An Analysis of Foreign Debt by the Arab Countries with Special Reference to Egypt, Morocco and Tunisia

Thesis Submitted for the degree of
Doctor of Philosophy
At the University of Leicester

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April 2001

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DEDICATION

TO
My father Q. A. G. Turkistani
My mother A. T. Ahmad

And To
My wife and children

ACKNOWLEDGMENTS

All praises are due to Allah, the Lord of the Worlds, and may the peace and blessing of Allah be upon His messenger Muhammad. Without the mercy and aid of Allah, this thesis- and anything else in life- could not have been begun nor completed.

I am deeply indebted to my supervisor Dr. Dilip Bhattacharyya. His ideas, advices and suggestions were of great importance to the thesis. His kindness and encouragement was well beyond the call of duty and his support was a driving force behind this thesis.

I owe special gratitude to my parents. In fact, I am deeply indebted to my father the great man, and to my mother the most caring lady for their patience, support and prayers. They deserve the rewards for every success I have done and will do in my life. I can only ask Allah to reward them for wonderful life they have given me, and all sacrifices they have happily made for my sake.

I am also indebted to my wife, Safia, for her continuous support, patience and endless sacrifices. Particularly, the encouragement and support I received before and during the PHD period from her are the real factors behind this success. Her great and noble efforts to make our life here in Leicester as enjoyable as possible under the pressure of the PHD research are invaluable and unforgettable.

My great gratitude is to my beloved children, Abdulrahim, Sara, Omar, Sundus and Lubaba not only for their sacrifices but also for their patience. They are the soul of my life. They made the PHD research period the most memorable in my life.

I would also like to express my gratitude to each one of my brothers and sisters for their continuous encouragements and prayers. My grandmother, may she rests in peace, and my three beloved aunts deserve continuous gratitude for their advice and support since, and especially during, my childhood.

Special thanks and prayers are to my respected brother, David W. Middleton, who was always ready to proof read many parts of this thesis. I am indebted and thankful to my close friend and brother Saleh Al-Askar who patiently helped me with the final typing and printing of this thesis. I am also thankful to many other friends and colleagues in Saudi Arabia and in the UK who made my research work easier and enjoyable.

Finally, many thanks are to my sponsor, King Abdul-Aziz University, and to the Saudi Arabian Cultural Attaché in London, whose invaluable support and ready assistance mad my scholarship possible.

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Abstract

This study attempts to model supply and demand behaviour in the international markets for capital in an effort to explain the accumulation of foreign debt in three Arab countries, Egypt, Morocco and Tunisia. At the same time it sheds some lights on the role that foreign debt plays in the current account, and on the economic policies that these countries pursue to tackle the accumulation of foreign debt.

In this study the demand for foreign debt was disaggregated into government demand and private sector demand. Hence, two demand models have been specified. Where, the government maximises an expected quadratic preference function, and the private sector maximises the expected returns from its financial portfolio. The two models are then empirically tested on data from the three Arab countries. Furthermore, the two models are then combined and empirically tested and compared to the disaggregated model.

The general framework of this study is that the governments of the Arab countries under study pursue internal and external acceptance in an effort to remain in power, which is empirically supported here. Increasing government expenditure, which implies higher budget deficit, reflects the government's efforts to gain internal acceptance. On the other hand, opening up the domestic economy to the world indicates the government's efforts to gain international acceptance.

This study concludes that the Arab countries under study have been undergoing imprudent economic policies that mainly accommodating the government's credit requirements. It has shown that the countries had accepted irresistible foreign loans contracts possibly to finance the current account deficits. Further, the IMF stabilisation program requirement to devalue the national currency, in order to increase foreign exchange inflows and hence reduce foreign debt, founds not to be working for the three Arab countries under study.

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CHAPTER 1 *Introduction*

Introduction

Over a 24 years period, the total foreign debt of the Arab countries[1] has risen sharply from almost $7 billion in 1972 (or 19% of GNP) to more than $230 billion in 1996 (or 79% of GNP)[2]. During this period, the percentage of the Arab countries total foreign debt ranges from 7% to 16% of the developing countries total foreign debt. This huge burden of foreign debt is, in fact, a unique experience in these countries' recent history. However, this foreign debt issue of the Arab world has not received sufficient in depth study and analysis.

Borrowing in general, and foreign borrowing in particular, as an economic policy has been under long discussion, and economic theorists have different opinion towards the merits of borrowing. However, if a country accepts foreign borrowing as an economic policy, one would expect two main reasons for external borrowing. A country may borrow externally either for investment or consumption purposes. To expand the country's productive capacity policymakers may decide to borrow to finance investment projects, and at the same time make a repayment plan according to future expected returns from these projects. On the other hand, a country may seek external borrowing to shelter current consumption from fluctuations in income as a result of internal or external shocks. In this case, the country will pay back its debt in future periods where higher income is expected. However, when the country's future income or returns (from investment) are not high enough to service and repay its foreign debt, as were expected, debt servicing difficulties will arise and a debt crisis may eventually outbreak.

In fact, a huge literature on issues related to the foreign debt has erupted since the outbreak of the international debt crisis in the 1982. This literature poses many questions to examine the debt crisis: how this stock of debt evolves over time, whether this debt situation is sustainable, what are the possible ways out from this debt trap etc. Within the framework of the neo-classical growth model, one strand of this debt literature is concerned with examining the borrower's optimal level of

[1] Twenty-two countries. See chapter 2 for definition of the Arab world.
[2] See Tables 2-8 and 2-9 in chapter 2.

debt and the sustainability of its debt policies. In such literature, an approach based on macroeconomic foundations is followed to determine under what conditions a debt path is stable or not. A survey of such studies is available in McDonald's (1982) article. Although such studies have been theoretically useful in analysing the debt capacity of a borrower country " ... there are ... great difficulties in applying the theoretical principles ... to practical judgements of debt capacity"[3].

The objective of this thesis is to investigate the factors that have contributed to the debt accumulation in the Arab world. Two models have been constructed and empirically tested. The first model follows the simultaneous equation approach, where a simple demand and supply structure is specified which leads to reduced form equations for foreign debt and economic growth. The second model, however, follows the standard optimisation approach in an effort to specify a demand model for foreign borrowing. In this model the country's foreign debt is disaggregated into two parts pertaining to the government sector and to the private sector. For each sector a demand model is to be specified and empirically tested. The attempt here is to capture decision-makers' behaviour (government and private sector) in accumulating the stock of foreign debt.

Plan of the thesis

This thesis consists of five main chapters. The first, chapter 2, gives a general outlook on the economies of the Arab world and their foreign debt problem. The second, chapter 3, introduces some important theoretical aspects that have been developed in the sovereign debt literature. An empirical chapter, chapter 4, is then follows in order to study the effects of foreign debt on the current account. The last two chapters, 5 and 6, are theoretical and empirical chapters aim at modelling (and empirically examining) the accumulation of foreign debt. Below we briefly introduce each chapter's aims and methodology.

Chapter two introduces the Arab world, where a general overview of the Arab world economy is to be discussed. The chapter focuses then on examining the Arab

[3] McDonald (1982), p. 614.

world debt position. In addition, a comparison to other major groups of debtor countries is stated.

The third chapter is a review of the literature. The literature on foreign debt is vast, and any attempt to review it all is an impossible task. However, in chapter three some theoretical developments in the debt literature that are related to the line of research of this thesis have been selected and discussed. Several important topics in sovereign debt have been discussed in this chapter (sovereign risks, loan pushing, insolvency versus illiquidity, debt overhang etc) to lay out the theoretical base for the models in chapter five and six.

To start examining the debt problem in the Arab world, chapter four sheds lights on the role played by foreign debt in the Arab countries' current account balances. An important cause of debt difficulties is current account deficits, which needs to be financed by foreign exchange inflows. This chapter not only examines the effects of foreign debt on the current account, but also attempts to study the monetary authorities responses to higher debt stock. In fact, this chapter follows M. Fry's modelling of the current account and the monetary reaction function. Two estimation methods are to be used in this chapter, OLS and 2SLS. The empirical results are then compared to Fry's.

Chapter five follows a line of debt literature that is concerned with the interactions between foreign debt build up and economic growth, and employs the simultaneous equation approach. In this chapter, a reduced form equation model is derived from two structural equations, demand and supply of foreign debt. In fact, the chapter employs an ad hoc functional relationship for demand and supply. While demand is assumed to be stimulated by changes in factors that affect the borrower country's national saving and domestic investment gap, supply is assumed to be affected by factors that determine loanable fund availability and a lender's perception of the borrower's creditworthiness.

As for chapter six, which is the core contribution of this thesis, it aims at studying the factors behind the Arab countries accumulation of foreign debt. Although, its main objective is similar to that in chapter five, it employs recent trends in

economic discipline, where an optimisation problem is to be set up. Further, the chapter disaggregates the stock of foreign debt into government's debt and private sector's debt. Hence two optimisation models are to be specified and empirically tested.

The government sector is assumed to have an objective function to maximise. It has been hypothesised that the government can achieve this objective if it can gain domestic and international acceptance. Domestic acceptance could be achieved through two sub-objectives: higher economic growth and more public expenditure. However, the road to international acceptance, it has been assumed, is a higher degree of openness and a better "business friendly" environment. Here, a quadratic preference function is used to create the government sector objective function. The government maximises this function subject to a set of constraints, which consist of a vector of non-controlled (but of the government's interest) and another vector of controlled variables. Following Theil (1964), the maximisation problem is solved and a demand function for foreign debt is derived. Which has been then empirically tested.

The private sector, on the other hand, is assumed to maximise its expected returns, which depend the composition of assets of the financial portfolio it holds, subject to the sector's total wealth. A portfolio approach and the mean-variance analysis have been employed to determine the sector's optimal financial portfolio, from which the private sector's demand for foreign funds is derived.

Contribution of this study

This thesis attempts to explore the rationale behind the accumulation of foreign debt in the Arab countries under study. To achieve this aim, we first study, in chapter four, the stock of foreign debt role in the current account balances, and examine the monetary authorities reaction to changes in a country's stock of foreign debt. Secondly, we study the borrowing behaviour of the decision-makers in these countries. Two models were built, in chapter five and six, to capture the determinants of stock of foreign debt.

CHAPTER 2 *Introduction to the Arab World*

Introduction

The "Arab World" consists of twenty two countries, namely: Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates, West Bank and Gaza, and Yemen Republic. However, this classification "Arab World" is not used in any of the economic publications of the World Bank, the IMF or the OECD. These Arab countries are scattered in two groups made by the Bretton Woods organisations, namely "Middle East and North Africa" and "Sub-Saharan Africa". The former comprises nineteen states, two[1] of which are not Arab countries, while the latter includes among its members four[2] Arab countries only.

The Arab World population totalled around 250 million in 1995, and it covers an area (in the African and the Asian continents) of more than 18 million square kilometres[3]. Almost two third of the total area locates in the African continent, which contains ten Arab countries and accommodates more than 150 million of population. The rest, twelve countries, are located in the Asian continent. The fertility rate in the Arab World is one of the highest in the world. It is about 2.5% compare to less than 1% in the industrial countries.

The Arab World has a very strong base for agricultural development. It covers a very large area of different climate, and it has the potential to grow variety of agricultural products, such as wheat, malt, maze, olives, beans, cotton, fruits, tea, coffee, pineapple, banana etc. In addition, it is very rich in mineral resources. Such as: iron ore, phosphate, magnesium, copper, coal, lead, gold, silver, uranium, zinc and above all oil and gas. In fact, the Arab countries have more than 50% of the world oil reserves, and about 17% of world reserve of gas. In addition, it produces about 28% of the world production of phosphate.

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[1] Iran and Israel.
[2] Djibouti, Mauritania, Somalia and Sudan.
[3] Compare to 370 million of population in 3.2 million square kilometres in the European Union.

Having these agricultural and mineral resources and a relatively very large market, population of 250 million, the Arab World has the necessary potentials to develop a very strong and large economy.

One world different countries

The Arab World has enough potentials (homogeneity in language, religion, and history and richness in the natural resources) that could lead any economy to a great economic success. However, many obstacles have been obstructing the way toward this success. This richness in the natural resources is not under the control of one economic planner (one government for example), which is the result of the fact that the Arab World is not a one political entity. These resources, however, are randomly and unevenly distributed among twenty-two entities.

What is more, the adaptation of different economic and political systems makes co-operation between these entities even more difficult. While six countries[4] follow the socialist political system and the centralised market economy. The other sixteen[5] countries follow different political systems and different degrees of "free market economy". Beside the fact that, each country has different starting point in its economic efforts towards development. Morocco is the first country, in this century, to set up an economic development plan, in 1956. Where the state of Bahrain started its first four years development plan in 1982.

So, not only that each country started its development plans in different dates but also within a framework of different political and economic ideologies, and with different given natural resources. As a result, the "Arab World" ends up with 22 different experiences of political and economic developments.
To show the huge differences in the economic potentials and achievements of the Arab countries, one can shed some lights on facts such as per capita income, size, and illiteracy rate.

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[4] Algeria, Iraq, Libya, Somalia, Syria and Tunisia.
[5] Comoros, Bahrain, Djibouti, Egypt, Jordan, Kuwait, Lebanon, Mauritania, Morocco, Oman, Qatar, Saudi A., Sudan, UAE, Yemen and West Bank and Gaza.

The Arab World includes between its members Somalia and Yemen, which had as low as $100 and $250, respectively, per capita income in 1995. However, it also includes Kuwait and UAE, which had made more than $17,000 in the same year. With regard to size, the Arab countries are too substantially different in their sizes. Djibouti, Qatar, Tunisia, Kuwait and Syria are countries with total area of less than 200 thousand square kilometres. While Mauritania, Sudan, Saudi and Algeria are big countries, each with total area exceeds 2 million square kilometres.
However, as a basic measure of human development, the illiteracy rate (percentage of population aged over 15 years) in 1995 is as impressive as 7.4% in Lebanon and about 14% in Jordan and Bahrain. However, in Morocco, Sudan and Djibouti it is very high, more than 50% of the total population of fifteen years old and above.

Several ambitious efforts have been tried to strengthen the weak political and economic ties among the Arab countries, in order to narrow the gap between their different standards of living. As a result, regional and sub-regional Arab organisations were established to serve the ultimate goal of united Arab World. The latest is the Great Free Trade Zone, which was established by the Economic and Social Council of the Arab League, in February 1997, and to be completely applied in ten years commencing 1998.

Arab international trade

It is not the intention of this thesis to study these efforts towards unity and their achievements, rather it is only to shed some lights on how strong or weak is the economic co-operation among the Arab countries. In fact, one measure of economic co-operation is used here, namely trade partners. Table 2-1 presents some basic aspects of the international trade in the Arab countries, in 1993.
The first column, trade/GNP, shows the size of Arab trade activities compare to their total economic activities[6]. This table gives a snap shot picture of the Arab world's position in the international trade. It goes without saying, the trade/GNP ratio is very high, almost 90%, in the Arab countries when one realises that the ratio is only about 25% in the industrial countries. This may reflect how seriously

[6] Measured by exports plus imports to GNP.

vulnerable the Arab economies are to any changes in factors affect their international trade.

What may make things worse, is the trivial power the Arab countries have in the arena of international trade. Their share of the world trade is very small, about 3% only.

Table 2-1 Trade statistics (1993)

Country	(Exp+Imp) to GNP	Exports of goods & services		Imports of goods & services		Share of main none Arab trade partners (%)	
		Bil. $	% of Total Arab	Bil. $	% of Total Arab	Exports	Imports
Qatar	--	3.60	2.27	1.80	1.12	80.3	53.1
Iraq	--	9.50	5.98	5.10	3.17	68	54.8
Algeria	45.1	10.88	6.85	11.56	7.17	71.4	74.4
Morocco	52.1	7.12	4.49	8.59	5.33	62.9	61.5
Syria	57	4.70	2.96	6.00	3.72	55.8	41.9
Egypt	62.1	9.95	6.27	14.50	9.00	50.3	54.5
Oman	71.0	5.41	3.41	4.75	2.95	43.2	45.4
Lebanon	71.3	0.73	0.46	4.64	2.88	6.0	45.6
Libya	80.0	8.50	5.35	10.20	6.33	81.1	66.5
Saudi Arabia	83.0	47.90	30.18	44.02	27.32	56.1	59.6
Tunisia	88.8	5.99	3.78	7.03	4.36	71.7	68.2
Yemen	91.8	1.34	0.84	2.57	1.59	65.6	40.8
Kuwait	94.6	11.44	7.21	10.60	6.58	78.5	58.8
UAE	126.6	23.98	15.11	20.83	12.93	40.7	37.3
Jordan	130.6	2.82	1.78	4.50	2.79	14.9	38.5
Bahrain	204.4	4.87	3.06	4.43	2.75	23.8	24.2
Total	-	158.74	100.00	161.14	100.00	-	-
Average	89.9	-	-	-	-	54.39	51.57

Source: Calculated from: The World Bank CD-ROM 1999, and the Economist 1995

However, only few countries dominate the Arab international trade. Saudi Arabia and UAE together make more than 40% of Arab countries total exports and imports. This is clearly evident from the two columns titled "% of total", which also show how trivial are the other countries' contributions to the Arab total trade. It follows that, the share of Saudi Arabia and UAE of international trade is relatively important, more than 1% of the international trade. Therefore, on the

contrary that the Arab World has a trivial importance in trade it actually has a strategic importance especially in exporting oil and gas to the rest of the world.

With regard to trade partners, most of the international trade of the Arab World is with none Arab trade partners, especially the industrial countries, as can be shown by the last two columns of Table 2-1. Naturally, as any typical LDC, most of the Arab World trade is with the industrial countries. The Arab countries are mainly exporters of few raw materials, and they import food and many manufacturing products. Furthermore, the Arab countries' export products are not complements but rather substitutes. As a result, intra-Arab trade is expected to be small. In fact, it makes less than 10%[7] of their total world trade.

Therefore, to study the economies of the Arab World, one needs to realise the fact that, although these countries share the same language, religion and history, they are not only politically but also economically different. However, regardless of the fact that they are twenty-two fragmented parts or countries there are, still, calls for greater intra-Arab economic co-operation.

[7] Zaki R. (89), p. 29. See also p. XI of Arab League, 1997.

Economic features of the Arab world

The need to have a general overall view of the Arab economies places some demand on the researcher to sort these twenty-two economies with respect to some economic characteristics, and then to classify them into few number of groups.

In fact, the Arab Countries League divided them in four groups. The first two groups are oil-exporting countries; one contains highly populated countries, Algeria and Iraq, while the other is the low population group, which comprises five countries namely, Kuwait, Libya, Qatar, Saudi A. and UAE. On the other hand, the second two groups are non-oil exporting countries, the middle income and the lower income groups. The middle-income group comprises Bahrain, Egypt, Jordan, Lebanon, Morocco, Oman, Syria and Tunisia, while the low-income group consists of seven countries, namely Comoros, Djibouti, Mauritania, Somalia, Sudan, West Bank and Gaza and Yemen.

This chapter is, more or less, following the Arab Countries League grouping. The two oil-exporting groups were combined into one group only. In this case the Arab World is divided into three groups, namely oil group, middle-income group and low-income group.

Mono-exporters

Similar to most LDCs, the Arab countries' exports of primary products account for a very high percentage of total exports. As a result, they have been troubled with the risks associated with undiversified sources of income. In particular, a shortfall in production and /or a decline in the world price of the primary product(s) may force an LDC into an economic tailspin as the terms of trade deteriorate.

Generally speaking, almost 75%[8] of total export earnings in the Arab World comes from primary products, as can be seen in Table 2-2[9]. In fact, more than 90% of export earnings, in the oil group, comes from exporting oil and refined products. While only about 51% of exports earnings come from exporting primary products

[8] Djibouti excluded from the total as it has no primary product to export. Its most export earnings come from re-exporting.

[9] See Table A1.1 in Appendix 1 for more details.

in the middle-income group. In this group, however, the oil sectors of some countries have considerable contribution in generating foreign revenues to the economy. As for the low-income group, exports of primary products, mainly agricultural, make 88% of total export.

Table 2-2 Exports of primary products (1992)

Country Group	% of Exports
Oil group	90.97
Middle Income	51.34
Low Income	88.38
Average	74.47

Source: Arab Banking Corporation

The share of primary products in total exports in two countries, Lebanon and Tunisia, are exceptionally low, 20% and 29.3% respectively. This may reflect low risk of diversification. In fact, it could be attributed to some facts of the structure of these two economies.

Lebanon is a small country that has been devastated by fifteen years of civil war and military occupation. Since the country has a weak base of mineral resources and a difficult land to cultivate, the Lebanese economy had been based on a strong service sector, international banking and tourism. This sector continues to have the highest share of the country's GNP in the 1980s and the 1990s. Although this country has a devastated economy, it has relatively diversified income sources.

As for Tunisia, its textile industry makes about one third of the manufacturing sector and contributes almost 40% of total exports. This industry's exports, as none-primary product source of income, help to diversify the country's sources of income.

As one might expect, countries of the oil group and the low-income group are closer to be classified as mono-exporters. One must say, however, that the gap between the income levels of the two groups is substantially large. As for as the countries in the middle income group concerned, most of them are doing reasonably well with respect to diversifying their sources of export revenues.

Origin of GDP

The total production of each sector in the economy will sum up to the gross domestic product GDP of the economy. The contribution of each sector to the GDP gives some insights of the structure of the economy, the importance each sector has and possibly the stages of development the country attained.
Each country usually divides its economy into three main sectors, namely agriculture, industry and service sectors. The industrial sector comprises manufacturing, mining and construction sub-sectors. Where, the service sector definition could be divided into trade and finance and other sub-sector.

(%) Table 2-3 Economic sectors contribution to GDP (1992)

Country	Agricultural	Industrial			Service	
		Manu-facturing	Mining	Const-ruction	Trade & Finance	Other Services
Oil group	6.0	11.5	31.5	8.5	14.1	28.3
Middle Income	12.4	17.0	10.1	5.0	24.6	30.7
Low Income	26.9	10.7	3.4	4.7	16.9	37.3
Average	13.8	13.5	16.0	6.2	19.0	31.5

Source: Arab Banking Corporation.

The agricultural sector in the Arab World is very weak and neglected. Table 2-3[10] shows that, on the average, this sector contributes less than 14% to the GDP. Its highest level was in the low-income countries, almost 30%. However, the agricultural share of the GDP was decreasing in this group, it has exceeded 42% in 1975, but then decreased to about 34% in 1982. In the oil producing group almost 60% of GDP is attributed to the mining and service sectors. While only 6% of the GDP comes from the agriculture sector.

On the other hand, the industrial sector produces about 35% of the Arab World GDP. The highest contribution is in the oil group, where these countries create more than 50% of their GDP in the industrial sector. In particular, as one might expect, the mining sector has the greatest share, 31% of GDP in the oil group.

[10] See Table A1.2 in Appendix 1.

The middle-income group, however, produces 32% of its GDP in the industrial sector. This group has the highest share of manufacturing sector in GDP, 17%, when compared to the other two groups. The manufacturing activities in the Arab World concentrate on consumption goods (mostly food products) textiles and chemical products. As for as the low income group concerned, on the average less than 20% of the GDP is produced in the industrial sectors of its countries.

The service sector, in fact, creates about half of the GDP, on the average, in all three groups. However, the service sector in four countries, Jordan, Lebanon, Djibouti and Yemen, contributes as high as 60-80% of their GDP. In fact, all four countries are poor in natural resources. Lebanon was the main centre for banking in the Middle East. However, the civil war in Lebanon has moved essential part of this importance to Jordan. On the other hand, Djibouti is a city-state that lacks any indigenous productive base; as a result it depends heavily on its service sector.

Food

Table 2-4 below shows land usage for agriculture in the Arab World[11]. The Food and Agriculture Organisation (FAO) classified about 44% of total area of the Arab World as Permanent Meadows and Pasture[12]. However, about 65% of this land is located in the oil group, in particular Algeria and Saudi Arabia.

(Million Hectares) Table 2-4 Agriculture usages of lands (1993)

Country	Total	Arable	Perm. CR	Perm. P.	Forest & W
Oil Group	684.3	18.1	1.3	444.7	6.9
Middle Income	401.8	21.3	8.7	33.9	11.6
Low Income	472.2	15.6	0.2	208.6	66.6
Total	1558.3	55	10.2	687.2	85.1
% of Total	100	3.5	0.7	44.1	5.5

Source: FAO - Production

In fact, only 5.5% of the Arab countries classified as Forest and Woodland[13], 78% of which located in the low-income group, particularly in the Sudan and Somalia.

[11] For detailed information see Table A1.3 in Appendix 1.
[12] FAO defines this usage as: land used permanently.. for herbaceous forage crops, either cultivated or growing wild. See FAO yearbook, Production, vol. 48, 1994.
[13] FAO defines this usage as: land under natural or planted stands of trees, whether productive or not.

Nevertheless, the Arab World has less than 1% of its land classified as Permanent Crops[14], which is mainly, 85%, located in the middle income group, in particular Syria and Tunisia.

Table 2-5 below shows the dependence of the Arab World on other countries for their food and animal needs[15]. The middle-income group has been exporting and at the same time importing most, 70%, of the Arab World exports and imports of food and animal.

(Million $) Table 2-5 Trade of food and animal

Country Group	ex & im	1970	1980	1985	1990	1994
Oil Group	Exports	81.7	25.7	18.0	66.6	63.3
	Imports	493.1	687.3	668.7	826.4	890.3
Middle Income	Exports	493.2	866.8	602.5	1342.3	1298.1
	Imports	561.1	2650.5	2788.1	3246.3	3378.6
Low Income	Exports	60.8	287.4	198.5	246.5	220.2
	Imports	71.1	1153.0	997.1	264	325.0
Total	Exports	635.6	1179.9	819.0	1655.4	1581.6
	Imports	1125.3	4490.8	4454.0	4336.7	4593.9

Source: FAO - Year Book

On the whole, the Arab World imports of food and animal more than tripled, 310%, between 1970 and 1994, however, the growth in its exports did not exceed 150% in the same period.

The highest growth rate in imports of food and animal was in the middle-income group. While the worst decrease in exports was 22% in the oil group.

[14] FAO defines this usage as: land cultivated with crops that occupy the land for long period and need not be replanted after each harvest.

[15] For detailed information see Tables A1.4 and A1.5 in Appendix 1.

Economic growth

The Arab World was enjoying rising prosperity during the first two decades, 1960s and 1970s. Afterward, however, the rate of growth slowed down considerably. In fact, the oil group has been making negative rate of growth since the early eighties. This could be attributed to the oil prices[16] deterioration during the eighties and to the II Gulf War in the early nineties.

In the oil group the risk of dependence on one source of revenue is evident in the strong relationship between oil prices and rate of growth.

(%) Table 2-6[17] Average annual growth rate of real GDP (100=1995)

Country Group	61-64	65-69	70-74	75-79	80-84	85-89	90-97
Av. Oil	11.23	9.50	5.78	10.01	-1.86	-0.70	-0.89
Av. Middle	6.77	10.90	5.80	9.14	5.96	2.71	4.69
Av. Low	4.88	4.30	0.69	5.55	2.46	1.33	2.05
Av. Arab World	8.05	8.84	4.70	8.57	2.38	1.19	2.26

Source: Calculated from: The World Bank, WDI CD-ROM, 1999.

On the other hand, the middle-income group rate of growth was fluctuating, on the average, within a reasonable range in the eighties and the early nineties. However, the low income group suffered from unfavourable weather conditions, since most of its members are agricultural countries. As a result, they experienced low rate of growth compare to the two groups. Except in the eighties and the nineties when it was doing very low but positive rate of growth.

[16] Brent spot price was $32.86 a barrel in 1982, then it continue to decrease until 1989 where it hit $18.24 a barrel. See International Energy Agency-OECD (1996).

[17] For more details see Table A1.6 in Appendix 1.

External debt in Arab countries

Source of external debt data

Four main sources of data on external debt could be mentioned, namely the Bank for International Settlements, the OECD, the IMF and the World Bank[18].

In this thesis the primary source for debt data is the World Bank publications, namely the Global Development Finance GDF which took over the World Debt Tables WDT since 1998.

However, we resort to the OECD publications, Financing External Debt of Developing Countries FEDDC and the External Debt Statistics EDS, for Arab countries who do not report to the World Bank Debtor Reporting System DRS, and also for Arab countries who do report to the DRS but lack data for few years. Naturally, sources of data should be mentioned wherever needed.

The Arab countries that do not report to the DRS are Bahrain, Iraq, Kuwait, Libya, Qatar, Saudi Arabia and UAE. However, the data for the other 14 Arab countries is available in our primary source, GDF/WDT.

Building up the external Debt

Determining the actual total external debt of the Arab World is, in fact, difficult and could be misleading. Therefore, one should be careful and cautious when dealing with aggregation of the external debt of the Arab countries.

The Arab World comprises 22 heterogeneous countries, their foreign debt accumulated for different reasons. Some of the countries resorted to foreign borrowing to ease some liquidity problem they were facing. While other countries decided to borrow externally as part of managing their portfolio investments.

Data availability is another difficulty in analysing the history of, and determining the size of, the Arab World foreign debt. Data for some countries is available in some sources where other Arab countries data is not available. At least two different sources of data needed to acquire data for all Arab countries, the World

[18] For more details about these sources, please see Appendix 2, p.218.

Bank and the OECD. This of course raises the possible difficulty of having different definitions[19] of total stock of debt.

However, having these in mind, an effort is made to build some necessary general background of external debt in the Arab World.

Table 2-7 shows the build up of external debt in the Arab World[20]. In 1996, total stock of debt amounted to $232 billion. Which means it increased by more than 10 folds since 1975, but only about 47% since 1985.

(US$ Billions) Table 2-7 Total external debt (EDT)

Country Group	71	75	82	85	90	93	96
Oil Group	1.3	7.6	26.2	66.2	94.6	94.4	100.6
% of total	19	38	28	42	44	44	43
Middle Income Group	4.7	9.9	54.4	75.9	95.7	94.1	102.4
% of total	72	50	59	48	44	44	44
Low Income Group	0.6	2.5	12.0	15.7	26.0	26.8	28.8
% of total	9	12	13	10	12	12	12
Total Arab World	6.5	20.0	92.6	1574.8	216.3	215.3	231.8

Source: The World Bank (WDT/GDF) and OECD (FEDDC or EDS).

The stock of the Arab World external debt is concentrated in two groups, the middle income and the oil group. The share of the middle-income group of total Arab World debt decreased from about 60% in 1982 to 44% in 1996. Whereas, the oil group share increased from 28% to 43% for the same period. On the other hand, the share of the low-income group kept relatively unchanged during the period.

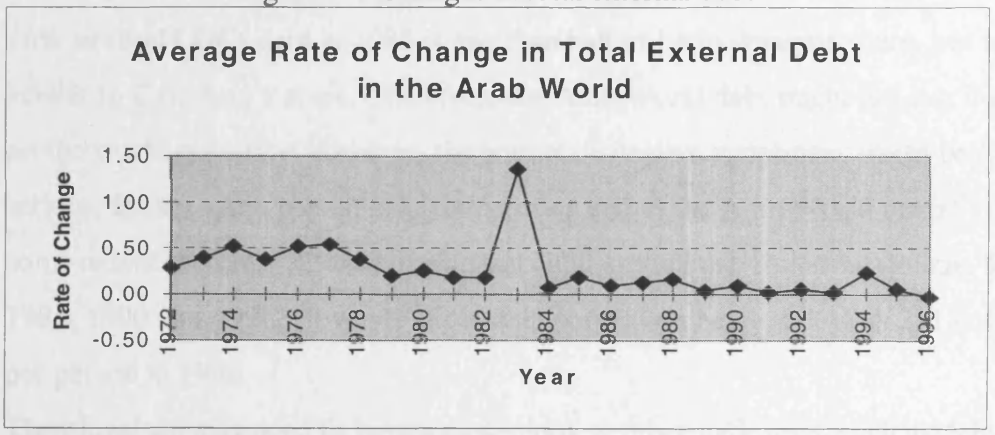
The two oil shocks, 1973 and 1979, affected both demand and supply of loanable funds. Import bills inflated considerably, in the Arab none oil exporters, and deteriorate the current account balances[21]. On the other hand, the huge increase in oil revenues in the oil exporting countries increased the supply of fund in the international capital market and lowered the real rate of interest for borrowing. These two incidences attracted and convinced the none oil exporters to resort to external borrowing and accumulate foreign liabilities in the 1970s. In general, the reduction of this group's share in total debt, in the late 1980s and 1990s, could be

[19] See Appendix 2, P. 218, where definitions of the OECD and the World Bank stated.
[20] For more details see Table A2.1 in Appendix 2.
[21] See Table A2.2 in Appendix 2.

attributed to the implementation of the IMF adjustment policies by, and the forgiveness of part of the debt of, some countries of the middle-income group. However, most none oil exporters of the Arab World started to have difficulties in servicing their external debt in 1980s. As a result, about 45 debt relief agreements were signed in the period (1980-1995)[22]. One cannot disagree with J. Williamson (1988) who said "The drop in the price of oil has posed a major problem of some of the debtor, although it has brought relief to others: overall it has probably made the debt problem worse rather than better" [23].

On the other hand, since the second half of the 1980s, the oil group experienced some difficulties in their oil revenue as a result of decreasing oil prices[24]. Furthermore, in the early 1990s some countries of the oil group, in fact, experienced huge increase in expenditure as a result of the second gulf war. This may explain the increasing share of this group since the second half of the 1980s.

Figure 2-1 Changes in total external debt



It should be mentioned that since 1983 the total Arab World debt is the sum of debt of twenty countries compare to thirteen countries only prior to 1983. This explains the huge jump in the rate of change in the figure above. Figure 1 shows, however, the trend in the change in the total stock of external debt of the Arab World, which had been increasing since 1972, but in a decreasing rate.

[22] See Table A2.3 in Appendix 2.
[23] A comment in: Sachs (1986) p. 433.
[24] Crude, Brent, oil spot price in 1985 was $27.62/bbl, and in 1986 it was $14.44/bbl. See: International Energy Agency, 1996.

External debt in the Arab region compare to other regions

This section is introduced to look at the Arab World debt from global perspective. In fact, some debt indicators can show the relative importance of the Arab World debt and how significant it is in the global economy. Table 2-8 compares total debt in Arab region to total debt in other regions in the world.

(US$ Millions) Table 2-8 Total debt [25] (EDT or DOD)

	72	75	82	85	90	96
All LDCs	93,433	186,272	793,072	1,006,080	1,443,944	2,095,428
ARAB	6,809	20,010	92,574	157,824	216,265	231,759
% of World	7	9	11	16	15	11
E. ASIA	11,390	20,609	92,046	127,978	239,293	477,219
% of World	12	11	12	13	17	23
LATIN A.	44,260	82,739	354,832	408,471	475,368	656,388
% of World	47	44	45	41	33	31

Source: Calculated from GDF, CD-ROM 1998.

However, Prior to 1983 actual total external debt of the Arab World might exceed what is presented here, as a result of lack of data for seven countries. Nevertheless, 16% of total LDCs debt in 1985 is less than half of Latin America share, but very similar to East Asia's share. Therefore, the Arab World debt might has less impact on the world economy; however, the impact on its own economies might be quit serious. In fact, each person in Latin America and in the Arab World bears[26] to some extent the same amount of external debt, around one thousand dollars, for 1985, 1990 and 1996. However, East Asia population bears as low as 251 dollars per person in 1996.

Therefore, we may need to have a closer look at other indicators, such as debt ratios, to see how seriously the debt might affect the economies of the Arab World.

Debt ratios

Debt ratios are good indicators to show how external debt and debt services affect the economy of the country concerned. Three ratios are commonly used in the

[25] For 1972 and 1975: total debt outstanding disbursed only (DOD), While for 1980 - 1995: total debt stock (EDT).

[26] Simply calculated: total external debt to total population.

literature, namely the debt to export, debt to GNP and debt service payments to export ratios. Generally speaking, these ratios, measure the debtor country's capacity to service its debt. They also shed lights on the burden of the external debt on the economy.

In particular, 'a high ratio of debt to GDP, the 'debt overhang' hypothesis, discourages investment and affects future output negatively, because most of the revenue generated by production and exports are used to repay current debt obligations'[27]. Furthermore, 'debt servicing, on the other hand, can be a real drain on heavily indebted countries. It deprives the economy of the direct and indirect benefits of a large percentage of exports. Thus the country foregoes some important multiplier-accelerator effect. This reduces the ability of its economy to grow and increases its dependence on foreign debt'[28].

