stable which has prevented the model-builders from using it so far.

borrowing for their capital requirements, the rate of investment could be considered as supply-determined and both the cost of capital and the availability of funds would be equally important in affecting the level of investment.

These considerations could make unreliable the use of the neoclassical model where input decisions are interdependent and based on the profit-maximisation process of the firm. However, this specification is consistent with the specification of the production-factor demand functions in the Bank of Greece model of the Greek economy (Garganas, 1992) which was fitted for the sample period 1958-1988. Furthermore, most of these considerations do not currently apply because, as mentioned in the previous chapter, the financial sector of the Greek economy underwent great structural reforms in the late 1980s and limitations on the availability of financial capital have been eliminated.

Labour demand

Labour is a quasi-fixed production factor since it takes time for the firms to reduce employment or fill existing vacancies. Labour demand is a positive function of output and negatively related to real wage costs:

$$N_t = \left[(1 - tp)(1 - \eta)\alpha \frac{Y_t}{(1 + scc + vc) \frac{W_t}{P_t}} \right]^{1-nl} N_{t-1}^{nl} \quad (18)$$

where tp is the production tax rate minus subsidies, η is the degree of monopoly, α is the share of labour in output, W_t/P_t is the real wage rate, scc the social security contributions by the employer, vc_t is vacancy costs as a percentage of real wages

and nl is the adjustment parameter. There is no information on vacancy costs for firms, so the assumption is made that they amount to 10% of wage costs. The Cobb-Douglas specification was chosen for simplicity. It allows for the assumption of lagged adjustment of employment to changes in demand and real wage costs in the short-run. The speed-of-adjustment parameter (nl) was set to be 0.85. Given the rigidities in the Greek labour market described in the previous chapter (hiring and firing regulation, low inter-industry labour mobility) and the fact that a similar estimate for the Bank of Greece model is equal to 0.67, the estimate for nl may underestimate the speed of adjustment between required and actual employment in the Greek economy.

Energy demand

Energy demand is a positive function of output and negatively related to relative energy prices, including taxes.

$$E_t = (1 - tp)(1 - \eta)(1 - \gamma)(1 - \alpha) \left[\frac{Y_t (\gamma K_t + (1 - \gamma) E_t)^\rho}{(1 + te) \left(\frac{PE_t}{P_t} \right)} \right]^{\frac{1}{1+\rho}} \quad (19)$$

where tp is the production tax rate minus subsidies, η is the degree of monopoly, γ is the parameter for the capital/energy composite in the production function, $(1-\alpha)$ is the share of the capital/energy composite in output, te is the energy tax rate, $(1/1+\rho)$ is the capital/energy elasticity of substitution.

3. Government Budget Constraint

The government is assumed to follow an exogenously given spending pattern instead of maximising an objective function. Current expenditure consists of interest payments on government debt ($i_t B_t$), purchases of goods and services ($PC_t G_t$), government investment ($PC_t JG_t$), government employment ($W_t NG_t$), government transfers to households (TRH_t), unemployment benefits (BEN_t) and other transfers (OTR_t).

Government spending is financed through labour income taxes (TL_t), social security contributions (SC_t), production taxes net of subsidies (TP_t), corporate income taxes (TC_t), energy taxes (TE_t), value-added tax (VAT_t), other indirect taxes (TAX_t) and other receipts (R_t):

$$\begin{aligned}\Delta B_t &= iB_t + PC_t(G_t + JG_t) + W_t NG_t + BEN_t + TRH_t + OTR_t - T_t \\ T_t &= TP_t + TC_t + TL_t + SC_t + TE_t + VAT_t + TAX_t + R_t\end{aligned}\quad (20)$$

Dynamic consistency requires the introduction of a debt rule which makes one or several spending or receipt categories of the government budget an instrument for debt stabilisation. As a standard setting, the following rule applies:

$$\Delta TAX_t = \psi_1 \left(\frac{B_t}{GDP_t} - \overline{\frac{B}{GDP}} \right) + \psi_2 \left(\frac{B_t}{GDP_t} - \frac{B_{t-1}}{GDP_{t-1}} \right) \quad (21)$$

The government will respond to a deviation of the debt-to-GDP ratio from its target level, $\overline{B/GDP}$, and from its value in the previous period by adjusting the indirect tax receipts (ΔTAX_t) depending on the size of ψ 's. $\psi_1=0.01$ and $\psi_2=0.02$ are chosen so that the debt reduction is implemented smoothly over time with no

sizeable short-run decreases in indirect taxes as government debt reaches the target level.

Total output is adjusted to include government wages into the definition of total GDP for consistency with the national accounts: $GDP_t = Y_t + W_t NG_t$

4. Prices and Wages

Domestic prices

It is assumed that firms adjust prices sluggishly, following changes in the level of capacity utilisation:

$$\log P_t = padj \log UC_t + \sum_{i=1}^4 \xi_i \log P_{t-i} \quad (22)$$

$$\text{with } \sum_{i=1}^4 \xi_i = 1$$

where *padj* is the adjustment parameter and UC_t is the capacity utilisation rate.

The *consumption price deflator* is defined in the following way:

$$PC_t = (1 + vatr) PM_t^{S_t^m} P_t^{1-S_t^m} \quad (23)$$

where *vatr* is the value-added tax rate, S_t^m is the openness variable, measuring the share of imports in total domestic demand and PM_t is import prices expressed in domestic currency. If S_t^m is equal to zero, then the consumer price deflator is determined entirely by the domestic market conditions. Identical assumptions are made for the investment deflator and the deflator of government expenditure.

Export Prices

Pricing of exports is set in the following way:

$$PX_t = P_t^{1-ptm} (WPXS_t ER_t)^{ptm} \quad (24)$$

where $WPXS_t$ is the competitors' price index expressed in dollars, ER_t is the GRD/US\$ exchange rate and ptm is a parameter determining the extent to which the market structure affects pricing. If ptm is zero, then export prices are determined entirely by domestic conditions. This would be consistent with a model of monopolistic competition with small firms each of which assumes that its influence on other firms is negligible. In models where the market structure leads to strategic interaction among firms, the determination of prices is affected by the competitors' moves and ptm will be closer to one.

The price adjustment parameter is estimated over the period 1975-95 and has a value of $padj=0.6$. This implies that prices adjust to changes in capacity utilisation rates fairly quickly. Similar estimates are reported in the Bank of Greece model. The estimate of the parameter of the pricing to market, $ptm=0.68$. This suggests that export prices are determined partly by considerations regarding the competitor countries' export prices.

Wage Rates

As with investment, there exist adjustment costs in the labour market. These take the form of searching and recruiting, training and mobility costs. Therefore, labour markets do not correspond to the Walrasian notion of a spot market where labour contracts are negotiated and clearing the market at each point in time. The labour market specification for this model follows the work of Howitt (1988) and Pissarides (1990).

The main assumption underlining this specification is that labour services supplied or demanded are not homogeneous, so the types of work offered or required are not clear either to the firms or to the workers. Trade in the labour market is, thus, uncoordinated and costly both in terms of time and money. Both workers and firms have an interest in longer term employment contracts. In this framework, there exists involuntary unemployment, even though expectations are rational and no privately attainable gains from trade are left unexploited.

A bargaining process takes place between firms and workers through which wages are determined so that they satisfy the arbitrage conditions described below. These conditions relate the costs and gains associated with the process of job-worker matching. The profit opportunities associated with a successful job-worker pairing are the basic incentive for job or worker searching in the labour market. In order to describe the wage bargaining procedure, we need to specify the expected returns of firms and workers during the process of job-worker matching.

Let V_t denote the present discounted asset value of a vacancy and J_t the present discounted value of an occupied position. The number of job openings is determined by the profit-maximisation procedure. Then, V_t and J_t follow these arbitrage conditions:

$$\begin{aligned} r_t V_t &= -vc_t + q(\theta)(J_t - V_t) + \dot{V} \\ r_t J_t &= GOS_t/N_t + s(V_t - J_t) + \dot{J} \end{aligned} \quad (25)$$

$r_t V_t$ is the capital-market *cost* of the asset 'vacancy' (or, the servicing cost of a loan worth V_t) which is equated to the labour-market *return* of the asset represented by

the right hand side of the equation. vc_t is the hiring cost, $q(\theta)(J_f - V_t)$ are the expected gains of changing the vacancy to an occupied position and \dot{V} are the capital gains (or losses) from changes in the valuation of the vacancy. The firm's hiring activities return a worker at the rate $q(\theta)$, where θ is the ratio of vacant positions (as a fraction of labour force) to the unemployment rate and expresses the tightness of the labour market. Firms find workers more easily, when there are more unemployed workers relative to vacant positions while workers find jobs more easily, when there are more vacancies than unemployed persons. By including θ , the model recognises the existence of externalities in the labour market, so that trade is more costly, the thinner is the labour market (Diamond, 1982).

Similarly, $r_f J_t$ is the capital-market cost of the filled position, GOS_f/N_t is the profit per worker, s is the probability for a position to become vacant, so $s(V_f - J_t)$ are the expected losses and \dot{J} are the capital gains (or losses) from changes in the value of the occupied position.

Equivalently, let E_t and U_t denote the present value of the human capital of an employed and unemployed person, so that E_t and U_t satisfy the following arbitrage equations:

$$\begin{aligned} r_t E_t &= w_t(1 - tl) + s(U_t - E_t) + \dot{E} \\ r_t U_t &= ben_t + leis_t + \theta q(\theta)(E_t - U_t) + \dot{U} \end{aligned} \tag{26}$$

$r_t E_t$ is the capital-market cost of the employed person's human capital which is equal to the *yield* of his being employed, determined by the sum of his after-tax labour earnings, $w_t(1 - tl)$, the expected losses from becoming unemployed, $s(U_t - E_t)$

and the capital gains from changes in the value of his human capital, \dot{E} .

Similarly, $r_t U_t$ is the cost of the unemployed person's human capital equated to the *return* of being unemployed which includes his income during unemployment, consisting of unemployment benefits and the imputed income of leisure, $ben_t + leis_t$, the expected gains from switching into employment, $\theta q(\theta)(E_t - U_t)$ and the capital gains from changes in the value of any of these components, \dot{U} .

The wage rate is determined from the Nash bargaining process which maximises the combined net return from a successful job-worker match for both the worker and the firm:

$$\begin{aligned} & \max(E_t - U_t)^\beta (J_t - V_t)^{1-\beta} \\ & 0 \leq \beta \leq 1 \end{aligned} \quad (27)$$

β denotes the bargaining strength of workers and it determines the fraction of total profits from a successful job-worker match that accrues to workers. As a solution to this problem, the following wage equation is obtained:

$$w_t = \frac{1-\beta}{1-tl} (ben_t + leis_t) + \frac{\beta}{1+scc} \left((1 - (1-tp)(1-\eta)(1-a)) \frac{Y_t}{N_t} + \beta_1 \frac{U_t}{N_t} \right) \quad (28)$$

The wage rate is a function of the reservation wage which comprises of the unemployment benefits and the value of leisure, $ben_t + leis_t$. Provided that workers have bargaining power ($\beta > 0$), their wage will exceed the reservation wage by an amount determined by their bargaining power, their productivity and the unemployment rate, U_t . The last term in the right-hand side of equation (28) is used as a proxy for the tightness of the labour market.

The wage equation includes the neoclassical labour supply hypothesis of consumption-leisure substitution, as well as assumptions from the wage bargaining theory. However, this wage equation is different from the neoclassical labour supply hypothesis in the following way. In the neoclassical model, taxation has its major impact on the number of hours a worker is willing to work for a given gross wage rate, given his marginal utility schedule for both consumption and leisure. In this model, these considerations are irrelevant since it is assumed that hours of work are institutionally fixed. Therefore, the mechanism of adjustment by which taxation influences employment is based on different principles. The two parties in the labour market share profits between them and they are implicitly cooperating 'against' a third player, the government, which tries to extract taxes in the case of a successful job-worker match. If the *marginal* tax rate increases, it is in the interest of both parties to minimise their tax burden by reducing the relative share of workers in total surplus, and vice versa, if the tax rate is reduced. The sensitivity with which the share of workers in total surplus reacts to tax changes varies with the bargaining strength of workers (Pissarides, 1990, ch. 8).

The assumption of bargaining power of workers is consistent with insider-outsider models and can explain the existence of involuntary unemployment. Incumbent workers have bargaining strength because it is costly for the firm to replace them, due to search and hiring costs. Usually insider-outsider models rely on the assumption of *complete* bargaining power of workers. As long as *some* bargaining power allows the workers to share part of the rent generated, the wage

rate exceeds the reservation wage giving rise to involuntary unemployment. It is assumed that workers and firms have symmetric bargaining power ($\beta=0.5$) in this model.

At each period a fraction of workers enters wage negotiations for a contract that will stretch over several periods. Therefore, a wage contract is set as a weighted average of the current and three consecutive periods, based on the current expectations of the economic conditions prevailing in these consecutive periods, $E_t(W_{t+i}P_{t+i})$:

$$WCONT_t = \sum_{i=0}^{N-1} \frac{1}{N} E_t(W(1)_{t+i}, P_{t+i}) \quad (29)$$

where N is the length of the wage contract set to be four periods and $W(1)$ is the nominal wage from the one period Nash bargaining solution. Because at each period a different contract is negotiated for a different group of workers, the average wage in the economy is given by:

$$W_t = \sum_{i=N-1}^0 \frac{1}{N} WCONT_{t-i} \quad (30)$$

5. International Trade

It is assumed that each country produces a product that is an imperfect substitute for the products of other countries. The import equation has the following form:

$$IM_t = S_t^m \left(\frac{PC_t}{PM_t} \right)^{\sigma^m} (C_t + G_t + I_t) \quad (31)$$

The imports of a country are a function of relative prices defined as the ratio of the domestic consumption deflator to the import deflator (PC_t/PM_t) and total domestic demand, composed of private and public consumption and total investment. The parameter σ_m is the price elasticity of imports and S_t^m is the openness variable.