Table 2-9[29] Debt ratios compare to other groups of countries

Debt Ratios (%)	Debtor Group	1972	1975	1982	1985	1990	1996
Debt / Export[30] (EDT/EX)	LDCs	77	65	117	159	162	137
	Latin A.	192	174	279	312	296	198
	E. Asia	95	76	112	142	136	102
	Arab	148	77	187	268	256	263
Debt / GNP (EDT/GNP)	LDCs	7	9	27	35	35	36
	Latin A.	22	22	48	61	46	37
	E. Asia	7	8	22	25	37	34
	Arab	19	19	51	73	96	79
D. Service / Export (TDS/EX)	LDCs	9	7	18	21	18	17
	Latin A.	26	26	47	37	25	32
	E. Asia	9	8	17	23	18	13
	Arab	26	11	18	18	17	12

Source: The World Bank, GDF; CD-ROM 1998.

To compare burden of debt in Arab countries with other regions in the world, Table 2-9 shows the three ratios for all LDCs and for three different regions of the world. The first two ratios show that the economies of the Arab World bear heavy burden of external debt compare to total LDCs and to Latin America and East Asia regions. In fact, the debt service ratio in the Arab World is not as high as that in

[27] Kaminarides and Nissan (93), p. 231.
[28] Metwally et al (94), p. 598
[29] The averages provided here do not cover all Arab countries, but only the available in the World Bank sources. See Table A2.4 in Appendix 2, for more details.
[30] If Sudan and Somalia were deleted from the average (EDT / EX) of Arab World, then the ratio will be reduced to:

1975	*1982*	*1985*	*1990*	*1996*
51	*132*	*176*	*168*	*163*

Latin America region, however, it is similar to and in some years higher than, East Asia and total LDCs ratios.

These ratios very clearly show the impact and the burden of external debt on the Arab World economies. They also show how serious it is compare to other regions of the world. In fact, if the burden of debt in the Arab World is not higher than that in other regions then they are roughly equal.

Table 2-10 groups the Arab World into the previous three groups, in order to see the burden of debt in each group. As one might expect, the table shows that the poorest the country the heavier the debt burden on the economy. Oil group have enough resources to service their debt[31], but low income group have very limited resources to encounter the debt crisis[32].

Table 2-10 Debt ratios in Arab countries

Debt Ratios (%)	Arab Debtor Groups	1972	1975	1982	1985	1990	1996
Debt / Export (EDT/EX)	Arab	148	77	187	268	256	263
	Oil	na	4	29	65	69	97
	Middle	174	85	152	208	177	137
	Low	122	205	444	727	696	564
Debt / GNP (EDT/GNP)	Arab	19	19	51	73	96	79
	Oil	23	8	9	23	33	36
	Middle	20	26	53	73	92	69
	Low	18	30	120	160	177	146
D. Service / Export (TDS/EX)	Arab	26	11	18	18	17	12
	Oil	na	na	31	17	21	17
	Middle	33	6	18	18	17	12
	Low	19	23	15	16	11	7

Source: The World Bank, GDF-CD-ROM 1998, and OECD-External Debt Statistics

[31] EDT/EX is very high in 1992 because of the huge increase in Iraq's liabilities as a result of the Gulf War.

[32] This is somewhat similar to what J. Kaminarides and E. Nissan (93) found in their sample of small countries: 'This study also concludes that high-income small countries could afford to incur larger debt to enhance their growth through exports, consumption and investment, than could the low-income small countries' p231.

Sustainability of debt policies

This section aims to shed some lights on the relationship between debt, deficit and growth, in order to formulate an idea about the sustainability of debt policies in the Arab countries. A particular fiscal criteria which meets solvency conditions is assumed. Then the Arab countries policies and previous growth rates are examined to find which countries met this criteria and which did not. For countries that did not yet meet the criteria, a question immediately arises: when they could achieve the criteria? The criterion used in this section is the Maastricht Treaty fiscal criteria.

The European Union countries signed the Maastricht Treaty in 1992. One of the main goals of the treaty is to achieve a debt convergence target, debt not to exceed 60% of GNP, by all members by 1999. McAdam (1998) made simple algebraic analysis to measure the distance between the required and actual debt to output ratio. Then he constructed a rudimentary model to find out how many years each country needs to close up this gap, given default rates of growth and interest. The model then solved for rate of growth to find out the necessary annual rate required to meet the debt convergence target, given a time span of seven years (1993-1999).

Here, McAdam work is introduced to formulate a rough idea about the sustainability of debt policies in the Arab countries.

Table 2-11 was created using the following two formulas used by McAdam[33] and applied to countries with 60% or more of debt to GNP ratio[34].

Required C/Y = $S^* = b_o (R-k)$, then

gap $= (S^* - \alpha)$, and

$$t = -\frac{1}{k} . Ln \left(\frac{b - \frac{\alpha}{k}}{b_o - \frac{\alpha}{k}} \right)$$

Where,

[33] See Appendix 3, P. 222-223, for more details about the formulas used.

[34] Table A3.1 in Appendix 3, which contains countries with debt ratio less than 60%.

C = current account balance,
Y = GDP,
R = real rate of interest, assumed to equal 5% for all countries,
k = real rate of growth, the total average rate of (1985-1993),
α = the current account balance to GDP,
b = total debt stock to GNP, and b_0 is the initial debt ratio, in 1993.

Interest rate = 5%

Table 2-11 Debt convergence

Country	Current Account Balance / GDP (1993)			# of years required	Debt / GNP	
	Present	Required	Gap		1993	1997
Somalia	-12.0	5.6	17.6	10	213	247
Mauritania	-11.2	5.4	16.6	12	244	220
Sudan	-9.1	7.4	16.5	16	262	112
Yemen	-11.3	2.4	13.7	3	104	70
Jordan	-6.6	3.6	10.2	9	144	114
Comoros	-4.8	2.1	6.9	1	66	104
Egypt	-4.8	0.7	5.5	0.8	66	36
Tunisia	-4.2	0.7	4.9	0.5	63	59
Morocco	-1.6	1.3	2.9	5	82	64
Syria	1.6	1	-0.6	37	147	97

Source: Current account / GDP, and rate of growth of real GDP are from World Development Indicator (WDI) - CD-ROM. Total debt stock to GNP is form Global Development Finance - CD-ROM. The 1997 debt ratio is calculated using total debt stock given by External Debt Statistics - OECD, and GNP from WDI-CD-ROM.

This table can distinguish between the countries that are experiencing sustainable fiscal policies and that are not, which may indicate that the countries with unsustainable debt policies are in fact on an explosive debt path. This is shown in column four of Table 2-11, which represents the difference between the present primary surplus and that required for immediate stabilisation of debt to GNP ratio, given a default rate of interest at 5%.

It also shows how many years each country would take to achieve the Maastricht debt target, assuming it will continue grow at the same average rate of growth for the period 1985 to 1993. In fact, some countries would fail to meet the treaty's target, since they require more than seven years to achieve it. Clearly, five out ten Arab countries, that had more than or equal to 60% ratio of debt to income in 1993, need more than seven years.

Morocco, for example, had current account deficit of 1.6% of its income, to achieve the debt convergence target set by the Maastricht Treaty it should have surplus in its current account of about 1.3% of its income. Therefore, the sustainability gap is about 3%, which needs about five years to cover. This implies that by 1997 Morocco should have achieved debt ratio not to exceed 60% of its income. However, the real fact is that by 1997 Morocco still running unsustainable debt position given by the fact that its actual debt ratio exceeds the 60% limit.

To conclude this chapter several facts could be mentioned here. The Arab world in not a one entity rather it is a fragmented nation. However, similar to other LDCs the Arab world is seriously dependent on external sources for its food and income. With respect to the debt position, every individual in the Arab world is indebted by $1000 to the foreigners. This figure is similar to the South American debt position, but four times the East Asian.

To analyse the foreign debt position in the Arab world one should note that some Arab countries are rather creditors, Saudi Arabia, Kuwait and UAE.

CHAPTER 3 *Review the Literature on Modelling International Lending and Borrowing Behaviour*

Introduction

Since the mid 1970s, developing countries have become increasingly dependent on financing their development plans from foreign sources. Many have, in fact, expressed their concern about the increasing debt obligations on these developing countries. The eruption of the debt crisis in 1982 was followed by a surge in publications to answer the how and why questions about the debt crisis.

In an open economy environment, countries with insufficient capital usually attract capital from capital abundant countries. In other words, private agents have strong incentives to move their capital from low rate of return projects (or countries) to higher rate of return projects (or countries).

Apart form this; basic economic theory of competitive market tells us that the borrower should be able to access the capital market (whether national or international) to finance its different needs (consumption, investment, etc.). That is a borrower can borrow from the capital markets any amount at any time if it is ready to pay the market rate of interest.

However, the recent international lending experience showed that the international financial market functions differently from what the economic theory suggests. Hence, many studies have been established to bridge this large gap between what the basic economic theories suggest and the actual practice of borrowers and lenders in the international financial market.

Changes in the structure of development finance

It has been argued that, the huge increase in the international commercial bank lending to the developing countries during the 1970s was in fact facilitated by institutional and financial innovations. As a result, much of the risks associated with sovereign lending have been reduced. These innovations enabled international financial mediators to absorb large deposits from surplus countries, and encouraged them at the same time to extend credit to developing countries.

Folkerts-Landau argues that "The greater role of bank lending in development finance has had important implications for the pricing and for the allocation of

development credit, as well as for the sharing of risk among lenders and borrowers"[1]. Folkerts-Landau mentioned three main risks associated with borrowing lending activities that have been reduced to levels enough to cause the 1970s surge in international lending.

The first is the reduction in risks on bank deposits. Where domestic financial authorities have been gradually assumed large portion of default risk of the deposit. These domestic financial authorities should, at the same time, cooperate and assist the international lenders to encounter any financial crisis, which was the case during the latest debt crisis although not instantaneously.

The second risk reduction is the introduction of cross-default clauses. As a result, international lenders are not to concern with the ability of a borrower (private or public agencies) in an LDC but with the country itself to pay. Finally, the third reduction is related to the risk sharing by lending through syndication, whereby many lenders subscribe to a small portion of a loan.

These financial innovations were coincided with (or in fact led) the changing in the structure of development finance. Where the international market for bank loans has replaced the international market for bonds and foreign direct investment as main source to finance development. Hence, making borrowing from international commercial banks the best option that not only assures larger amounts of fund, but also less foreign involvements in the national economy.

These major changes in the structure of (and innovations in) the international market for commercial loans have far-reaching consequences in the literature of sovereign debt. Where, great efforts have been spent to formalise a proper theory of sovereign debt. While some of these efforts are contributing more to the theoretical level, others are contributing more to the practical level within the literature. Based on the basic concepts of the corporate finance theory, many studies have contributed to the literature by applying debt management techniques to government foreign borrowing, and by introducing the borrower's sovereign dimension to the aspects of debt management.

[1] Folkerts-Landau (1985), p. 317.

Debt management

It has been argued that the complex environment of the international financial markets places a great burden on the borrower country to efficiently manage its external borrowing through appropriate macroeconomic policies. "A country must plan and execute a tightly controlled medium-term borrowing strategy in order to obtain the amounts required- and in the currency, and with the maturity and interest rate that are appropriate- while the borrowers satisfy their financial needs"[2]. Williamson found that "the country that pursued the more cautious policy in the short run had a distinctly better performance in the longer run. Prudent macroeconomic policies clearly are important"[3]. Further, Glick and Kharas (1986) concluded "The wide-ranging effects of foreign borrowing ... point to the need to integrate external debt management into a more general framework of macroeconomic management"[4].

An efficient debt management implies that a borrower country is aiming at an optimal portfolio structure that can achieve its primary objective. D. Leong (1999) defines five approaches that could be followed to determine a country's primary objective, namely assisting monetary policy, minimising costs, minimising risks, improving the allocation of risk in the economy, and improving the credibility of government policy.

When the primary objective is established, the debt management "agency" should start functioning accordingly. Mehran (1985) stated the basic functions for any debt management, which are: policy, regulatory, operational, accounting and statistical analysis. The policy function involves coordination among the agencies (that are related to the management of the country's foreign debt) to determine the appropriate policies and strategies for sustainable external borrowing. Mehran (1985, p.10) argued "This, in turn, is affected by the flows that the country can use efficiently, and how it can generate the additional foreign exchange earnings needed to meet the service charges without risking external payment difficulties".

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[2] Kalderen L. (1985), p.111.
[3] J. Williamson (1991), p. 4.
[4] Glick and Kharas 91986), p. 296.

On the other hand, the regulatory function is concerned with establishing the necessary institutions to record and monitor all external debt. In fact, "Countries differ in the degree of control exercised by the authorities, the strictness of the regulatory environment, and the nature of the reporting system"[5].

With respect to the operational function, it means to adopt an appropriate strategy to participate in the international financial markets. In fact, this is the primary function of any debt management. Where, maturity structure, currency composition and costs of borrowing (interest and exchange rates) are efficiently examined to come up with the best possible portfolio of liabilities.

The accounting function concerns with the collecting detailed information on the external debt and with the provision of an efficient payment mechanism. In fact, "The fundamental decision to make in devising an accounting framework for external debt is to decide what constitutes an external debt"[6]. Two problems possibly arise here. Measuring total debt becomes difficult if many domestic agencies are authorised to sign external debt contract. The second problem is conceptual in nature. "Should the external debt be measured gross or net, with the latter involving an adjustment for the external reserves of the borrows? ..., whether direct foreign investment should be included with external debt"[7].

Finally, the analytical function of debt management is to explore various options available to the country given the market conditions and the future structure of the external debt. The aim of this function is to assist policymakers to determine the sustainable level of debt, and to keep them well informed about the country's debt position to avoid any possibility of debt difficulties.
In a world with uncertainty, shocks to output and spending can cause great difficulties to policymakers in any country. Efficient debt management should be able to help in reducing unexpected fluctuations, establishing lines of credit for

[5] H. Mehran (1985), p.11.
[6] Ibid, p.16.
[7] Aliber R. Z. (1980), p. 3.

example to smooth cash flows to the country, and to establish an efficient early warning system.

In the debt management literature, several important theoretical arguments have been discussed. Such as the sustainable level of debt contract, its mix of private and public sectors debt, its maturity structure, its currency composition, debt service pattern, and risks associated with the cost of borrowing, such as the rates of interest and foreign exchange. In addition, the literature examined the relationship between external debt and the economic performance of the country, economic growth, growth of exports and imports, rate of inflation, the country's ability to generate savings, level of foreign exchange reserves.
In short, the general objective of any debt management is to keep the size of country's debt within serviceable limits.

The maturity structure of the external debt is an essential job to the debt manager. In fact, many have argued that, one of the main causes of the current debt crisis is the maturity structure mismatch. Developmental projects usually have very long time horizon to mature, and to finance them with shorter maturity structure of external borrowing may lead to financial difficulties and crisis.
In theory debt contract with long-term maturity allows longer time for imbalances in the economy to be corrected. However, short-term debt could increase vulnerability but it is usually less expensive than the long-term debt. Therefore, debt managers have to recognize the trade-off between maturity and cost of debt.

Another important aspect of debt management is the currency composition of the debt contract. Diversification should provide a higher degree of insurance against shocks. It has been suggested that the currency composition of the country's debt needs to be closely linked to the country's general structure of foreign exchange earnings, exports.

External borrowing is usually contracted at agreed world rate of interest, and most of the time plus a margin. Managing the possible risks of fluctuation in the costs of borrowing is another aspect of the debt management. In other word, reducing the

risks of fluctuations in interest rates and in the exchange rate is an essential task to be carried by the debt manager.

In addition, the debt management literature examined the time-consistency argument. Persso (1984) addresses the question: "whether an optimal fiscal policy still is time-consistent, and if so whether that requires any systematic management of the maturity structure of the, domestic and foreign, debt"[8]. Finally, an important strand of the debt literature examines the recent market based solutions to the debt crisis, debt-equity-swap and debt buy-back, which is also an essential role of debt management. However, this strand of the debt literature is beyond the scope of this thesis.

[8] Persso (1984), p.2.

Theoretical aspects in the literature of sovereign debt

A quick glance at the motives behind borrowers and lenders to sign a borrowing contract might help to understand their future actions and behaviour. A developing country seeks loans from the international capital market for several reasons. It may undergo short-run shortages in its income stream, so it borrows to shelter consumption from fluctuations in income. The country will repay the debt in its high-income period. Alternatively, the country may have some ambitious development plans, but less than required national savings. So, it borrows for investment motive, and expects to make enough returns to repay its debt.
On the other hand, the financial market has an important role in channelling savings from surplus savers to those who are short of savings. The market has another role to play, risk diversification. Lenders usually willing to transfer risks from more risk-averse (industrial nations) to less risk-averse (developing countries).

Mathematical and econometrics models were constructed to study demand and supply behaviour (and also to examine conditions) in the international credit markets during the recent debt crisis. Many international debt issues attracted the attention of researchers. Borrowers' debt capacity and sustainability of borrowers' debt policies are the main topics in some studies aiming at finding the causes of the debt crisis. Other studies aim at the same target, but from different prospective. They examine the sovereign risks in the international capital markets, and how the borrower's behaviour affects lenders perception of sustainability of its debt problem. The following are some of the main issues addressed in such studies: Identifying the type of the debt crisis, whether it is insolvency, illiquidity or repudiation. Identifying the effects of risks associated with international debt contracts on the actual lending/borrowing activities. Examining the role and effectiveness of penalty in dealing with sovereign risks. Whether lenders are overextended in their lending to developing countries, if so then they should bear the main responsibility for the debt crisis.
This chapter introduces some of the important theoretical development in the sovereign debt literature.

Sovereign risks

Risks associated with lending to sovereign entity are important and assumed to be among the main reasons behind this large gap between the competitive theory and the actual practice in the international market for credit. It has been argued that these risks have great deal of effects on borrowers and lenders behaviour.

Three problems are usually associated with (domestic or international) debt contracts, namely enforcement, adverse selection and moral hazard problems.
The enforcement issue is an important obstacle in any sovereign debt contract. The sovereign debt contract lacks the power of a third party, international court form example, to enforce its terms. In fact, there is no international body that has the direct power to control actions of the contract's parties, which violate the terms of a contract, taken by a sovereign entity. Therefore, self-enforcing contract, if exists, is the ultimate contract, where lenders and borrowers find it in their interest to abide by the terms of the contract.

Besides the problem of enforcement, international market for capital suffers the problem of asymmetries of information. Asymmetry of information usually leads to moral hazard and adverse selection problems. It has been argued that, increasing the interest rate or the collateral or both may secure the contract for the banks, on the contrary it could increase the riskiness of the international bank's loan portfolio, and eventually reduce its profits. In fact, increasing the interest rate or the collateral or both will create unhealthy market condition. Under those circumstances, either a good borrower will be discouraged, which is an adverse selection problem, or loans will be pushed to be invested in riskier projects, a moral hazard problem.
The existence of these asymmetries of information in the international capital market may cause significant problems to the efficient functioning of the market.

Credit rationing

When the international credit market experience some stickiness in the prices of capital, the interest rates, the nature of the market equilibrium might change

drastically, either too little lending transactions will take place or no loans offered at all. In this case a borrower country, could be denied loans even though it is prepared to offer higher than the market interest rate or/and to put up more collateral than is required from similar borrowers.

It has been argued that during the recent debt crisis, lenders often deny future loans to a borrower who defaulted an old loan, rather than raising the rate of interest that this borrower would have to pay.
In fact, two problems: "... enforcement and commitment (the lender can not pre-commit himself to a ceiling on indebtedness) ... may constraint lending ... even though additional lending may be mutually beneficial in the absence of these problems"[9]. In other words "The reluctance of banks to increase their exposure in return for a higher spread reflects the fact that the gain from such an action is more than offset by the increase in the expected loss"[10].

Therefore, the international capital market exhibits the existence of credit ceiling and eventually an excess demand equilbria as a result of imperfect information. Eaton and Gersovitz (1980) build an empirical model to find the probability that individual countries are subject to credit constraints. They estimated the model using a cross-section of 45 indebted developing countries in two years 1970 and 1974. They found 56 out of their 81 observations could be classified as constrained, suggesting that credit rationing was an important aspect of lenders behaviour during the periods under study.

The credit rationing argument implies that borrowers bear most of responsibility of the debt crisis. Their behaviour in the market is the driving force behind the credit rationing argument. However, in the opposite side another argument is offered to put lenders behaviour in the spotlight as one of the main factors behind the debt crisis. Below the loan pushing argument is introduced.

[9] Eaton et al (1986), p. 406.
[10] McDonald (1982), p. 633.

Loan pushing

Lenders behaviour should have an important role in the recent debt crisis. Some studies argue that lenders in fact pushed developing countries to borrow more than what they would voluntarily take at the prevailing market rate of interest. Surely, creditors cannot force any one to borrow; instead they can encourage borrowing by offering loans with soft terms.

When the commercial banks have excess supply of loanable funds, as weak demand for credit prevails in the industrial countries, they may extend generous loans even to unreliable customers. "A lack of first-class debtors led to the granting of loans to less solvent debtors, and the element of security was neglected in favour of the profit component"[11]. Furthermore, Thapa and Mehta (1991) examined the empirical role of the potential for political bailout on sovereign lending. They concluded "during the last decades and a half, the possibility of political bailout appears to have played a major role in the flow of credits to the LDCs"[12].

In fact, the loan pushing may involve a big softening of the terms relative to the borrower's expectations. The spread between the cost of fund and the rate at which loans were offered to the borrower might be shortened. Similarly, maturity on the loans may be significantly lengthened.

The developed countries experienced excess supply of fund in the 1970s. It has been argued that, not only they get red off this excess supply but also they promote their exports by pushing it to the developing countries.

Lenders offered these soft loans contracts to developing countries as a result of weakening demand for loans from borrowers in developed countries.

"Kindleberger comments: when interest rates decline sharply for any reason, lenders look around to make loans at high interest rates and take greater risks, in a sort of backward-bending supply curve, to preserve their old incomes"[13].

In addition "... Andrew Brimmer observed ... the main explanation (for the sharp rise in bank lending to the LDCs) appear to lie in the abundant supply of funds to

[11] Cited from P. Korner et al (1986), p.22-23.
[12] Thapa and Mehta (1991), p.552.
[13] Darity, and Horn 1988, p.16.

the Eurodollar market and the failure of demand for loans from borrowers in developed countries"[14].

The developed countries gained extra, trade, bonus by pushing their excess supply to the developing countries. "The view that 'trade follows loans' is discussed in the context of U.S. lending to Latin America"[15]. Furthermore, Jain (1986) "...found a strong statistical relationship between U.S. banks loans to a country and contemporaneous U.S. investment and trade activity" [16].

Many studies attempt to examine the supply side conditions and lenders' behaviour during the recent debt crisis. "The terms on which external finance is supplied are likely to be influenced by borrower behaviour, and the debt capacity of a borrower will depend not just on interest costs but also on such factors as refinancing terms and the existence of quantity rationing"[17].
Some studies examined the above widespread concern about lenders behaviour. Where, it has been claimed that, lenders were carelessly extending loans to developing countries. This behaviour may create danger to the fabric of the international financial system. For example, Feder and Just (1977) examine the relationship between some country risk measures and the terms of credit, such as spread over LIBOR. A strong and significant relationship is found between the spread and the country risk measures: the debt service ratio, an index of export fluctuations, the import to reserve ratio, the import to GNP ratio, per capita GNP and the projected GDP growth rate.

However, such studies on lenders behaviour can't clearly conclude whether lenders overextended loans to developing countries. Yet these studies certainly indicate "... that there may be scope for developing countries to enhance their borrowing terms and, hence, their debt capacity by recognizing how their own behaviour affects their creditworthiness"[18]. For example, McFadden at el. (1985) argued that a

[14] Darity, and Horn 1988, p.8.
[15] Basu K. (1991), p. 25
[16] See Darity, and Horn (1988), p.10.
[17] McDonald (1982), p. 628.
[18] McDonald (1982), p. 635.

borrower country might hold reserves to attract credit and satisfy lenders requirements.

Insolvent or illiquid borrowers?

A major strand of the debt literature deals with the debt repayment difficulties in the developing countries. That is to diagnose the borrower's debt difficulties in order to prescribe the proper relief program. Obviously, a borrower country either willing or unwilling to continue servicing its debt. When a country borrower is unwilling to honour its debt, it simply repudiates.

However, a country may be willing to honour its debt, but cannot continue to meet its debt obligations for different reasons. Two main diagnoses are given in the literature to describe a willing but unable borrower, namely insolvent and illiquid. A country is insolvent when its debt exceeds its wealth, measured as the present discounted value of its future income. The illiquidity problem is less severe, however, and more manageable problem than insolvency. In a specific period of time both, insolvent and illiquid borrowers, face the fact that their maximal income is less than their total debt obligation. However, the illiquidity problem implies that future income stream (discounted at present value) is more than total debt.

Cooper and Sachs (1985) distinguish between the three types of risks associated with international debt contracts, insolvency, illiquidity and repudiation. They assume that creditors can impose sanctions when a borrower repudiate. Sanctions may amount to a proportion, θ, of the country's wealth, θW. Part of the sanctions is the amount of foreign assets that could be seized by lenders, γW. When a borrower repudiate an outstanding debt D, lenders will loss $D(1-\gamma)$ but the borrower gains $(D-\theta W)$. The difference between θ and γ provides a space for negotiations and may allow for rescheduling.
Cooper and Sachs argue that both liquidity and repudiation risks can limit indebtedness to levels far below potential solvency levels.

The illiquidity problem arises because of capital market imperfection. In fact, in a competitive market an illiquid borrower will be financed so immediately that the illiquidity problem never exists.

Therefore, illiquidity may exist while the country is in fact solvent. In a bad year individual lenders may fear that all other lenders will seek to exit and stop lending a debtor country with temporary difficulties. As a result, a panic may spread and credit will be cut off.

In other words, an efficient loan package may require all banks to refinance the debt of a heavily indebted country at below-market rates, in order to keep it from imminent default. However, each individual bank may try to withdraw its own credit (and become a free-rider) in order to leave the debt burden to the other banks[19]. Usually, the illiquidity problem, when exists, is so huge that one lender may not be able to solve it. Consequently, all lenders are required to act together in a concerted manner to avoid an illiquidity crisis.

Debt overhang

Some studies[20] argue that the best way to think about the debt crisis is as one of debt overhang. In fact, Krugman (1988) sees the distinction between liquidity and solvency problem is not useful, as illiquidity arises because of doubts about solvency. The concept of "debt overhang" reflects the actual debt problem, where a debtor country has some difficulties in repaying its old debt and needs new borrowing too. Husain (1997, p.519) stated "The debt overhang effect, then, depends on both the creditor's ability to extract repayments from the debtor government and the ability of the debtor government to raise revenue from its citizenry". In fact, the presence of a "debt overhang" may give lenders an incentive to lend at an expected loss in order to protect their existing claims.

Consider the following debt problem: a borrower country with a stock of inherited debt. The country is required to make debt repayment, D, in year 1. But the country cannot repay the debt in full, unless a new loan, L, is extended which will

[19] See Sachs (1984).
[20] Sachs (1984) and Krugman (1985, 1988).

be due (plus the remaining of the old debt plus interest off course) in year 2. In the above scenario if lenders did not extend the new loan to the borrower, then the "debt overhang" problem will arise. Graphically this country borrower is expected to be in the wrong side of the "debt Laffer curve". The debt overhang is argued to have detrimental effects on investment. It may act as a tax to depress not only national investment but also future debt repayment capacity.

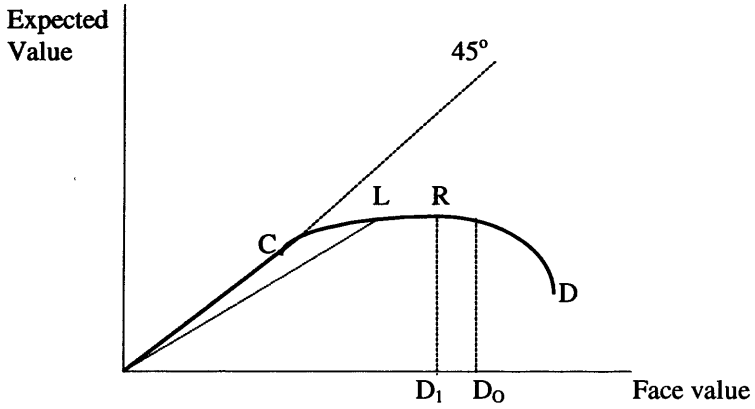


Figure 3-1 Debt Laffer curve[21]

At point C, the debt overhang begins; where the expected repayment begins to fall short of the face value of debt,
At point L, the slop of the ray from the origin is less than unity,
At point R, the curve starts to turn down again.

From figure (1), one can see that beyond R, such as D_o, any further lending is not wise, as the expected future repayment falls. Instead a market-based debt reduction, to D_1 for example, is necessary and will benefit both lenders and the borrower.

Krugman (1988) examined the country's potential resource transfer in period two and lenders' optimal decision whether to finance or to forgive in period one, first in a world without uncertainty and then with uncertainty.
In a world without uncertainty, it is optimal for lenders to immediately reduce their claims on the country with debt overhang problem. However, when uncertainty exists, Krugman emphasised that it is in the interest of the lenders to finance a borrower country with debt overhang problem. In fact they will be better off even

[21] The curve is cited from W. Cline (1995), p. 163.

if the unlucky state (where the present value of what they will receive is less than the initial debt) took place, as they will receive the full present value of the country's potential resource transfer in the second period. Which is more than what they would get without the new lending in the first period.

However, some studies[22] examined the basis of the debt overhang argument, and eventually reject the idea of debt forgiveness as a way out of the debt crisis. Among these studies, some empirical works were carried out to test whether investment was inversely affected by the debt burden in some indebted countries. Either no inverse effects on investment were found, or a very minimal inverse effect found but does not support the conclusion that writing down the debt will foster investment. Furthermore, Husain (1997) shows how the domestic tax system can determine the economic consequences of an external debt overhang. "The analysis indicates the fairly strong, and probably unrealistic, assumptions about the domestic tax system are needed to argue that the investment disincentives associated with the debt overhang are large enough to place a country on the wrong side of the Laffer curve"[23].

[22] See Cline (1995) who reviewed some of these studies.
[23] A. M. Husain (1997), p.519.

Modelling sovereign debt

One main approach to investigate the causes of the international debt crisis is to examine borrower country's debt capacity and debt sustainability. In this approach models have been built by first setting up a macroeconomic accounting identity (such as the balance of payments, current accounts and saving-investment gap, etc.), then other macroeconomic relations are used to work out implied dynamics. Accordingly, the borrower country can establish a sustainable debt policy. However, the above approach lacks the supply side of the debt crisis. It is possible that lenders may not consider this policy as sustainable. In fact, both demand and supply factors are equally important to analysis the recent debt crisis. In addition, sovereign risk is not taken into account by this approach, as the international dimension adds more complication to the analysis.

It has been argued that the borrower country behaviour not only based on maximising an intertemporal utility function but also on the option it has of whether to repay the debt obligations or simply to negate it. As a result efforts have been spent to introduce default penalty in order to overcome this problem. The ideal situation, however, is to find a self-enforcing contract. That is, it is in the interest of the contract parties to abide by its terms.

In fact, the borrower decision to repay or repudiate depends on the welfare loss (due to penalties imposed by the lenders) compare to the costs of the debt service burden. However, at the other end of the debt contract, lenders know that the borrower will repudiate its debt whenever it exceeds the penalties. Therefore, a credit ceiling is expected to be drawn, beyond which the borrower is not allowed to borrow more, even though more lending could be mutually beneficial.

In Jaffe and Russell (1976) the international capital market is associated with sovereign risk. They established a two period model with honest and dishonest borrowers, where an arbitrary default penalty could be imposed exogenously. A debt ceiling is established, as lenders cannot distinguish between borrowers.

In their seminal contribution to the literature of sovereign debt, Eaton and Gersovitz (1981) developed an infinite horizon model, where the country borrows for short-term consumption smoothing purposes. This implies that trend income and consumption are the same. However, the country has alternating bad and good years. It borrows in a bad year and repay (principal and interest) in the next year, which is assumed to be a good year.
In the model lenders can impose default penalty, permanent exclusion from future access to the credit market, which is determined endogenously. Lenders realise the borrower country's disutility from the permanent exclusion from the market.
The relationship between default benefits and the size of the outstanding debt is argued to be positive. As a result lenders will supply loans below a maximum level (a ceiling) at which the borrower country is indifferent between the cost of penalty and the burden of the debt repayment. In fact, the country borrower is supplied the minimum of the two amounts: the credit ceiling and that amount which maximises (discounted) borrower's utility.
Eaton and Gersovitz found that the introduction of uncertainty, two bad years occurring back to back, can reverse some of their conclusions.

In a two-period model with inherited debt, Krugman (1985) introduces uncertain punishment cost and underlies the rational of the debt rescheduling. The penalty consists of two parts: a known credit cut and a fixed cost that is unknown to both lenders and borrowers when the decision (repay or default) is made.
He argues that, this uncertain cost could be interpreted as a measure of all actual uncertainty such as future growth in exports, terms of trade and political events.
In the first period, borrower country has to choose to repay or to repudiate. However, repayment in the first period assures, to the borrower, new loan in the second period. In other words, lenders can avoid default in the first period if the new loan exceeds the debt service. Therefore, it might be in the best interest of the lenders to postpone debt servicing and avoid immediate default.
In Sachs (1982, 1984) and Krugman (1985) rescheduling reflects time inconsistency problem. Lenders cannot commit themselves to imposing default punishment. They might find it optimal not to penalise default, but to renegotiate in

order not to loss all their claims. This makes the credibility of default penalty questionable.

Grossman and Van Huyck (1985) present an alternative way to interpreting rescheduling. In their model, national income has two components: a stochastic part, which echoes external threat or internal discontent, and a deterministic part, which represents returns from investing last period's borrowing. Consequently, they were able to distinguish between excusable (partial repayment due to bad state of the nature), and inexcusable (repudiation) defaults. As a result, excusable default does not preclude continued access to the market while inexcusable default leads to credit cut.

Eaton and Gersovitz (1980) are interested in studying the interactions between developing countries behaviour in borrowing and reserve holding. They argue that debt could provide means of financing reserves, which implies that debt and reserves are complements in smoothing the country's consumption as its income fluctuates over time. In this case the relationship between borrowing and reserves accumulation is positive. Alternatively, borrowing and reserves are substitutes, where a negative relationship between the two is expected. Here, borrowing itself works as transaction instruments.

Demand

Within the framework of portfolio allocation problem, the authors, Eaton and Gersovitz (1980), analyse borrowing and reserve-holding behaviour of a small developing country.

The country has a level of national wealth, W , and holds a combination of: a productive assets, capital, which is risky as it is related to export performance, reserves which are not risky, and debt to the private international capital market in amounts up to a credit ceiling, $\overline{D}$.

The country's utility function is $U\ (W\ ,\ \overline{D}\ ,\ Z\ )$, where, $Z\ =$ a vector of other variables.

They constructed demand functions for capital, reserves, and debt, which are function of Z : export variability, import share of GNP, real growth rate, real per capita income, expected interest rate on debt, debt to public lending institutions, and national wealth.

Supply

If the borrower chooses to default, then it will have the following utility function, $U(W + D, 0, Z)$, Where D is the actual debt which becomes part of its wealth if default took place, and 0 represents penalty, as the country's access to capital market is denied, therefore $\overline{D} = 0$.

For this reason, lenders will impose a credit ceiling, $\overline{D}$, which depends positively on the value of the borrowing of continued access to international market for credit. This will preclude repudiation condition:

$$U(W + D, 0, Z) \geq U(W, \overline{D}, Z)$$

Estimation

They estimate their model using a cross-section of 45 indebted developing countries in two years 1970 and 1974. Their result support the hypothesis that borrowing is a substitute for reserves as a medium of transaction. In addition, almost 70 per cent of their observations are classified as constrained, suggesting that credit rationing was an important aspect of lenders behaviour during the periods under study.

McFadden et al (85) provide econometric analysis of the repayment problem in the international capital market, and estimation of the probability of crisis. Their theoretical foundation based on their view that the persistent and growing current account deficits are the proximate sources of the debt dilemma. They assumed that a developing country will set policy to maximise an intertemporal welfare function. This policy should balance the benefits of consumption and investment financed by current account deficits against the costs of financing these deficits.

At the beginning of each period the borrower country sets up a demand for new borrowing, which might be the result of intertemporal optimisation subject to

macroeconomic constraints and behaviour. Besides the demand constraints, the actual amount borrowed depends on the supply constraints (lenders perception of the borrower creditworthiness) too.

They run maximum likelihood estimations for their model using data for 93 countries over the period 1970-1982. Their model is aiming at finding demand related variables and supply related variables that affect the probability of repayment problems. They conclude that oil price increases have been a major source of international credit risk. For most oil-importers increases in real oil prices increased substantially the probability of repayment problems. Although, the worldwide recession had drastic effects for some countries, on the whole it appears to have increased risks only moderately.