Similarly, exports of each country are defined as follows:

$$EX_t = S_t^x \left(\frac{WPXS_t ER_t}{PX_t} \right)^{\sigma_x} WDEM_t \quad (32)$$

where ER_t is the Drachma/US\$ exchange rate. Exports are determined by relative prices defined as the ratio of the competitors' price index (in dollars) to the export deflator ($WPXS_t/PX_t$) expressed in domestic currency and the world demand ($WDEM_t$). The parameter σ_x is the price elasticity of exports and S_t^x is the variable indicating the degree of export performance in the foreign markets. The competitors' price index is constructed as a weighted average of import prices, the weights determined by the share of the individual exporting country in total imports of the importing country.

To capture possible sluggish responses of imports and exports to price changes, the relative price variables appear in the model as distributed lags of up to four quarters. This specification leads to different short- and long-run price elasticities. The latter have been restricted to one. The short-run price elasticity of imports is $\sigma_m=0.51$ and the short-run price elasticity of exports is $\sigma_x=0.92$.

The current account is the sum of the trade balance, net transfer payments,

FTR_t and interest income from net foreign assets. The change in the net foreign asset position (the capital account) is an endogenous variable, determined by the accumulation of current account balances:

$$F_t = (1 + r_t)F_{t-1} + EX_t \left(\frac{PX_t}{P_t} \right) - IM_t \left(\frac{PM_t}{P_t} \right) + \frac{FTR_t}{P_t} \quad (33)$$

6. Financial Markets

Capital is assumed to be perfectly mobile across all countries which means that the financial markets are fully integrated. The exchange rate of country j with respect to the US Dollar is determined endogenously, according to the following interest arbitrage relation:

$$i_t^j = i_t^{US} + \frac{E_t \Delta ER_{t+1}^j}{ER_t^j} + RPREM_t^j \quad (34)$$

where $E_t \Delta ER_{t+1}^j / ER_t^j$ is the expected depreciation rate of country j 's currency against the dollar, as of time t , and $RPREM_t^j$ is the risk premium, exogenously determined.

Assets (short and long term private and government bonds) in domestic financial markets are perfectly substitutable. It is assumed that there is no money illusion, implying that the Fisher equation holds:

$$i_t = r_t + \frac{E_t \Delta P_{t+1}}{P_t} \quad (35)$$

where i_t and r_t are the nominal and real interest rates, respectively, and $E_t \Delta P_{t+1} / P_t$ is the expected inflation rate, as of time t . The long-run interest rates are linked to

short-run rates by the relationship:

$$i_t^l = i_t + \frac{E_t \Delta i_{t+1}^l}{i_t^l} \quad (36)$$

Money demand is modelled by a conventional money demand equation which stresses both transaction and speculative motives of money holding:

$$\frac{M_t}{P_t} = (Y_t (1 + i_t)^b)^{1-b} \left(\frac{M_{t-1}}{P_{t-1}} \right)^{bt} \quad (37)$$

where b is the interest rate elasticity of money demand.

It is assumed that the monetary authorities follow an interest rate policy reaction function as follows:

$$i_t = i_{t-1} + ism \left(\frac{m_1}{b} \right) \log \left(\frac{MT_t}{M_t} \right) + (1 - ism) m_2 \log \left(\frac{\Delta P_t}{\Delta PT_t} \right) \quad (38)$$

where MT_t is the money target, ΔPT_t is the inflation target and ism , m_1 , m_2 are switch variables. m_1 takes a higher value to indicate money targeting and a smaller value to indicate interest rate targeting. In the former case, interest rates are set to ensure the money target is met instantaneously, while in the latter case, money supply changes to ensure that interest rates are kept constant. With m_2 positive, m_1 close to zero and $ism \neq 1$, the above interest rate rule approximates inflation targeting.

In order to emulate the EMU conditions (common currency and common monetary policy), the above interest rate reaction function has been added for a EU aggregate.

The QUEST II model, as any representative agent model, provides a tightly structured and highly aggregated framework to perform macroeconomic analysis based on microeconomic foundations. It allows for the analysis of the dynamic effects of macroeconomic changes and enhances the understanding of intertemporal issues. QUEST II was built specifically for the European economies and was calibrated to their historical information. For this reason, it offers insights about the operation of these countries and their reaction to disturbances, their interaction with each other and the rest of the world. The results of standard simulations are consistent with both the theoretical analysis and other empirical evidence (Roeger and in't Veld, 1997). Therefore, the model performs well in predicting the transmission of the effects of economic policy on the domestic economies and internationally. However, because some parameter estimates are different from estimates of similar specifications (as in the Bank of Greece model of the Greek Economy) and from what would be expected given our knowledge of the Greek economy, caution will have to be applied in the discussion of the stochastic simulation results.

Table 4.1: Model parameter values		
	Germany (DE)	Greece (GR)
probability of death ¹ , p	0.005	0.005
time preference ² , θ	0.0024	0.0025
share of liquidity constraint ³ , λ	0.3	0.3
output elasticity of labour ⁴ , α	0.6	0.6
embodiment parameter ⁴ , τ	0.05	0.05
capital/energy substitution ⁵ , $1/(1+\rho)$	0.8	0.8
adjustment costs for capital ⁶ , φ	31.04	22
depreciation rate, δ	0.0125	0.0125
degree of monopoly, η	0.17	0.15
price adjustment, $padj$	0.35	0.60
pricing to market ⁷ , ptm	0.25	0.68
bargaining strength of workers ⁵ , β	0.5	0.5
coefficient of U in wage rate equation, β_1	-2	-1.7
short-run price elasticity of imports	0.22	0.51
short-run price elasticity of exports	0.23	0.92
interest elasticity of money demand, b	-0.5	-0.5

1. Implies a forward-looking horizon of 50 years ($1/4p$).
2. Determined from the relationship between wealth and consumption implied by the life cycle model, the value shown here is the mean value for each country over the 1990s.
3. Same coefficient imposed for all countries. Individual country estimates ranged from 0.2 to 0.4 on quarterly data and 0.2 to 0.6 on annual data (estimation period: 1975-96).
4. Estimated on annual data over period 1974-95.
5. Imposed coefficient (see text)
6. Estimated on quarterly data for DE and annual data for GR.
7. Estimates based on regressions of eq. (24, export prices) in first differences, over period 1975-95.

Chapter Five

Experimental work and results

In this chapter we describe the experimental work that was performed in order to determine what kind of impact the abandonment of flexible exchange rates and monetary sovereignty will have on the Greek economy. The next section describes the changes made to the model in order to emulate the two different exchange rate regimes. In section two we present the procedure of structural disturbance identification. Section three provides additional information on the stochastic simulations and discusses the effects of each kind of disturbance on the economy. Finally, the results of these simulations are presented and discussed in section four.

1. Empirical adaptation of the model

Because of computer memory limitations, the QUEST II model was edited so that only the structural models of Germany and Greece are included. The model of Germany was chosen because of the dominant role of this country in the EU and because it is the major EU trade partner of Greece. Greek exports to Germany represent 39% of its total exports to the EU and imports from Germany represent more than 25% of total Greek imports from the EU (European Commission, 1999a). All trade linkage equations are also included but the variables corresponding to the countries other than the two mentioned are set as exogenous.