Conclusion

In this chapter, we have presented some of the main theoretical aspects arise in the sovereign debt literature, where both microeconomic and macroeconomic based models have been discussed. However, the focus of this review of literature is to highlight the main possible determinants of debt difficulties.

A debt crisis could be attributed either to the borrower or to the lenders (or more realistically to both) behaviour. A borrower (or a lender) who does not follow an optimising behaviour (in a competitive environment) could strongly contribute to a debt crisis. Bad debt management and poor macroeconomic management by the borrower country are the main general reasons behind a debt crisis.

Similarly, lenders could contribute to the debt crisis when they carelessly push credits to an insolvent debtor. Further, when lenders are not welling to continue extending credit to a solvent but illiquid debtor (at least to preserve their existing loans) a debt crisis is imminent.

To sum up, one may pull together the different strands of the debt literature presented in this chapter. From one perspective, however, one can divide the bulk of the sovereign debt theoretical literature into two main topics, although inter-related. First, studies examining borrowers and lenders behaviour with no existing debt, where the credit rationing and loan pushing arguments belong to this first topic. Secondly, some other studies are concerned with borrowers and lenders behaviour when a repayment difficulty arises. In this strand of the literature we deal with the illiquidity, insolvency and debt overhang problems.

On the other hand, however, the debt management literature reviewed in this chapter is more of a practical nature. Where it is concerned with all aspects of borrowing from initialising a debt contract, thorough solving any debt difficulties, until fully repaying the debt.

CHAPTER 4 *Current Account and Monetary Reaction Models*

Introduction

This chapter aims at examining the effects of foreign liabilities accumulations on the current account of three Arab indebted countries. In addition, it attempts to study the behaviour of the monetary authorities in these countries with respect to changes in some economic variables, particularly increasing foreign liabilities.
To achieve these aims, the chapter uses the current account model and the monetary reaction function specified by Maxwell Fry in a series of publications. The two models are to be empirically estimated using data from three indebted Arab countries, Egypt, Morocco and Tunisia for the period 1976-1996[1]. Fry's estimation results are then used as guidelines to which this chapter's estimation results are compared. The chapter consists of two main parts. The first part presents Fry's two models, which includes the necessary theoretical background and the specification of each model. In the second part, re-estimation of the two models is presented, analysed and compared to Fry's main findings.

In this introduction we start with a quick glance at the current account position and sources of international financing in the three Arab countries. Where we analyse the countries' behaviour in financing their current account deficits.

The analysis is built on Table 4-1 presented below, and on similar Tables A4.1 and A4.2 in appendix 4. The structure of the three tables is identical. While the data in Table 4-1 is for totals and averages for the whole period 1977-1998, Tables A4.1 and A4.2 present total and average data for every five year period.
The three tables have a column for the current account deficits, in which a minus sign means surplus. The tables also include six sources of finance, each of which has two columns, the amount of finance ($) and the percentage share in the current account deficit (%). Necessary definitions of each column and ways of calculating some columns are all given in appendix 4.

Table 4-1 shows us the sources of finance that the three Arab countries resort to in order to finance their foreign exchange obligations. The table covers the 1977-

[1] Two countries, Egypt and Morocco, overlap our sample and Fry's sample.

1998 period and consists of two parts, total and average. The first presents the period's cumulated amount (in billions of $US) and the corresponding percentage ratio of each item with respect to the current account deficit. The second part presents the period's average amount and the corresponding period's average percentage ratio of each item with respect to the current account deficit.

Table 4-1

Country	Current Account Deficit	Sources of financing the current account deficits (1977 - 1998)											
		Δ in Gross International Reserves		Non-Debt Creating Flow		IMF Credit		Δ in Long Term Debt Stock		Δ in Short Term Debt Stock		Net Errors & Omissions	
	$	$	%	$	%	$	%	$	%	$	%	$	%
Total													
Egypt	13.8	17.9	130	17.2	125	-0.23	1.69	23.5	170	0.83	5.99	0.44	3.17
Morocco	16.9	3.97	23.5	2.90	17.2	-0.35	2.08	18.1	107	0.37	2.17	-0.79	4.68
Tunisia	11.8	1.48	12.6	4.99	42.3	0.09	0.76	6.82	57.9	0.68	5.76	2.09	17.7
Average													
Egypt	0.63	0.81	239	0.78	203	-0.01	13.3	1.17	802	0.04	173	0.02	104
Morocco	0.77	0.18	101	0.13	32.9	-0.02	30.1	0.91	403	0.02	34.5	-0.04	36.0
Tunisia	0.54	0.07	45.7	0.23	38.0	0.004	9.48	0.34	143	0.03	17.6	0.09	26.6

Source: Calculated from: IMF CD-ROM, and latest issues of the International Financial Statistics. $ = Billions of $.

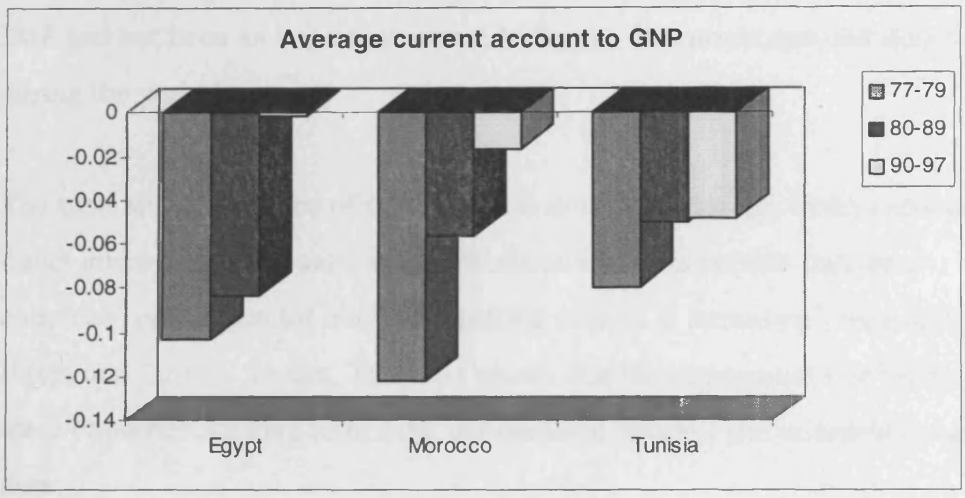
The three Arab countries under study had experienced persistent current account deficits during the 1977-1998 period, this is quite apparent from the two tables and the three figures in appendix 4. With the exception of one period in Egypt, the deficit continues during the five periods in all countries. The 1990-1994 period decline in Egypt's current account deficits (in fact a yearly surplus of 1.5 billion dollars has been recorded[2]) could be attributed to political rather than economic reasons. Egypt's political position with respect to the Gulf War II had to be rewarded by its international lenders. This came in a form of cancelling $13 billion of its debt (to US and Arab donors) and also a 50% debt relief (by the Paris Club creditors) of debt/debt service falling due[3].

Figure (4-1)[4] illustrates the average ratio of current account balance to GNP for Egypt, Morocco and Tunisia in three time periods from 1977 to 1997. Although the three countries were experiencing persistent deficits during the 1977-1997

[2] See table A4.1 in Appendix 4.
[3] Trends in Developing Economies (1993), p. 157.
[4] Appendix 4, p.226, presents three other figures, one for each country, show the annual current account balances.

period, those deficits as a ratio to GNP were, in fact, declining in all three countries. This is particularly clear in Egypt and Morocco, as the figure shows.

Figure 4-1



Although, the countries had a long period of current account deficits and debt difficulties, they did not suffer exhaustion in their foreign exchange reserves. The net accumulation of foreign exchange reserves is amounting to 17.9, 4.0 and 1.5 billions of US$ during the 1977-1998 period in Egypt, Morocco and Tunisia, respectively.

One possible explanation is that the foreign reserve build-up is, in fact, a transaction demand. These reserves are accumulated to be used to service the foreign debt obligations, and also to meet lenders requirements to disburse new loans to the country. This phenomenon is not unique to those countries, however. Many indebted developing countries had experienced similar accumulation of reserve during periods of debt difficulties and current account deficits[5]. Therefore, the international reserves do appear to be an important source of financing the current account deficit in the Arab countries under study.

The table shows that foreign borrowing (long-term public and publicly guaranteed debt and short-term debt) was the favoured source of finance to which these countries had resorted during the period under study. The two tables in appendix 4

[5] See for example McFadden et al (1985) and Eaton & Gersovitz (1980).

show that the foreign debt build up in these three countries followed similar trend to that seen in many other indebted developing countries. The seventies and the eighties exhibited increasing amounts of foreign debt (long and short term), while the nineties was a decade in which foreign debt declined. On the other hand, the IMF had not been an important source of finance for current account deficits during the period.

The table shows a source of finance that is non-debt creating, which consists of net direct investment, gold sales and SDR allocations. It is notable that these countries' preference for non-debt creating sources is increasing[6], especially in Egypt and Tunisia. In fact, Table 4-1 shows that the main sources of finance in these countries are long term debt, international reserves and non-debt creating flow.

In many developing countries it is possible to consider "net error and omissions" as reflecting the capital outflow that the countries were able to avoid reporting, capital flight. The tables in appendix 4 are able to give some insight on capital flight and its relation to important global and regional events.
The debt crisis in 1980s is very clearly associated with high amounts of capital outflow. During the period about 2.0, 0.29 and 0.60 billion of US dollars were reported as net error and omissions in Egypt, Morocco and Tunisia respectively. In the Gulf War II period the countries experienced capital flight too. Where about 0.8 and 0.9 billion of US dollars were reported as net error and omissions in the balance of payments of Egypt and Tunisia during the 1990-1994 period.

[6] See the two Tables A4.1 and A4.2 in Appendix 4.

The specification of the current account model

Maxwell Fry, in a series of publications, analyses the effects that excessive foreign debt accumulation have on the current account of the developing countries, within a general framework of financial liberalisation and economic growth. In particular he adapted McKinnon-Shaw's framework, and formulated a current account model to examine whether foreign capital flows into an LDC improve or deteriorate its current account deficit.

McKinnon (1973) and Shaw (1973) "analyze developing economies that are financially repressed. Their central argument is that financial repression- indiscriminate "distortions of financial prices including interest rates and foreign exchange rates"- reduces "the real rate of growth and the real size of the financial system relative to nonfinancial magnitudes. In all cases this strategy has stopped or gravely retarded the development process" (Shaw1973, 3-4). Their prescription is the removal of these distortions imposed by so many governments in developing countries"[7].

Fry argues that neither McKinnon nor Shaw provide any formal framework for the analysis of an open economy environment[8]. However, He presented some other studies that extended the framework to accommodate for an open economy, where the exchange rate[9] and reserve requirements[10] become policy instruments.

To construct a model of foreign debt accumulation Fry started with the balance of payments account, where the current account deficit is usually financed by either capital inflows or by reducing the country's official reserves. Ignoring error and omission, the balance of payments account is as follows.

$$CAY + KAY \equiv \Delta RY \qquad (4\text{-}1)$$

Where CAY = Current account to GNP
KAY = Capital account to GNP
RY = Official reserves to GNP

[7] M. Fry (1995), p.20, for details of McKinnon-Shaw framework see chapter 2.
[8] Ibid, p.53.
[9] Fry mentioned Kapur (1983) and Mathieson (1979), see p. 53 onward Fry (1995).
[10] Here Fry mentioned his own work (1981), and A. Courakis (1984, 1986), see p. 132 onward in Fry (1995).

Here domestic investment is allowed to exceed national savings when financing the current account deficit. Therefore, domestic investment is equal to national saving plus the current account deficit (or foreign saving)[11], such that

$$IY = SNY + SFY \tag{4-2}$$

Where IY = National investment to GNP
SNY = National saving to GNP
SFY = Foreign saving to GNP

Then $CAY = SNY - IY$ (4-3)

The above equation says that the set of determinants of the current account deficit are all variables in the national saving and of the domestic investment functions. Hence, Fry specified a national saving function and a domestic investment function. From these two structural equations he derived the reduced form current account model, such that:

$$CAY = \alpha_0 + \alpha_1 FLY_{t-1} + \alpha_2 DETY_{t-1} + \alpha_3 DETY_{t-1}^2 + \alpha_4 DDCY + \alpha_5 TTL + \alpha_6 YG + \alpha_7 RW + \alpha_8 REXL_{t-1} + \alpha_9 CAY_{t-1} \tag{4-4}$$

Where

FLY = Accumulation of current account deficits to GNP
DETY = Government and government guaranteed debt to GNP
DDCY = Change in domestic credit to GNP
TTL = Ln (terms of trade index) YG = Real growth rate
RW = World rate of interest REXL = Real exchange rate

Next we are to discuss the determinants pf the effective cost of foreign borrowing and the introduction of two alternative measures of foreign liabilities, and their roles in the saving and the investment functions. We are then presenting the specifications of Fry's two structural equations of saving and investment.

[11] Using the national income definition of the balance of payments on current account, which is equal to the balance of payments definition plus unrequited transfer.

The effective cost of foreign borrowing

Fry presented the key components of his open economy model graphically[12], where the current account deficit is the difference between the domestic investment and national saving. The graph presents the planned levels of national saving, foreign saving and domestic investment on the horizontal axes and the real interest rates on the vertical axes. He presented the graph once under no financial repression in the country and another under interest ceiling restriction. In this model Fry assumed that the effective cost of foreign borrowing equals the effective domestic real interest rate.

However Fry argued, "effective costs of foreign borrowing or domestic shadow interest rates ... are unobservable"[13]. To overcome this problem Fry derives a reduced form equation for real interest rates from simple demand and supply model for foreign saving. Since the demand for foreign saving is equal the gap between saving and investment, it is a function of all variables that determine national saving and domestic investment.

The supply for foreign saving is determined by the world interest rates plus a country-specific risk premium. Following other studies[14], the risk premium is assumed to be a function of previous debt build up and a measure for the country's macroeconomic management, which is assumed to be proxied by the ratio of public sector credit to total domestic credit.

In his empirical model Fry dropped the macroeconomic management measure, hence the reduced form expression for the effective cost of foreign borrowing that to be used to construct our current account model is:

$$r = f(RW, DETY_{t-1}, FLY_{t-1}) \qquad (4\text{-}5)$$

Where r = effective cost of foreign borrowing, or domestic shadow interest rates

[12] See the two figures in p. 81-82 in Fry (1995).
[13] Fry (1993a) p. 64.
[14] Fry (1995, p.85) mentioned Dooley (1986) and Edwards (1986).

As a result, RW, $DETY_{t-1}$ and FLY_{t-1}, will be substituted for r in the saving and the investment structural equations.

Two measures of foreign liabilities

Fry introduced two measures of foreign liabilities, DETY and FLY, to examine whether they have different role to play in the current account.

Financial repression is more likely to reduce national saving, average productivity of investment and economic growth. Fry argued that foreign debt DETY possibly has two conflicting effects, fiscal and financial, on national savings. On the one hand, the ratio of foreign debt by the government DETY could *reduce* domestic savings through encouraging capital flight, fiscal effect. On the other hand, higher debt ratio negatively affects the supply of foreign saving, which would produce higher domestic real interest rates that possibly encourage households to *increase* their saving ratio, financial effect.

Similarly, foreign debt could have two conflicting effects to domestic investment. The debt overhang argument supports Fry's analysis that government debt may have negative effects to the domestic investment. However, he argued that in the early stages of foreign borrowing government's debt might have positive effects to the domestic investment. He states that "Entrepreneurs may perceive that there would be profitable investment opportunities in export activities as debt service amounts and the government is forced to intensify its drive to raise foreign change earnings"[15].

An alternative measure of foreign indebtedness, last year's accumulated current account deficit to last year's GNP, FLY_{t-1}, is suggested by Fry. Where he showed how this variable plays an important role in the saving function, and consequently in the current account model. He argued that this type of foreign liability FLY possibly reflects the stabilising mechanism in the current account that have been shown in the analysis of the previous graphs[16].

[15] Fry (1993a) p.64.
[16] Fry (1995), p. 83.

The saving function

The national saving function is based on the standard life cycle saving model. This model assumes that each household consumes all its resources during its lifetime. Where income-earning household saves while young, in order to consume during the non-earning stage of life, becoming old. Particularly Fry's saving model is based on a version of life-cycle model that incorporates rate of growth effect[17]. Fry argued that all factors that influence the aggregate saving ratio must enter through one of the following four variables[18]:

1) The mean age of consumption
2) The mean age of income
3) The level of household consumption over its lifetime
4) The rate of growth in aggregate real income

Fry stated that the national saving function is determined by the following variables:

$$SNY = f(YG, r, TTL, DDCY, SNY_{t-1}) \qquad (4\text{-}6)$$

Substituting the determinants of the effective cost of borrowing, the saving function becomes as follows:

$$SNY = f(YG, RW, DETY_{t-1}, FLY_{t-1}, TTL, DDCY, SNY_{t-1})^{19} \qquad (4\text{-}7)$$

Expected signs

The analysis of the expected relationship between each explanatory variable and the national saving is presented below. Fry argues that "in an open economy, ..., the rate of growth in income differs form the rate of growth in output due to terms-of-trade changes"[20]. He decomposed the real income growth into income growth due to real output growth YG, and real income growth due to terms of trade changes TTL. To test for these different effects, both YG and TTL are introduced in the saving function, and are expected to positively affect national saving.

[17] Which is developed by A. Mason (1981, 1987), see p.88 Fry (1995).
[18] See Fry (1995), p.91.
[19] Please see Fry (1995, 88-95) for the detailed specification of this function.
[20] Fry (1993b) p. 354

Credit rationing is widespread in the LDCs. Fry argued that, even when interest rate is almost zero for investment lending, there are restrictions on consumer lending. Hence, changes in credit availability to a liquidity constraint household are expected to have a negative sign in the saving function. Credit availability is measured here by the ratio of change in domestic credit to GNP, DDCY.

The world real rate of interest RW is a determinant of domestic real interest rates (positive effect). However, at the same time, it measures returns on foreign financial assets (negative effect). Therefore, the effect of world real interest rates on the saving ratio is ambiguous.

It has been discussed above that foreign debt $DETY_{t-1}$ is expected to have conflicting and possibly non-linear influence on national saving. Therefore, Fry introduced this debt ratio twice, $DETY_{t-1}$ and $DETY^2_{t-1}$, in the saving function in order to capture these conflicting and possibly non-linear effects.

As for the other type of foreign liability FLY_{t-1}, it could have a negative effect on net wealth and consequently reduces consumption and increase saving. Fry argued that the cumulative current account deficit to GNP ratio FLY_{t-1} could possibly exert a stabilising effect to the current account through the saving function. Therefore, contrary to DETY, this variable is expected to have a sign in the current account model.

To capture any adjustment lag in the saving function Fry added the previous year's national saving ratio to the function.

The investment function

Fry's investment function is based on the flexible accelerator model[21]. In this model a desired capital stock is set to be proportional to real output, and the investment function is equipped with an adjustment mechanism. The adjustment mechanism allows the actual investment rate to adjust partially in any one period to the difference between the desired investment rate and the investment rate in the previous period"[22]. The flexible accelerator model allows economic conditions to influence the speed of adjustment. Here, the speed of adjustment is determined by the following variables in the investment function.

$$IY = f(YG, TTL, DDCY, RW, r, REXL, IY_{t-1}) \qquad (4\text{-}8)$$

The interest rate variable is substituted for: $r = f(RW, DETY_{t-1}, FLY_{t-1})$ as discussed above, then Fry's investment function is as follows:

$$IY = f(YG, TTL, DDCY, RW, DETY_{t-1}, FLY_{t-1}, REXL, IY_{t-1}) \qquad (4\text{-}9)$$

Expected signs

Below, we are stating Fry's analysis of the expected effects each explanatory variable has on domestic investment. With respect to world real rates of interest RW, it is expected to have a discouraging effect to the domestic investment ratio, assuming an open economy framework. However, this variable effect on the current account is ambiguous.

As for real economic growth, YG, it is expected to encourage investment. However, its final outcome effect on the current account is ambiguous. It depends on whether the investment (positive) effect outweighs, or not, the savings (positive) effect.

The effect on investment ratios of a change in the terms of trade TTL depends on whether this change is permanent or temporary. A permanent increase in terms of

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[21] Fry (1995, p. 95) argued that estimating the neoclassical investment function is difficult for reasons such as: lack of data on capital stock and on the return to capital.

[22] Fry (1993b) p. 355-356.

trade will obviously raises the investment ratio. This increase in the investment ratio will deteriorate the current account if it exceeds the increase in saving ratio as a result of an improvement in TTL. However, a temporary improvement in TTL will reduce the investment ratio, which will support the increase in saving, and hence improve the current account.

An increase (appreciation) in the real exchange rate REXL affects the investment ratio through its effect on the prices of imported intermediate goods. An increase in the price of intermediate imports will reduce the profitability of domestic investment projects.

Credit availability (as proxied by DDCY) plays an important role in determining the investment ratio. Changes in domestic credit DDCY are expected to have a positive relationship with the investment ratio.

Fry argued that the two foreign liabilities variables (DETY and FLY) are possibly serve as proxies for the country-specific risk premium, hence negative effects to the investment ratio are expected. However, as it has been discussed above that the foreign debt measure DETY is expected to have conflicting effects on the investment function. In these circumstances, $DETY_{t-1}$ and $DETY^2_{t-1}$ are included in the investment equation in order to capture this conflicting effect. Hence, the expected effect is ambiguous.

Finally, last year's investment ratio is a necessary component of the flexible accelerator model, a positive effect on this year domestic investment is expected and as a result a negative effect to the current account is expected.

Deriving the current account model

Assuming a linear form for the above two functions of national saving and domestic investment (4-7 and 4-9), Fry derived his reduced form current account model as presented in equation 4-4. However, it should be mentioned that in his derivation of the model he constrained the coefficients of SNY_{t-1} and IY_{t-1} (in 4-7

and 4-9 respectively) to be equal but opposite in sign, and substitute them by CAY_{t-1}, see equation 4-3. In addition, the lagged form of the exchange rate variable replaces the current. Fry found[23] that the coefficient of the exchange rate variable is significant when lagged from is used and insignificant when the current form is used.

The current account deficits and foreign debt

It has been argued that, when domestic investment exceeds national savings the current account will be in deficit. One way to finance this deficit is to borrow foreign savings from the international capital market. In Fry current account model, the current account deficit is simultaneously determined by the demand and the supply of foreign savings. Hence, Fry's current account model attempts to capture the essential determinants of this iterative process.

Fry claimed that his model allows the debt burden ratio to converge to a sustainable steady state level. In other words, an informal error correction process is embodied in the model. When an increase in the foreign debt does improve the current account and as a result reverses the debt accumulation, the country is then in the steady state.

Fry stated that "if foreign indebtedness reduces investment by more than it reduces saving, or raises investment by less than it raises saving, rising foreign indebtedness improves the current account and so slows down the build-up of foreign debt"[24]. The error correction mechanism in the current account appears to have been enjoyed by many large industrial countries.

In contrast, many indebted developing countries have been suffering from rising current account deficits. Fry suggested that current account deficits financed through government and government guaranteed foreign debt are probably not

[23] See Footnote 3, p.265-266 in Fry (1995).
[24] Fry (1993a) p. 61.

self-correcting. He argued that, this type of foreign liability has actually financed capital flight in many heavily indebted countries.

As the government increases its foreign borrowing to meet increasing fiscal expenditure, the households will read this as leading to an increase in future taxation and respond by increasing saving, assuming that the Ricardian equivalence hypothesis holds. Hence, positive effects on the current account are expected.

However, household may respond in an alternative way as suggested by Ricardo himself. As the government increases its foreign borrowing, households anticipate higher future taxes. As a result they may be encouraged to transfer their assets abroad[25] to exempt them from this burden of taxation, capital flight. Fry suggested an alternative analysis. Households may expect that a "rising foreign debt ratio may goad the government into stimulating exports, which could involve a devaluation in the real exchange rate. In this case the real returns on assets held abroad could be higher than the real returns on domestic assets"[26]. Obviously, this will put extra pressure on households to protect their assets' value by transferring more abroad.

Therefore, the build-up of government debt can reduce national savings by more than reducing investment, and hence deteriorate the current account balance. This analysis shows how foreign debt could have a negative effect on the current account and therefore becomes a destabilising factor.

[25] Since most LDCs usually restrict capital transferred abroad, households can go around these restrictions by over-invoicing their imports and under-invoicing their exports.
[26] Fry (1993, a) p.63.

Fry's empirical estimation

Fry empirically estimated the above current account model, 4-4. He used data from 26 developing countries for the period 1960-1988. The regression method is iterative Three-Stage Least Squares 3SLS. The empirical model is a system of 26 equations (one for each country) with cross-equation equality restriction on all coefficients except the intercept. Therefore, one equation will be estimated and its estimates applied to a representative LDC rather than to any single country.

The current account model instruments are: FLY_{t-1}, $DETY^2_{t-1}$, CAY_{t-1}, YG_{t-1}, RW, $REXL_{t-1}$, $DDCY_{t-1}$, TTL_{t-1}, DOILPL, DDCGY, and RYO; where INFGAP is the inflation gap between domestic and USA inflation, DDCGY is net domestic credit to the government/GNP, DOILPL is oil price inflation, and RYO is the rate of growth in OECD output.

Fry's estimation results showed that the coefficients of the two foreign liability measures FLY_{t-1} and $DETY^2_{t-1}$ are significant but have different effects on the current account balance.

On the one hand, the cumulated current account deficit FLY_{t-1} works as a stabilising factor to the current account. That is to say, the previous year's cumulated current account deficit improves current account balance.

On the other hand, the estimation shows that the other measure ($DETY^2_{t-1}$) of foreign liability has in fact a negative effect on the current account balance. This type of foreign liability build up destabilises the current account balance as a result of capital flight. Therefore, unlike FLY, financing the current account deficits through this type of foreign liability DETY does not have the self-correcting mechanism.

The specification of the monetary reaction function

To examine the source of developing countries' increasing rates of inflation (whether imported), Fry tested the hypothesis that the way of conducting the monetary policy is the reason behinds the developing countries' high rates of inflation. He specified a monetary reaction function as part of a macroeconomic model designed [by Fry et al (1988)] for a small semi-open developing country.

This function addresses the question: whether the developing countries pursue systematic discretionary monetary reaction policies? Particularly, this function examines the monetary[27] reaction of the developing countries to the accumulation of their foreign debt. Following other works[28], Fry specified the central bank objectives as to achieve: a balance of payments target, an inflation target and response to oil price shock. The monetary authority's reaction policy is represented by the ratio of the change in domestic credit to GNP.

$$DDCY = \pi_0 + \pi_1 FLY_{t-1} + \pi_2 DETY_{t-1} + \pi_3 DNFAY + \pi_4 DNFAY_{t-1} + \pi_5 INFGAP + \pi_6 INFGAP_{t-1} + \pi_7 DOILPL + \pi_8 DOILPL_{t-1} + \pi_9 REXL + \pi_{10} DDCGY + \pi_{11} DDCGY_{t-1} \quad (4\text{-}10)$$

Where

DNFAY	= Change in net foreign assets of the banking system / GNP
INFGAP	= Inflation gap between domestic and USA inflation
DOILPL	= Oil price inflation
DDCGY	= Change in net domestic credit to the government / GNP

An increase in the government's foreign debt DETY could cause an increase in domestic credit DDCY by increasing the public sector borrowing requirements for foreign debt service[29]. For this reason Fry included the ratio change in net domestic credit to the government to GNP, DDCGY to take into account this effect. In other words, to separate the monetary authority's reaction to changes in

[27] Fry (1993b) argues that: fiscal policy response to foreign debt build-up is already included in the effects of FLY and DETY variables on SNY and IY functions, since fiscal policy directly affects either national saving or domestic investment. Footnote 9, p.366

[28] G. Reuber (1964) and R. Froyen (1974).

[29] See Fry (1993a, p. 71).

government credit requirement from its reaction to foreign debt accumulation, Fry added DDCGY to the function[30].

Expected signs
Below, we state Fry's analysis with respect to the expected effects that each explanatory variable has on domestic credit. It is expected that monetary policy will be tightened when the previous year's foreign debt burden, FLY_{t-1} and $DETY_{t-1}$, was high, in order to improve the current account balance.

The function investigates whether the monetary authorities adopt any systematic sterilisation operations in order to neutralise the effects that the changes in net foreign assets of the banking system (scaled by GNP) DNFAY have on the money supply; a negative relationship is expected.
Usually, tight monetary policy is expected as a gap widens between domestic inflation and USA-inflation, INFGAP. The monetary response to exogenous shocks is also examined here. In particular, when oil price inflation DOILPL is high, either tight or expanded monetary policy is, in fact, a possible reaction response.

Similarly, last year's change in the real exchange rate change, $REXL_{t-1}$, has an ambiguous effect on the availability of domestic credit. For example, a devaluation of the domestic currency possibly has either a positive or a negative effect on the domestic credit availability in an indebted economy. In other words, the monetary authorities in indebted countries may either adopt tight or expansionary policy as a response to a real devaluation in the domestic currency.

A devaluation accompanied by tight monetary policy is usually effective to improve the current account, as devaluation discourages investment and tight monetary policy stimulates saving. Hence the current account is improved. In this case a positive relationship between $REXL_{t-1}$ and DDCY is expected.

[30] In fact, Fry (1993, p.71) found that when DDCGY and $DDCGY_{t-1}$ are excluded from the model, the estimated coefficient of DETY is more than doubled.

On the other hand, devaluation increases the domestic currency cost of servicing foreign debt, which increases demand for credit to service the foreign debt (especially by the public sector). If the monetary authorities choose to accommodate this increase in demand for credit, then a negative relationship between $REXL_{t-1}$ and DDCY is expected. Therefore, either a positive or a negative sign is expected.

An increase in the domestic credit requirements by the government, as measured by the change in net domestic credit to the government (scaled by GNP) DDCGY, may push the monetary authorities to squeeze (partially or completely) domestic credit to the private sector. A positive sign is expected.

Fry's empirical estimation

Fry estimated the monetary policy reaction model using data from 26 developing countries for the period 1960-1988. The regression method is iterative 3SLS. The empirical model consists of a system of 26 equations (one for each country) with cross-equation equality restriction on all coefficients except the intercept. Therefore, the estimates apply to a representative LDC rather than to any single country.

The set of variables used as instruments in the domestic credit model includes the current account equation instruments plus $DNFAY_{t-1}$, $INFGAP_{t-1}$, $DDCGY_{t-1}$, lagged money supply growth DM2 and US inflation, USINF.

It has been found that the monetary authorities in Fry's sample of developing countries do appear to exercise (systematic) monetary policy responses to changes in several economic variables.

Monetary reactions to foreign liabilities build up

The estimates of the domestic credit equation show that the reaction of the monetary authorities in the developing countries to foreign debt build up depends on the type of debt. An increase in FLY_{t-1} will push the authorities to reduce domestic credit expansion, which will improve the current account balance. In

contrast, however, they expand domestic credit as the $DETY_{t-1}$ increases, which worsens the current account balance.
Particularly, the monetary authorities in his sample of countries do appear to implement appropriate contractionary monetary policy (restrict credit; i.e. reduce DDCY) this year in response to an increase in the previous year's cumulated current account deficits (FLY_{t-1}). On the other hand, however, they fail to adopt a more restrictive monetary policy (reducing DDCY) when government and government guaranteed debt (DETY) rises. Rather, they react with an expansionary monetary policy.

One could argues that an increase in foreign debt $DETY_{t-1}$ leads to an increase in domestic credit as a result of increasing public sector demand for credit in order to meet foreign debt obligations. Nevertheless, Fry argues that this effect is already taken into account by including DDCGY in the model. He offered an alternative explanation: "... the monetary authorities expand domestic credit when $DETY_{t-1}$ increases not only to the public sector increased debt service expenses but also to accommodate the private sector increased debt service burden or even to facilitate capital flight"[31].

[31] Fry (1993,a) p.71.

Reestimating Fry's models

In this chapter we apply Fry's two models, the current account model and the monetary reaction function, to data from the three Arab countries, Egypt, Morocco and Tunisia. Hence, this chapter aims at examining the role of the foreign debt accumulation in the economies of the countries under study, particularly on their current account balances. Furthermore, the chapter is investigating these countries' monetary policies towards the accumulation in the foreign debt.

Apart from this, this exercise tests the robustness of Fry's models when applied to different sets of countries/periods, and when using different estimation methods. Therefore, this chapter's estimation results are reported and compared to Fry's results.

With respect to the data sets, we first pool the three countries' data together and empirically estimate the two models. Then, each country's time-series data is used to estimate the two models. Here, we will be able to compare the performance of the two models' when applied using time series data to them selves when using the panal data results.

As for as the estimation method is concerned, two estimators OLS and 2SLS are used. This further examines the stability of Fry's models when estimated by different estimation methods.

The 2SLS and the 3SLS estimators

The Two Stage Least Squares estimator 2SLS is an instrumental variable method, which presents a limited information technique that can be used to estimate either an identified or over-identified equation from a system of simultaneous equations. Compared to the OLS estimator, the 2SLS takes out the residuals $\hat{\mu}$ from Y to determine $\hat{Y}$. Therefore, when $Y = \hat{Y}$: OLS and 2SLS estimates are identical.

As for as the 3SLS estimator is concerned it, too, is an instrumental variable method, but it is used for estimating a system of simultaneous equations, which explicitly takes into account the covariance across equations.
Although both 2SLS and 3SLS are consistent estimators, the 3SLS is asymptotically more efficient. "The basic rationale for 3SLS, as opposed to 2SLS, is its use of information on the correlation of the stochastic disturbance terms, of the structural equations in order to improve asymptotically efficiency"[32]. In fact, if covariance across equations vanishes, then one can't improve efficiency upon the 2SLS by applying 3SLS.

Using a single equation model (in the current account model and the monetary reaction function) Fry constructed a system of 26 equations, one for each country, and used the 3SLS with cross-equation equality restrictions on all coefficients except the intercept. Given the above definitions of the 3SLS and other estimators, one can question the appropriateness of considering a set of identical equations, where each belongs to an individual country, as a set of simultaneous equations to be estimated by the 3SLS estimator.

Although our set of countries contains more homogeneous (at least with respect to external shocks) countries compare to Fry's we are planning, in this chapter, to use the 2SLS estimator instead of the 3SLS. A correlation coefficient matrix of the residuals[33] of the three countries' current account estimation has been performed and reported in appendix 6. The stochastic disturbance terms across the three countries are not correlated. Therefore, we can argue that, one cannot improve efficiency upon the 2SLS by applying 3SLS.
In fact, it has been stated that the " 2SLS avoids the bias (and inconsistency) of OLS while, at the same time, it avoids the sensitivity to specification error and measurement error (and the cost) of 3SLS and FIML"[34]. Furthermore, the 3SLS usually requires a larger sample size than the 2SLS estimator to improve efficiency.

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[32] Intriligator (1978), p.403.
[33] Here the residuals of each 2SLS estimation were saved and then the correlation coefficient matrix is calculated. See p.231.
[34] Intriligator (1978), p.420.

Under these circumstances, and since we deal with small sample of data in this chapter, we consider the 2SLS estimator as a good alternative to estimate consistent and reasonably efficient estimates.

Data and the stationarity question

Fry did not perform, neither report, any stationarity testing of his data, as the sample is small and no enough degrees of freedom will be available for appropriate test for unit root. However, we attempt to perform unit root testing for each variable. Since our sample size is even smaller than Fry's, we do not claim that our attempt will result powerful results with respect to stationarity of the data, rather it will give good insight into the description of the data.

Two sets of empirical exercises are to be performed in this chapter. While the first empirical exercise uses the sample as a panel data, the other uses the sample in its time series form. Hence, two unit root tests are to be carried out, the Augmented Dick Fuller (ADF) tests for panal and time series data.

The detailed ADF results are reported in appendix 4, Tables A4-3 to A4-6. Before each of the two empirical exercises a table will be reported that shows the unit root test results of the relevant variables. However, all estimations are performed using the variables in their level forms.

Following So Im, Pesara and Shin (1997), this chapter uses the equation below to perform the panel data unit root test.

$$\overline{Z}_{N,T} = \frac{1/N\sum_{i=1}^{N} t_{i,T}(\rho_i, \hat{\gamma}) - 1/N\sum_{i=1}^{N} E[t_T(\rho_i,0)]}{\frac{1}{N}\sqrt{\sum_{i=1}^{N} V[t_T(\rho_i,0)]}}$$

Where

$\overline{Z}$ is the calculated t-stat, N = # of countries, T = # of observations,
i = 1, 2, 3, t_i = the calculated t-stat for country i using the ADF test,
ρ_i = # of lags used in ADF test for the i^{th} country,
$E[t_T]$, $V[t_T]$ are the critical mean and variance, respectively,
from Table 2 of So Im, Pesara and Shin (1997).