The model was also edited to emulate the two different regimes that are to be compared: the monetary union and the flexible exchange rate regime. The

monetary union is emulated by assuming that there is one common currency (the EURO) and a common monetary policy is implemented by the European Central Bank. Following these lines, a EU-aggregate interest rate reaction function is used, similar to equation 38 in the previous chapter. The European money stock is the aggregate of all member countries' and the European inflation rate is defined as the weighted average of the domestic inflation rates. The weights are determined by the relative size of each economy in the EU. The expected depreciation rate of the EURO with respect of the US Dollar is determined by the difference between European and US interest rates along the same lines as in equation 34 in the previous chapter. The EURO/USD exchange rate is defined as the weighted average of the exchange rates of the national currencies with respect to the US Dollar.

The flexible exchange rate regime is modelled by omitting the equations for the EU aggregates described above and making the Drachma/Mark exchange rate endogenously determined. The domestic authorities implement an independent monetary policy as determined by the interest rate reaction function. They can target the stability either of interest rates or of the money supply or of the inflation rate. In this study, we assume that the Greek monetary authorities target the interest rate which is consistent with the monetary policy followed during the biggest part of Greece's recent economic history.

A set of 'baseline' data was obtained through a deterministic simulation of each model corresponding to each of the two exchange rate regimes. These

baseline data will provide the 'yardstick' in order for us to compare the results of the stochastic simulations and calculate the variability of the Greek economy under the two different exchange rate policies.

2. Identification of structural disturbances

In order to run the stochastic simulations, it is necessary to identify the structure of disturbances in the Greek economy based on the historical data. For this purpose, a Vector Autoregression (VAR) is used and restrictions are imposed on the long-run coefficients – a method introduced by Blanchard and Quah (1989).

A Vector Autoregression is a system created by making each of a set of variables dependent on its own lagged values and the lagged values of the other variables in the set. In a structural VAR, the researcher is able to use the economic theory to transform the standard (reduced-form) VAR model into a system of structural equations. This is achieved either by imposing contemporaneous restrictions or by imposing long-run restrictions on the coefficients (Keating, 1992). The Blanchard and Quah (BQ) method of identifying structural disturbances utilises the latter method.

Specification of the VAR

Two variables are chosen here for the VAR: real output, y , and the consumer price index, p ¹. Both series are measured in logarithms. Annual data² are used

¹ Real GDP in Drachmae at 1987 market prices and Consumer Price Index with 1987=100.

² It was not possible to find continuous series of quarterly data for the sample period. The difference in periodicity between the structural VAR and QUEST II was not considered important for the identification of the relation between the residuals and the pure disturbances.

between 1966-1995, from the World Bank Development CD-ROM Database (1998). The two variables are chosen so that the structural shocks be distinguished between nominal ('demand') and real ('supply') disturbances. Following the reasoning by Bayoumi and Eichengreen (1992), it is assumed that aggregate demand disturbances have only a temporary effect on output but a permanent impact on prices, while aggregate supply disturbances affect output and prices permanently.

Before proceeding with the estimation of the structural VAR, it is necessary to examine the stochastic properties of the data used in order to avoid spurious correlation. Two widely used unit root tests for non-stationarity were applied to check whether the chosen variables are stationary around a trend: the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) statistics. These tests examine the null hypothesis of a unit root in time series against the alternative hypothesis of stationarity. The results of these tests are presented in the table below.

Table 5.1: Stationarity Test Results		
<i>Series in levels</i> *	ADF	PP
Real output (y)	-3.37	-2.34
Consumer price index (p)	-0.85	3.34
<i>Series in first difference</i>	ADF	PP
Real output (y)	-3.86	-4.7
Consumer price index (p) **	-2.7	-2.1

* MacKinnon critical values for rejection of the hypothesis of a unit root are -4.34, -3.59 and -3.23 at 1%, 5% and 10% significance level, respectively, for both tests. The null hypothesis is rejected if the value of the test statistic exceeds (in absolute terms) the critical value. The lag length for the test PP test was determined using the Newey-West estimate.

** For CPI, the alternative hypothesis is this of stationarity around a constant term. MacKinnon critical values for rejection of the hypothesis of a unit root are -3.7, -2.97 and -2.63 at the usual

From the results in the table, it is obvious that the ADF test rejects the null hypothesis of nonstationarity in the level of real output but only at the 10% significance level, while the PP test cannot reject it. Because the ADF test statistic is very close to the critical value at the 10% significance level while the PP test statistic is so much different, we assumed that output is non-stationary around a trend (we prefer to err by treating a stationary series as non-stationary than doing the reverse). Both tests cannot reject the null hypothesis of a unit root in the level of the consumer price index at any level of significance.

The same tests were repeated for the first differences of these variables. The results indicate that the real output is first-difference stationary around a trend while the ADF and PP tests are inconclusive whether the consumer price index is first-difference stationary around a constant term. For this reason, the Leybourne-McCabe (LM) test was used to examine the stationarity of the first difference of CPI around a constant term. It examines the null hypothesis of stationarity against the alternative of unit root (Kwiatowski et al., 1992). This test cannot reject the null hypothesis of stationarity around a constant term for the first difference of the price level at the 1% significance level³. Therefore, the VAR is estimated using the first difference of the two variables.

The Akaike Information Criterion (AIC) and the Schwarz Criterion (SC) are commonly used as a measure of the balance between good fit and parsimonious

³ The LM test has a value of 0.466. The critical values for stationarity around a constant are 0.739, 0.463 and 0.347 at the 1%, 5% and 10% significance level, respectively. The null hypothesis is rejected if the value of the test statistic exceeds the critical value.

specification of the model. They are used to determine the appropriate length of the distributed lags in the unrestricted VAR. The model with the smallest information criterion is selected, which, in this case, is of order one. At this lag length, the residuals of the VAR are serially uncorrelated.

We used the Chow's Forecast Test to examine the structural stability of the model. The null hypothesis of no structural change was not rejected⁴.

The Blanchard and Quah Method

After the unrestricted VAR has been estimated, the coefficient and the residual covariance matrices are used to identify the structural disturbances. In this study, the BQ method of identification of pure structural disturbances is used and it is described in this section. The underlying assumption of this method is that the reduced-form residuals (from the VAR) are composites of the 'pure' disturbances. The purpose is to decompose these shocks in order to identify the disturbances that are needed to run the stochastic simulations. The main characteristic of the BQ method is that it imposes long-run theoretical restrictions instead of contemporaneous restrictions imposed by alternative techniques of structural VARs.