An econometric problem arises as one concerns him self with the variables order of integration in the current account model. The cumulated current account deficits (FLY) is the sum of the previous current account deficits, it is impossible (by construction) to be of the same order of integration as the current account variable (CAY). On suggestion to overcome this econometric problem is to drop the FLY from the current account model[35].

[35] However, another suggestion is to keep FLY among the independent variables but lagged one year, as done by Fry. This is justified since we are going to have two I(2) variables, DETY and FLY, among the independent variables that are higher than the order of integration of the dependent variable CAY, I(1). See these estimations in Appendix 6.

The current account model

Panel data estimations

The model is estimated using data from three Arab major indebted countries, namely Egypt, Morocco and Tunisia, for the period 1977 to 1996. Variables definitions are similar to Fry's, which are shown with their sources in appendix 5. The data consists of twenty observations for each country, which makes too few degrees of freedom for cointegration analysis. However, Table 4-2 below shows the unit root test for the relevant variables, which give good data description.

Table 4-2 Order of integration

Using panel data unit root test (intercept included)

Variables		Panel DATA	
		ADF	I(?)
Current account/ GNP	CAY	-5.014	1
P. and Publicly Guaranteed debt	DETY	-10.807	2
Real GNP growth	YG	-10.575	0
Ln (terms of trade index)	TTL	-4.597	1
Real Exchange Rate	REXL	-3.698	1
Change in domestic credit / GNP	DDCY1	-5.869	0
World Real Interest Rate	RW	– 4.097	1
Period		1977 - 1996	

The critical values for t stat for N=3 and T=20 at 1% is calculated from:
So Im, Pesaran and Shin (1997) Table 4. such that:
$t_{(3,20)} = -2.67 = \{-2.50 + [-2.50-(-2.33)]\}$

The data used in the estimation of model (1) in Table 4-3 are in their level forms only. In fact, the panel data unit root test shows similar order of integration of most of the variables.

2SLS estimation of the model

Table 4-3 presents our empirical estimation (model 1) of Fry's current account model. We applied Fry's model to a data set of different countries[36] and different time periods. The estimation method we apply is the 2SLS. The country effect is taken into account by adding two country dummies to the set of independent variables. Tunisia was chosen to be the benchmark country. Here we are assuming that the three countries have a common slope but different intercepts. The intercept term in the regression result, C, represents Tunisia's intercept. The two dummies

[36] Egypt and Morocco are among the 26 countries in Fry's sample.

coefficients tell us by how much the intercepts of Egypt and Morocco differ from C.

The instrumental variables for model (1) are the intercept, the two country dummies, FLY_{t-1}, $DETY_{t-1}$, YG_{t-1}, $DETY^2_{t-1}$, $REXL_{t-1}$, CAY_{t-1}, TTL_{t-1}, RW, $DDCY_{t-1}$, DDCGY, DOILPL, and RYO.

Table 4-3 2SLS estimation results of CAY (Panel data)

Dependent Variable: CAY

Independent Variables		Fry (1993) 3SLS	Model (1) 2SLS
Intercept		*not reported*	0.077 (0.653)
Country Dummies	Egypt	*not reported*	- 0.067 (3.854)*
	Morocco		- 0.199 (3.994)*
FLY_{t-1}		0.112 (24.359)*	-
$DETY_{t-1}$		-	0.260 (1.886)**
$DETY^2_{t-1}$		- 0.081 (17.709)*	- 0.125 (1.277)
DDCY		- 0.037 (6.888)*	- 0.006 (0.313)
TTL		0.019 (10.161)*	- 0.038 (1.495)
YG		- 0.001 (0.093)	0.270 (1.781)**
RW		- 0.056 (6.503)*	- 0.551 (3.784)*
$REXL_{t-1}$		- 0.004 (1.895)*	- 0.079 (3.721)*
CAY_{t-1}		0.655 (36.199)*	0.347 (3.179)*
Sample Size	Countries	26	3
	Period	1960-1988[37]	1977-1996
	# of Obs.	597	60
Adjusted	R^2	0.685	0.657
Serial Correlation (LM)			0.25 (0.62)
Functional Form (LM)			1.58 (0.21)
Normality (LM)			3.28 (0.19)
Heteroscedasticity (LM)			0.68 (0.41)

t-ratios in parenthesis. Significant at 5% = *, 10% = **

Table 4-3 shows that, the 2SLS method used in our data is able to produce five significant variables compared to seven variables by Fry. The estimation is carried

[37] Varies from country to country.

out after dropping FLY as suggested previously[38]. In addition, the estimated model passed all diagnostic tests[39], serial correlation, functional form, normality and heteroscedasticity. Intuitively, this seems to be a good result given the small sample size.

With the exception of three variables, $DETY_{t-1}$, TTL and YG, model (1) achieved similar results to Fry's with respect to coefficients signs. However, changes in domestic credit to GNP, DDCY, seem to have had no statistically significant effect on the current account balance in our sample of countries/period.

On the contrary to Fry's finding, an improvement in the terms of trade TTL improves the current account balance, it worsens it in the Arab countries under study. This negative relationship (although insignificant) could be attributed to the possibility that the improvement in the terms of trade is seen to be permanent by entrepreneurs in the three countries, and therefore it encourages investment. This increase in investment is believed to exceed the incremental effect that the improvement in TTL has on national saving. In that case, deterioration to the current account is expected.

In our empirical estimation of the model we have both DETY and $DETY^2$ as measures of foreign debt. Although, $DETY^2$ shows similar negative sign as Fry, it is statistically insignificant. On the other hand, the other measure of foreign debt DETY exerts positive and significant relation with CAY. Furthermore, its coefficient value (0.26) of the foreign debt variable DETYt-1 is more than three times that in Fry's estimation (0.08). Applying Fry's argument, this indicates a stabilising effect to the current account.

In fact, if one disregards the fact that $DETY^2$ coefficient is insignificant, the total net effect of $DETY_{t-1}$ and $DETY^2_{t-1}$ on the current account balance is positive (0.294 plus -0.148). Which still suggests a stabilising effect on the current account.

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[38] For comparison reason, and another reason mentioned in footnote 35, the model is also estimated with FLY, and the estimation result is reported in Appendix 6 Table A6.2.

[39] It should be mentioned that the null hypothesis of these four tests is as follows: H_0: the problem does not exist. The alternative H_a: the problem does exist.

Yet, one cannot infer any definite conclusion from this, as the coefficient of $DETY^2_{t-1}$ is insignificant. In appendix 6, Table A6.1 shows the current account model estimation with FLY. However, the estimation result shows (similar to Fry) positive sign coefficient for FLY[40].

The conflicting signs that $DETY_{t-1}$ and $DETY^2_{1-1}$ have in our estimation results, support Fry's suspicion that government and government guaranteed debt could have a conflicting and possibly non-linear influence on an LDC's saving and investment behaviour and eventually on the current account balance. This may suggest that the government and government guaranteed debt in our sample of countries might improve the current account balance in some stages and worsen it in another stages during the period under study.

An increase in the real world interest rate RW deteriorates the current account balance of the countries under study. This may suggest that the increase in RW not only decreases investment but also national saving. However, the reduction in domestic investment is less than the reduction in national saving. The reduction in national saving is possibly caused by the attractiveness of foreign assets' higher returns, capital flight.

As for REXL, an appreciation in the last year's real exchange rate REXL stimulates domestic investment and finally deteriorates the current account balance. Contrary to Fry's negative (insignificant) estimate of income growth coefficient YG, but similar to his expectation, our estimation shows a positive and significant coefficient. This result may imply that higher income growth increases national saving more than it increases domestic investment and thus improves the current account balance. Finally, last year's rise in the current account deficit encourages efforts to improve this year's current account deficit.

[40] The estimation result presented in Table A6-1 is very similar to that in Table 4-3, with one difference of the significance level of the variable YG.

Technically speaking, the model not only works well when applied to a small sample of different countries and a different time period, but also when using a different, but simpler, estimation method.
Although, Fry's current account model works reasonably well with respect to the estimated coefficients' significancy, it shows important different results (compared to Fry's) with respect to the coefficient signs of some variables, particularly, the debt variables.

OLS estimation of the model

Although the Ordinary Least Squares, OLS, estimator yields biased and inconsistent estimators when estimating simultaneous equations, it usually produces estimators that are efficient and insensitive to specification error[41]. Thus Fry's current account model is estimated by OLS. The OLS estimation results are then compared to the 2SLS, as shown in appendix 6 Table A6.2.

The OLS and the 2SLS estimations' results show similar ability to explain the variation in the data, 67% and 66% respectively. Furthermore, similar to the 2SLS estimation results, the OLS are able to pass all diagnostic tests.
Generally speaking, the OLS estimator produces very similar results compared to the 2SLS. In particular, all coefficients in the OLS estimation have identical signs to that of the 2SLS. In addition, all significant coefficients in the 2SLS estimation (with the exception of TTL) are significant in the OLS estimation. Furthermore, both estimators estimated very similar values for the coefficients: $DETY_{t-1}$, RW, $REXL_{t-1}$, CAY_{t-1}.

Given the small sample size we can conclude safely that the current account model may be estimated (and achieve reasonable good results) by a simpler to apply, and easier to compute, estimator (OLS rather than 2SLS or 3SLS estimators) at least for the country/period used in this chapter.

[41] See Intriligator (1978), p.379.

The time series estimations

Using panel data from 26 developing countries Fry's current account empirical estimates are applied to a representative developing country rather than to any single country in his sample. Alternatively, here we are re-estimating this model using time series data. This practice will shed some light on the performance of Fry's current account model when applied to each country's data separately, and also on the appropriateness of pooling the data.

Table 4-4 below, shows the unit root test results of the relevant variables in the current account model for each country.

Table 4-4 Order of integration

Variable Name		Order of Integration		
		Egypt	Morocco	Tunisia
Current account/ GNP	CAY	0	1	1
P. and Publicly Guaranteed debt	DETY	2	1	2
Real GNP growth	YG	0	0	0
Ln (terms of trade index)	TTL	1	1	1
Real Exchange Rate	REXL	1	1	1
Change in domestic credit / GNP	DDCY1	0	0	0
World Real Interest Rate	RW	1	1	1

Since the time series is very short for each country, we consider the above unit root test as a good data description rather than a powerful stationarity testing. For this reason, the 2SLS and the OLS estimations are carried out using the variables in their level forms.

2SLS estimation of the model for each country

The current account model is empirically estimated using available data for each country. While Egypt's data covers the period 1972-1996, the available data for Morocco and Tunisia cover the 1976-1996 and 1977-1996 periods, respectively. The variables used as instruments in the 2SLS are the same as that in the panel data case[42]. Table 4-5 below presents the estimations results of the current account model after dropping the variable FLY[43].

[42] See Appendix 6, p.232, for the exact instruments used for each country.
[43] See Table A6-3 in Appendix 6 for estimation results with FLY.

Table 4-5 2SLS estimation results of CAY (Time series data)

Dependent Variable: CAY

Independent Variables		2SLS Estimation of Fry's model		
Intercept		0.300 (1.194)	- 0.394 (0.112)	- 0.878 (0.929)
FLY_{t-1}		-	-	-
$DETY_{t-1}$		0.102 (0.449)	0.502 (1.855)**	- 0.015 (0.035)
$DETY^2_{t-1}$		- 0.088 (0.488)	- 0.175 (0.577)	0.594 (1.284)
DDCY		- 0.034 (1.043)	0.136 (0.325)	0.074 (0.289)
TTL		- 0.083 (1.695)	0.054 (0.078)	0.134 (0.639)
YG		0.127 (0.494)	0.105 (0.248)	- 0.143 (0.241)
RW		- 0.049 (0.115)	- 0.552 (1.031)	0.031 (0.047)
$REXL_{t-1}$		- 0.076 (1.500)	0.071 (0.504)	0.195 (1.498)
CAY_{t-1}		0.201 (0.800)	- 0.016 (0.040)	- 0.221 (0.839)
Sample Size	**Countries**	**Egypt**	**Morocco**	**Tunisia**
	Period	**1972-1996**	**1976-1996**	**1977-1996**
	# of Obs.	**25**	**21**	**20**
Adjusted R^2		**0.475**	**0.851**	**0.632**
Serial Correlation (LM)		**1.62 (0.20)**	**1.05 (0.30)**	**0.26 (0.61)**
Functional Form (LM)		**0.11 (0.74)**	**0.61 (0.44)**	***4.25 (0.04)***
Normality (LM)		**1.23 (0.54)**	**0.12 (0.94)**	**0.26 (0.88)**
Heteroscedasticity (LM)		**1.59 (0.21)**	**0.61 (0.43)**	**0.53 (0.47)**

t-ratios in parenthesis. Significant at 5% = *, 10% = **

In general, the empirical estimation of the current account model to each country's time series data yields different results when compared to the panel data estimation results. This suggests that one should be very careful in generalising any conclusion from pooled data estimation results. In fact, the time series estimations of the current account model show how each country behaves differently.

Here, all variables in the model appear not to have any significant role to play in the current account variations, with exception of DETY in Tunisia only. The same cannot be said about the pooled data estimation of the current account model where many variables are significant, with the exception of three: DDCY, TTL and $DETY^2$.

Although, Egypt and Morocco estimations show no signs of any specification problem, the Tunisian estimation does; it shows functional form problem.

Comparing the estimation results in the two Tables 4-4 and 4-5, the panel data estimation seems to be more reflecting the current account behaviour of Egypt and Morocco, especially with respect to changes in the four variables: DETY, $DETY^2$, YG and RW. The only significant variable is shown in Tunisia's estimation. Tunisia shows significant and positive coefficient for the variable $DETY_{t-1}$. However, this result does not support Fry's conclusion of a destabilising effect of the government and government guaranteed debt on the current account.

Although YG, RW_{t-1}, $REXL_{t-1}$ and CAY_{t-1} are quite significant in the panel data case, they show no significant relation to the current account balance in any country.

For the sake of comparison (with Fry's work), the current account model was re-estimated with the variable FLY_{t-1} among the independent variables. Table A6-3 in Appendix 6 shows the estimation results of the model. The estimated model shows some interesting results with respect to the two measures of foreign liabilities, FLY and DETY.

Fry had two main conclusions: that while FLY has a stabilising mechanism to the current account, DETY, on the other hand, has a stabilising effect to the current account. In contrast, our empirical estimations of the model (that are shown in Tables A6-1 and A6-3 in appendix 6) do not, generally speaking, support Fry's conclusions.

The cumulated current account deficit variable FLY shows a self-correcting mechanism in Egypt current account but not in the other two countries. In fact, also the foreign debt variables (DETY and $DETY^2$)[44] show positive (net) effect on the current account, not only in Egypt but also in the other two countries[45]. Which contradicts Fry's two main conclusions.

[44] The estimated coefficients for these two variables show two conflicting effects, as suspected by Fry, on the current account.

[45] It should be mentioned that, the net effect of the two variables representing government foreign debt show similar magnitudes in the three countries, about 0.40. This may deserve further exploration in future work.

Morocco and Tunisia's data are not able to show any support to Fry's conclusion of a self-correcting mechanism of FLY. Rather, the cumulated current account deficit, shows a destabilising (negative) effect to the current account.

The positive (net) effect of foreign debt on the current account may point to (and possibly support) the debt over-hang argument, as discussed in chapter three. This argument states the detrimental effects of foreign debt build up on domestic investment. The current account model is built on the identity: CAY=SNY-IY, the positive effect of DETY on CAY may come through a reduction in investment (keeping saving constant), or through an increase in saving[46] but without any improvements in investment.

It is notable that the two data sets estimations suggest the same conclusion with respect to the positive effect of the government and government guaranteed foreign debt DETY on the current account. This positive effect persists in the three countries, either as a one group or as individual countries. According to Fry's analysis, this possibly suggests that financing current account deficits through this type of foreign liabilities DETY seems to be effective in improving the current accounts of the countries under study.
On the other hand, however, the time series data set estimation results suggest that the current account balance in each country is not affected by the other variables in Fry's model. Therefore, no policy implications could be derived from these insignificant variables in the time-series estimations.

OLS estimation of the model for each country

The current account model was estimated again for each country separately using the OLS estimator. The estimation results are shown in Table A6-4 in appendix 6. When compared to the 2SLS estimations, the OLS have slightly higher levels of adjusted R^2. At 10% level of significanance all three estimations show no specification error, except heteroscedasticity that is found in Egypt's estimation.

[46] A strand in the foreign debt literature focuses on the negative relationship between savings and external finance. See D. McDonald (1982), p.610.

With respect to the significant variables, although the OLS estimations show slightly more number of significant variables, they are not very different from the 2SLS. Furthermore, both estimators OLS and 2SLS estimated the same sign[47] for each variable, with only one exception of DDCY in Tunisia.

[47] The model is re-estimated with FLY, but not reported here. The estimated coefficients signs for FLY and DETY are identical to that estimated by the 2SLS.

The monetary reaction function

Panel data estimations

Variables definitions are similar to Fry's, which are shown with their sources in appendix 5. The data consists of twenty observations for each country, which makes too few degrees of freedom for cointegration analysis. However, Table 4-6 below shows the unit root test for the relevant variables, which give good data description. The variables used in the estimation of model (2) in Table 4-7 are in the forms as appearing in Table 4-6. In fact, the panel data unit root test shows not very different order of integration of the variables concerned.

Table 4-6 Stationarity test results

(Intercept included) Using panel data unit root test

Variables		Panel data	
		ADF	I(?)
Change in domestic credit / GNP	DDCY1	-5.869	0
P. and Publicly Guaranteed debt	DETY	-10.807	2
Real Exchange Rate	REXL	-3.698	1
Change in domestic credit to government / GNP	DDCGY1	-5.860	0
Change in net foreign assets / GNP	DNFAY11	-3.753	0
Inflation gap F4	INFGAP	-4.162	0
Oil Inflation	DOILPL	– 4.321	0
Period		1977 - 1996	

The critical values for t stat for N=3 and T=20 at 1% is calculated from:
So Im, Pesaran and Shin (1997) Table 4. such that:
$t_{(3,20)} = -2.67 = \{-2.50 + [-2.50-(-2.33)]\}$

2SLS estimation the function

Using 2SLS we empirically estimate Fry's monetary policy reaction function model and examine the monetary authorities' responses to the foreign debt build up in the three Arab countries. Model (2) in Table 4-7 presents our empirical results.
The instrumental variables used in model (2) are the following: the intercept, the two country dummies, FLY_{t-1}, $DETY_{t-1}$, $DETY^2_{t-1}$, $REXL_{t-1}$, TTL_{t-1}, $DDCY_{t-1}$, YG_{t-1}, RW, DDCGY, $DDCGY_{t-1}$, DOILPL, $DOILPL_{t-1}$, RYO, $DNFAY1_{t-1}$, $INFGAP_{t-1}$, $DM2_{t-1}$, USINF and CAY_{t-1}.

The estimation results of Fry's monetary reaction function, model 2, do not suffer from any specification problem. In addition, the goodness of fit measure, R^2, is

quite high, 0.93, compare to Fry's, 0.80, and the number of significant estimated coefficients is reasonably good.

The variables that showed similar sign and significant effect on the domestic credit DDCY as in Fry's estimation are $DNFAY_{t-1}$, $DOILPL_{t-1}$, DDCGY and $DDCGY_{t-1}$.

Table 4-7 2SLS estimation results of DDCY (Panel data)

Dependent Variable: DDCY

Independent Variables		Fry (1993) 3SLS	Model (2) 2SLS
Intercept		*not reported*	0.017 (0.153)
Country Dummies	Egypt	*not reported*	- 0.011 (0.307)
	Morocco		- 0.163 (1.431)
FLY_{t-1}		- 0.071 (22.241)*	-
$DETY_{t-1}$		0.082 (29.333)*	0.090 (0.280)
$DETY^2_{t-1}$		-	- 0.110 (0.475)
DNFAY		- 0.221 (24.068)*	1.003 (3.129)*
$DNFAY_{t-1}$		0.060 (7.046)*	0.367 (1.737)**
INFGAP		0.086 (35.578)*	- 0.872 (2.349)*
$INFGAP_{t-1}$		- 0.025 (12.266)*	0.449 (1.747)**
DOILPL		0.018 (11.713)*	- 0.024 (0.660)
$DOILPL_{t-1}$		0.016 (9.671)*	0.064 (1.859)**
$REXL_{t-1}$		- 0.016 (19.432)*	- 0.072 (1.483)
DDCGY		0.732 (87.255)*	1.808 (14.447)*
$DDCGY_{t-1}$		0.025 (2.686)*	0.382 (3.512)*
Sample Size	**Countries**	**26**	**3**
	Period	**1960-1988[48]**	**1977-1996**
	# of Obs.	**644**	**60**
Adjusted	**R^2**	**0.802**	**0.931**
Serial Correlation (LM)			**0.72 (0.40)**
Functional Form (LM)			**0.10 (0.75)**
Normality (LM)			**0.20 (0.90)**
Heteroscedasticity (LM)			**2.09 (0.15)**

t-ratios in parenthesis. Significant at 5% = *, 10% = **

[48] Varies from country to country.

Therefore, it seems that the monetary authorities accommodated more than 180 % (in the first year) of the increase in the government's credit requirements. This, more than 100% response, may indicate that the monetary authorities in these countries are accommodating the private sector too. In the second year, however, the monetary authorities appear to continue their policy but by accommodating only 38% of last year's government requirement of credit, and partially squeeze (62% of DDCGY) available credit to the private sector. These results, and the insignificant coefficients for DETY, may encourage further investigation on the possible relation between DETY and DDCGY as discussed by Fry.

The two coefficients of the change in net foreign assets DNFAY exert the same positive sign, suggesting that the monetary authorities expand, rather than contract, domestic credit when foreign exchange receipts rises. In fact, the estimated coefficients are quite high compare to Fry's finding. Surprisingly, the monetary authorities in the three Arab countries under study seem to increase (considerably) domestic credit when net foreign assets rose. Fry found similar positive response in Turkey. He analyses this positive effect of DNFAY as follows. "In these countries, domestic credit was increased when foreign exchange receipts rose so that a larger volume of capital equipment and raw material imports could be financed. Rather than contracting domestic credit to sterilise foreign exchange inflows, these countries banks reacted by expanding domestic credit to stimulate investment and growth"[49].

The three Arab countries' monetary authorities seem to accommodate last year's increase in oil prices, $DOILPL_{t-1}$, but unable to respond to the current change in oil prices.

As for inflation, the monetary authorities seem not to accommodate this pressure in the first year, but do accommodate it in the second year, INFGAP. They seem to pursue substantial sterilisation policies towards higher inflation rates. This is apparent from the (significant) greater than one coefficient, -0.87. It perhaps

[49] Fry (1993) p. 69.

reflects the comprehensive economic reform programs undertaken by the three countries in the late 1980s and early 1990s. However, over a two-year period, the authorities seem to reduce domestic credit by 42% of any increase in oil prices, (-0.87 + 0.45 = 0.42).

Although, the estimated coefficient of the real exchange rate change REXL is negative, indicating that central banks expand domestic credit after depreciation in the national currency. However, the estimated coefficient for REXL does not show any significant performance in our application of Fry's monetary reaction function.

The monetary authorities in the three Arab countries seem not to respond to any changes in the two measures of foreign debt, DETY and $DETY^2$. The estimated coefficients for these two variables are statistically insignificant[50]. Therefore, in contrast to Fry's finding, the monetary authorities have shown no (systematic) reaction at all towards changes in foreign liabilities, DETY and FLY, in the three countries during the periods under study. Which would be acceptedable from already credit constraint countries.

In conclusion, the monetary authorities seem to pursue (systematic) monetary policies to changes several economic variables, but not to the building up of the foreign liabilities.

OLS estimation of the function

The monetary policy reaction function was re-estimated by OLS[51]. The estimation results are presented in Tables A6-6 in appendix 6. In fact, the two estimation methods produce almost identical results. This may be considered as supporting our conclusion in the previous section.

[50] For comparison reason, this model is re-estimated by including FLY. The estimation result is reported in Appendix 6, Table A6-5. The three foreign liabilities variables, FLY, DETY and $DETY^2$, are all statistically insignificant.

[51] With and without FLY included in the set of the independent variables.

The time series estimations

The monetary reaction function model is empirically estimated using available data for each country. While Egypt's data covers the period 1972-1996, the available data for Morocco and Tunisia cover the 1976-1996 and 1977-1996 periods, respectively. The variables used as instruments in the 2SLS are the same as that in the panel data case[52].

However, the Table below shows the unit root test for the relevant variables, which give good data description. The data used in the estimation of the models in Table 4-9 is in the form appearing in Table 4-8. In fact, the unit root test shows not very different order of integration of the variables concerned.

Table 4-8 Stationarity test results
(Intercept included)

Variable Name		Order of Integration		
		Egypt	Morocco	Tunisia
P. and Publicly Guaranteed debt	DETY	2	1	2
Real Exchange Rate	REXL	1	1	1
Change in domestic credit / GNP	DDCY1	0	0	0
Change in domestic credit to government / GNP	DDCGY1	0	0	0
Change in net foreign assets / GNP	DNFAY11	0	1	0
Inflation gap F4	INFGAP	0	1	1
Oil Inflation	DOILPL	0	0	0

2SLS estimation of the function for each country

Table 4-9 below presents the estimations results of the current account model after dropping the variable FLY[53].

The 2SLS estimations of the monetary reaction function for each country separately produce paradoxical results. While Egypt and Morocco show good number of significant variables, six and three respectively, Tunisia cannot produce any significant variable and shows very low adjusted R^2. On the border of 5% level of significance the model's estimation using Moroccan data shows serial correlation in the error term.

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[52] See Appendix 6, p.236, for the exact instruments used for each country.
[53] See Table A6-7 in Appendix 6 for 2SLS estimation results with FLY.

When compared to the panel data estimation, Table 4-7 above, Egypt's estimation shows very similar results, with respect to coefficient signs and number of significant variables. On the other hand, Morocco and Tunisia show different (compare to the panel case) estimation results. Therefore, the panel data estimation is more reflecting Egypt's data, and the analysis of the two results will be similar.

Table 4-9 2SLS estimation results (Time series data)

Dependent Variable: DDCY

Independent Variables		2SLS Estimation of Fry's model		
Intercept		- 0.095 (0.942)	0.051 (0.348)	0.071 (0.264)
FLY_{t-1}		-	-	-
$DETY_{t-1}$		0.197 (0.478)	0.210 (2.104)**	- 0.138 (0.143)
$DETY^2_{t-1}$		- 0.145 (0.425)	- 0.157 (2.123)**	0.015 (0.015)
DNFAY		1.472 (4.707)*	- 0.062 (0.241)	- 0.240 (0.278)
$DNFAY_{t-1}$		0.301 (0.856)	0.257 (0.901)	1.206 (1.692)
INFGAP		- 0.966 (1.931)**	0.140 (0.544)	- 0.077 (0.147)
$INFGAP_{t-1}$		0.971 (2.099)**	- 0.209 (1.435)	- 0.035 (0.071)
DOILPL		0.011 (0.160)	- 0.013 (0.693)	- 0.070 (1.757)
$DOILPL_{t-1}$		0.131 (1.996)**	- 0.036 (1.212)	- 0.049 (1.191)
$REXL_{t-1}$		- 0.093 (1.029)	0.049 (0.599)	0.040 (0.213)
DDCGY		1.997 (12.604)*	1.033 (3.868)*	1.446 (0.931)
$DDCGY_{t-1}$		0.517 (3.106)*	- 0.204 (0.804)	- 0.115 (0.085)
Sample Size	Countries	Egypt	Morocco	Tunisia
	Period	1972-1996	1976-1996	1977-1996
	# of Obs.	25	21	20
Adjusted	R^2	0.943	0.834	0.043
Serial Correlation (LM)		0.24 (0.63)	*3.77 (0.05)*	0.70 (0.40)
Functional Form (LM)		0.11 (0.74)	0.24 (0.63)	2.59 (0.11)
Normality (LM)		1.46 (0.48)	1.24 (0.54)	0.09 (0.96)
Heteroscedasticity (LM)		0.89 (0.35)	0.05 (0.83)	2.38 (0.12)

t-ratios in parenthesis. Significant at 5% = *, 10% = **

The significant variables in Morocco's estimation are the two foreign debt variables, DETY and $DETY^2$, and the variable change in credit to government DDCGY ratio. Morocco is the only estimation that shows significant coefficient for any of the foreign liabilities variables. As foreign debt increases the Moroccan

monetary authority seems to increase domestic credit in response, possibly to further stimulate investment and growth. However, the non-linear effect of foreign debt is evident from the significant coefficient estimate for $DETY^2$. Which seems to reduce the initial increase in domestic credit as the foreign debt to GNP ratio increases.

In Morocco, the monetary authority seems to increase aggregate domestic credit by slightly more than 100% in response to an increase in government credit requirements, DDCGY.

OLS estimation of the function for each country

The monetary reaction function has been estimated using the OLS estimator (see Table A6-7 in appendix 6). The OLS estimations produce the same results as the 2SLS with respect to the number of significant variables and the estimated signs of each variable. The serial correlation still persists in Morocco, but no specification problem has been detected in the other two countries.

Conclusion

This chapter examined the role of foreign debt accumulation in the economies of the Arab countries under study. Fry's current account model and monetary reaction function are empirically estimated using data from the three Arab countries, Egypt, Morocco and Tunisia.

Two sets of data are used in our empirical work. The first set pools the three countries data together and covers the 1977-1996 period. The second data set consists of three time series sub-sets one for each country covering the periods: 1972-1996, 1976-1996 and 1977-1996 for Egypt, Morocco and Tunisia respectively. Although unit root tests have performed and discussed, no attempt has been made to change the data according to the test results, as the sample is very short in size. The unit root results were considered as a good description of the data. However, since two variables, current account deficit to GNP (CAY) and cumulative current account deficit to GNP (FLY), in Fry's set of independent variables are not possible (by construction) to be of the same order of integration, thte latter FLY is dropped from our estimations of the two models.

A country effect is taken into account when applying the models to the panel data set, so that country dummies are introduced where Tunisia is chosen as the benchmark country. In addition, two estimation methods, 2SLS and OLS, have been applied to each of these two data sets. Four diagnostic tests (serial correlation, functional form, normality and heteroscedasticity) are reported with each estimation output. TSP version 4.2 and Microfit version 4.0 are the two statistical packages that are used to estimate the two models.

Generally speaking, our estimations' results show that the current account model and the monetary reaction function perform fairly okay when applied to the sample of countries and time periods in this chapter.

Current account model

The panel data estimation shows better result than the time series estimations, with respect to the number of estimated significant variables. In fact, of the three time series estimations, Table 4-5, only one variable is found to be significant, $DETY_{t-1}$

in Morocco. However, of the four estimations only one specification problem (functional form) has been detected, the Tunisian estimation.

In contrast, the panel data estimation of the model has produced several significant variables. In fact five out of the eight independent variables are significant, the exceptions are $DETY^2$, DDCY and TTL.
These different results of the panel and the time series cases raise a question about the usefulness of pooling the three countries data, and point to the risk in concluding any policy implications from the panel data results.

However, since our concern in this chapter is foreign debt's role in the current account, the foreign debt variable DETY seems to show[54] similar effect on the current account in the three countries. In fact, the government and government foreign debt, represented by DETY and $DETY^2$, in our empirical results again contradict Fry's main finding. The government debt DETY exhibits a self-correcting effect on the current account in all three countries, either estimated separately or pooled together. It should be mentioned, however, that Fry emphasised that his "estimates apply to a representative developing country in this sample rather than to any single country"[55].

This positive effect could be explained as follows. After independence[56] and particularly during the sixties and the seventies, these countries underwent ambitious, or even over ambitious, development visions and plans. In addition, openness policies where adopted as a strategy for higher rates of growth in the early eighties. The export sectors were supported and encouraged to grow in order to meet the countries' need for foreign exchange and servicing foreign debt. Under these circumstances, of ambitious development plans and willingness to achieve high export potential target, borrowing from foreign resources suggests itself to the governments' of these countries as a catalyst to economic growth.

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[54] This conclusion is built on the estimated signs of the two DETY variables, and on disregarding whether the estimated coefficient is significant or not.
[55] M. Fry (1993), p.67.
[56] 1936, 1956 and 1956 for Egypt, Morocco and Tunisia respectively.

Which seems to achieve certain success that is reflected in the current account balance.

Alternatively, one can suggest that this positive sign of DETY is consistent with some phenomenon in another debtor countries, where the explanation offered is that these countries borrow externally to increase their holding of foreign reserves, perhaps to impress, or meet the borrowing requirements of, the international capital markets.

In conclusion, our estimation results cannot produce similar to Fry's conclusion with respect to the effect of foreign debt on the current account. In fact, the government foreign debt DETY shows consistent significant positive (unlike) Fry effect.

Monetary reaction function

One main conclusion from the model is that the monetary authorities in the countries under study, especially of Egypt and Morocco, care mostly about the government's requirements of credit.

Similar to the current account model, the monetary reaction function estimations show different results when using the panel data than when using the time series data. In fact, the panel data estimation seems to reflect the Egyptian data more than reflecting the other two countries.

With respect to the specification error in the estimations, we found the problem of serial correlation in Morocco only. However, the model is not able to explain more than 4.3% of the variations in the domestic credit DDCY in Tunisia.

The monetary authorities of Egypt and Morocco seem to react to changes in net domestic credit to government to GNP ratio, DDCGY, with a systematic sterilisation to its effect on the money supply. In fact, the relationship between DETY and DDCGY as mentioned by Fry, and presented previously in this chapter, needs further examination.

Our time series estimations results of the monetary reaction function can conclude that Egypt do systematically pursue some monetary policy to changes in some

economic variables, but not to changes in foreign debt. The other two countries seem to not pursuing any monetary reaction to changes in most of the economic variables.
However, if one can disregard the insignificance of some of the estimated coefficients for the two foreign debt variables, it could be concluded that the three countries, in fact, pursue rather an expansionary monetary policy (unlike Fry's results) as the ratio of foreign debt to GNP increases[57].

Finally, on the one hand, the panel data estimations of Fry's two models did show some good results with respect to the number of significant variables and other statistical criteria. On the other hand, however, the time series estimations have two problems. The first is expected, which states that every country has different attributes and potentials and as a result can show different behaviour and reaction to changes and shocks, when compared to other countries.
The second problem is not unexpected but unpleasant, which arises when the current account model is not working completely with the time series data. The monetary reaction function model works with some countries, Egypt, but not with the others.

The two models estimated in this chapter do deserve further research, taking into account the integration/cointegration issue. In addition, the time series and the panel data estimation results suggest further inspection of the two models' specification to take into account the countries' under study characteristics.

[57] Here we are concerned with the net effect, that is the total of the estimated coefficients DETY plus $DETY^2$.

CHAPTER 5 *Simultaneous Equation Approach to Study Foreign Debt*

Introduction

Having examined and showed the important role that the stock of foreign debt play in the current accounts of the three Arab countries, this chapter and chapter six are devoted to examine how these countries' stock of foreign debt accumulated. Particularly, this chapter aims at modelling the demand and the supply of foreign borrowing in order to shed some light on the factors behind the stock of debt accumulation in the Arab countries under study.

On the demand side, a developing country may need to borrow in the international capital markets either for financing imports of physical capital or for smoothing domestic consumption. On the supply side, however, rich countries who are usually have excess of savings, look for markets with shortages in capital, LDCs, to invest and lend their excess of capital. In addition, factors that affect borrower country's creditworthiness may play an important role in supply.

Supply and demand interact in a plane of quantities and prices of foreign debt. Where each borrower country determines its demand schedule according to economic and political factors. On the same plane, however, different supply curves are available for countries with identical economic potentials but with different levels of creditworthiness in lender's perception. One of the main determinants of the supply curve position is lender's perception of the borrower country's creditworthiness.

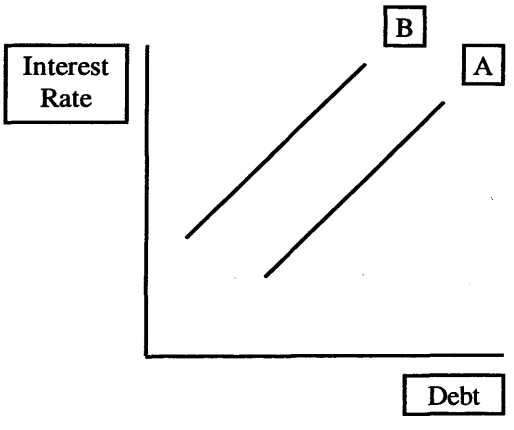

Figure 5-1 Supply of loans

Economic and political factors influence lenders' perceptions of any country's creditworthiness. If two countries "A" and "B" have identical demand curves, but lenders see that "A" is more creditworthy than "B", then they will offer "A" a supply schedule which is located to the right of the supply schedule of country "B", see the figure above. This implies that country "A" enjoys softer terms than "B", lower rates, longer grace and maturity periods etc.
The intersection of the demand and supply curves determines the equilibrium level of debt and rate of interest.

Therefore, borrowers and lenders determine the equilibrium levels of debt and interest rate every year in the international capital market. Over the years, as a result, a borrower country builds up its stock of foreign debt. Bad debt management is an important reason behind the piling up of the stock of debt. However, other set of reasons could be attributed to factors beyond the (full) control of the debtor country.
Indeed, one can specify three factors that cause the stock of debt to accumulate. First of all, a country augments its stock of foreign debt by simply borrowing new debt from the international capital markets.

A foreign exchange rate shock is another factor behinds the accumulation of foreign debt. "While it is true that this rapid growth of debt reflects the worsening current account situation, it is significant that nearly half of the increase is ascribable to the successive devaluations of the Tunisian dinar against the US dollar"[1]. In fact, similar story could be said about Egypt and Morocco[2]. These shocks may cause potential capital loss and eventually limit the country's access to the international capital markets. When measured against the domestic currency, an exchange rate shock may escalate the debt-service costs, and increases import bills.

The changes in the international rate of interest are the third possible factor behind the accumulation of foreign debt. In particular, foreign debt contracted in a flexible

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[1] Raynauld, Andre` O. C. (1988), p.15.
[2] See Table 6.9 p.179 in chapter 6.

rate of interest is seriously vulnerable to changes in interest rates. A higher interest rate means a heavier debt service burden on the economy. This could cause arrears in interest payments and eventually augment the stock of debt when rescheduling takes place.

Taking into account the above analysis of the main determinants of foreign debt accumulation, a simple reduced form equation model is to be specified in the following sections. This model is to be derived from two structural equations, demand and supply of foreign fund, where we assume that the two endogenous variables are the stock of foreign debt and the economic growth. The model is then empirically estimated using data from the three Arab countries and using the 3SLS estimator. Next, we start with a review of the literature on foreign debt and economic growth.

A review of some empirical studies of foreign debt and economic growth

A strand in the foreign debt literature is concerned with foreign debt determinants and its role, if any, in economic growth. Some studies empirically investigate the determinants of foreign debt accumulation by using a system of simultaneous equations or by using supply and demand framework etc. Some recent studies of this type are to be reviewed below.

To study the relationship between foreign debt and economic growth in a group of Arab countries, Metwally and Tamaschke (1994) used a simultaneous equation model.

While many developing countries suffered from the heavy burden of their foreign debt, the south Asian countries had a successful external borrowing experience, during the current international debt crisis. The successful experience of the South Asian countries could be analysed as follows. Foreign debt inflow is used to build the economy's productive capacity, which has its effect in accelerating growth, increasing foreign investment, and raising domestic savings. Consequently, the need for foreign borrowing will be reduced and the stock of debt will start to diminish.

On the other hand, heavily indebted countries endured a real drain of foreign exchange in order to meet their obligations to service their foreign debt. Consequently, these countries' ability to grow was reduced, and their dependence on foreign debt increased. However, a slowdown in growth will deteriorate a country's creditworthiness. As a result, the net capital inflow will be reduced.

Realising that the debt and economic growth relationship is rather complex, a system of simultaneous equations is specified. Metwally and Tamaschke model consists of four equations: debt service, stock of foreign debt, equity capital inflow and economic growth. The model aims at examining (empirically) the interaction between these four equations. They applied the model to three indebted Arab countries, Algeria Egypt and Morocco for the period 1975-1992, using OLS and 2SLS. The model was applied to each country's time series data. The two

estimation methods produced identical results with respect to the estimated coefficients' signs and reasonable level of significance.

Three variables are considered to be the main determinants of the total stock of foreign debt, namely the ratio of total credits to total debts in the current account of the balance of payments, equity capital inflow and the rate of growth of domestic savings. Their estimations suggest that improvements in the balance of current account, an increase in an inflow of direct private investment and an accelerated growth in savings contribute toward reducing foreign debt. In addition, the estimation results obtained by both OLS and 2SLS, suggest that servicing a heavy debt could have an adverse effect on growth.

Chowdhury (1994) conducted Granger causality tests in an attempt to resolve the ongoing controversy about the cause and effect relationship between foreign debt and economic growth. He obtained mixed results, which suggest that the debt-growth relationship is not a simple one. Alternatively, he constructed a system of simultaneous equations, which consists of a set of four equations: private and public foreign debt, capital accumulation and production.
Chowdhury disaggregated the stock of debt into public and private sector debt. He argues that higher private sector debt has an adverse effect on the level of income, while higher public and publicly guaranteed debt could have either a positive or a negative effect on the level of income. On the other hand, he argues that the income level could have two contradictory effects on the level of indebtedness, the net effect of which depends on which effect outweighs the other.

Using 3SLS estimation, he applied the model to ten debtor countries in Asia and the Pacific for the period 1970-1988. Based on data limitation, he pooled the cross-section data and estimated the resulted cross-section-time-series data.
The two sectors' foreign debt equations include the following four variables: level of income, percentage of labour force in agriculture, terms of trade index and the previous year's level of debt. Besides these variables, the level of public and publicly guaranteed debt equation includes a proxy variable to measure income

inequality. All variables were statistically significant. The estimation results support the conclusion that foreign debt is not a primary cause of economic slowdown.

Chowdhury found a positive effect on the accumulation of debt of changes in this year's level of income and the previous year's debt burden, in both the public and private sectors debt equations. He argued that income inequality could lead to social and political tensions. His estimation shows that more income inequality problems could increase the accumulation of foreign debt in the public sector. In addition, he found that the greater the percentages of the labour force employed[3] in agriculture the smaller the accumulation of foreign debt in both sectors. Finally, the estimation results show that improvements in terms of trade could reduce the foreign debt accumulation in the public sector but not in the private sector.

The role of external resources in the development process is a topic of interest in many studies concerned with the sources of growth. The traditional literature views external resources as a vehicle to bridge the saving and foreign exchange gaps and to increase economic growth. However, the international debt crisis raised doubts about this traditional view. The foreign debt overhang problem shows how, in heavily indebted countries, an accumulation of foreign debt may reduce domestic saving and investment, and, hence, economic growth.
Within this framework Caceres (1995) examines the role of external resources in economic growth. In this study economic growth is expressed as a function of external and internal resources.

The model expresses income, y, as a function of domestic and foreign savings, S and F respectively, and a time trend, T: $y = f(S, F, T)$. Foreign savings are proxied and measured as the magnitude of the current account deficit, used with positive sign. A translog functional form is used to model this relationship. This function is a generalised Cobb-Douglass production function with varying elasticity of substitution and provides a convenient approximation of any production frontier[4].

[3] Labour force in agriculture is taken as an indicator of the industrial structure of the economy.
[4] Caceres (1995), p.395.

The model is estimated by OLS, using cross-section-time-series data from four Central American countries for the period 1971-1985. The paper's empirical results show the following findings:

1) Domestic savings exert a greater impact on economic growth than external savings;
2) When external savings is disaggregated into two components (net official external debt disbursements and net inflows of foreign investment), foreign investment shows a negative elasticity while the foreign debt elasticity is almost zero, with respect to economic growth.

In the same line of literature, Gani (1999) studies the determinants of foreign debt and the relationship between debt and growth in some LDCs. He specified two models, foreign debt and economic growth.

The foreign debt model is a reduced form equation derived by Looney (1989). The model is derived from a basic supply and demand of total public foreign indebtedness in the LDCs where the main influences of supply and demand on the country's indebtedness is isolated by considering a reduced form equation that measures the influences of all independent variables simultaneously[5]. The supply function is specified as a function of foreign reserves and exports.

While the demand was specified as a function of: income, current account balance, imports and such unproductive public sector expenditure as military, health and education expenditure. Gani argued that, if a country borrows externally to finance recurrent expenditure and not investment projects, then debt service burden may quickly become unmanageable. He considered two additional important variables in determining total external debt, world rate of interest and foreign exchange rate, which are included in the model.

For the economic growth model Gani used a production function type framework. Where, foreign debt is considered to enter as an input in the production function together with labour, capital, exports and government expenditure.

[5] Looney (1989), p.77.

The two models were estimated (by the generalised least squares GLS estimator) using pooled data for six Pacific Islands for the 1985-1992 period. His empirical results show that total international reserves, exports, unproductive government expenditure and the current account balance determine total external debt (positively).
However, his overall finding from the empirical estimation of the growth model, is that actual debt and debt service exerted an adverse effect on economic growth in the countries under study.

The above literature gives the reader a flavour about the on-going debate on the determinants of foreign debt accumulation in different sets of LDCs, and on the role of foreign debt in economic growth in these countries. In the next section a model of foreign debt accumulation is specified using a supply and demand framework, where models of foreign debt and economic growth, in linear function forms, are jointly estimated by OLS, 2SLS and 3SLS.

Structural model of foreign debt accumulation and economic growth

This chapter concerns with some Arab countries' behaviour in building up their stock of foreign debt. Here, it has been assumed that, these countries determine the amount of foreign debt and the rate of economic growth within a framework of demand and supply of foreign fund.

To build this framework, we employ an ad hoc functional relationship to examine foreign debt build up and its interaction with economic growth. Further, we assume that linear functional form is appropriate to capture the demand and the supply behaviour.

Although the foreign debt model is similar to Gani's (1999) ours differs in details. In addition, the model's primary aim is to examine the factors behind the accumulation of foreign debt in selected Arab countries.

The reduced form equations

The model consists of two structural equations, demand and supply of foreign fund, where the two endogenous variables are total foreign debt stock and economic growth. The specifications of the demand and supply equations will follow in the next section. The two reduced form equations presented below will be estimated simultaneously:

$$yg = \pi_{10} + \pi_{11} r + \pi_{12} nsy + \pi_{13} el + \pi_{14} op + \pi_{15} ttl \qquad (5\text{-}1)$$

$$D = \pi_{20} + \pi_{21} r + \pi_{22} nsy + \pi_{23} el + \pi_{24} op + \pi_{25} ttl \qquad (5\text{-}2)$$

Where

yg	= debtor's real rate of growth	D	= foreign debt
r	= rate of interest on debt	el	= exchange rate
op	= (export + import / GDP)	ttl	= terms of trade
nsy	= (real net saving / real GDP) in OECD		

Therefore, the five variables, ttl, r, el, op, and nsy are expected, we argue, to be able to explain the accumulation of foreign debt in the selected Arab countries.

Obviously interest rates and the exchange rate are considered important factors in the accumulation of foreign debt. Debt contracts with a flexible rate of interest make debtor countries vulnerable to changes in world interest rates. An increase in world interest rates will increase debt service requirement for the same stock of debt. In fact, it could increase the stock of debt itself if the country is not able to service its debt fully and resort to rescheduling agreements with lenders, or simply resort to new borrowing to pay the interest payment due.
Similarly, fluctuations in the exchange rate will obviously change a country's stock of debt when measured in terms of the domestic currency.

An excess supply of savings in the OECD countries may encourage lenders to offer debt contracts with soft terms in order to attract enough borrowers and reduce their excess of supply.

The degree of openness is expected to have a role to play in the accumulation of foreign debt. More open economies are expected to sign debt contracts with softer terms than less open economies, hence avoiding heavy debt burden. When a country opens its economy more, it could reduce its need for foreign borrowing for it might be better placed, compare to less open economies, to gain foreign exchange revenue through higher exports and lower imports.
On the other hand, decision-makers in more open economies may be encouraged to acquire more foreign funds to finance ambitious development plans. Under imprudent and weak debt management the country may eventually suffer from a heavy burden of debt stock.

The terms of trade index have its effects on trade competitiveness and export revenue. Permanent improvements in the terms of trade, which implies an increase in export earnings, could reduce the stock of debt for two reasons: one is related to improvements in debt service ability and the other is related to the reduction in the country's need for new foreign debt.

The structural equations

Our simple model is based on the notion that the forces of supply and demand for foreign funds determine a country's foreign debt and the rate of economic growth. Supply is determined by two sets of factors. The first set contains factors that can affect fund availability in the rich countries. The second set of factors is related to a lender's perception of a borrower's creditworthiness. On the other hand, the demand for foreign funds is determined by the factors that affect the gap between actual national savings and required domestic investment.

Below we specify the demand and supply structural equations.

Demand

The demand for foreign debt equation is built on the assumption that an LDC borrows from foreign sources (to finance its development plans) when it undergoes a negative net saving (national saving minus domestic investment), and repays the debt when positive net saving is achieved.

Therefore, the (structural) demand equation for foreign funds is as follows:

$$d^d = a_0 + a_1 yg + a_2 r + a_3 e1 + a_4 ttl \qquad (5\text{-}3)$$

Where

d^d	= demand for foreign debt	yg	= debtor's real rate of growth
r	= rate of interest on debt	e1	= exchange rate,
ttl	= terms of trade		

Following the previously stated reasons behind the foreign debt accumulation, four variables are assumed to play the main role in determining the demand for foreign debt. Namely, the domestic rates of growth, the rate of interest on the debt, exchange rate changes and the terms of trade index.

In the "take-off" stage, an LDC may borrow externally to build its economic productive capacity. Under prudent debt management where borrowed funds are used in successful investment projects (or carefully used to smooth current consumption as higher future income is expected) one would reasonably expect higher economic growth, a greater inflow of foreign investment and an increase in

domestic savings. Under those circumstances, the country's need for foreign debt will be reduced. Therefore, a negative relationship is expected between growth and the demand for foreign debt, $a_1 < 0$, see equation (5-3).

In general, an increase in the world rate of interest, ceteris paribus, would be considered as a factor discouraging borrowing from the international capital market. It has been overwhelmingly argued that the low real rate of interest in the seventies was an important factor for increasing developing countries foreign debt. Therefore, a negative relationship is expected in the demand equation, $a_2 < 0$.

A country with a stable currency is usually in a better position to borrow externally and may offered debt contract with softer terms. However, the effect of changes in the exchange rate on the demand for foreign debt is, in fact, ambiguous and depends on the net adverse effects, a_3?, as stated below.

A decrease in the domestic currency exchange rate, an appreciation, would reduce the debtor country competitiveness in tradable, and eventually may deteriorate its export revenues. The reduction in foreign exchange revenues puts the debtor country in a difficult position to service its foreign debt. In fact, under certain circumstances, the country may find itself in need to borrow externally to service its current debt. As a result, a negative relationship is expected. However, on the other hand, appreciation has favourable effects for the debtor countries. It reduces the stock of foreign debt and debt service requirements when measured in terms of domestic currency. This may ease the country's domestic financial needs, and possibly reduce demand for new borrowing.

Similarly, an increase in the domestic currency exchange rate, devaluation, has two contrasting effects on a country's demand for foreign borrowing. On the one hand, it could inflate the total stock of debt and debt service as measured by domestic currency. This may advocate the need for more foreign borrowing.
On the other hand, devaluation may increase the country's foreign exchange income from exports, which would strengthen the country's ability to finance its development plans and to service its foreign debt as well. This is likely to reduce

the need for external borrowing. The final demand response to a change in exchange rate depends on which effect outweighs the other.

A permanent rise in the terms of trade increases a country's welfare and reinforces economic growth through higher export revenues. As a result, the need for foreign borrowing will be reduced, $a_4 < 0$.

Supply

Assuming that the supply side is influenced mainly by factors determine availability of loanable funds in rich countries and by factors affect lender's perception of borrower's creditworthiness.

Equation (5-4), below, is the second (structural) equation, which represents supply of foreign fund:

$$d^s = b_0 + b_1 yg + b_2 r + b_3 nsy + b_4 op + b_5 ryo \qquad (5\text{-}4)$$

Where

d^s = supply of foreign debt
op = (export + import / GDP)
nsy = (real net saving / real GDP) in OECD
ryo = real rate of growth in OECD

Suppliers of foreign funds will consider a higher rate of growth, in a debtor country, as an encouraging indicator of creditworthiness. Higher economic growth should improve the country's ability to service and repay its foreign debt. Therefore, a positive relationship is expected between the amount of debt supplied and the rate of growth achieved, $b_1 > 0$.

Openness (exports plus imports divided by GDP) reflects the country's degree of integration with the international market economy. This is a creditworthiness measure from another perspective. More open economies are likely to have better access to the international market for capital and are easy to be penalised and persecuted in case of default. Therefore, a positive relationship is expected, $b_4 > 0$.

A change in the rate of interest influences lenders' expected rates of return. Lenders are expected to increase their returns if they extend more funds to a creditworthy borrower if the rate of interest increases, ceteris paribus. However, under certain circumstances lenders will find it risky to extend more funds at higher rates of interest. Extending debt to a heavily indebted country may push the country into a debt crisis. In this case, lenders will not respond to a debtor country's demand for debt at a higher rate of interest, $b_2 = 0$.
A lower rate of interest may discourage savings in the rich countries and eventually reduce available funds for lending. In general, a positive relationship is expected between the rate of interest and the supply of loanable funds, $b_2 > 0$.

Availability of loanable funds is affected by changes in rich countries' income. Economic growth and the saving rate (in the OECD countries) are two alternative measures of availability of loanable fund. Both are expected to have a positive effect on the supply of foreign debt b_3 and $b_5 > 0$. However, these two variables are likely to be highly correlated with income and reflect the same information. Here, we drop the economic growth variable ryo, and the saving rate in OECD countries is to be used as the measure of loanable fund availability.

Deriving the reduced form equations

The Structural Equations

$$d^d = a_0 + a_1 yg + a_2 r + a_3 el + a_4 ttl \qquad (5\text{-}3)$$

$$d^s = b_0 + b_1 yg + b_2 r + b_3 nsy + b_4 op \qquad (5\text{-}4)$$

$$D = d^d = d^s \qquad (5\text{-}5)$$

Where $a_1 \langle 0$ and $b_1 \rangle 0$

The endogenous variables:

D = total debt stock
Where d^d = demand, d^s = supply
yg = debtor's real rate of growth

The exogenous variables:

r = rate of interest on debt el = exchange rate ttl = terms of trade
nsy = (real net saving / real GDP) in OECD
op = (export + import / GDP) = debtor's economy degree of openness

Substitute (5-3) and (5-4) into (5-5), then, with simple manipulations, we find the growth reduced form equation:

$$yg = \pi_{10} + \pi_{11} r + \pi_{12} nsy + \pi_{13} el + \pi_{14} op + \pi_{15} ttl \qquad (5\text{-}1)$$

where

$$\pi_{10} = \frac{b_o - a_o}{a_1 - b_1} \qquad \pi_{11} = \frac{b_2 - a_2}{a_1 - b_1} \qquad \pi_{12} = \frac{b_3}{a_1 - b_1}$$

$$\pi_{13} = \frac{-a_3}{a_1 - b_1} \qquad \pi_{14} = \frac{b_4}{a_1 - b_1} \qquad \pi_{15} = \frac{-a_4}{a_1 - b_1}$$

Similarly, we can find the foreign debt accumulation reduced form equation:

$$D = \pi_{20} + \pi_{21} r + \pi_{22} nsy + \pi_{23} el + \pi_{24} op + \pi_{25} ttl \qquad (5\text{-}2)$$

where

$$\pi_{20} = \frac{a_1 b_o - b_1 a_o}{a_1 - b_1} \qquad \pi_{21} = \frac{a_1 b_2 - b_1 a_2}{a_1 - b_1} \qquad \pi_{22} = \frac{a_1 b_3}{a_1 - b_1}$$

$$\pi_{23} = \frac{-a_3 b_1}{a_1 - b_1} \qquad \pi_{24} = \frac{a_1 b_4}{a_1 - b_1} \qquad \pi_{25} = \frac{-a_4 b_1}{a_1 - b_1}$$

The growth and debt models specified above, equations (5-1) and (5-2), are to be empirically tested in the following section. However, we start by discussing the expected signs of the above reduced form equations according to our priori expectations of the variables in the structural equations.

Expected signs of the parameters of the reduced form equations

Note that since $a_1 \langle 0$ and $b_1 \rangle 0$ then $(a_1 - b_1) \langle 0$

$\pi_{11} = \frac{b_2 - a_2}{a_1 - b_1} \langle 0$ since $b_2 \rangle 0$; $a_2 \langle 0$

$\pi_{12} = \frac{b_3}{a_1 - b_1} \langle 0$ since $b_3 \rangle 0$

$\pi_{13} = \frac{-a_3}{a_1 - b_1} ?$ since a_3 ?

$\pi_{14} = \frac{b_4}{a_1 - b_1} \langle 0$ since $b_4 \rangle 0$

$\pi_{15} = \frac{-a_4}{a_1 - b_1} \langle 0$ since $a_4 \langle 0$

$\pi_{21} = \frac{a_1 b_2 - b_1 a_2}{a_1 - b_1} ?$ since it is not known as a priori whether:

$(a_1 b_2)$ is $\langle$ or $\rangle$ or $=$ $(b_1 a_2)$

$\pi_{22} = \frac{a_1 b_3}{a_1 - b_1} \rangle 0$ since $a_1 \langle 0$; $b_3 \rangle 0$

$\pi_{23} = \frac{-a_3 b_1}{a_1 - b_1} ?$ since a_3 ?

$\pi_{24} = \frac{a_1 b_4}{a_1 - b_1} \rangle 0$ since $a_1 \langle 0$; $b_4 \rangle 0$

$\pi_{25} = \frac{-a_4 b_1}{a_1 - b_1} \langle 0$ since $a_4 \langle 0$; $b_1 \rangle 0$

Table 5.1 summarises the expected direction of the relationship between each independent variable and the two endogenous variables. Obviously, signs of the interest rate and the exchange rate coefficients in the debt reduced form equation cannot be determined beforehand. Similarly the sign of the exchange rate coefficient in the growth reduced form equation is not clear as a priori.

Table 5.1 Expected signs

Growth Eq.	Expected Signs	Debt Eq.	Expected Signs
π_{11}	-	π_{21}	+ if $[(a_1 b_2) - (b_1 a_2)] < 0$
			- if $[(a_1 b_2) - (b_1 a_2)] > 0$
π_{12}	-	π_{22}	+
π_{13}	+ if $a_3 > 0$	π_{23}	+ if $a_3 > 0$
	- if $a_3 < 0$		- if $a_3 < 0$
π_{14}	-	π_{24}	+
π_{15}	-	π_{25}	-

The empirical analysis

Analysing the effects of the explanatory variables in the debt reduced form equation

While the measure of loanable fund availability, nsy is expected to affect the stock of foreign debt positively, improvements in the measures of integration with the international economy, op and ttl, are expected to reduce the stock of total debt.

From the structural equations, one can't determine, as a priori, the interest rate coefficient, π_{21}, sign in the debt (reduced form) equation.

$$\pi_{21} = \frac{a_1 b_2 - b_1 a_2}{a_1 - b_1}$$

It has been discussed in a previous section that $a_1 < 0$, $b_1 > 0$ and $a_2 < 0$, as a priori. Therefore, the sign of π_{21} is determined by the sign of the interest rate coefficient in the supply (structural) equation, b_2, that is lenders response to changes in world rates of interest.

Lenders would be willing to supply more funds at a higher rate of interest to a borrower without a serious and heavy debt burden. As a result, at a higher interest rate, borrowers with healthy economies could increase their stock of foreign debt, $\pi_{21} > 0$.

On the other hand, however, lenders would not come forward to supply more funds at a higher rate of interest to a borrower with serious debt difficulties. As a result, heavily indebted countries may not be willing, or allowed, to increase their debt stock at higher world rates of interest, $\pi_{21} \leq 0$, or they would be credit constrained. In other words, interest rates may not clear the international market for capital "demand and supply are not fully equilibrated by adjustments in the interest rate spread"[6].

[6] McFadden et al. (1985), p.190.

A positive π_{21} in heavily indebted countries would suggest that: at high rates of interest borrowers would be able to convince lenders or lenders were careless or had another non-economic interests to extend extra credit to risky borrowers. With respect to the expected sign for the exchange rate coefficient π_{23}, it is determined by the sign of the exchange rate coefficient in the demand (structural) equation, a_3. That is to say, it depends on the borrowers response to a change in the exchange rate.

$$\pi_{23} = \frac{-a_3 b_1}{a_1 - b_1}$$

A negative demand response, $a_3 < 0$, would result a negative relationship between the exchange rate and the accumulation of foreign debt in an LDC, $\pi_{23} < 0$.

A negative relationship would support the IMF argument of the effect of devaluation on reducing the country's debt burden. A *negative* effect of a change in the exchange rate on the accumulation of foreign debt may mean that domestic currency was pegged at an unsustainable exchange rate. This in turn may signal (to lenders) a lack of the economic control necessary to generate enough foreign exchange for debt service. That is to say, if the debtor country devalued its over-valued currency, it would be able to service its debt and eventually reduce its total stock of debt.

Countries integrated with the international economy are expected to be able to avoid a high accumulation of foreign debt for they can sign debt contracts with softer (more favourable) terms compared to less open countries. In addition, other means of financing (foreign direct investment, for example) are usually more available to countries with higher degrees of integration with the world economy.

A permanent increase in the terms of trade index will improve the competitiveness of an economy's tradable in the international markets. Therefore, a country's net inflow of foreign exchange will increase. As a result, its ability to service its current

debt will improve and its total foreign debt stock, and eventually its need for new borrowing may start to diminish.

Empirical procedure and estimation results

As stated earlier our sample consists of the three Arab countries, Egypt, Morocco and Tunisia, over the period 1970 to 1996. The two equations (5-1) and (5-2) are simultaneously estimated for each of the sample countries using the three stage least squares 3SLS estimator. The three countries' data are then pooled for estimation by the 3SLS. Applying the rank and order conditions for identification to the structural model, it can be seen that every equation is over-identified[7].

The debt accumulation equation and the growth equation were also estimated individually by OLS and by 2SLS. The empirical results are very similar to our 3SLS results presented below and support the conclusion following from it. Appendix 7 includes these two estimations' results.

The instruments used in both models are[8]: all exogenous variables, the two endogenous variables, the real rate of growth in OECD countries, oil price inflation and the inflation gap between domestic and USA inflation, all lagged one year, and the rate of inflation in the USA. Tables 5.2 and 5.3 present the empirical 3SLS estimations, which produce consistent and efficient parameters for the growth models and the foreign debt accumulation models respectively.

The performance of the debt model is much better than that of the growth model. None of the estimated parameters in the growth model is significant, and their goodness of fit, R^2s, is too low in all four estimations. Further, serial correlation is detected in the Moroccan and the Tunisian estimations[9]. This suggests that the growth model needs to be re-specified in order to explain economic growth better in the countries under study. This re-specification work possibly implies some

[7] See Appendix 8, p.240.
[8] The same instruments are used for the 2SLS estimations.
[9] In fact, the DW test decision is inconclusive, but the LM test rejects the null hypothesis of no serial correlation.

alteration to the debt model too. However, empirical results are rather likely to improve.

Table 5.2 3SLS estimation results of the growth model

Dependent Variable: Real GNP growth = YG

Independent Variables		Egypt	Morocco	Tunisia	Pooled
Constant	C	- 0.030	- 0.122	0.891	- 0.109
		(0.062)	(0.150)	(1.180)	(0.552)
interest rate on debt	r	1.827	1.088	0.051	0.348
(π_{11})		(1.466)	(0.981)	(0.062)	(0.701)
OECD: savings / GNP	nsy	- 1.025	0.806	- 1.362	- 0.115
(π_{12})		(0.683)	(0.805)	(1.128)	(0.239)
exchange rate	e1	0.037	- 0.004	- 0.043	- 0.0009
(π_{13})		(1.229)	(0.636)	(0.551)	(0.267)
openness	op	- 0.065	- 0.217	0.090	- 0.008
(π_{14})		(0.461)	(0.658)	(0.610)	(0.117)
terms of trade index	ttl	0.011	0.036	- 0.167	0.032
(π_{15})		(0.129)	(0.214)	(1.062)	(0.843)
Sample Size		**25**			**75**
Period		**1972-1996**			
Method of estimation		**3SLS**			
R^2		**- 0.321**	**0.080**	**0.046**	**- 0.004**
DW		**2.454**	**2.635**	**2.367**	**2.418**

On the other hand, the debt accumulation model produces many significant estimated parameters and high R^2s especially in the three individual country estimations.

Table 5.3 3SLS estimation results of the foreign debt model

Dependent Variable: Total debt stock = D

Independent Variables		Egypt	Morocco	Tunisia	Pooled
Constant	C	8.653	- 7.967	4.174	- 4.119
		(1.611)	(1.960)*	(3.581)*	(0.956)
interest rate on debt	r	82.74	14.66	1.002	36.24
(π_{11})		(6.018)*	(2.641)*	(0.782)	(3.345)*
OECD: savings / GNP	nsy	25.68	16.85	1.691	78.87
(π_{12})		(1.550)	(3.363)*	(0.907)	(7.528)*
exchange rate	e1	0.768	0.246	0.504	- 0.270
(π_{13})		(2.311)*	(7.180)*	(4.194)*	(3.571)*
openness	op	- 2.890	- 0.662	0.769	- 8.571
(π_{14})		(1.858)**	(0.401)	(3.392)*	(5.896)*
terms of trade index	ttl	- 2.413	1.239	- 1.022	0.766
(π_{15})		(2.534)*	(1.456)	(4.218)*	(0.926)
Sample Size		**25**			**75**
Period		**1972-1996**			
Method of estimation		**3SLS**			
R^2		**0.729**	**0.902**	**0.962**	**0.274**
DW		**2.196**	**1.383**	**1.583**	**1.682**

Please note that all coefficients are divided by 10^{10}. Significant at 5% = *, 10% = **

The debt model produces excellent results especially when applied to Egypt's data where most of the estimated parameters are significant and have the expected signs.

Three variables (nsy, e1 and op) kept the same sign and are significant in at least three out of the four estimations. The terms of trade index, ttl, estimated coefficients are significant and have negative signs in Egypt and Tunisia but a positive sign in Morocco. The estimated coefficients of the interest rate are positive in all four estimations.

All estimated coefficients, except for nsy, are significant in Egypt's estimation. In addition, the three variables: nsy, op and ttl get the expected signs. As for the two variables, r and e1, their signs are not determined beforehand. Interest rate on debt, r, and the exchange rate, e1, are positively related to the total stock of debt.

Interest rate

All four estimations show a positive effect of the interest rate on the countries' stock of foreign debt. This variable is statistically insignificant only in Tunisia's estimation. As has been argued previously, this positive relationship may reflect an imprudent management of foreign debt by the debtor country. Alternatively, it could reflect the importance of non-economic factors to lenders (or that lenders were careless) in extending high cost loans to such a heavily indebted country.

OECD saving rate

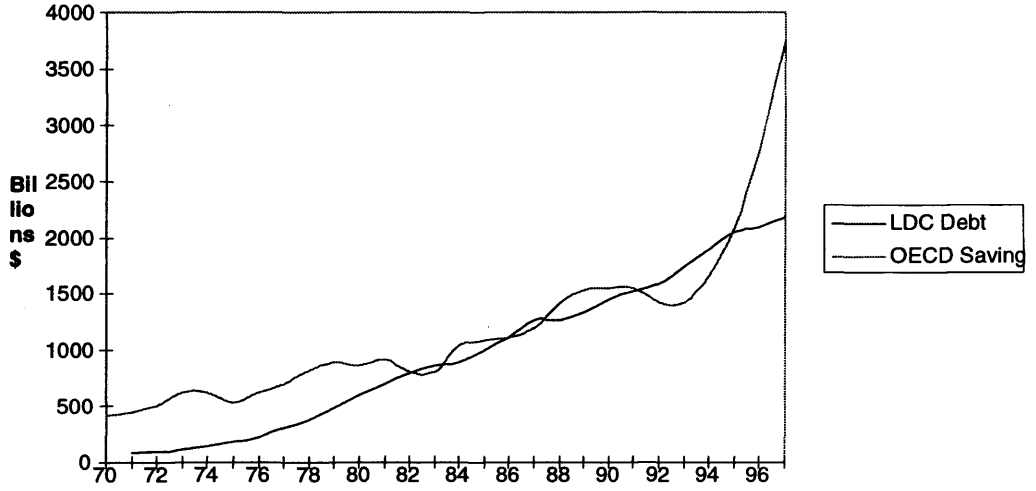
The rate of saving in rich countries, the OECD, plays a great rule in the stock of foreign debt accumulation in the three countries. As expected all four estimations produce positive coefficients for this variable and the positive effect is statistically significant in all but Tunisia's estimation.

Figure (5.1) shows the total amount of net savings in OECD countries and the total amount of LDC's debt stock. This figure is an approximate indication of the loanable fund availability in the international capital market during the period 1970-1997. From the figure it is notable that periods of excess supply dominate the

market. The distance between actual debt and available funds is relatively narrow during the debt crisis period 1982-1991.

Figure (5.1) and the estimated positive coefficients of two variables: the OECD net saving rate and the interest rate may together support the loan pushing argument. This suggests that saving accumulations in rich countries were pushed to Morocco (and probably to Egypt too) possibly through softer terms of debt contracts.
" ... the main explanation (for the sharp rise in bank lending to the LDCs) appears to lie in the abundant supply of funds to the Eurodollar market and the failure of demand for loans from borrowers in developed countries"[10].

Figure 5-2 OECD net savings and LDCs' total debt stock



Source: Total debt stock: Global Development Finance, CD-ROM, 1998.
Net Saving: OECD, National Accounts, 1999. (At price levels and PPPs of 1990).

Exchange rate

We have argued that, depreciation of a currency could have two conflicting effects. On the one hand, it causes heavier debt service obligations, when measured by the domestic currency. On the other hand, it could improve the country's international

[10] See Darity and Horn (1988), p.8.

competitiveness, hence, increase foreign exchange earnings and may reduce foreign debt burden. The final effect depends on which effect outweighs the other.
The positive sign of the exchange rate coefficient in each country's estimation suggests that, as a result of devaluation these countries suffer from the pressure of a heavier debt burden, more than enjoying international competitive gains. In other words, losses outweigh benefits from devaluation. Which does not support the IMF argument.

In fact, the three countries resorted to a direct management of their foreign exchange at least during the seventies and early eighties. However, since the late 1980s and the early 1990s all three countries have been undergoing substantial IMF reform programs, which include reforming the foreign exchange systems[11]. However, as the foreign exchange rate devalued, the burden of the stock of total foreign debt on the economy increases, possibly as a result of the increase in debt service payments due, which are not compensated by the expected increase in export revenues.

Openness

The Egyptian and Moroccan estimations show as expected, negative sign for the openness variable, however, it is statistically significant in Egypt only. Although, both countries adopted policies to open up their economies, the debt difficulties they experienced[12] may have reduced their ability to access international markets to finance their maturing debt. Alternatively, being integrated with the world economy may encourage lenders to support borrowers for non-economic reasons[13].

In contrast, Tunisia's debt stock increases as the economy moves towards integration with the world economy. In the Arab world, Tunisia is one of the countries most closely linked to the international markets. In addition, although it

[11] See Domac and Shabsigh (1999), p.6.
[12] 9 and 1 multilateral debt relief agreements signed by Morocco and Egypt, respectively, during the period: 1970 - 1995. See Table A2.3 in Appendix 2.
[13] Egypt got a 50% reduction in its debt as reward for its political stand in the II Gulf War in 1990.

has a fairly heavy debt burden[14], its financial reputation is good in the international capital markets. Its debt service payments were never in arrears or difficulties and it did not have to sign any debt relief or rescheduling agreements during the period under study.

Having said that, the positive sign of the openness coefficient in Tunisia may suggest that Tunisia chose to continue using external borrowing as the main financing means of capital inflows to meet its domestic demand for capital.

Terms of trade

The terms of trade coefficient shows mixed results. While, as expected, it is negative and highly significant in Egypt and Tunisia, it is positive but insignificant in Morocco and in the pooled data estimations. Improvements in the terms of trade, in Egypt and Tunisia, reduce the country's stock of foreign debt, possibly as a result of the increase in export revenues and economic growth.

[14] In 1996 Debt / GNP is 54% in Tunisia compare to 46% and 61% in Egypt and Morocco, respectively.

Conclusion

This chapter's main aim is to examine the accumulation of foreign debt stock in the three Arab countries. To achieve this aim a simple model is introduced which is built on an ad hoc functional relationship of supply and demand in the international foreign debt markets.

Given the model's simple structure, the empirical results of the foreign debt accumulation equation are reasonably good. Furthermore, these results are able to reflect some facts of the countries under study and also to touch on some of the foreign debt arguments in the literature.

The positive and significant estimated coefficient for the exchange rate in each country's estimation suggests that, the IMF usual condition, among others, for economic reforms (a devaluation) is in fact detrimental in the three countries under study.

The model is also able to reflect the difference between Tunisia and the other two countries with respect to their debt difficulties. Tunisia, a country with a good debt reputation, can acquire more foreign debt as it opens its economy to the international markets.
However, as Morocco and Egypt, both of whom have had debt difficulties, open their economies to the world economy, it become easier for lenders to limit their access to the international capital markets.