Consider a system where a vector of variables, X_t , can be represented by an infinite moving average representation of an equal number of independent shocks, ε_t^i

⁴ The null hypothesis is rejected if the computed F exceeds the critical F. The values of the F statistics computed by the test were 0.41 and 0.29 for each equation. The critical values of F are 2.46, 3.22 and 5.52 at the 1%, 5% and 10% significance level, respectively.

$$X_t = C_0 \varepsilon_t + C_1 \varepsilon_{t-1} + \dots + C_s \varepsilon_{t-s} = C(L)$$

with

$$E(\varepsilon_t) = 0 \quad (1)$$

$$E(\varepsilon_t \varepsilon_\tau') = \begin{cases} I, & \text{for } t = \tau \\ 0, & \text{for } t \neq \tau \end{cases}$$

where I is the identity matrix and $C(L)$ are square matrices in the lag operator, L , with $C(L) = \sum_{s=0}^{\infty} C_s L^s$. The coefficients, $c_{ij}(L)$, are polynomials showing the effects of the shocks on the elements of X . The sequence of C_s for $s=0, 1, 2, \dots$ illustrates the dynamic response of the variables to the structural shocks. If the variables in X are stationary, then the impulse responses must approach zero as s becomes larger.

The $C(L)$ coefficients are not known but this representation can be recovered from the data by the estimation of a VAR. Each variable is regressed on lagged values of itself and the rest of the variables that comprise X :

$$X_t = B_1 X_{t-1} + \dots + B_k X_{t-k} + e_t \quad (2)$$

where B are the estimated coefficient matrices and k is the order of the VAR. The vector e_t is a white noise vector, that is,

$$E(e_t) = 0$$

$$E(e_t e_\tau') = \begin{cases} \Omega, & \text{for } t = \tau \\ 0, & \text{for } t \neq \tau \end{cases} \quad (3)$$

where Ω is a symmetric positive definite matrix.

So long as the variables in X are stationary, this system can be inverted to obtain the moving-average representation

$$X_t = B_1 X_{t-1} + \dots + B_k X_{t-k} = B(L)X_{t-1} + e_t = (I - B(L)L)^{-1} e_t = A(L)e_t \quad (4)$$

where $A(L) = (I - B(L)L)^{-1}$ are matrices in the lag operator, L , defined as above.

An important implication from (1) and (4) is that the residuals of the VAR can be expressed as linear combinations of the structural (pure) shocks:

$$e_t = C_0 \varepsilon_t \quad \text{and that} \quad C_s = A_s C_0, \quad \text{for all } s \quad (5)$$

where C_0 is the matrix which indicates the relation between the reduced-form residuals and the structural disturbances.

The following relationship is implied between the variance/covariance matrices of the residuals and the pure shocks from (1), (3) and (5):

$$E(e_t e_t') = C_0 E(\varepsilon_t \varepsilon_t') C_0' = \Omega = C_0 C_0' \quad (6)$$

Since $\Omega (n \times n)$ is a symmetric matrix with known elements, estimated from the VAR, it contains $(n^2 + n)/2$ distinct elements (the elements along and below the principal diagonal) and it determines an equal number of elements of C_0 (in other words, it imposes an equal number of restrictions on the elements of C_0). In order to exactly identify C_0 , it is necessary to impose $(n^2 - n)/2$ additional restrictions on the structural model. In this particular case, with $n=2$, the number of restrictions imposed by Ω equals $3 = (2^2 + 2)/2$ and we need $1 = (2^2 - 2)/2$ additional constraint on the elements of C_0 for it to be exactly identified. One way to do this would be to

assume that C_0 is a Choleski factorisation of Ω . This method implies an ordering of the variables in the VAR such that all the effects which could be attributed to more than one shocks are attributed to whichever comes first in the ordering (in other words, it is required that all the elements above the principal diagonal of C_0 be zero). This method has been criticised on the grounds that it is arbitrary and it imposes 'incredible identifying restrictions' to the structure on the orthogonal ε_t sequences (Enders, 1995, ch. 5). Another way to identify C_0 is to adopt a structural VAR approach and impose short-run or long-run restrictions on the elements of C_0 based on the economic theory.

Because the impact of pure disturbances on the *levels* of variables is more useful and consistent for the purposes of this study than the impact on the *change* in the variables, the moving average representation of the true model (1) is generated recursively assuming that all the elements of ε_t are equal to zero at time zero and earlier. For example,

$$X_1 = X_0 + C_0\varepsilon_1$$

and

$$X_2 = X_1 + C_0\varepsilon_2 + C_1\varepsilon_1.$$

Replacing X_1 in the second expression yields:

$$X_2 = X_0 + C_0\varepsilon_1 + C_0\varepsilon_2 + C_1\varepsilon_1 = X_0 + C_0\varepsilon_2 + (C_0 + C_1)\varepsilon_1.$$

Repeating this operation for all X up to X_t yields the following:

$$X_t = X_0 + C_0\varepsilon_t + (C_0 + C_1)\varepsilon_{t-1} + \dots + \sum_{s=0}^{t-1} C_s\varepsilon_1 = X_0 + C(L)\varepsilon_t = X_0 + \sum_{\xi=0}^{t-1} C_\xi\varepsilon_{t-\xi} \quad (7)$$

where $C_{\xi} = \sum_{s=0}^{\xi} C_s$. Since the differenced specification ΔX is stationary, the C_s matrix goes to zero as s gets large. This implies that C_{ξ} converges to the sum of coefficients in $C(L)$. Restrictions on this sum of coefficients are used to identify the long-run structural VAR models. In this case, the vector X_t includes the change in prices and the change in real output, $X_t = (\Delta P_t, \Delta Y_t)'$, and the vector of structural disturbances consists of demand and supply shocks, $\varepsilon_t = (\varepsilon_t^d, \varepsilon_t^s)'$. In this framework, the restriction that is imposed to the long-run coefficient matrix is that demand disturbances have no permanent effect on output. Both kinds of shocks have permanent effects on prices and supply shocks have permanent effects on output. The model implies that the cumulative effect of demand shocks on output must be zero.

Let $C(1)$ be the long-run coefficient matrix (setting $L=1$, each element of $C(1)$ is the sum of the equivalent elements of C_{ξ} , for all ξ):

$$C(1) \equiv \begin{bmatrix} c_{pp} & c_{py} \\ c_{yp} & c_{yy} \end{bmatrix} \quad (8)$$

where the coefficient $c_{ij}(1)$ represents the long-run response of the variable i to one standard deviation unit of pure shock in variable j .