Furthermore, the model results were able to touch upon the "loan pushing" argument. Therefore, it could be concluded that Morocco (and possibly Egypt too) was not credit constraint during the period under study; rather loans were possibly pushed to it. At higher rates of interest and higher rates of OECD savings, lenders are able to push loans to these countries.

The estimation results show how pooled data estimation may lead to a misleading[15] conclusion with respect to the issue under study, debt accumulation. Therefore, individual case studies are possibly more appropriate to reflect each country's attributes and problems.

Finally, many suggestions could be offered to improve the model's performance. They are possibly related to the bad performance of the growth equation. This equation could be re-specified by taking into account some long run factors such as population and technology. In addition, other suggestions are possibly related to the model's functional form. Another functional form and a more coherent framework should be worked out to improve the model. The following chapter is, in fact, an alternative approach to the problem.

[15] See for example the estimated coefficients of exchange rate, e1, in Table 5-2.

CHAPTER 6 *Modelling Government And Private Sectors Demand For Foreign Borrowing*

Introduction

In chapter four, we examined the role that can be plaid by the stock of foreign debt in the current account. In this chapter, however, we intend to study how the stock of foreign debt accumulated.

In general, the interaction of demand and supply of foreign capital in the international markets for capital will determine the actual debt. Modelling demand and supply behaviour is ideal to understand all factors contributed to the actual debt position.
In fact, we assume that in a plane of quantity and price suppliers determine a supply curve, for each country, that reflects their perception of this country's creditworthiness and reputation. The borrower country will determine its demand curve in the same plane, where the interaction of the two curves will then determine the equilibrium amount of debt and the rate of interest.

Here, we assume that each country is a small borrower who has no power to affect prices in the international markets for capital. In addition, we assume that the international creditors can supply as much fund as demanded by borrowers at the market rate of interest, given a minimum level of creditworthiness and reputation. As a result, we confine our efforts in this chapter to examining borrower's behaviour in determining their demand for loanable fund.

Modelling demand

This chapter aims at building a theoretical basis for the demand for foreign debt to study how it evolves over time. An empirical model is then specified and examined using data from the three Arab countries.

The theoretical model starts with the assumption that in an LDC two sectors of the economy demand foreign savings, namely the government sector and the private sector. Obviously, each sector has a different objective function and a different set of constraints that determine its demand.
Having said that, one does not rule out the fact that these two sectors' demands are interrelated. Sachs (1984; p.11) argued that " ... the pure borrowing model

should differentiate between the private and public sectors and take seriously the empirical fact that most international lending to developing countries is to the public sector, or to the private sector with public sector guarantees".

Since domestic capital markets in the developing countries are usually very limited, the public and private sectors resort to the international capital markets to bridge the gap between national required investment and available domestic savings, and possibly to shelter consumption from income fluctuation. The government sector demands foreign capital for several reasons. In general, a government borrows to bridge the gap between its expected revenue and its required expenditure. On the other hand, the private sector demand for foreign capitalis influenced by the need to finance imports of intermediate goods for domestic investment projects.

Government sector

Realising that, the government does not only depend on power to coerce, but also on the consent of the governed. In other words, it needs to provide enough (or minimum level of) services to gain people's acceptance in order to remain in power. In addition, each country does not live in isolation; rather it has relationships with the rest of the world. To preserve these relationships, the government needs to seriously consider interests of the rest of the world when making decisions that have international dimension.

We assume that the government has a primary objective, that is to continue in power. To achieve this objective, the government works toward acceptable levels of national income, government expenditure and business-friendly environments for investment. In fact, through these three sub-objectives the government can gain, we assume, national and international acceptance and, as a result, may avoid a change in government.

While the first two sub-objectives help the government to attain the main interests of its citizens and/or the national pressure groups, the last is to indicate to the

international community that the country is integrated in the international economy and abides by its laws.
To formulate the government's objective function we follow Theil's (1964) specification of a quadratic preference function, this consists of controlled and non-controlled variables. The government maximises this function subject to a set of constraints. The constraints are linear functions that relate each non-controlled (sub-objective) variable to all controlled variables plus other variables.

An economic growth model and a government expenditure model are specified to represent the government's sub-objectives. The sub-objective "business-friendly environment for investment" is embodied in the growth and government expenditure models, as business-friendly measures. An empirical model for government demand for foreign capital is specified and empirically estimated by OLS.

Private sector

As far as the private sector's demand is concerned, it demands foreign capital to finance investment projects. It is argued that foreign borrowing is one asset (with negative returns) among others in the sectors' optimal financial portfolio.
To model the private sector's demand we resort to the assets demand literature. An individual firm plans its production for n periods in the future, depending on technology and on input and output prices. At each point of time, the firm have three sources of returns: profits from output production sales, returns from two portfolios: financial and real assets. Foreign borrowing is a negative asset in the financial portfolio.

We assume that the private sector consists of rational homogeneous firms which are risk avers. This assumption implies that one can aggregate firm demands to establish the private sector demand for foreign borrowing. In addition, assuming weakly separable utility function will enable us to examine firm behaviour in maximising its utility of each portfolio separately, subject to a budget constraint. Since foreign borrowing is a negative asset in the individual firm financial

portfolio, we examine the firm's behaviour in determining the optimal financial portfolio.

To determine its optimal financial portfolio, a firm maximises the total returns subject to total wealth. Using the portfolio approach and the mean-variance analysis, we can formulate the firm's demand for foreign capital.

Private sector's data

Data on the private sector's stock of foreign debt is usually unavailable. Here, the difference between the "total stock of debt" and the "public and publicly guaranteed debt" (reported in the World Bank's Global Development Finance) is considered to represent the private sector stock of foreign debt. However, the "public and publicly guaranteed debt" surely contains debt belongs in the private sector, but which is difficult to isolate.

Apart from data inaccuracy, it could be argued that the ability of the sector to borrow internationally depends on some observed and unobserved factors, such as the private sector's "hidden accounts" in international commercial banks. Suppliers of credit are possibly able to disclose (and have access to) these unobserved "hidden accounts" factors, and accordingly determine the supply curve appropriate to this specific private sector.

The argument of the existence of an unobserved financial potential in the private sector and its relation to the sector's foreign borrowing behaviour, could add a new perspective to the hidden economy issue[1], which is beyond the scope of this thesis. Nevertheless, the above argument implies that the amount of loanable funds available to the private sector is based not only on observed but also on unobserved financial potentials. This may lead to an interesting phenomena, where the private sector stock of debt is, in fact, much larger than its observed financial potentials.

[1] J. Williamson in fact reads the 28% decline in per capita GNP in Bolivia (the result of the debt crisis) as how much of the economy forced underground. See his discussion to J. Sachs (1986), p. 432.

Inter-related sectors

Although private and government sectors have their demand functions distinct, they are in fact interrelated. The private sector's demand and supply for foreign capital is strongly affected by the public sector's behaviour and reputation in the international capital markets.

When the public sector is able to access the international capital market, international creditors will be encouraged to deal with the private sector, with or without the public sector guarantee. Similarly, however, "private companies and banks are able to tap sources of funds not normally open to a sovereign borrower. This gives the country cost advantages and the potential to increase its total borrowing rapidly if need be"[2].

Furthermore, when the government sector signs new foreign debt contracts, the private sector may read this new capital inflow as possible opportunities for private investment. If the government borrows an amount of foreign fund to finance new infrastructure projects, for example, the private sector may expects higher rates of economic growth, and in turn more private investment opportunities. In an economy with capital shortages, the sector will have to resort to foreign funds to finance its new expected investment projects.

Therefore, the two models, of the two sectors, are to be combined together in order to estimate the country's demand for foreign funds. Besides that, not only that the combined model might be able to reflect the inter-relationship between the two sectors' debt but also the relative size of the private sector debt, as the available disaggregated data is not accurate.

[2] Mehran (1985), p. 101.

The government sector demand

The government is assumed to be able to accomplish its primary objective (to continue in power) if it is able to achieve three sub-objectives: an increase in national income, an increase in government expenditure and an improvement in the economy's business-friendly environments for foreign investment. However, we admit that the measure for "business-friendly environments" is particularly embodied in the first two sub-objectives. Thus determinants of income growth and government expenditure are to be reviewed below.

Following Theil's (1964) specification of a quadratic preference function, the government is assumed to facing two sets of variables: controlled and non-controlled variables. The non-controlled variables are interesting from the government's point of view, and its preference levels depend on them. The two sets of variables are linearly related. Therefore, the government's problem is to maximise a quadratic preference function subject to a set of constraints that linearly connect the two sets of variables.
In our model we assume that the government faces two non-controlled variables namely the economic growth and the government expenditure and two controlled variables, foreign debt and exchange rate[3].

The model with no uncertainty

The objective function

At the beginning of each period and in a world with no uncertainty, a government is assumed to maximise an objective function, subject to a system of constraints. Here, we consider a particular form of government objective function following Theil (1964) where there are m real variables, $x_1,..., x_m$, which are under the government control. These real variables are elements of vector X of mx1 dimension. The elements of this column vector are to be called "controlled variables". Similarly, the government has another vector Y of nx1 dimension whose elements, $y_1, ..., y_n$, are beyond its control. The government is interested in achieving an optimum level of each of the elements of Y.

[3] Fixed exchange rate system is adopted in the three countries and for most of the period under study.

Further, the government's preference is (assumed) to be best represented by the means of a quadratic preference function:

$$\theta(X,Y)=a'X+b'Y+\frac{1}{2}X'AX+\frac{1}{2}Y'BY \qquad (6\text{-}1)^4$$

Where, a and b are mx1 nx1 vectors of fixed elements, respectively.
A and B are matrices, mxm and nxn respectively, of fixed elements.

The constraints

Next, we assume that each of the non-controlled variables, Y, depends linearly on all controlled variables, X. That is to say, vectors X and Y are linearly related such as:

$$Y = RX + S \qquad (6\text{-}2)$$

Where

R is an nxm matrix of fixed elements describing the multiplicative structure of the constraints,
S is an nx1 vector of (stochastic or) non-stochastic variables.

First and second order maximum conditions

Maximising the government preference function subject to the constraints will result in conditions under which desired levels of X and Y are obtained, X° and Y° respectively.

One mathematical approach to solve a maximisation problem is by eliminating the non-controlled variables, Y, from the preference function and replacing it by the constraints. Then we can differentiate the function with respect to the controlled variables, X.

Now, substituting the constraints (6-2) into the preference function (6-1):

$$\theta(X,RX+S)=a'X+b'(RX+S)+\frac{1}{2}X'AX+\frac{1}{2}(RX+S)'B(RX+S)$$

$$\theta(X,RX+S)=a'X+b'RX+b'S+\frac{1}{2}X'AX$$
$$+\frac{1}{2}(X'R'BRX+S'BS+X'R'BS+S'BRX)$$

---

[4] For simplicity, Theil's cross product: $(X'CY+Y'C'X)$ is ignored here, without any loss in generality.

Where, $X'R'BS = S'BRX$ and both are scalars.

Rearranging:

$$\theta(X, RX+S) = \left(b'S + \frac{1}{2}S'BS\right) + (a' + b'R + S'BR)X + \frac{1}{2}X'(A + R'BR)X \qquad (6\text{-}3)$$

Let

$$k_0 = [b'S + \tfrac{1}{2}S'BS] \qquad (6\text{-}4)$$

$$k = [a' + b'R + S'BR]' \text{ Or} \qquad (6\text{-}5)$$

$$k = \begin{bmatrix} I & R' \end{bmatrix} \begin{pmatrix} a & 0 \\ b & B \end{pmatrix} \begin{pmatrix} 1 \\ S \end{pmatrix}$$

$$K = [A + R'BR] \qquad (6\text{-}6)$$

$$K = \begin{bmatrix} I & R' \end{bmatrix} \begin{pmatrix} A & 0 \\ 0 & B \end{pmatrix} \begin{pmatrix} I \\ R \end{pmatrix}$$

Where

k_0 is a scalar, k is an mx1 vector,

K is an mxm symmetric matrix.

Then substituting (6-4), (6-5) and (6-6) into (6-3):

$$\theta(X, RX+S) = k_0 + k'X + \frac{1}{2}X'KX \qquad (6\text{-}7)$$

Differentiating (6-7) with respect to X, provided that K is non-singular:

$$\frac{\partial\theta}{\partial X} = 0 + k + KX = 0$$

$\therefore$ the stationary point is

$$X^\circ = -K^{-1}k \qquad (6\text{-}8)$$

For X° to be maximum:

$$\frac{\partial^2\theta}{\partial X^2} = K\langle 0$$

$\therefore$ If K is negative definite, then it is a sufficient condition for X° to be maximum. Where, (6-8) is the government's optimal level of the controlled variables, which could be used to drive the optimal level of the non-controlled variables when substituted in (6-2): $Y = RX + S$.

The model with uncertainty

Uncertainty and certainty equivalence

Relaxing the assumption that the government lives in a world with no uncertainty, and introduce uncertainty through the additive structure of the constraints, where the non-controlled variables, Y, are determined by X and a vector of random variables is included in S.

Since the non-controlled variables, Y, contains stochastic elements, the government maximises the expected preference function $E\theta(X,Y)$ subject to stochastic constraints: $Y = RX + S$.

It is assumed[5] that the elements of the vector S are subject to a joint distribution with finite variances. The means, variances, and covariance of these elements are independent of the controlled variables, X.

Therefore, the problem becomes: the government maximises the preference function $E\theta(X,Y)$ subject to the stochastic system of constraints $Y = RX + S$.

First and second order conditions

Here we re-specify the objective function by eliminating the non-controlled variables, Y. First we set up the government's maximisation problem under uncertainty:

$$E\theta(X,RX+S) = E(k_0) + E(k')X + \frac{1}{2}X'KX \qquad (6\text{-}9)$$

Where, K is independent of S as can be seen from previous definition of K, (6-6), and hence it is non-stochastic.

For any level of X attained by the preference function (6-7), it is possible for the preference function (6-9) to attain the same level of X when the random vector S coincides with its expectation: $S = E(S)$, then:

$$k_0 = b'E(S) + \tfrac{1}{2}E(S'BS) \qquad (6\text{-}4)`$$

[5] Theil (1964); p.54.

$$E(k) = E[a' + b'R + S'BR]' \quad (6\text{-}5)$$
$$K = [A + R'BR] \quad (6\text{-}6)$$

Here, K is not affected, as it is independent of S. But since k is a linear function of S, then, when S is replaced by $E(S)$, we obtain $E(k)$. Therefore, the preference level attained under the condition $S = E(S)$ is:

$$\theta(X, RX + E(S)) = b'E(S) + \frac{1}{2}E(S')BE(S) + E(k')X + \frac{1}{2}X'KX \quad (6\text{-}10)$$

Therefore, comparing (6-9) and (6-10) where $S = E(S)$ will result:

$$\begin{aligned} E\theta(X, RX + S) - \theta(X, RX + E(S)) &= E\left(b'S + \frac{1}{2}S'BS\right) - b'E(S) - \frac{1}{2}E(S')BE(S) \\ &= b'E(S) - b'E(S) + E\left(\frac{1}{2}S'BS\right) - \frac{1}{2}E(S')BE(S) \\ &= \frac{1}{2}E(S'BS) - \frac{1}{2}E(S')BE(S) \\ &= \frac{1}{2}\sum_i\sum_j b_{ij}Cov(S_i, S_j) \end{aligned} \quad (6\text{-}11)$$

Since it has been assumed that the variances and covariance of the elements of S are independent of X, then (6-11) is a constant.

It follows that, the expected preference level, $E\theta(X, RX + S)$, could be obtained from the preference level $\theta(X, RX + E(S))$ only by adding a constant.

Therefore, the two functions (6-9) and (6-10) must reach their maximum for the same X.

The stationary point for (6-10) is:

$$\hat{X} = -K^{-1}E(k) \quad (6\text{-}12)$$

Where, $\hat{X}$ is the expectation of X^*.

Similar to the no uncertainty case, $\hat{X}$ is considered a maximum if K is negative definite.

Finally, it could be concluded that the government preference function under certainty equivalence case differs only by a constant, which has no effect when finding the first order condition when compared to the case where no uncertainty exists.

Hence, (6-8), or (6-12), and (6-2) model government behaviour in determining the controlled and the non-controlled variables to achieve at least a minimum national and international acceptance in order to continue in power.

Empirical model

We have assumed that the government is interested in two non-controlled variables, economic growth and government expenditure, and two controlled variables: foreign debt and exchange rate.
In fact, models (6-2) and (6-8) or (6-12) are empirically testable. Where model (6-8):

$$X^{\circ} = -K^{-1}k$$

This model shows each of the two controlled variables in vector X is a function of all variables in the vector S. Estimating (6-8) to find the optimal X, which is then substituted in (6-2) to find the optimal Y:

$$Y^{\circ} = RX^{\circ} + S$$

The government works to achieve Y°, as this will assure a minimum levels of national and international acceptance and, as a result, the government remains in power. From this procedure, it is notable that both sets of variables are to be functions of all variables in the vector S. Below, we discuss the variables included in this vector S.

We argue that, elements of vector S in the model could be grouped into two sets of variables. The first set contains variables that reflect country characteristics such as education level, population growth, rate of inflation, and degree of openness. The second set, however, should contain variables that measure economic shocks and economic policies, such as terms of trade, fiscal revenues

and world rates of interest. Obviously, while the country characteristics set reflects long-term changes, the other set will reflects short-term changes and effects.

The next section will review the literature on economic growth and government expenditure. This review intends to find the determinants of these two non-controlled variables. These determinants are the literature's view on what variables should be included in the vector S.

Determinants of economic growth

The neo-classical growth theory explains economic growth as the outcome of interactions between two factors: technology and conventional inputs, capital and labour. However, in the long run, the economy will expand as a result of technological progress, which is beyond the control of policy makers. Therefore, economic growth is exogenously determined under the neo-classical theory. This suggests that economic policies have no effect on growth in the steady state; rather it can affect growth during transition from a steady state period to another. The neo-classical models have been interpreted as predicting that per capita income across countries would tend to converge to the same level, assuming all countries had access to the same technology and shared similar rates of saving and investment.

In fact, since the late eighties, the neo-classical growth models have been under attack, for they fail to explain observed differences in per capita income across countries. As a result, the endogenous growth theory emerged and led to a welcome resurgence of interest in the determinants of economic growth. Within the framework of the endogenous growth theory, models were built to examine the long run effects of economic policies and economic and political shocks on economic growth.

Mankiew Romer and Weil (1992) suggested that differences in per capita income across countries are best explained by using an augmented Solow growth model. Investment in human capital is believed to enhance technological progress, and eventually growth. Mankiew et al (1992) empirically show that human capital accumulation can be an important source of long-run growth. Their model is an augmented neo-classical Solow-Swan model, which includes human capital in the production function and saving decisions of the economy.

Solow model

In the Solow model, the economy has two factors of production, capital K and Labour L. Both are paid their marginal products. For a given level of technology, A, the economy produces output Y using K and L.

Assuming a Cobb-Douglas production function:

$$Y_t = K_t^{\alpha}(A_t L_t)^{1-\alpha} \qquad (6\text{-}13)$$

Where $0<\alpha<1$

The model assumes that L and A grow exogenously at rates n and g, respectively:

$$L_t = L_0 e^{nt} \qquad (6\text{-}14)$$

$$A_t = A_0 e^{gt} \qquad (6\text{-}15)$$

Therefore, the number of effective units of labour, A_tL_t, grows at n+g.

Here, saving rate, s, population growth, n, and technology progress, g, are all exogenous.

Suppressing the time subscript t for simplicity and let:

$$k = \frac{K}{AL}, \text{ And} \qquad y = \frac{Y}{AL}$$

Where k is the stock of capital per effective unit of labour.

y is the level of output per effective unit of labour.

Dividing (6-13) by AL:

$$\frac{Y}{AL} = K^{\alpha}(AL)^{-\alpha} \Rightarrow \quad y = \left(\frac{K}{AL}\right)^{\alpha} \quad \Rightarrow \quad y = k^{\alpha}$$

It has been assumed that, the economy invests a constant fraction s of output, and that the stock of capital diminishes by the growth in population, the progress in technology and the rate of depreciation. Hence, the evolution of k follows:

$$\dot{k}(t) = sy - (n + g + \delta)k$$

Or $$\dot{k}(t) = sk^{\alpha} - (n + g + \alpha)k \qquad (6\text{-}16)$$

At the steady state: $\dot{k}(t) = 0$, and $k = k^*$ then re-arranging (6-16)

$$s(k^*)^{\alpha} = (n + g + \delta)k^*, \text{ then}$$

$$k^* = \left(\frac{s}{(n + g + \delta)}\right)^{\frac{1}{1-\alpha}} \qquad (6\text{-}17)$$

Solow's main prediction concerns are the impact of saving, s, and population growth, n, on real income.

Taking logarithms of (6-13) and (6-17)

$$\ln Y = \alpha \ln K + (1-\alpha)\ln A + (1-\alpha)\ln L \qquad (6\text{-}13a)$$

$$\ln k^* = \left(\frac{1}{1-\alpha}\right)(\ln s - \ln(n + g + \delta)) \qquad (6\text{-}17a)$$

Then, rearrange (6-13a)

$$\ln Y - \ln L = \alpha \ln K - \alpha \ln L - \alpha \ln A + \ln A$$

Rearrange again:

$$\ln\left(\frac{Y}{L}\right) = \ln A + \alpha \ln\left(\frac{K}{AL}\right)$$

Or $$\ln\left(\frac{Y}{L}\right) = \ln A + \alpha \ln k \qquad (6\text{-}18)$$

Taking logarithms of (6-15)

$$\ln A = \ln A_0 + gt \qquad (6\text{-}15a)$$

For $k = k^*$, substitute (6-15a) and (6-17a) into (6-18)

$$\ln\left(\frac{Y}{L}\right) = \ln A_0 + gt + \left(\frac{\alpha}{1-\alpha}\right)(\ln s - \ln(n + g + \delta))$$

Rearranging:

$$\ln\left(\frac{Y}{L}\right) = \ln A_0 + gt + \left(\frac{\alpha}{1-\alpha}\right)\ln s - \left(\frac{\alpha}{1-\alpha}\right)\ln(n + g + \delta) \qquad (6\text{-}19)$$

Mankiew et al (1992) estimated equation (6-19). While, the empirical results show expected signs (of the saving and the population growth coefficients, according to the Solow model), the estimated coefficients show very large magnitudes compare to those that the model expects. This does not support the Solow model. As a result, Mankiew et al (1992) examined the effect of splitting capital into physical and human capital on the Solow growth model.

Mankiew et al (1992) extension

Mankiew et al (1992) explored the effects of adding human capital accumulation to the Solow model. This produced the following production function, which splits capital into physical and human:

$$Y_t = K_t^{\alpha} H_t^{\beta} (A_t L_t)^{1-\alpha-\beta} \qquad (6\text{-}20)$$

Where, H is the stock of human capital, and other notations are as defined above. Re-writing (6-20) in per effective unit of labour and suppressing time scripts for simplicity:

$$y = k^{\alpha} h^{\beta}$$

Similar to what has been shown above in the Solow model, physical and human capital accumulate according to the following functions:

$$\dot{k}(t) = s_k y - (n + g + \delta)k$$

Or $$\dot{k}(t) = s_k k^{\alpha} h^{\beta} - (n + g + \alpha)k \qquad (6\text{-}21)$$

$$\dot{h}(t) = s_h y - (n + g + \delta)h$$

Or $$\dot{h}(t) = s_h k^{\alpha} h^{\beta} - (n + g + \alpha)h \qquad (6\text{-}22)$$

Here Mankiew et al (1992) assume that the same production function applies to human capital, physical capital and consumption, and that human capital depreciates at the same rate as physical capital. Therefore, similar to the Solow model, a decreasing return to scale prevails, $(\alpha + \beta) \langle 1$.

Dividing (6-21) by k, and realising that at steady state: $\dot{k}(t) = 0$, and $k = k^*$ and $h = h^*$:

$$s_k k^{*\alpha-1} h^{*\beta} = (n+g+\alpha) \quad \Rightarrow \quad k^{*\alpha-1} = s_k^{-1} h^{*-\beta}(n+g+\alpha)$$

$$k^* = \left(s_k^{-1} h^{*-\beta}(n+g+\alpha)\right)^{\frac{1}{\alpha-1}} \text{ Rearranging:}$$

$$k^* = \frac{(n+g+\delta)^{\frac{1}{\alpha-1}} h^{*\frac{-\beta}{\alpha-1}}}{s_k^{\frac{1}{\alpha-1}}} \qquad (6\text{-}21a)$$

Similarly, dividing (6-22) by h, and realising that at steady state: $\dot{h}(t) = 0$, and $h = h^*$ and $k = k^*$:

$$s_h k^{*\alpha} h^{*\beta-1} = (n+g+\alpha) \quad \Rightarrow \quad k^{*\alpha} = s_h^{-1} h^{*1-\beta}(n+g+\alpha)$$

$$k^* = \left(s_h^{-1} h^{*1-\beta}(n+g+\alpha)\right)^{\frac{1}{\alpha}} \text{ Rearranging:}$$

$$k^* = \frac{(n+g+\delta)^{\frac{1}{\alpha}} h^{*\frac{1-\beta}{\alpha}}}{s_h^{\frac{1}{\alpha}}} \qquad (6\text{-}22a)$$

Now, equating (6-21a) and (6-22a) in order to derive the steady state human capital per effective unit of labour:

$$h^{*\frac{1-\alpha-\beta}{\alpha(\alpha-1)}} = \frac{s_k^{\frac{1}{\alpha-1}} s_h^{\frac{-1}{\alpha}}}{(n+g+\delta)^{\frac{1}{\alpha(\alpha-1)}}}$$

$$h^* = \left(\frac{s_k^{\alpha} s_h^{1-\alpha}}{(n+g+\delta)}\right)^{\frac{1}{1-\alpha-\beta}} \qquad (6\text{-}23)$$

Equation (6-23) is the steady state human capital per effective unit of labour.

Using the same procedure, but solving for $\dot{k}^*$, we can get the steady state physical capital per effective unit of labour:

$$k^* = \left(\frac{s_k^{1-\beta} s_h^{\beta}}{(n+g+\delta)} \right)^{\frac{1}{1-\alpha-\beta}} \qquad (6\text{-}24)$$

Taking logarithms of (6-20)

$$\ln Y = \alpha \ln K - \alpha \ln(AL) - \beta \ln(AL) + \ln A + \ln L + \beta \ln H$$

Re-arranging:

$$\ln Y - \ln L = \ln A + \alpha \ln k + \beta \ln h \qquad (6\text{-}20a)$$

Substituting (6-23), (6-24) and (6-15a) into (6-20a):

$$\ln\left(\frac{Y}{L}\right) = \ln A_0 + gt + \alpha \ln\left(\frac{s_k^{1-\beta} s_h^{\beta}}{(n+g+\delta)} \right)^{\frac{1}{1-\alpha-\beta}} + \beta \ln\left(\frac{s_k^{\alpha} s_h^{1-\alpha}}{(n+g+\delta)} \right)^{\frac{1}{1-\alpha-\beta}}$$

$$\ln\left(\frac{Y}{L}\right) = \ln A_0 + gt + \frac{\alpha(1-\beta)}{1-\alpha-\beta} \ln s_k + \frac{\alpha\beta}{1-\alpha-\beta} \ln s_h - \frac{\alpha}{1-\alpha-\beta}(n+g+\delta)$$
$$+ \frac{\beta\alpha}{1-\alpha-\beta} \ln s_k + \frac{\beta(1-\alpha)}{1-\alpha-\beta} \ln s_h - \frac{\beta}{1-\alpha-\beta} \ln(n+g+\delta)$$

$$\ln\left(\frac{Y}{L}\right) = \ln A_0 + gt + \frac{\alpha}{1-\alpha-\beta} \ln s_k + \frac{\beta}{1-\alpha-\beta} \ln s_h + \frac{\alpha+\beta}{1-\alpha-\beta}(n+g+\delta)$$

Then

$$\ln\left(\frac{Y}{L}\right) = \ln A_0 + gt + c_1 \ln s_k + c_2 \ln s_h - c_3 \ln(n+g+\delta) \qquad (6\text{-}25)$$

Where $c_1 = \frac{\alpha}{1-\alpha-\beta}$ $\quad c_2 = \frac{\beta}{1-\alpha-\beta}$ $\quad c_3 = \frac{\alpha+\beta}{1-\alpha-\beta}$

Mankiew et al (1992) estimated the above equation (6-25), which is called the augmented Solow model. Their estimation results show that adding human capital to the Solow model improves its performance with respect to the magnitude of the estimated coefficients, which become more consistent with the Solow model.

Economic policies and economic growth

In the steady state, Solow growth model suggests that the economic growth depends on two exogenously determined factors: technological progress and population growth. The saving rate can influence growth in the short run only, due to the assumption that capital exhibits diminishing returns to scale.

Therefore, this framework does not allow economic policies to play any long term role in economic growth. Rather, they are allowed to affect output or output growth rate during transition states of the economy only.

On the other hand, however, endogenous growth models are able to establish long-term linkages between economic policies and economic growth[6].
Many studies have been carried out to examine the possible linkages between long-term growth and a variety of policy measures. Economic policies, in fact, can affect long run growth, when they are either directed towards encouraging the accumulation of capital and/or towards facilitating a stable business friendly environment. Hence, whatever the aim, economic policies could affect economic growth.

The Ghura and Hadjimichael (1996) study extends a neo-classical growth model and follows the endogenous growth framework to create linkages between public policies and economic growth in the long run. In fact, they simply added to Mankiew et al (1992) a 1xm raw vector of policy and other variables, X. This vector of policy variables can affect the level of technology and efficiency in the economy. Therefore, their technology grows at:

$$A_t = A_0 e^{gt+X\theta} \qquad (6\text{-}15b)$$

where θ is an mx1 vector of coefficients related to these policy and other variables, and other notations are as previously defined.

Hence, the growth equation is the same as Mankiew et al (1992) equation (6-25), with an extra vector of policy and other variables:

$$\ln\left(\frac{Y}{L}\right) = \ln A_0 + gt + X\theta + c_1 \ln s_{kh} + c_2 \ln s - c_3 \ln(n+g+\delta) \qquad (6\text{-}26)$$

Ghura and Hadjimichael (1996) empirically tested this model (6-26) using data for 29 African countries during the period 1981-1992. The GLS estimator is used to correct for heteroscedasticity.

[6] The assumption here is non-decreasing returns to scale.

Their vector of economic policies includes policies that affect: inflation, budget deficits and exchange rates, and other variables such as: changes in the terms of trade, weather and political freedom.

Their empirical results indicate that "policy environment" have significant effect on growth. It has been shown that economic growth is stimulated by government policies which reduce the budget deficit (without lowering government investment), reduce inflation, increase the terms of trade to maintain external competitiveness, promote structural reforms, increase human capital development and reduce population growth.

The literature on economic growth suggests several variables that have important roles in determining growth. Therefore, these variables comprise some of elements of the vector S in our government model (6-8): $X^{\circ} = -K^{-1}k$,
Where $k = [a' + b'R + S'BR]'$ as shown in (6-5).
The following are the determinants of economic growth as suggested by standard economic growth literature:

population growth	investment
inflation	terms of trade
government budget deficit	export growth
openness	national income

The following section will review the standard literature on the determinants of government expenditure.

Determinants of government expenditure

Wagner's law

It is impossible to write about determinants of government expenditure without mentioning the important contribution of Adolph Wagner at the end of the nineteenth century. His contribution is related to the behaviour of government expenditure over a long period of time.

In the nineteenth century, many Western countries had experienced the phenomenon of a growing public sector in relation to national output. Wagner argues that this phenomenon is more than a simple historical accident. Studying historical evidence, he was able to formulate generalisations about government expenditure, which were later called "Wagner's Law".

He found that long-run growth in government expenditure is derived from growth in the economic activity of a country. Further, government expenditure grows in proportion to the country's per capita output. In fact, he found the growth in government expenditures is more than proportional, which worries policy-makers as this implies that there is a limit to which government expenditure can be controlled. Therefore, the growing complexity of economic activity requires a greater involvement of the public sector in the country's total output.

Peacock and Wiseman(1967, p.18) stated that Wagner suggests that "... the need for increased participation by the state originates in the "inevitable" centralization of administration and in the atomization of social and economic life that results from economic development". In addition, Peacock and Wiseman (1967) argued that Wagner's view of the superiority of the public corporation to the private joint stock enterprise, is the main reason behind his analysis of the growing involvement of the government sector in an economy's output, not only in the material production but also in the provision of other economic and social services.

Peacock and Wiseman (1967) argued that, Wagner's law is not independent of his own view with respect to the rule of the state. In addition, they could not consider his argument as a general law (applicable to all countries and in all periods of

time). Rather, they accept his general approach, but do not consider his "law" more than a valuable statistical observation. Consequently, they suggested an alternative approach to the study of public expenditures, in which they not only consider long-term, but also short-term questions.

In examining the data of British government expenditure, they realised that the major peaks were during the two world war periods. Furthermore, they observed a decline in government expenditure after the wars, but not to pre-war levels. "In Britain, the plateaus of expenditure establish themselves at successively higher levels, and the share of government expenditure in national product remains much greater after the wars than it was immediately before them"[7].

The people views of a reasonable burden of taxation and a desirable level of public expenditure are of great relevance to Peacock and Wiseman's explanation of the time pattern of growth in public expenditure. Where during normal and quite periods, the divergence between the two views (revenue and expenditure) tends to be fairly stable.
However, this divergence could be adjusted by social disturbances, which could lead to people re-appraising their attitudes and, thereby, create a displacement effect.
"People will accept, in a period of crisis, tax levels and methods of raising revenue that in quieter times they would have thought intolerable, and this acceptance remains when the disturbance itself has disappeared"[8].

Peacock and Wiseman argued that, although the "displacement effect" has a significant role, it can't (alone) explain the evolution of the public sector. Finally, using the concept of a "displacement effect", Peacock and Wiseman analysed the possibly "permanent" effects of some variables on government expenditure. In particular, they discussed the effects of population, prices and unemployment.

To construct a model of demand for public services, some studies are based on the optimising behaviour of the parties demanding public services. In fact, these

[7] Peacock and Wiseman (1967), p. 26.
[8] Ibid, p. 27.

studies have resorted to the optimisation literature of the consumer theory, where they aggregate individual demands to establish the society's demand for public service.

In these studies, however, it has been argued that a society's demand is not independent of political process. Furthermore, it is assumed that "voters are utility maximizing and that political parties are vote maximisers"[9]. Therefore, any demand model should reflect this political process. "The median voter model" is one main strand of the literature that takes the society demand for a single public good to be the median of the individual demands for the good. Therefore, changes in government expenditure can be explained by factors that generate the median voter's demand for public output, and by factors affecting the cost of supplying public services.

On the other hand, other studies argue that the strong assumptions of the median-voter model are difficult to meet. Where, the model assumes "that the public sector's budget is balanced, that there is representative democracy everywhere, and that the individual is the best judge of his own welfare - in which case, the government is assumed to be neutral, in the sense that it does not enter directly in decisions about the level of public spending"[10].

Dao argued "another possible objection to the median voter model stems from the fact that it hinges upon the degree of democratization in a country. Its application may thus be inappropriate for less developed economies. Since per capita income is used as a measure of economic development, and since development is associated with a voter's ability to articulate his/her demand for public services, we think that it would be more appropriate to formulate that the person with mean income is decisive"[11].

The mean-voter model

Dao (1994) modified the model developed by Atkinson and Stigiltz (1980) to become that the person with mean, rather than median, income is decisive. That is

[9] Brown and Jackson (1990); p.109.
[10] Taiwo (1991), p. 154.
[11] M. Dao (1995); p.68.

to say, the government behaves as if it maximise the preferences of the mean-voter subject to a budget constraint. He assumed a logarithmic linear functional form for his demand for public good model:

$$\ln G = \alpha_0 + \alpha_1 \ln Y_{pc} + \alpha_2 \ln P_{AV} + \alpha_3 \ln U + \alpha_4 \ln N_d \qquad (6\text{-}27)$$

Where

G = total quantity of public good, Y_{pc} = per capita income,

P_{AV} = marginal price of G for the person with the average income,

U = the level of urbanisation, N_d = population density.