The theoretical restriction assumed above is represented in $C(1)$ as follows:

$$C(1) = \begin{bmatrix} c_{pp} & c_{py} \\ 0 & c_{yy} \end{bmatrix} \quad (9)$$

With this final restriction, a system of four structural equations is complete and can be solved simultaneously to determine the values of the four elements of

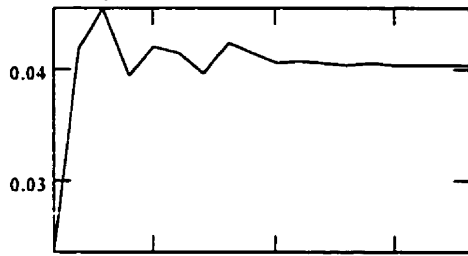
C_0 . The system is presented below. Once the elements of C_0 are calculated, the structure of pure disturbances is identified and the stochastic simulations can be performed.

$$\begin{aligned}
 c_{pp0}^2 + c_{py0}^2 &= \sigma_p^2 \\
 c_{yp0}^2 + c_{yy0}^2 &= \sigma_y^2 \\
 c_{pp0}c_{yp0} + c_{py0}c_{yy0} &= \sigma_{py} \\
 a_{yp}(1)c_{pp0} + a_{yy}(1)c_{yp0} &= 0
 \end{aligned} \tag{10}$$

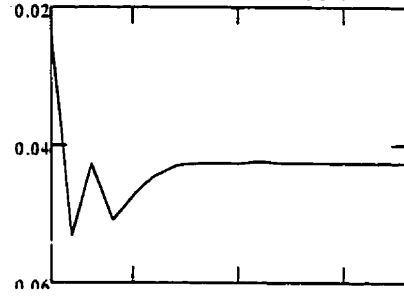
where c_{ij0} are the elements of C_0 , σ_{ij} are the elements of the residual covariance matrix, $\Omega(2 \times 2)$, $a_{ij}(1)$ are the elements of the $A(1)$ matrix calculated from the estimated coefficients from the VAR in equation (4).

The impulse responses of prices and output to demand and supply shocks are presented in the following diagrams as they were estimated using the structural VAR model. The impulse responses of prices presented in the top two panels indicate that both demand and supply shocks have permanent effects on the level of prices. Of the bottom two panels, the one on the left-hand side represents the long-run restriction imposed on the structural model that demand shocks have only temporary effects on the level of output. The panel on the right-hand side illustrates the implication of the long-run restriction that only supply shocks have permanent effects on output.

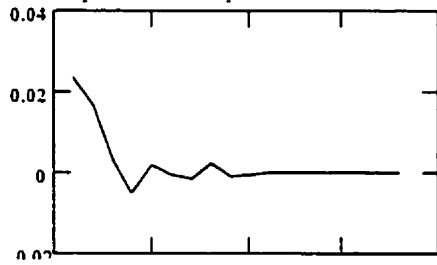
Response of Prices to Demand Shocks



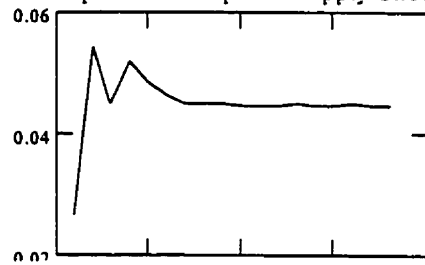
Response of Prices to Supply Shocks



Response of Output to Demand Shocks



Response of Output to Supply Shocks



3. Stochastic Simulations

The stochastic simulations are similar to the Monte Carlo methods in that sets of numbers are randomly drawn from a standard normal distribution set with mean zero and standard deviation one⁵. Given the set of these random variables and the coefficients in C_0 estimated by the BQ method, the relationship in (5) is used to calculate the disturbances (the time subscript is omitted for simplicity): $e_i = \sum_j c_{ij} \varepsilon_j$, where e_i is the shock to variable i , c_{ij} is the coefficient indicating the contemporaneous effect for variable i of the pure disturbance in variable j (the element of matrix C_0) and ε_j is the pure disturbance in variable j (random variable). The underlying assumption is that a shock in a variable is a combination of pure disturbance in the variable itself and responses to disturbances in other variables.

Every solution of the model with a given set of shocks is merely a deterministic simulation which provides a prediction of the endogenous variables for a given time period. When several repetitions of this process are performed, useful statistics such as the mean and variance of the endogenous variables can be estimated. In this particular case, stochastic simulations were run for a period of 40 quarters and repeated 100 times.

The model is simulated using the TROLL software system. It is assumed that expectations are model-consistent, i.e. the leads in the model are equal to the solution values for future periods. A Newton-Raphson solution algorithm is used to

⁵ The random variables were generated by the software used for the stochastic simulations, TROLL (Hollinger, 1997):

calculate the simultaneous solution to the model. The algorithm stacks the time periods into one multiple system of equations and solves them simultaneously (Hollinger, 1997).

The effects of nominal and real disturbances

In this section we describe how each kind of the disturbances used in the stochastic simulations is transmitted throughout the economy in the QUEST II model. Nominal disturbances may be due to monetary or fiscal shocks. In the EMU framework, a monetary expansion in all EU countries results in an immediate depreciation of the EURO/US\$ exchange rate and a rise in prices. The real exchange rate depreciation is smaller because import prices rise, too, as a result of the depreciation. The positive effects of a monetary expansion on output are short-lived and in the medium term, output returns to its equilibrium level. Under flexible exchange rates, similar changes take place after the Greek monetary authorities have implemented expansionary policies.

The effects of a fiscal disturbance depend on many factors. Assumptions about the financing of the fiscal deficit as well as assumptions on the behaviour of monetary authorities are crucial elements in the way the fiscal policy affects the economy. In this case, it is assumed that a fiscal expansion is financed through an (future) increase in indirect taxes in accordance with the government's intertemporal budget constraint. In the monetary union, it is assumed that the European Central Bank targets the money supply. Under flexible exchange rates, it is assumed that the domestic monetary authorities target the interest rate which is consistent with

the policy rule followed by the Greek monetary authorities for the biggest part of the country's recent economic history, as described in chapter three. Under these assumptions, a fiscal expansion leads to an increase in output and the price level, initially. However, the impact on output is completely reversed and, in the medium term, it becomes slightly negative. Forward-looking agents anticipate future reductions in income and profitability due to higher taxes. For this reason consumption and investment decrease immediately following a fiscal disturbance.

Following the assumption that nominal disturbances have a permanent impact on the price level, we consider price disturbances as the consequence of excess demand in the empirical formulation of the model. Under flexible exchange rates, an increase in domestic demand boosts output growth but only temporarily and output soon returns to its long-term equilibrium level. Imports increase reflecting the fact that a portion of the increase in the domestic demand is satisfied by imported goods. The trade deficit increases and, because of the outflow of capital, the exchange rate depreciates. The price level increases. Real wages increase but only in the short-term and for as long as output increases while employment remains unchanged. The adjustment process induces similar changes under the two exchange rate regimes with the difference that changes in output and prices are more pronounced under the flexible exchange rate regime.

Real disturbances are due to technological changes, changes in preferences or other institutional changes (changes in the tax structure or the labour market) that affect production. In the empirical specification of this model, real disturbances are

represented by shocks to potential output. Under flexible exchange rates, after an adverse technological shock has occurred, potential output decreases and the price level increases. Real wages decrease while employment remains almost unchanged. Consumption and investment decrease as well. The exchange rate depreciates while the real exchange rate appreciates because domestic prices decrease at a greater rate than import prices increase. Adjustment takes place along the same lines when the exchange rates are fixed among the European currencies and a common monetary policy is implemented. The only difference is the fact that changes in real wages become more pronounced in the EMU framework.