Assuming that G can generate benefits to the individual such as:

$$G^* = GN^{-a} \qquad (6\text{-}28)$$

Where

N = population,

a = the coefficient of publicness in consumption:

($a = 1$) to a private good ($a = 0$) to a pure public good

Assuming the cost of G is assumed to equal to:

$$E = P_G G N^c \qquad (6\text{-}29)$$

Where

P_G = the price per unit of G

$c >$ implies diseconomies of scale in producing G in large population

$c <$ implies decreasing per unit of costs in large population

Assuming that the tax share of the decisive voter is $1/N$. Hence the decisive voter chooses a desired level of public good subject to an effective cost per unit:

$$P_{AV} = P_G N^{a+c-1} \qquad (6\text{-}30)$$

Then the desired level of G^* is

$$\ln G^* = \alpha_0 + \alpha_1 \ln Y_{pc} + \alpha_2 \ln\left(P_G N^{a+c-1}\right) + \alpha_3 \ln U + \alpha_4 \ln N_d \qquad (6\text{-}31)$$

From (6-28): $\ln G^* = \ln\left(GN^{-a}\right)$ (6-28`)

From (6-29): $G = EP_G^{-1}N^{-c}$ (6-29`)

Substituting (6-29`) into (6-28`): $\ln G^* = \ln\left(EP_G^{-1}N^{-a-c}\right)$ (6-32)

Substituting (6-32) into, and add $\ln(P_{AV})$ to both sides of, (6-31) you van get:

$$\ln E/N = \alpha_0 + \alpha_1 \ln Y_{pc} + (1+\alpha_2)\ln P_G + \alpha_3 \ln U + \alpha_4 \ln N_d + (1+\alpha_2)(a+c-1)\ln N \qquad (6\text{-}33)$$

Add $(-\ln Y_{pc})$ to both sides of (6-33), and realise that $Y_{pc} = \frac{Y}{N}$, we can get:

$$\ln E/N = \alpha_0 + (\alpha_1 - 1)\ln Y_{pc} + (1+\alpha_2)\ln P_G + \alpha_3 \ln U + \alpha_4 \ln N_d + (1+\alpha_2)(a+c-1)\ln N \qquad (6\text{-}34)$$

Dao used OLS in estimating equations (6-33) and (6-34). He used a cross-sectional data from 105 developed and less developed countries, where average values for the 1970-1980 period is used.

To model government expenditure behaviour, one can assume fiscal revenue as a given factor that is exogenously determined. However, a government usually resorts to foreign borrowing when fiscal revenue is not enough to meet government expenditure. Therefore, it could be argued that fiscal revenue plays an important role in determining expenditure.

In an effort to quantify the impact on government expenditure of a change in fiscal revenue, D. Fielding (1997) examined in a set of LDCs some factors that were expected to play an important role in determining aggregate public sector expenditure. He used a theoretical modelling approach that draws on insights from the private consumer theory. Further, he stated that the government would resort to foreign borrowing when the national economy's total expenditure exceeds national income plus the economy's net wealth.

Assuming that the government maximises a social welfare function that values two variables: Its own expenditure and private disposable income, both now and in future periods up to horizon N. Fielding (1997) argued that, for a given level of national income the government could achieve optimal private disposable income by adjusting taxes.

Using a log-linear functional form, Fielding empirically examined the government expenditure in 12 African countries for the 1973-1989 period. He argues that,

fiscal revenue and national income besides interest rates, inflation, and exchange rate are possible determinants of the government expenditure.
He concluded that "not only are government revenue and expenditure are highly correlated, but that current expenditure is dependent on current fiscal revenue, rather than vice versa. This suggests that these governments' access to credit for consumption smoothing is limited"[12].

Empirical model

It follows, from the above literature, that several variables are considered the main determinants of government expenditure. Together with the determinants of economic growth, the determinants of government expenditure comprise the elements of the vector S in our model.
Below what the standard government expenditure literature suggests as the main variables that affect government expenditure:

national income	fiscal revenue
inflation	world rates of interest
urbanisation	population

To conclude, we can argue that the variables we suggested as that possibly have roles to play in determining our model's controlled and non-controlled variables $X^{\circ} = -K^{-1}k$ and $Y^{\circ} = R\overset{\circ}{X} + S$, are not very different from what the standard literature on economic growth and government expenditure suggest.

[12] D. Fielding (1997) p.389.

The private sector demand

Most developing countries exhibit shortages in capital. Where the domestic markets for capital are usually not capable of meeting domestic demand. As a result, the private sector borrows foreign capital when domestic sources are not enough to facilitate some of its investment projects.

To model the private sector demand for foreign debt we resort to the theory of assets demand where demand is usually a function of wealth, expected return, risk and liquidity. In particular, the mean-variance approach is to be used for modelling the private sector demand.

We assume that the private sector consists of number of homogeneous firms who are risk averse. Below we derive a model by first assuming that a representative firm holds diversified portfolio to minimise risk. Then the mean-variance approach is presented as an appropriate model of maximising expected returns under uncertainty.

The portfolio approach

In theory, each firm plans its production for n periods, depending on technology, input and output prices, and future profits. The firm holds part of profits in the form of financial and real assets, and works to maximise its expected returns from both. In fact, the firm may borrow externally for short-run adjustment of its portfolio or as a part of the long-run production plan. Therefore, the firm can hold some sort of foreign liabilities in its financial portfolio.

It can be said that at each point of time the firm maximises its returns from production, financial and real assets subject to its total wealth. Adopting Bhattacharyya (1978) specification of a utility function, U_i:

$$U_i = U[f_1(q_1, q_2, ..., q_n), f_2(X_1, X_2, ..., X_k), f_3(J_1, J_2, ..., J_m)]$$

Where q_i = services flow from the i^{th} output product,
X_i = services flow from the i^{th} financial asset,
J_i = services flow from the i^{th} real asset.

Where a firm is assumed to maximise utility from three sets of commodities: its output products, its financial assets, and its real assets.

The above specification of the utility function implies that the marginal rate of substitution (MRS) between any two commodities across sets is very small. That is to say, the elasticity of substitution between two commodities (an output product and a financial asset) from two different sets (production set and financial set) is very low. In other words, satisfaction gains from q_i, X_i and J_i are said to be "weakly separable".

The process of demand for any item (from any set) is better explained if one assumes that decisions are made in two stages. At stage one, the Firm allocates its total wealth to each set. Here, allocation decisions depend on the total wealth and also on average price ratios of the different sets. Hence, at this stage firms allocate their total wealth to each set of commodities.

On the other hand, at stage two the firm formulates its demand for each item in the financial set, for example, according to the wealth already allocated to this set and prices within this set only. This implies that the demand for a particular commodity is independent of (or "weakly separable" from) the demand for commodities in other sets. In other words, the firm's concern in stage two is to decide on the composition of each set, independent of the others.

Therefore, within the general framework of the portfolio approach a firm maximises a "weakly separable" utility function subject to its wealth constraints:

$$\text{Max.} \quad U_i = U[f_1(q_1, q_2, ..., q_n), f_2(\mathrm{X}_1, \mathrm{X}_2, ..., \mathrm{X}_k), f_3(J_1, J_2, ..., J_m)]$$

$$\text{S. t.} \quad \sum_{i=1}^{n} P_{qi} q_i + \sum_{i=1}^{k} P_{\mathrm{X}i} \mathrm{X}_i + \sum_{i=1}^{m} P_{Ji} J_i = W$$

Where P_{qi} = price of per unit of q_i $\quad P_{\mathrm{X}i}$ = price of per unit of X_i,

P_{Ji} = price of per unit of J_i, $\quad W$ = total wealth and income.

This chapter attempts to analyse the private sector's demand for one set of commodities, the financial portfolio. Here, the representative firm will decide the composition of this portfolio $(\mathrm{X}_1, ..., \mathrm{X}_k)$ in each period, according to its terminal

wealth and prices within this portfolio only. Every firm is assumed to diversify its portfolio as a result of the uncertainty presence in the rates of return from different assets. Therefore, in every period, the firm chooses a portfolio of financial assets that maximises the expected utility subject to the allocated wealth.

In particular, the chapter is concerned with the private sector demand for foreign borrowing, which is an item in the sector's (or the representative firm's) financial portfolio. Hence, a demand function for foreign borrowing is to be derived from the sector's total demand for financial assets.

The mean-variance portfolio analysis

The mean-variance analysis is widely used as an empirical approach for decision-making under uncertainty. This approach assumes that the satisfaction a firm gains from its assets is positively related to the expected returns (the mean) on its portfolio, and negatively related to the riskiness (the variance of the returns) associated with this portfolio. Therefore, a firm's preference over risky assets depends only on the expected returns of these assets and their variances.

Assuming that all firms are homogeneous, and that they are rational and risk-avers, in one-period portfolio selection, these firms seek efficient "mean-variance" portfolio choice subject to the same set of constraints.
A quadratic utility function, or a negative exponential utility function, is usually used to formulate individuals' preferences. Bhattacharyya (1978) compared different approaches, and demonstrated how all leads to the same objective function. The details of Bhattacharyya's derivations are presented in appendix 9 (p.241).

Following this general form of an objective function, we assume that the private sector objective function is as follows:

$$E[U(Z)] \Rightarrow \left(\mu - \frac{b}{2}\sigma^2 \right) \qquad (6\text{-}35)$$

Where

E = is the subjective expectation operator,
Z = total returns, here $Z \sim N(\mu, \sigma^2)$

$\mu = E(Z)$ is the total expected returns from the financial portfolio,

$\sigma^2 = E[Z - E(Z)]^2$ measures risks.

Where

$$\sigma^2 = E\left((Z - E(Z))(Z - E(Z))'\right) \qquad \text{since: } Z = VR'$$

$$\sigma^2 = E\left((VR' - E(VR'))(VR' - E(VR'))'\right)$$

$$\sigma^2 = E[V'(R - E(R))(R' - E(R'))V]$$

$$\sigma^2 = V'E\left((R - E(R))(R - E(R))'\right)V$$

$$\sigma^2 = V'Cov(R)V$$

$$\sigma^2 = V'\Sigma V$$

Private sector demand for financial assets

Let each firm holds k assets in its financial portfolio whose initial values are V_1, V_2, ..., V_k. Let also R_1, R_2, ..., R_k be the rates of returns from the k assets respectively. The following is the firm's utility function that it needs to maximise subject to total wealth:

$$U_i = E(R')V - \frac{b}{2}V'\Sigma V \qquad (6\text{-}36)$$

Where

R is a kx1 vector of rates of return,
V is a kx1 vector of assets value,
$\mu = E(Z) = E(R')V$ = expected returns,
$\sigma^2 = V'\Sigma V$ = associated risks[13],
Σ is a kxk matrix whose elements are the system's parameters.

Here, it should be realised that only returns, R, are random variables.

The first order conditions

A firm maximises total expected returns given a level of risk. This maximisation problem can be presented as:

$$\text{Max.} \left(U(Z_i) = E(R')V - \frac{b}{2}V'\Sigma V\right) \qquad (6\text{-}37)$$

$$\text{S.t. } W = I'V \qquad (6\text{-}38)$$

[13] See appendix 9, p. 242, for defining Σ.

Where

I is a column vector of order kx1,

W is total wealth allocated to the financial portfolio.

The structural equations, can be obtained by every individual by maximising Z_i according to:

The lagrangian:

$$L = E(R')V - \frac{b}{2}V'\Sigma V + \lambda(W - I'V)$$

Where λ is the lagrangian multiplier,

Then the first order conditions are the structural equations:

$$\frac{\partial L}{\partial V} = E(R) - b\Sigma V - \lambda I = 0$$

$$\frac{\partial L}{\partial \lambda} = W - I'V = 0$$

Rewriting the first order condition in a matrix form:

$$\begin{pmatrix} V \\ \lambda \end{pmatrix} = \begin{pmatrix} b\Sigma & I \\ I' & 0 \end{pmatrix}^{-1} \begin{pmatrix} E(R) \\ W \end{pmatrix} \qquad (6\text{-}39)$$

The first order condition could be solved[14] to find the demand function for the financial assets, V :

$$V = \frac{1}{b}F_{11}E(R) + F_{12}W \qquad (6\text{-}40)$$

Where

$$F_{11} = \left(\Sigma^{-1} - \frac{\Sigma^{-1}II'\Sigma^{-1}}{I'\Sigma^{-1}I}\right), \text{ and } \qquad F_{12} = \frac{\Sigma^{-1}I}{I'\Sigma^{-1}I}$$

F_{11} = kxk symmetric matrix, whose elements are determine from matrix Σ

F_{12} = kx1 vector of coefficients for the terminal wealth assigned to each assets

$\left(\frac{1}{b}F_{11}\right)$ and F_{12} are the system's parameters[15]

b = a scalar, E(R) = k x1 vector of independent variables,

V = k x1 vector dependent variables, W = total wealth.

[14] See appendix 9, p.242, for detailed derivations.

[15] F_{11} and F_{12} are defined in Appendix 9, p. 243.

Assuming that the private sector holds 3 assets only, k = 3, for example: equities V_1, foreign debt V_2, and domestic debt V_3. Then the above demand function for V becomes:

$$\begin{pmatrix} V_1 \\ V_2 \\ V_3 \end{pmatrix} = \left(\frac{1}{b}\right) \begin{pmatrix} f_{11} & f_{12} & f_{13} \\ f_{21} & f_{22} & f_{23} \\ f_{31} & f_{32} & f_{33} \end{pmatrix} \begin{pmatrix} E(R_1) \\ E(R_2) \\ E(R_3) \end{pmatrix} + W \begin{pmatrix} f_{121} \\ f_{122} \\ f_{123} \end{pmatrix} \qquad (6\text{-}41)$$

This chapter is concerned only with the demand of the private sector for external liabilities, V_2. Although it is part of the system, we are interested only in the demand function for V_2:

$$V_2 = \sum_{i=1}^{3} c_i E(R_i) + f_{122} W \qquad (6\text{-}42)$$

Where

$c_i = \frac{1}{b} f_{2i}$

$E(R_i)$ is subjective expected rates of return

W is the private sector total wealth

V_2 is the value of external debt liabilities held by the private sector.

The private sector demand for foreign borrowing in a linear form:

$$V_2 = c_0 + c_1 E(R_1) + c_2 E(R_2) + c_3 E(R_3) + f_{122} W \qquad (6\text{-}43)$$

Where the three rates of returns are that of the private sector's interest.

The combined model

We have argued in the introduction of the chapter that the two sectors are, in fact, interrelated. In addition, since accurate disaggregated data on foreign debt is unavailable, we calculated the difference between total stock of debt and public and publicly guaranteed debt as the private sector foreign debt. However, this difference is surely biased towards the public and publicly guaranteed debt. For these reasons, we combined the two models, which will represent the country's total demand for foreign borrowing.

Since:

$$D = D_g + D_p$$

Where

D is total stock of debt

D_g is the public and publicly guaranteed debt

D_p is the private sector debt.

From (6-8) and (6-2), the derived government sector demand for foreign borrowing is

$$D_g = f_g(S) \qquad (6\text{-}44)$$

Where

S is a vector of independent variables.

From (6-42) the private sector demand for foreign borrowing is

$$D_P = f_P(R,W) \qquad (6\text{-}45)$$

Where

R is a vector of interest rates,

W is private sector wealth.

Combining (6-44) and (6-45) will results the country's total demand for foreign borrowing:

$$D = f_g(S) + f_P(R,W) \text{ Or}$$

$$D = f(S,R,W) \qquad (6\text{-}46)$$

Empirical estimation of the government sector's model

To model the government behaviour in accumulating foreign borrowing we have specified two exogenously determined (controlled) variables namely the stock of foreign debt and exchange rate. The two endogenous (non-controlled) variables, however, are economic growth and government expenditure. This implies that the decision to borrow externally is not a straightforward decision; rather it is an outcome of a complex process.

The nominal exchange rate is taken as a controlled variable since the countries under study were following fixed exchange rate systems during most of the period under study. This is reflected in the graphs in appendix 10, p.244. Where the nominal exchange rates were depreciating during the period, but the movements were following a "jumping" behaviour, specially in Egypt and to some extent in Morocco and Tunisia.

We have assumed that, the government is interested in the two endogenous variables, as they can together achieve national and international acceptance for the government.

The general framework of the model is that the government maximises a quadratic preference function equation (6-1) in an effort to remain in power. The constraint equation (6-2) in this maximisation problem connects the two sets of controlled, X, and non-controlled, Y, variables.
In the previous sections a solution to the government maximisation problem was found such that:

$$X^{\circ} = -K^{-1}k \qquad (6\text{-}8)$$

For maximum X, K should be negative definite. All variables are as defined previously.

The term k in (6-8) includes S as can be seen from (6-5), hence the vector of the controlled variables, X, is a function of all variables in S. Now, assuming that (6-2`) and (6-8) are in linear form, we start by estimating (6-8) which will yield X°. The optimal X is then substituted in (6-2) to find the optimal Y:

$$Y^{\circ} = RX^{\circ} + S \qquad (6\text{-}2^{`})$$

Therefore, each variable in the vector Y is a function of all variables in S as well. After all, all variables in the vector Y and vector X are functions of all variables in S.

In our empirical exercise we are estimating (6-8) and (6-2`) in order to test for our model's ability to explain the data. In addition, the empirical exercise will be applied to data from three countries, estimated separately, to see the applicability of the model for different countries. In this model we claim that government's decision to borrow externally is not a straightforward decision, rather it is an outcome of a process that our model aims at capturing.

Following a similar approach to the "general to specific"[16], we start by estimating all sets of the independent variables in our model. The size of the model is then reduced according to basic statistical criteria. Here, however, the statistically insignificant variables are to be dropped from the first estimation to find the model that is reasonably able to explain the variation in the data. Hence, it is expected that not all independent variables be, empirically, affecting each of the four dependent variables.

Data and variables

Four estimations are to be carried out for each country, where each of the four dependent variables, the stock of foreign debt, the exchange rate, the government expenditure to GNP ratio and the economic growth, is regressed against the same set of independent variables in the vector S. The independent variables are as specified previously.

The vector S includes two sets of independent variables, the first reflects country characteristics, and the second measures economic shocks and policies, such as:

human capital,	population growth,	inflation,
degree of openness,	national income,	terms of trade,
fiscal revenues,	world rates of interest,	investment.

[16] See chapter 4 in Charemza and Deadman (1992).

All variables definitions and sources are shown in appendix 5.

Variables' stationarity

The time series data used in this thesis is short, varied between 20 and 25 observations. In particular, the empirical works in this chapter are based on time series for the 1975-1995 period, i.e. 21 observations only. When the time series are not long enough for stationarity testing, only a few degrees of freedom will be available for cointegration analysis. So, the estimations' results presented in this chapter are carried out by using raw data.

However, one could argue that since the estimations are based on possibly non-stationary data, their results are not credible and may be spurious. For this reason, the Augmented Dickey Fuller, ADF, test for unit root has been applied to all variables in the vectors X, Y and S.

Appendix 11 includes the unit root test result for each variable. Table A11.2, p.246, in the appendix shows these results. From this table, it is notable that most variables are either I(0) or I(1), and only three variables are, in fact, I(2).

Since the data is very short and that most of the series are of the same order of integration we see no reason for worrying about our estimation result's credibility. In addition, we argue that our estimation results are based on a proper theoretical modelling, where economic theory support the variables chosen in the model.

Excepted signs in the debt model

The vector X consists of two variables, stock of foreign debt and exchange rate. Prior to the empirical estimation, a discussion of the expected effects on the accumulation of the government's stock of foreign debt of the independent variables in S is presented below.

Investment ratio

The variable used in this chapter is gross domestic investment to GDP ratio. The effect of investment ratio on the government's stock of foreign debt is ambiguous.

In fact, the debt over-hang argument (see chapter three, p.40) analyses the detrimental effect that the stock of foreign debt has on investment.
We argue that, successful investment projects, especially that involve foreign exchange inflow, could eventually reduce the country's need to borrow externally, as higher investment improves economic growth[17], which in turn increases income and domestic savings and reduces the need to borrow externally. In other words, when higher investment ratio means increase in foreign exchange inflow, which improves the country's ability to service its current debt, and reduces not only the possibility of debt crisis but also the country's demand for new foreign borrowing. Hence, a negative relationship is expected.
However, in the early stages of building investment projects the demand for imported intermediate capital goods is usually very high. In that case, one might expect a positive relationship between the investment ratio and the government's stock of foreign debt in the early stages.

Population

The variable to be used in our following estimations is growth in population. The usual view is that higher population growth would lower the growth rate of per capita GDP. This view is based on the notion that having and raising children is time costly. Further, more population could imply more demand for public services, which requires more government expenditure.
In that case, lower economic growth is expected to put extra pressure on the country's burden of foreign debt, and may eventually increases its stock of foreign debt. Therefore, higher population would increase the government's stock of foreign debt, unless the government is able to domestically finance both foreign debt obligations and new demand for public services.

Budget deficit

The variable is the ratio of the government budget deficit (including grants) to GDP[18]. We argue that higher budget deficit negatively affects the government's ability to service its debt. This causes difficulties in payments due and may lead to rescheduling and further pushes the government to borrow new debt in order to

[17] See for example Knight, Loayza and Villanueva (1993) and Levine and Renelt (1992).
[18] A negative value means surplus and a positive value means deficit.

service its old debt. In addition, it could be argued that high deficits is a proxy for high public debt, which possibly signals higher taxes and lower public capital in the future[19], and eventually reduces growth rate and the government ability to service its foreign debt.

However, the government can avoid borrowing new debt, given that it can finance its budget deficit by increasing taxes on the people. In that case, no significant relationship is expected between the two variables. This option is possible but risky, as it could lead to social unrest in such poor less developed countries. Therefrore, a positive relationship is expected[20].

World rates of interest

This variable is calculated from the London Interbank Offer Rate (LIBOR) with reference to the US inflation. It has been argued that, the stock of foreign debt is possible to rise as a result of changes in factors beyond the debtor's control. A rise in the world interest rate will increase the interest payment obligations without any actual increase in the current stock of debt.

When the country is unable to pay the interest payments due, it either chooses to reschedule the interest payment or to borrow new foreign debt to pay this interest payment due. In both cases, the stock of foreign debt will rise. A positive sign is expected.

Inflation gap

The variable is to be used as the difference between the domestic and the USA inflation rates.

It could be argued that, higher inflation rate reduces the real value of the stock of debt and debt services; as a result one would expect a negative effect of inflation on the stock of debt.

However, very high rates of inflation hinder the economic growth. If this effect on economic growth rate holds long enough, the economy will generate less foreign exchange, which makes foreign debt servicing heavier and much difficult to meet.

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[19] See Easterly and Rebelo (1993), p. 429.

[20] According to this variable definition (see footnote # 17 of this chapter) this means a negative sign.

This may push the government to increase its stock of debt either by rescheduling or by borrowing new debt to pay its obligations for old debt. Therefore, a positive effect is expected for domestic inflation on the government's stock of foreign debt.

Openness

This variable is calculated as exports plus imports to GDP. The degree of openness is a signal to the international community of the country's degree of integration with the world economy. The higher the degree of openness the better access the country has to the international capital markets, and as well the more vulnerable it is to penalties by the lenders. The final effect is in fact ambiguous.

% Change in export growth

This variable reflects the growth in the country's export sector. A higher export growth means an increase in the country's export earnings of foreign exchange, which improves its position to service its foreign debt. The increase in the county's earnings of foreign exchange may reduce its need for foreign borrowing and eventually its stock of debt.

However, it could be argued that the increase in the country's reserve of foreign exchange (as a result of expanding export sector) improves its creditworthiness, as a result the country may be offered better access to the international capital markets that may encourages new borrowing, and eventually increases the stock of debt (see chapter three p.37, for the loan pushing argument). Therefore, the effect on the government stock of foreign debt is ambiguous.

% Change in the terms of trade

This variable is presented as the percentage change in the terms of trade. The effect of this variable on the stock of the government foreign debt might come through its effect on economic growth. In fact, it has been argued that terms of trade shocks have an ambiguous impact on national output and that the actual effect on economic growth depends "on the responses of domestic production to the changed incentives implied by the shift in the terms of trade"[21].

[21] Barro and Lee (1994), p.24.

Ghura and Hadjimichael (1996) found positive relationship between the terms of trade and economic growth. They suggested that this relationship supports "the notion that terms of trade losses contributed in part to the poor growth performance"[22].

In fact, an increase in the terms of trade improves the country's competitiveness in the international markets, which implies an increase in export revenue and in the country's reserve of foreign exchange. Therefore, the improvements in the terms of trade is expected to improve the country's ability to service its foreign debt and may eventually reduces its need for foreign borrowing and its stock of foreign debt.

However, the same argument presented above in the export growth section is applied here. Hence, the effect of the percentage change in the terms of trade on the government stock of foreign debt cannot be determined as a priori.

Human capital

In the estimations below, we will use gross secondary enrolment ratio as a measure for human capital. A positive effect on economic growth of an increase in the country's human capital potentials is found in many economic growth studies[23]. In fact, if this positive effect on economic growth of the human capital holds, this variable will have two contrasting effects on the government's stock of foreign debt.

On the other hand, lenders perception of the borrower country's creditworthiness is positively related to its economic growth, which may suggest a positive effect of an increase in human capital on the stock of foreign debt. This may support the loan pushing argument (see chapter three p.37). On the other hand, higher economic growth possibly reduces the country's need to borrow externally. In that case, an increase in human capital reduces the government's stock of foreign debt.

[22] p. 624.

[23] In fact, Barro and Lee (1993) found a negative effect of female secondary school attainment on economic growth.

Real income

Real gross national product is the real income variable to be used in our empirical model. When a debtor country moves into a period of higher real income, its debt burden gets lighter, its demand for new borrowing reduces and eventually its stock of foreign debt declines. Therefore, a negative relationship is expected between real income and government's stock of foreign debt.
However, one does not role out the positive effect possibility. The international capital markets perceive a country with high real income as creditworthier than a country with low real income. As a result, high real income countries have better access to the international capital markets and possibly get new debt contracts at soft terms.

Tax revenue to GDP ratio

The empirical model below will use this variable as a ratio to GDP. The government usually resorts to foreign borrowing when it cannot raise enough domestic resources (tax revenue for example) to meet its required expenditure. Therefore, this variable is expected to relate negatively to the government's stock of foreign debt.

The estimations

The six tables below represent the estimation results of the following two models for each country:

$$X^{\circ} = -K^{-1}k \qquad (6\text{-}8)$$

$$Y^{\circ} = RX \circ + S \qquad (6\text{-}2`)$$

Using similar to "general to specific" approach we get two estimations for each model for each country. For each country, we start the empirical exercise by estimating each model with all the independent variables from the vector S that are available for the country concerned. Secondly, we reduce the models' size by re-estimating the models with less number of variables.

Ordinary Least Squares, OLS, estimator is used in all empirical exercises below, and the period used is the 1975-1995. Two models are estimated for each country,

and reported in two different tables. The first table contains the estimation results of the above two models (6-8) and (6-2`) in their general forms. Using the t-stat criteria to dropping insignificant variables, the second table shows the estimation results of (6-8) and (6-2`) in their specific forms.

Table 6-1 Egypt's OLS estimation of the government (general) model

Independent Variables		Dependent Variables			
		Controlled		Non-Controlled	
		Exchange Rate	Debt Stock^	Real GDP Growth	Gov. Exp./GDP
		E1	A4	Y6	G2
Intercept	C	7.271 (9.319)*	3.45 (2.588)*	8.175 (1.075)	37.09 (3.058)*
Gross Domestic Investment / GDP	i6	- 0.107 (6.739)*	0.068 (2.485)*	- 0.085 (0.547)	- 0.711 (2.879)*
Population Growth	n	- 2.054 (4.864)*	- 0.391 (0.542)	- 2.269 (0.551)	4.735 (0.721)
Budget deficit / GDP	B	- 0.040 (3.302)*	- 0.132 (6.375)*	0.483 (4.084)*	1.291 (6.846)*
World (LIBOR) real interest rates	rw	4.464 (2.017)**	15.30 (4.044)*	- 11.61 (0.538)	- 5.039 (0.146)
Inflation gap (Egypt - USA)	F4	2.474 (2.370)*	5.91 (3.313)*	3.633 (0.357)	- 41.77 (2.574)*
(Exports+Imports) /GDP	Op	2.747 (4.941)*	- 3.03 (3.189)*	2.524 (0.466)	7.231 (0.837)
Sample Size / Period # of Observations		1975-1995 21	1975-1995 21	1975-1995 21	1975-1995 21
R^2		0.971	0.898	0.673	0.858
Serial Correlation (LM)	χ^2 (1)	0.93 (0.33)	1.51 (0.2)	0.04 (0.8)	1.09 (0.3)
Functional Form (LM)	χ^2 (1)	*12.3 (0.00)*	0.98 (0.3)	0.00 (0.9)	1.16 (0.3)
Normality (LM)	χ^2 (2)	1.46 (0.48)	1.17 (0.6)	0.02 (0.9)	0.34 (0.8)
Heteroscedasticity (LM)	χ^2 (1)	1.53 (0.22)	0.01 (0.9)	1.59 (0.2)	0.01 (0.9)

Table 6-2 Egypt's OLS estimation of the government (specific) model

Independent Variables		Dependent Variables			
		Controlled		Non-Controlled	
		Exchange Rate	Debt Stock^	Real GDP Growth	Gov. Exp./GDP
		E1	A4	Y6	G2
Intercept	C	Same as Table 6-1	2.850 (3.992)*	12.19 (2.271)*	37.95 (3.690)*
Gross domestic investment / GDP	i6		0.060 (2.635)*	-	- 0.699 (3.121)*
Population Growth	n		-	- 4.254 (1.791)**	4.045 (0.915)
Budget deficit / GDP	B		- 0.133 (6.623)*	0.447 (5.795)*	1.295 (7.190)*
World (LIBOR) real interest rates	rw		13.80 (5.375)*	-	-
Inflation gap (Egypt - USA)	F4		5.850 (3.365)*	-	- 41.44 (2.667)*
(Exports+Imports) /GDP	Op		- 3.080 (3.340)*	-	7.471 (0.910)
Sample Size / Period # of Observations			1975-1995 21	1975-1995 21	1975-1995 21
R^2			0.896	0.652	0.858
Serial Correlation (LM)	χ^2 (1)		1.07 (0.30)	0.14 (0.71)	0.82 (0.37)
Functional Form (LM)	χ^2 (1)		0.98 (0.32)	0.06 (0.81)	0.97 (0.33)
Normality (LM)	χ^2 (2)		1.74 (0.42)	0.03 (0.99)	0.37 (0.83)
Heteroscedasticity (LM)	χ^2 (1)		0.05 (0.82)	1.28 (0.26)	0.003 (0.96)
Lagrange Multiplier Statistic (LM)	χ^2 (1)		0.43 (0.51)	1.22 (0.88)	0.03 (0.86)

^ = All coefficients are divided by 10^{10} t-ratios in parenthesis Significant at 5% = *, 10% = **
Italic means the existence of corresponding specification problem.

Table 6-3 Morocco's OLS estimation of the government (general) model

Independent Variables		Dependent Variables			
		Controlled		Non-Controlled	
		Exchange Rate	Debt Stock^	Real GDP Growth	Gov. Exp./GDP
		E1	A4	Y6	G2
Intercept	C	1.044 (0.579)	- 0.200 (0.488)	11.69 (0.795)	27.06 (5.143)*
Gross secondary enrolment ratio	h52	0.243 (5.373)*	0.066 (6.408)*	- 0.231 (0.627)	0.036 (0.273)
Budget deficit / GDP	B	- 0.002 (0.028)	- 0.039 (1.987)**	- 0.127 (0.182)	0.754 (3.012)*
World (LIBOR) interest rates	rw1	- 0.151 (2.697)*	- 0.027 (2.096)**	0.065 (0.143)	- 0.108 (0.661)
% change in terms of trade	T3	0.021 (0.674)	- 0.019 (2.725)*	- 0.048 (0.192)	- 0.162 (1.802)**
% change in exports	ex	- 0.030 (2.217)*	0.009 (2.883)*	- 0.078 (0.697)	0.047 (1.184)
Inflation gap (Morocco - USA)	F4	6.373 (0.886)	- 3.01 (1.848)**	27.25 (0.465)	- 27.94 (1.332)
Sample Size: Period		1975-1995	1975-1995	1975-1995	1975-1995
Sample Size: # of Observations		21	21	21	21
R^2		0.925	0.962	0.133	0.803
Serial Correlation (LM)	χ^2 (1)	*3.49 (0.06)*	*3.17 (0.08)*	*5.65 (0.02)*	2.45 (0.12)
Functional Form (LM)	χ^2 (1)	1.90 (0.17)	1.87 (0.17)	0.27 (0.60)	*3.93 (0.05)*
Normality (LM)	χ^2 (2)	*6.18 (0.05)*	0.85 (0.65)	0.67 (0.72)	1.42 (0.49)
Heteroscedasticity (LM)	χ^2 (1)	0.25 (0.62)	0.35 (0.55)	*3.12 (0.08)*	1.78 (0.18)

Table 6-4 Morocco's OLS estimation of the government (specific) model

Independent Variables		Dependent Variables			
		Controlled		Non-Controlled	
		Exchange Rate	Debt Stock^	Real GDP Growth	Gov. Exp./GDP
		E1	A4	Y6	G2
Intercept	C	-	-	9.893 (1.996)**	27.90 (28.725)*
Gross secondary enrolment ratio	h52	0.266 (23.861)*	0.061 (23.56)*	- 0.182 (1.111)	-
Budget deficit / GDP	B	-	- 0.047 (4.821)*	-	0.658 (6.098)*
World (LIBOR) real interest rates	rw1	- 0.117 (3.286)*	- 0.026 (2.105)**	-	-
% change in terms of trade	T3	0.013 (0.499)	- 0.020 (2.953)*	-	- 0.177 (2.166)*
% change in exports	ex	- 0.029 (2.257)*	0.009 (2.924)*	- 0.081 (0.930)	0.045 (1.197)
Inflation gap (Morocco - USA)	F4	5.128 (0.884)	- 2.590 (1.932)**	22.60 (0.510)	- 23.85 (1.477)
Sample Size: Period		1975-1995	1975-1995	1975-1995	1975-1995
Sample Size: # of Observations		21	21	21	21
R^2		0.919	0.962	0.130	0.797
Serial Correlation (LM)	χ^2 (1)	*3.85 (0.05)*	1.68 (0.20)	*5.59 (0.02)*	2.14 (0.14)
Functional Form (LM)	χ^2 (1)	2.31 (0.13)	2.42 (0.12)	0.07 (0.79)	0.94 (0.33)
Normality (LM)	χ^2 (2)	2.36 (0.31)	0.70 (0.70)	0.71 (0.70)	1.76 (0.42)
Heteroscedasticity (LM)	χ^2 (1)	0.001 (0.97)	0.19 (0.67)	*3.08 (0.08)*	0.09 (0.76)
Lagrange Multiplier Statistic (LM)	χ^2 (1)	1.62 (0.44)	0.35 (0.55)	0.08 (0.99)	0.65 (0.72)

^ = All coefficients are divided by 10^{10} t-ratios in parenthesis Significant at 5% = *, 10% = **
Italic means the existence of corresponding specification problem.

Table 6-5 Tunisia's OLS estimation of the government (general) model

Independent Variables			Dependent Variables			
			Controlled		Non-Controlled	
			Exchange Rate	Debt Stock ^	Real GDP Growth	Gov. Exp./GNP
			E1	A4	Y6	G2
Intercept		C	0.548 (1.297)	0.261 (1.160)	18.84 (1.042)	8.430 (0.917)
Tax revenue / GDP		v3	- 0.025 (1.395)	- 0.028 (2.947)*	- 0.428 (0.562)	0.806 (2.081)**
Budget deficit / GDP		B	0.029 (2.716)*	0.009 (1.528)	- 0.568 (1.242)	0.991 (4.263)*
Gross secondary enrolment ratio		h52	0.019 (11.47)*	0.020 (23.55)*	- 0.079 (1.142)	0.042 (1.190)
% change in terms of trade		T3	- 0.002 (0.741)	0.007 (3.766)*	0.065 (0.472)	- 0.005 (0.069)
Population Growth		n	- 0.025 (0.570)	0.046 (1.966)**	0.693 (0.372)	0.078 (0.082)
Sample Size	Period		1975-1995	1975-1995	1975-1995	1975-1995
	# of Observations		21	21	21	21
R^2			0.936	0.982	0.270	0.753
Serial Correlation (LM)	χ^2 (1)		0.17 (0.68)	0.74 (0.39)	0.54 (0.46)	*5.61 (0.02)*
Functional Form (LM)	χ^2 (1)		*10.2 (0.00)*	0.01 (0.91)	0.01 (0.93)	0.73 (0.39)
Normality (LM)	χ^2 (2)		2.27 (0.32)	0.53 (0.77)	0.59 (0.74)	1.84 (0.40)
Heteroscedasticity (LM)	χ^2 (1)		*2.93 (0.09)*	0.10 (0.75)	2.42 (0.12)	0.85 (0.36)

Table 6-6 Tunisia's OLS estimation of the government (specific) model

Independent Variables			Dependent Variables			
			Controlled		Non-Controlled	
			Exchange Rate	Debt Stock ^	Real GDP Growth	Gov. Exp./GNP
			E1	A4	Y6	G2
Intercept		C	0.637 (1.773)**	-	-	27.30 (17.71)*
Tax revenue / GDP		v3	- 0.031 (2.029)**	- 0.018 (5.815)*	0.326 (1.413)	-
Budget deficit / GDP		B	0.028 (3.067)*	-	- 0.742 (1.795)**	1.185 (5.868)*
Gross secondary enrolment ratio		h52	0.019 (15.300)*	0.021 (23.63)*	- 0.071 (1.066)	0.048 (1.597)
% change in terms of trade		T3	-	0.006 (3.522)*	-	0.068 (1.009)
Population Growth		n	-	0.061 (2.891)*	1.036 (0.586)	-
Sample Size	Period		1975-1995	1975-1995	1975-1995	1975-1995
	# of Observations		21	21	21	21
R^2			0.932	0.979	0.217	0.662
Serial Correlation (LM)	χ^2 (1)		0.33 (0.56)	0.21 (0.65)	0.64 (0.42)	2.04 (0.15)
Functional Form (LM)	χ^2 (1)		*6.91 (0.01)*	1.00 (0.32)	0.02 (0.88)	1.38 (0.24)
Normality (LM)	χ^2 (2)		0.54 (0.77)	0.57 (0.75)	0.48 (0.79)	1.49 (0.48)
Heteroscedasticity (LM)	χ^2 (1)		1.28 (0.26)	0.37 (0.54)	2.38 (0.12)	0.92 (0.34)
Lagrange Multiplier Statistic (LM)	χ^2 (1)		1.12 (0.57)	3.25 (0.20)	1.42 (0.49)	*4.77 (0.09)*

^ = All coefficients are divided by 10^{10} t-ratios in parenthesis Significant at 5% = *, 10% = **
Italic means the existence of corresponding specification problem.