4. Results

In order to compare the impact of the two regimes, EMU and flexible exchange rates, on the stability of the Greek economy, we need a variability measure. In this study, we use the variability measure proposed by Fair (1998). Let y_t^j be the solution value of variable y for quarter t on the stochastic simulation j and let y_t^* be the baseline value from the deterministic simulation. The variability measure, L_j , computes the mean squared deviation of the variable from its base value as a percentage of these base values for the whole prediction period, $t=1, \dots, T$, for the stochastic simulation j . Measure L computes the square root of the mean of L_j for all the simulations $j=1, \dots, J$:

$$L_j = \frac{1}{T} \sum_{t=1}^T \left(\frac{100(y_t^j - y_t^*)}{y_t^*} \right)^2$$

$$L = \sqrt{\frac{1}{J} \sum_{j=1}^J L_j}$$
(11)

The values of the variables used in the calculations of (11) are in levels and multiplying the squared deviation in the L_j formula by 100^2 expresses L in percentage points. For the interest rate, the deficit/GDP ratio and the debt/GDP ratio, which are already in percentage points, L_j is calculated as:

$$L_j = \frac{1}{T} \sum_{t=1}^T (y_t^j - y_t^*)^2$$
(12)

The results from the simulations of the model are presented in the following table. The second column reports the results from the stochastic simulations of the model corresponding to the EMU, the third column presents the results from the stochastic simulations of the flexible exchange rate model and the fourth column shows the percentage change in the volatility of each variable due to the transition from the flexible exchange rate system to the EMU. The 'exchange rate' and 'interest rate' labels refer to the EURO/USD and the European interest rate, respectively, in the second column (monetary union) while they refer to the GRD/USD and the Greek interest rate, respectively, in the third column (flexible exchange rates).

VARIABLE	EMU	FLEXIBLE EXCHANGE RATES	% CHANGE (due to EMU)
Gross Domestic Product	1.75	1.76	-0.43
Private Consumption	2.69	2.95	-8.92
Private Fixed Investment	2.80	2.74	2.03
Exports	0.74	0.85	-12.55
Imports	3.04	3.35	-9.41
Domestic Price Level	1.90	1.67	13.32
Real Wage Rate	2.10	2.05	2.20
Employment	0.14	0.15	-0.41
Public Deficit/GDP	1.24	1.77	-29.94
Public Debt/GDP	4.03	5.94	-32.15
Exchange Rate	0.80	2.28	-64.99
Interest Rate	0.007	0.012	-43.10

We should point out that L is a summary variability measure that indicates the deviation of each variable from its baseline and, because this deviation is squared, the direction of the variability cannot be identified. Furthermore, if a variable is determined by two other variables that each becomes more volatile in the EMU, it need not become more volatile as well, if the movements of its two components counteract each other. For these two reasons, it is hard to explain the change in the volatility in some variables as it appears in the table.

The results presented in the table are consistent with the predictions of the theory of OCA, as discussed in chapter two. The results indicate that, in the EMU, the stability of the interest rate, the exchange rate and the government budget will

increase. Under these circumstances, adjustment in the Greek economy will take place through the increased volatility of the domestic price level.

More specifically, moving from flexible exchange rates to the EMU does not affect the stability of output and employment (if anything, they become slightly more stable). Of the components of output, all, except investment, become more stable in the monetary union. Imports become less volatile because of the greater stability in import prices due to the much more stable exchange rates (EURO/US\$) and because of the modestly greater stability in the domestic effective demand. Exports are less volatile because of the more stable relative prices. According to QUEST II (equation 24 in chapter four), export prices are determined as the weighted average of the domestic price level and the competitors' prices expressed in domestic currency (EURO). The weight by which each of these components affects export prices depends on the parameter ptm which, for the Greek economy, has a value of 0.68. This means that competitors' price behaviour is more important in determining export prices than the domestic price level and, because it becomes more stable (due to the much more stable exchange rate), it offsets the greater volatility in the domestic price level.

The domestic private consumption becomes less variable in the monetary union which is due to the increased stability of human wealth (not shown in the table). As pointed out above, it is hard to explain this result as most of the determinants of human wealth become either slightly more stable (unemployment benefits) or slightly more volatile (real wages). Private investment becomes slightly

more volatile. This can be attributed to the increased volatility of the real interest rate (not shown in the table) and the increased volatility of profit, as discussed below.

The stability of output does not increase very much, even though each of its components, except investment, becomes more stable compared to its own baseline value. This could be attributed to the way the monetary policy is formulated in the monetary union. The European interest rates are set by the monetary authority using the EU reaction function. With the relevant Greek variables bearing a small weight in this reaction function, the EU interest rates are practically set exogenously to the Greek economy which may be a destabilising factor for the output level. For example, if an excess demand shock occurs in the Greek economy and the EU interest rates do not move to counteract it, the output level (and the medium-term growth rate) will deviate from its long-term steady state equilibrium. This is also consistent with the higher volatility of real interest rates and private fixed investment.

The domestic price level becomes more volatile which is expected given the increased stability in the exchange rate (EURO/US\$), the European interest rates and the slightly increased stability of output. This finding is consistent with the theory that when exchange rates (among European currencies) are fixed, domestic price movements relative to foreign prices (real exchange rate movements) are necessary for the adjustment process, as discussed in chapter two. This result is

also consistent with the empirical evidence that European firms adjust to shocks by changing their profit margins and mark-up (European Commission, 1996).

With increased volatility in the domestic price level and almost the same real wage volatility, the profitability of domestic firms will become more volatile as well. The increased volatility of firms' profit may lead to more bankruptcies which may, in turn, affect negatively the growth rate and level of output. It is, therefore, important that Greek firms be able to effectively adjust to disturbances. This can be achieved through greater product market flexibility and less government intervention.

As our discussion of the Greek economy indicated in chapter three, regulation of firm operations, and particularly price setting, still exists in certain sectors. However, recent changes in the Greek private sector have led to deregulation and greater competition. Furthermore, there has been a great deal of consolidations and mergers which should allow Greek firms to effectively face pressures on their profit margins when this becomes necessary. Also, the modernised operation of the Athens Stock Market and the reformed financial system offer the Greek private sector better access to investment funds and reduce the liquidity constraints and the reliance of the Greek firms on borrowing to finance investment. In this environment of greater availability and greater options of investment funds, firms are able to survive the increased competition (because of more research and development funding and product diversification) and disturbances (because of lower costs associated with financing investment and increased flexibility).

Another problem of the Greek private sector identified in chapter three is the great mismatch between skills demanded and offered in the labour market. Therefore, the ability of the labour markets and the firms to adjust will be enhanced by an education system designed to follow closely the technological developments and to offer the qualifications required by the economy. This should help workers adjust to new conditions of employment and technology and enable firms to survive in an increasingly competitive environment.

The considerably lower variability of the deficit/GDP and debt/GDP ratios in the monetary union is a surprising result because of the fact that the public sector budget is the only stabilisation tool available to a domestic government when country-specific disturbances occur. However, this finding could be attributed to the greatly decreased volatility of debt-servicing costs due to the less volatile European interest rates.

This raises the issue of whether the guidelines regarding the domestic governments' fiscal discipline are necessary and whether they can be consistently followed. The Stability and Growth Pact is an agreement reached by the European Council in 1997 which underlines the importance of sound government finances in strengthening the conditions for price stability and sustainable growth. It requires that member countries avoid excessive general government deficits, i.e., deficits in excess of 3% of GDP. As discussed in chapter two, evidence suggests that economic integration has increased among the European country members and that disturbances are more probable to be industry or region-specific (in the same

country) rather than country-specific. Therefore, disturbances will be more synchronised in the EMU and greater coordination of national fiscal policies will be required to counteract these disturbances. Furthermore, it is required that the national governments be in such a budgetary position that will provide sufficient room for the fiscal stabilisation policies to operate in the EMU without breaching the 3% threshold. The minimum benchmark figure for Greece regarding its budget deficit has been calculated at 1.5% of GDP (European Commission, 1999b). As noted in chapter three, one of the problems of the Greek public sector is that the tax system yields weak revenues, which is mainly due to the narrow tax base and the tax authorities' inability to combat the widespread tax evasion. In order to correct this weakness, the tax authorities have indeed made progress in modernising the tax collection and audit system, which has contributed to the reduction of the deficit/GDP ratio in the recent past.

In summary, this study has used stochastic simulations to evaluate the impact on the stability of the Greek economy of the transition from flexible exchange rates to participating in the EMU. The model used for this purpose is the multi-country model used by the European Commission called QUEST II. The disturbances are identified, following Blanchard and Quah (1989), in a structural VAR framework by imposing restrictions on the long-run coefficients. The results from the stochastic simulations indicate that in the monetary union the stability of output will only slightly increase even though each of its components, with the exception of private fixed investment, becomes more stable. The domestic price

level will become more volatile. Also, the public sector deficit and debt as percentage of GDP, the (European) interest rates and the exchange rate with respect to the US Dollar will all be more stable in the monetary union.

Chapter Six

Conclusion

This thesis evaluates the impact of Greece's joining the EMU on the stability of its economy by examining how a small open economy reacts to disturbances, specific to this country, before and after giving up monetary policies as a means of adjustment. The multi-country model used by the European Commission, QUEST II, has enabled us to compare the response of the Greek economy to disturbances under flexible and fixed exchange rates. This is a highly aggregated model which includes structural models for all EU Member States, USA and Japan linked with trade-feedback equations. It combines the recent theoretical developments of macro-econometric model building, namely, a strong microeconomic foundation, a neoclassical supply side, imperfectly competitive goods markets, adjustment costs in both the capital and labour markets, and stock-flow interactions. The model was appropriately edited to conform with computer memory limitations and to emulate the two different exchange rate regimes.

We have used stochastic simulations similar to the Monte Carlo methods. Sets of error terms are randomly drawn from a standard normal distribution set with mean zero and standard deviation one. These error terms correspond to nominal and real disturbances (shocks to the price level and shocks to real output, respectively). We have identified the structure of these disturbances using a structural Vector Auto-Regression (VAR) approach and, following Blanchard and

Quah (1989), by imposing restrictions on the long-run coefficients of the moving average representation.

The choice of the optimal exchange rate regime and, especially, the desirability and viability of a monetary union have attracted a lot of attention and created a great deal of discussion among economists during the last decade. When comparing the two alternatives, the main criterion is how each facilitates adjustment after a disturbance has occurred in an economy. Flexible exchange rates provide a useful tool for immediate change in the relative prices (real effective exchange rates) while under fixed exchange rates (or a common currency) other adjustment mechanisms are required.

The theory of Optimum Currency Areas (OCA) provides useful insights about these adjustment mechanisms, the benefits of joining a monetary union and the costs from joining in the absence of such mechanisms. The theory of OCA is reviewed in chapter two. Each of the earlier contributions to this theory singled out one characteristic that would make the currency area viable. Factor mobility, market integration and product diversification were among the criteria put forward. More recent contributions focussed on the rationale of forming a currency union, the benefits and costs for a country participating in it. The benefits can take the form of enhanced efficiency because of eliminated transaction costs and exchange rate risk, exchange reserve pooling and greater policy coordination. The costs include eliminated monetary sovereignty, limited fiscal autonomy and greater regional vulnerability to disturbances if regional specialisation occurs.

The characteristics of the Greek economy were presented in chapter three. The knowledge and understanding of the particular conditions prevailing in the Greek sectors is important in discussing the model and the stochastic simulation results. The Greek economy was subject to four major disturbances that occurred in the seventies and early eighties, namely the collapse of the Bretton Woods agreement, the two oil-price crises, the membership in the EC and the expansion of the public sector. The slowing down of output growth and the acceleration of the inflation rate were the main consequence of these disturbances. The high degree of government intervention distorted the operation of the product and production-factor markets. In the last half of 1990s, progress has been made in reforming the structural weaknesses in those markets and reversing the deterioration of certain variables (the growth of output, the inflation rate and the public deficit). Despite the progress, there are still rigidities to be corrected, in the labour market, in the operation of private firms and in the structure of the government budget. Some of these issues were addressed in the discussion of the stochastic simulation results.

The results from the stochastic simulations indicate that in the monetary union the stability of output will only slightly increase even though each of its components, with the exception of private fixed investment, becomes more stable. The domestic price level will become more volatile. Also, the public sector deficit and debt as percentage of GDP, the (European) interest rates and the exchange rate with respect to the US Dollar will all be more stable in the monetary union.

Limitations and Suggestions for future research

Certain issues need to be addressed regarding the limitations of this study and the ways that it can be extended for future research projects. First, if the empirical finding reported in chapter two is accurate and economic integration makes the disturbances across countries more highly correlated than they were historically, then, our stochastic simulations are likely to have overestimated the variability of certain Greek variables. It would be difficult to estimate how the historical correlations might change.

Second, the entire model as used by the European Commission includes structural models for all EU country members, the USA and Japan. Due to computer memory limitations, however, the model was edited to include only these for Germany and Greece. The stochastic simulation of the entire model would give a more accurate evaluation of the impact of participation in the EMU. Because of the small size of the Greek economy relative to all EU country members and the rest of the world, the spillover effects from country-specific shocks may not be considerable and, therefore, the results themselves may not be greatly affected by the use of the entire QUEST II model. However, such an exercise will allow for a more complete study of the transmission of shocks to the rest of the world through the trade linkage equations.

Third, the high degree of aggregation of the model does not allow us to observe relative price movements among the different Greek sectors. By introducing greater detail in the model one would be able to observe how different

sectors would be affected by disturbances under the alternative exchange rate regimes. For example, the only disaggregation of output in the model is between the private and public sector. Output could be further disaggregated to define agricultural output separately from that in manufacturing in a weighted function using input-output weights

Finally, the model does not include labour mobility. Empirical evidence indicates that labour mobility in Europe is lower than in the USA or other currency areas and this is mainly due to cultural barriers. However, it is reasonable to expect that, as the labour markets become more integrated, labour mobility will increase. To the extent that there is labour mobility among the EU country members the variability of real wages may be lower and this of employment higher. Labour mobility could be modelled in a similar fashion as the trade linkage equations, i.e. include equations relating domestic employment with employment abroad so that net migration flows can be a function of wage differentials between countries, the unemployment rate and a risk factor (identified as the variance of income).

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