Tables 6-1 to 6-6, present the estimation results of the six models, and report four diagnostic tests for each model. It should be mentioned that, the null hypothesis here is as follows: H_0: the specification problem under consideration does not exist, and the alternative is H_1: the problem does exist. To determine whether dropping the insignificant variable(s) from the "general" model improves the foreign debt model, we use a variable deletion test: the Lagrange Multiplier statistic, which is reported in the diagnostic section of the "smaller" model tables. When a specification problem is detected an italic font is used in the diagnostic section of each table.

The models' performance

The performance of the estimated models is judged by three general criteria. First, the basic statistical tests: t-stat and R^2. The second criterion is the consistency of the estimated coefficients' signs. Thirdly, the four diagnostic tests: serial correlation, functional form, normality and heteroscedasticity. The hypotheses tested here are:

H_0: the specification problem under consideration does not exist,

H_1: the problem exists.

Where the Lagrange Multiplier Statistic (LM-statistic) test is used and reported in each table. This test follows the chi square distribution.

The model performance with Egypt's data

Egypt's estimations are presented in Tables 6-1 and 6-2. The estimated coefficients' signs of four variables, i6, B, F4 and Op, kept their signs unchanged in each of the four models when moving from the model in Table 6-1 to the model in Table 6-2. Using the LM-statistic (at 5% level of significance) all models' performance improved as a result of dropping the selected insignificant variables from the "general" form model.

In addition, all four estimations in the two tables were able to pass the diagnostic tests with the exception of the real exchange rate estimations, where a functional form problem is detected.

Modelling exchange rates is usually a complicated task. However, in its present form, the model performs fairly okay as it shows that all estimated coefficients are significant, and that the model's explanatory power R^2 is quite high, 0.97, in Table 6-1. In fact, the detected functional form problem may suggest that non-linear modelling may be required for this model.

The economic growth model explains not very high percentage of the variation in the Egyptian growth data in both tables. Furthermore, this model estimated only one significant variable namely the budget deficit ratio, in Table 6-1, and two variables, population and budget deficit, in Table 6-2.

With respect to the foreign debt model, all estimated coefficients in Table 6-1 are significant, but the population growth variable, the estimated model explains good amount of the variation in the data and passes all diagnostic tests. This variable is then dropped, and the model is re-estimated and presented in Table 6-2, which shows a very good performance. In fact, the LM statistic indicates that dropping the population variable does improve the model. Therefore, the foreign debt model in Table 6-2 is the Egyptian demand model.

The model performance with Morocco's data

Tables 6-3 and 6-4 show the estimation results of the models when applied to the Moroccan data. When moving from general to specific (Table 6-3 to Table 6-4) all variables kept their signs unchanged.

The re-estimations of the models (after dropping the insignificant variables from each model in Table 6-3) improve the performance of the four models, using the LM-statistic, at 5% level of significance.

In fact, the overall performance of the model when applied to Morocco's data is less impressive compared to Egypt. Each estimated model in Table 6-3 suffers from some sort of specification problem. Serial correlation is found in all models but the government expenditure. The functional form problem is found in the government expenditure ratio model. The normality problem is detected in the exchange rate model. The heteroscedasticity problem arises in the growth model.

Moving from the general form models in Table 6-3 to the specific form models in Table 6-4 solves the serial correlation problems in the foreign debt model only. In addition, the normality problem and the functional form problems disappear in the specific models of exchange rate and government expenditure. However, heteroscedasticity persists in the growth model even in its specific form.

It should be mentioned that, the economic growth model continues to perform poorly, with respect to the number of significant variables estimated and the model's explanatory power.

With respect to the foreign debt model, all estimated coefficients are significant, but the constant term, in the general and specific forms. However, the general model estimation shows serial correlation. In contrast the specific model in Table 6-4 does not show any specification problem, and the LM statistic shows an improvement upon the "general" model. Hence, the foreign debt model in Table 6-4 presents the Moroccan demand for foreign borrowing.

The model performance with Tunisia's data

Table 6-6 shows the estimation results of the four models as the most insignificant variables in each model of Table 6-5 were dropped. Only one (insignificant) variable changed its sign when moving from general to specific form of the growth and government expenditure models, v3 and T3 respectively. The rest of the variables show sign consistency. However, the LM-statistic shows that moving from the general to the specific model improves all four models but only at 10% level of significance.

The foreign debt model, the economic growth model and the government expenditure model do not suffer from any specification problem in the two tables. However, the exchange rate model does continue to have the functional form problem.

Therefore, the performance of the model with the Tunisian data is not that impressive specially when compared to Egypt and Morocco.

Although the economic growth model does not suffer from any specification problem, it is still performing very poorly as in the previous two countries. The foreign debt model in Table 6-6 has all its estimated coefficients significant, and no specification problem is shown in the model. In fact, the LM statistic indicates that dropping the constant term and the budget deficit variable do improve the model. Hence, it is our best model for the Tunisian demand for foreign borrowing.

Analysing the estimation results

Investment ratio (i6)

This variable shows important role to play in the Egyptian models only. Tables 6-1 and 6-2 show that, lower investment ratio forces the Egyptian government to devalue its national currency, and to increase its share in the domestic economic activities.

However, a higher investment ratio raises the government's stock of foreign debt. This positive (and significant) relationship implies that either not many successful projects were experienced in Egypt, or that the Egyptian successful projects were not generating enough foreign exchange inflows to at least service its stock of foreign debt.

The above analysis of the investment role in accumulating more foreign debt stock is supported, we argue, by the insignificant, and rather negative role that the gross domestic investment ratio plays in the Egyptian economic growth model. Which is consistent with the debt overhang argument (see chapter three p.40).

Population growth (n)

This variable is significant in the exchange rate and the economic growth models of Egypt, and only in the foreign debt model of Tunisia. As population growth rises, the Tunisian government's stock of foreign debt increases, Table 6-6. However, the estimated relationship between population growth and the exchange rate of the Egyptian pound suggests that, as the population rate of growth decreases the Egyptian currency rate of exchange increases (depreciation), see Table 6-2.

The estimated coefficients of the population rate of growth show as expected impact on the growth and the government expenditure models. More population seems to be more burdens on the government's expenditure, and consequently slows down Egypt's economic growth, Table 6-2.

Budget deficit ratio (B)

This variable plays important role in each country. The budget deficit ratio is positive and highly significant in the government expenditure model in all three countries, which may indicate that these countries' governments depend on deficit financing.

The Egyptian real economic growth model estimation shows a significant positive coefficient for this variable. It seems that the government dependence on deficit financing to boost economic growth is useful, Table 6-2.

In Egypt and Morocco, a higher budget deficit ratio decreases the government's stock of foreign debt. Therefore, contrary to what we were expecting, a negative relationship is estimated. It could be argued that, to finance budget deficit the government resorts to foreign debt, hence an increase in foreign debt decreases the budget deficit.

It is interesting to realize the two different patterns of effects that budget deficit plays in the economy. Egypt and Morocco are following the same pattern, but Tunisia is different.

In Egypt and Morocco, as the government increases the exchange rate and the stock of foreign debt (the two controlled variables in our model) its budget deficit decreases, which consequently reduces its expenditure and deteriorates economic growth (the two non-controlled variables in our model).

On the other hand, Tunisia's government (the least indebted country compare to Egypt and Morocco) seems to have enough room to increase its controlled variables (E1 and A4) in order to improve public services, G2, but not economic growth, Y6.

World real rates of interest (rw)

It should be mentioned, however, that real world interest rate is used in Egypt estimation and nominal world interest rate is used in Morocco[24].

This variable shows significant effects in the exchange rate and the government debt models in Egypt and Morocco. However, the estimated coefficients' signs are different.

In Egypt, who follows more flexible exchange rate arrangements[25], when (foreign) world interest rates increase the demand for national currency decrease, which in turn increases its rate of exchange (depreciation). However, the exchange rate model for Morocco, whose currency is pegged to a composite of currencies[26], shows that as the world interest rate increases, the Moroccan dinar's rate of exchange is rather decreased (appreciation).

In Egypt, an increase in the world interest rate causes the debt service to be heavier to the extent that the government have either to reschedule (fully or partially) its interest payment due, or borrows new foreign debt to meet its current obligations. In either case, the government's stock of foreign debt increases. In contrast, the Moroccan government seems to (prudently) decrease its stock of foreign debt as the world rate of interest increases.

Inflation gap (F4)

In two countries, Egypt and Morocco, the inflation gap measure shows significant role to play in the government's stock of foreign debt model and the government expenditure model.

At periods of higher rates of inflation the government, in the two countries, seems to reduce its expenditure, possibly as part of a general policy to encounter inflation, as has been shown in chapter four.

However, at high inflation periods, the two countries react differently with respect to foreign borrowing. The Egyptian government tends to increase its foreign borrowing. Morocco, which is a lower inflation country compare to Egypt, chooses to reduce its stock of foreign debt.

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[24] Replacing the nominal world rate of interest with the real in the Moroccan estimation will not change the signs, but the statistical significance of the coefficients. The same is true in the Egyptian estimation.

[25] As reported in the IMF publication: IFS Yearbook 1998.

[26] Ibid.

At high inflation rates, people tend to reduce their holdings of domestic currency and either increase their holdings of foreign assets, capital flights, or adjust their portfolio towards more domestic real assets. If this continues for long enough, depreciation is inevitable, which seems the case in Egypt, Table 6-2, as it exhibits positive and significant coefficient.

Openness (Op)

This variable seems to play important role in the Egyptian estimation only. The degree of openness to the world economy has an important role in reducing the stock of government debt and in depreciating the Egyptian pound. However, it shows no (significant) role to play in Egypt's real economic growth and in its government's share in the national output.

The negative relationship between the openness measure and the government stock of foreign debt could be explained as follows. An open economy, such as Egypt's, not only vulnerable to lenders penalties but also to their rewards, if any. In fact, the favourable (to the lenders) political stand that Egypt showed in the II Gulf War was rewarded by 50% debt forgiveness, in the early 1990s.

The positive effect of the openness measure in the exchange rate model may reflect the world economy's perception with respect to Egypt's currency exchange rate. As the economy opens to the world economy, a devaluation of an "over-valued currency" is required.

% Change in the terms of trade T3

This variable has important role to play in the Moroccan and the Tunisian economies. While an improvement in the terms of trade decreases the stock of the government foreign debt in Morocco, it rather increases it in Tunisia.

The Moroccan estimation of the government expenditure model shows negative and significant effect of the terms of trade. It could be argued that, an increase in the rate of change in the terms of trade increases investment, particularly of the private sector (which is usually more efficient compared to the public sector). Eventually, the private sector's share in national output increases at the expense of the public sector share.

Human capital H52

The human capital measure plays an important role in three models: the exchange rate, the foreign debt and the government expenditure models in Morocco. It plays an important role in the first two models in Tunisia. In fact, the estimated coefficients for this variable in the two countries are positive in the three models, see Tables 6-3 and 6-6.

In the two countries the government seems to devalue the national currency and increase external borrowing in order to improve the country's human capital. We argue that, the government's decision to devalue the national currency is an effort to gain international acceptance. Similarly, the government's effort to improve human capital is to gain people's acceptance.

Although all estimated coefficients for the human capital measure in the growth model are insignificant, the negative signs (Tables 6-3 and 6-6) are, in fact, contrary to what many economic growth studies suggest. However, Barro and Lee (1994) estimated a negative coefficient for a similar variable, the female secondary school attainment. They argued that, the spread of male and female schooling is a good measure of backwardness of the country.

% Change in exports ex

This variable shows significant effects on the exchange rate and the stock of foreign debt in Morocco only. A decrease in the rate of change of export depreciates the domestic currency. In fact, the decrease in export growth could imply a decrease in foreign demand for the country's exports, and as a result a decrease in demand for the country's currency, if this continues long enough it could lead to depreciation.

The effect of the increase in the export growth on the stock of the government's foreign debt is expected to be positive if lenders are able to push more loans (see chapter three p.37 for the loan pushing argument) to what they perceive as a good borrower. Alternatively, this variable could reflect the country's degree of openness as well. More open economies are usually able to find softer terms of international borrowing than less open economies. Therefore, the government

may find it attractive to borrow externally to finance more of its spending, hence the stock of foreign debt increases.

Tax revenue to GDP ratio v3

This variable is significant in two models of Tunisia, the foreign debt model and the exchange rate model.

However, the government can increase its foreign borrowing in order to avoid the possible social unrest as a result of higher taxes, and to gain people's acceptance. Devaluation makes foreign goods expensive and possibly reduces the country's import duties. In addition, devaluation has a positive effect on foreign exchange revenue from exporting, which in turn helps to reduce the government's burden of foreign debt.

The Tunisian government's ability to tax its people implies a higher tax share in the national output. In fact, this is similar to Fielding (1997) result. Where government expenditure is found to be highly affected (positively and statistically significant) by changes in fiscal revenue. Less fiscal revenue limits the government's expenditure.

The government ability to tax people may help it to reduce the country's dependence on foreign sources of finance, and eventually to decrease its stock of foreign debt.

Overall performance

Table 6-7 below is constructed to summarise the performance of the four models in the three countries. The table is very informative and can point out to the performance of each country's estimation. We start by examining the performance of each of the four models separately: the exchange rate, the foreign debt, the economic growth and the government expenditure models.

The exchange rate model

Although all variables in the model are significant and play important roles in determining the real exchange rate of the Egyptian currency, Table 6-1, all six estimations of this model perform poorly, as each suffers from some specification problems. This is, in fact, not strange since modelling exchange rate is usually not a straightforward task[27].

Egypt's estimations show one specification problem (functional form). However, several specification problems were detected in the estimations of Morocco and Tunisia.

Table 6-7 Overall performances

Models		Egypt		Morocco		Tunisia	
		Table 6-1	Table 6-2	Table 6-3	Table 6-4	Table 6-5	Table 6-6
Exchange rate	D, #	f, 6/6	Same as in 6-1	s,n, 3/6	n, 3/6	f, h, 2/5	f, 1/3
	Sig. Var.	i6, n, B, rw, F4, op		h52, rw1, ex	h52, rw1, ex	h52, B	h52
Foreign debt	D, #	5/6	5/5	s, 6/6	6/6	4/5	4/4
	Sig. Var.	i6, B, rw, F4, op	i6, B, rw, F4, op	B, rw1, F4, T3, h52, ex	B, rw1, F4, T3, h52, ex	V3, B, h52, T3, n	V3, h52, T3, n
Economic growth	D, #	1/6	2/2	s,h, 0/6	h, s, 0/6	0/5	1/4
	Sig. Var.	B	B, n	-	-	-	B
Gov. Exp. ratio	D, #	3/6	3/5	f, 2/6	2/6	s, 2/5	1/4
	Sig. Var.	i6, B, F4	i6, B, F4	B, T3	B, T3	v3, B	B

D = Diagnostic problems:
s = Serial correlation, f = Functional form, h = Heteroscedasticity, n = Normality.
# = Number of significant variables to total number of estimated variables, excluding the intercept.
Sig. Var. = estimated significant variables. - = All estimated variables are insignificant.

[27] See Pilbeam K. (1992) p.239, where explanations are given to the poor results of exchange rate models.

The economic growth model

Similar to the exchange rate model, the economic growth model performs very poorly in our empirical estimation exercises. The model estimates very few number of significant variables, zero, one and two variables in Morocco, Tunisia and Egypt, respectively.

The government expenditure model

This model performs fairly well in all three countries. The general form of this model shows few specification problems, functional form in Morocco and serial correlation in Tunisia. The model works better in Egypt, where good number of significant variables is found, and not a single specification problem is detected. It is interesting to note that the budget deficit ratio plays significant role in all three countries. Which was explained as reflecting the deficit financing policy experienced by the governments of the three countries.

The foreign debt model

The government's foreign debt model shows very good performance in the all three countries. No specification problems, and all estimated coefficients show significant effects, Tables 6-2, 6-4 and 6-6.

Three variables, budget deficit, world interest rates and inflation, overlap two estimations of the foreign debt model, Egypt and Morocco. These variables are common important determinants of these two countries' government demand for foreign funds. Similarly, the human capital and terms of trade are two common determinants in Morocco and Tunisia.

It is obvious that the empirical estimation (of the determinants) of the government's stock of foreign debt equation is very successful in each country. The model is able to explain 0.90, 0.96 and 0.98 of the variation in the stock of public and publicly guaranteed debt in Egypt, Morocco and Tunisia respectively.

The government's demand for foreign borrowing

Changes in the stock of foreign debt are usually attributed mainly to three general factors: the flow of new debt, changes in the world interest rates and changes in the exchange rate. The above empirical estimations, which are represented in Table 6-8 below, of the foreign debt models, accommodate the first two factors. These estimations are not explicitly taking account of the effects of the exchange rate changes on the government demand for foreign borrowing. In this section we plan to augment the foreign debt model with a measure of exchange rate changes, and examine the new model empirically.

Table 6-8 The countries' best foreign debt models

Independent Variables		Dependent Variables A4 Foreign Debt Stock^		
		Egypt	Morocco	Tunisia
Intercept	C	2.850 (3.992)*	-	-
Gross Domestic Investment / GDP	i6	0.060 (2.635)*	-	-
Budget Deficit / GDP	B	- 0.133 (6.623)*	- 0.047 (4.821)*	-
World (LIBOR) real interest rates	rw	13.80 (5.375)*	- 0.026 (2.105)**	-
Inflation gap (Egypt - USA)	F4	5.850 (3.365)*	- 2.590 (1.932)**	-
(Exports+Imports) /GDP	Op	- 3.080 (3.340)*	-	-
Gross secondary enrolment ratio	h52	-	0.061 (23.56)*	0.021 (23.63)*
% change in terms of trade	T3	-	- 0.020 (2.953)*	0.006 (3.522)*
% change in exports	ex	-	0.009 (2.924)*	-
Population Growth	n	-	-	0.061 (2.891)*
Tax revenue / GDP	v3	-	-	- 0.018 (5.815)*
Sample Size — Period		1975-1995	1975-1995	1975-1995
Sample Size — # of Observations		21	21	21
R^2		0.896	0.962	0.979
Serial Correlation (LM)	χ^2 (1)	1.07 (0.30)	1.68 (0.20)	0.21 (0.65)
Functional Form (LM)	χ^2 (1)	0.98 (0.32)	2.42 (0.12)	1.00 (0.32)
Normality (LM)	χ^2 (2)	1.74 (0.42)	0.70 (0.70)	0.57 (0.75)
Heteroscedasticity (LM)	χ^2 (1)	0.05 (0.82)	0.19 (0.67)	0.37 (0.54)

t-ratios in parenthesis Significant at 5% = *, 10% = **

Italic means the existence of corresponding diagnostic problem.

^ = All coefficients are divided by 10^{10}.

In fact, the national currencies of the three countries under study were depreciating with respect to the US dollars, during the 1975-1995 period.

Depreciation increases the stock of foreign debt when measured by the domestic currency. Table 6-9 below provides the results of a simple calculation of the effect on the stock of the government's foreign debt as the exchange rate changes. The table is meant to give a general idea of the exchange rate role in accumulating the foreign debt in the three countries. It is understood that to measure the accurate effects one needs to take into account the exchange rate changes in all other major currencies of the debt contracts. The formula used in calculating Table 6-9 is

$$\Delta A4_t = \frac{el_t - el_{t-1}}{el_t} A4_t$$

Where, $\Delta A4_t$ is the change in the stock of foreign debt at time t,
$A4_t$ is the stock of foreign debt at time t,
el_t is the exchange rate at time t.

Table 6-9 The government's debt and exchange rate changes

Years	$\Delta A4_t$		
	Egypt	Morocco	Tunisia
1975	-	15	45
1977	-	-162	-86
1979	4,598	-266	-57
1981	-	1,613	623
1983	-	2,300	584
1985	-	95	-645
1987	-	-2,160	-486
1989	6,992	-225	41
1991	14,437	264	228
1993	256	1,249	681
1995	64	-1,281	-371

(US$ Mil.)

This table shows the amount of changes in the stock of the government foreign debt that caused by changes in the exchange rate. While positive signs in the table mean loses, negative signs mean gains from an appreciation of the currency. Although the currencies of the three countries' were following an upward trend (depreciation) during the period[28], the Moroccan and the Tunisian currencies were fluctuating more than the Egyptian currency.

[28] See the graphs in Appendix 10, p.244.

Obviously, for the same dollar value of the stock of foreign debt, depreciation in the national currency increases the interest payment required on the same level of debt, when measured by the national currency.

The depreciation could be severe to the extent that the government may not be able to pay the interest payment due. In that case the government can either capitalise the interest through rescheduling, or borrow new debt to pay the interest due, or simply repudiate. The last option is usually risky and the consequences might be difficult to the country. However, the first two options lead to an increase in the government's stock of foreign debt.

Table 6-10 Adding a measure of the exchange rate effect to the debt model

Independent Variables		Dependent Variables Δ4 Foreign Debt Stock^		
		Egypt	Morocco	Tunisia
Intercept	C	2.110 (2.339)*	-	-
Gross Domestic Investment / GDP	i6	0.062 (2.772)*	-	-
Budget Deficit / GDP	B	- 0.110 (4.093)*	- 0.044 (4.279)*	-
World (LIBOR) real interest rates	rw	11.30 (3.554)*	- 0.024 (1.957)**	-
Inflation gap (Egypt - USA)	F4	5.080 (2.819)*	- 2.410 (1.784)**	-
(Exports+Imports) /GDP	Op	- 2.790 (2.988)*	-	-
Gross secondary enrolment ratio	h52	-	0.057 (12.011)*	0.009 (3.115)*
% change in terms of trade	T3	-	- 0.019 (2.728)*	0.003 (2.163)*
% change in exports	ex	-	0.008 (2.843)*	-
Population Growth	n	-	-	0.025 (1.391)
Tax revenue / GDP	v3	-	-	- 0.006 (1.683)
Interest payments	int	6.395×10^{-10} (1.291)	1.121×10^{-10} (1.017)	2.926×10^{-10} (3.996)*
Sample Size — Period		1975-1995	1975-1995	1975-1995
Sample Size — # of Observations		21	21	21
R^2		0.907	0.964	0.989
Serial Correlation (LM)	χ^2 (1)	1.98 (0.16)	2.36 (0.12)	0.22 (0.64)
Functional Form (LM)	χ^2 (1)	1.65 (0.20)	1.62 (0.20)	2.61 (0.11)
Normality (LM)	χ^2 (2)	1.39 (0.50)	1.25 (0.53)	0.83 (0.66)
Heteroscedasticity (LM)	χ^2 (1)	0.04 (0.84)	0.53 (0.47)	0.05 (0.82)

t-ratios in parenthesis Significant at 5% = *, 10% = **

Italic means the existence of corresponding specification problem.

^ = All coefficients are divided by 10^{10}.

We argue that the interest payment variable will be a good measure of the effects of the exchange rate changes on the government's stock of foreign debt. This variable will be added to the empirical models in Table 6-8.

The above analysis implies that an increase in the exchange rate (depreciation) will increase the interest payments and in turn the stock of debt, hence a positive relationship is expected. However, if the government managed to pay the interest payment due then no effect is expected.

Table 6-10 shows the estimation results after adding the new variable, interest payments. For comparison reason, the estimation results in Tables 6-2, 6-4 and 6-6 are represented in Table 6-8 above.

Two of the three estimations of the model show encouraging results, Egypt and Morocco, where all variables kept their signs unchanged. With regard to the Tunisian model, two variables changed their signs as a result of introducing the interest payment variable to the model, human capital measure and the terms of trade variable; the latter becomes insignificant as well. However, in the three estimations the estimated coefficients for the interest payment variable are positive. This positive effect implies that, the exchange rate fluctuation has a role to play in the three countries accumulation of the stock of foreign debt. However, this variable is significant in Tunisia only.

Since rescheduling events in Egypt and Tunisia are very minimal during the period under study, the positive effect of the interest payment variable means that the governments of the two countries resort to new borrowing to service their old debt. On the other hand, in Morocco the government resorts to rescheduling to ease the current debt burden (as this country is with the highest number of rescheduling cases, in our sample).

Therefore, we argue that the interest payment variable performs well in measuring the exchange rate effect on the government's stock of foreign debt. This is clear from the estimated positive signs.

Empirical estimation of the private sector model

The private sector's demand for foreign borrowing specified in this chapter is based on the theory of demand for assets. Particularly, the mean-variance portfolio approach is used, where an individual firm diversifies its portfolio to maximise the expected returns.

Assuming that the sector consists of homogeneous firms, which are risk averse, we can then aggregate the firm demands to establish the private sector demand for foreign borrowing. Therefore, the sector maximises the expected total returns, Z, from its financial portfolio, subject to its total wealth, W.

Here, we assume that the private sector financial portfolio consists of three types of assets: two domestic and one foreign. In the theoretical section of this chapter we solved the above maximisation problem, from which we are able to separate a demand function for foreign borrowing only, equation (6-43), such as:

$$-V_2 = c_0 + c_1 E(R_1) + c_2 E(R_2) + c_3 E(R_3) + f_{122} W + u$$

Where, $E(R_i)$ the subjective expected rates of return,
W the private sector total wealth,
V_2 the private sector's stock of foreign debt,
u error term

Following Parkin (1970) the subjective expectations are, assumed to be, best presented by the previous year's rates of return:

$$D_P = c_0 + c_1 R_{1t-1} + c_2 R_{2t-1} + c_3 R_{3t-1} + f_{122} W + u \qquad (6\text{-}47)$$

Where, $D_P = -V_2$
R_1, R_3 domestic rates of return,
R_2 the world rates of interest,
$c_0, c_1, c_2, c_3, f_{122}$ are the coefficients to be estimated.

It should be noted that, the foreign asset in the private sector's financial portfolio yields negative returns. Hence, the sector's stock of foreign debt is introduced as negative values in our model.
In the following section the above model (6-47) is to be empirically estimated to examine the private sector's demand for foreign debt.

Data and variables

D_P is the private sector's stock of foreign debt. In our sample of countries, data on the private sector's stock of foreign debt is usually unavailable. However, the difference between the "total stock of debt" and the "public and publicly guaranteed debt" is to be considered as the private sector's stock of foreign debt. Although the public and publicly guaranteed debt possibly contains debt belongs to the private sector, yet it is difficult to isolate.

Several domestic rates of interest are available in the IMF and the World Bank publications: the International Financial Statistics (IFS) and the World Development Indicators (WDI) respectively. While three rates are available (for our sample of countries) in the IFS and the WDI namely the deposit rate[29], the lending rate[30] and the discount rate[31], the WDI includes the real interest rates[32] as well.

The rate of return on domestic assets could be represented by two rates: the domestic real interest rates, R_4, and the lending rate or the discount rate, R_5. The cost of foreign borrowing is measured by the world real rates of interest, rw.

Data on interest rates for the period under study is available for each country as follows. While data on the four rates is available for Egypt, only one rate is available for Tunisia, the discount rate. The other rates are available but for shorter periods. Unfortunately, no domestic interest rates data is available for Morocco for the period under study, so no estimation could be carried out for this country.

W is the private sector's wealth. We argue that, this variable could be measured by either manufacturing, industry or service value added and scaled by GDP. Here, we use the service value added as a measure of the private sector wealth,

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[29] (IFS, March 2000, p. xix) Usually refers to rates offered to resident customers for demand, time or saving deposits.

[30] (IFS, March 2000, p. xix) The bank rate that usually meets the short-and medium-term needs of the private sector.

[31] Or bank rate, (IFS, March 2000, p. xix) is the rate at which the central banks lend or discount eligible paper for deposit money banks.

[32] World Development Indicators CD-ROM 1999 definition is the deposit rate less the rate of inflation measured by the GDP deflator.

since the service sector is the largest in these countries' economies, see chapter two Table 2.3, p.14.

Expected signs

The private sector model includes four variables, three of which are rates of return and one is a measure of the sector's total wealth. It has been stated that two of the assets yield positive returns, and one yields negative returns.

The following analysis of expected signs is based on the realization that the stock of debt is presented as negative values as shown in (6-41) and (6-47). Equation (6-47) is best looked at as a supply function of an asset, where own price coefficient is expected to have a positive sign. However, it has been argued, in the previous government sector model[33], that an increase in the world interest rate might increase the stock of debt in an already indebted country. This was justified as that the burden of servicing the debt becomes heavier, and the private sector has either to reschedule (and capitalise) the interest payment due, or to borrow new debt to pay these interest payments due.

Each of the other two assets can have either a positive or a negative sign. When negative signs are estimated for the coefficients of the domestic interest rates, this will indicate that domestic assets and foreign asset (foreign borrowing) are substitute products. The increase in returns from domestic assets may reduce the need for foreign borrowing. Similarly, a positive sign of the coefficient of the domestic rates indicate that domestic and foreign assets are complement products. This implies that domestic sources of capital are not capable to meet the private sector total demand for capital.

With respect to the wealth variable, as the private sector wealth expands, more investment projects are expected, which require more domestic and international financing. A positive relationship is expected between the total wealth measure and the sector's demand for foreign borrowing.

[33] See p.159 and p.172 of this thesis.

The estimation results

Table 6-12, below, shows the model's estimation results for both countries. Since the private sector model consists of sever rates of interest (domestic and foreign), one may suspect multicolinearity. A correlation coefficient test has been performed, where it shows that the highest correlation does not exceed 0.46.

The time series for each variable is kept and used in its level forms. However, despite the fact that the series are not long enough, they were tested for stationarity as shown in Table 6-11 below, which is extracted from Table A11.2 in appendix 11. The stationarity tests show that with the exception of Egypt's real interest rates, R_4, all variables are, in fact, integrated of order one, I ~ (1). Hence, we argue that the estimation results presented in Table 6-12 are credible and not spurious.

Table 6-11 Order of integration

	Egypt	Tunisia
World real rates of interest; rw	1	
Private sector's stock of debt; A5	1	1
Real interest rate; R_4	0	-
Discount rate; R_5	1	1
Service value added to GDP; X6	1	1

Equation (6-47) represents the private sector's demand for foreign debt. This equation has been estimated by OLS using data from Egypt and Tunisia that covers the period 1977-1996 and 1976-1996 respectively.

Egypt's estimation

Three rates of returns are estimated to examine their roles in determining the private sector's stock of foreign debt. The estimation results show that all three rates play significant roles in determining Egypt's stock of foreign debt. The private sector's wealth has as expected positive effect on demand for foreign borrowing.

The estimated coefficient for the foreign borrowing own rate of interest indicates that as the world rate of interest increases the stock of the private sector foreign

expected to increase the current burden of foreign debt servicing and, at the same time, reduces the demand for foreign borrowing to finance new domestic investment projects in the current year. It seems that, in Egypt the increasing effects outweigh the reducing effects. As a result, a higher world interest rate increases the demand for new borrowing, possibly to service old debt.

The estimated coefficients of the two domestic rates indicate that domestic assets and foreign assets (foreign borrowing) are complement products. As the rates of return on domestic assets increase the stock of the private sector foreign debt increases.

Table 6-12
OLS estimation of the private sector model

Independent Variables		Dependent Variable: - A5^	
		Egypt	Tunisia
Intercept	C	0.749 (1.165)	0.352 (3.419)*
World (LIBOR) real interest rates	rw(-1)	- 3.700 (2.945)*	0.090 (0.909)
Domestic real interest rates	$R_4(-1)$	0.013 (2.191)*	-
Domestic discount rates	$R_5(-1)$	0.034 (2.975)*	- 0.017 (10.138)*
Private sector's wealth: Service value added / GDP	X6	- 0.032 (2.096)**	- 0.005 (2.809)*
Sample Size	Period	1977-1996	1975-1995
	# of Observations	20	21
R^2		0.676	0.872
Serial Correlation (LM)		0.48 (0.49)	0.19 (0.66)
Functional Form (LM)		0.07 (0.79)	0.03 (0.86)
Normality (LM)		6.72 (0.04)	2.24 (0.33)
Heteroscedasticity (LM)		0.01 (0.91)	0.00 (0.97)

t-ratios in parenthesis. Significant at 5% = *, 10% = **
^ = All coefficients are divided by 10^{10}.

Although all estimated coefficients are statistically significant, the model exhibits a specification problem, normality. At the same time, the model is able to explain only 0.68 of the variation in the sector stock of debt. This may suggest that the model requires additional information in order to explain higher percentage of the variation in the data and possibly to overcome the normality problem as well.

Tunisia's estimation

The estimated coefficient for the world real rates of interest indicates (as expected) that, as the rates of interest increase Tunisia's private sector demand for

foreign borrowing decreases. However, the estimated coefficient of this variable is statistically insignificant.
This result could reflect the fact that the burden of the foreign debt service is less severe in Tunisia than in Egypt. Tunisia is the least indebted, and the most financially sound, country among the three countries in our sample.

In Tunisia only one domestic rate of interest is available, the discount rate, R_5. IT could be argued that, the domestic asset competes with foreign borrowing to finance the private sector's demand for capital. In other words, the negative and significant effect of the domestic discount rates demonstrates that domestic sources of finance are a substitute for foreign sources of finance, in Tunisia. A decrease in the previous year's domestic rates of interest reduces this year's demand for debt from foreign sources, and probably increases the demand from domestic sources, ceteris paribus.

Similar to Egypt and as expected, Tunisia's private sector's wealth is measured by its service sector's value added to GDP. The estimated significant wealth coefficient indicates that, as total wealth (the service sector) grows, the private sector demands more foreign borrowing, probably to finance new investment projects.

The model shows no specification problem when applied to data from Tunisia. Furthermore, it is able to explain high percentage, 0.87, of the stock of the private sector's foreign debt variation.

Overall performance

The lack of data not only caused the dropping of Morocco from our sample, but also to estimate the model with fewer variables for Tunisia.
Nevertheless, two estimations results are reported in Table 6-12. While the Egyptian estimation showed the normality problem, the Tunisian had none of the specification problems. Each country's estimation shows the different role of the three interest rates used in the demand for foreign borrowing, but similar role of the wealth measure.

The domestic and foreign sources of finance substitute each other in Tunisia. However, domestic and foreign assets operate as complements in Egypt. Similarly, the effect of world real rates of interest on the stock of foreign debt is different in the two countries. The model was able to (correctly) reflect the debt burden difference between the two countries. The total wealth measure shows the same positive effect on the stock of foreign debt in both countries.

Empirical joint estimation of the two sectors' model

The previous two sections of this chapter present the estimation results of the demand for foreign debt by each sector separately. It has been argued that, in those two sections, factors which drive the private sector demand are different from those that drive government sector demand.

An alternative approach is followed in this section, where the two demand models are combined together and estimated as a one model, which will represent the country's total demand for foreign debt.

In fact, the stock of government sector demand is defined, in this chapter, as public and publicly guaranteed debt, which is shown in the World Bank publications. Subtracting government debt from the country's total stock of debt will give the private sector stock of foreign debt. This raises questions about how accurate these measures of debt are, and whether they under- or over-estimate the actual stock of foreign debt in the two sectors.

Since each sector demand function is assumed to take the linear form, the combined function is assumed to be linear as well, such that:

$$f(D) = f_g(D_g) + f_P(D_p)$$

In equation (6-46) we defined the combined demand model for foreign debt:

$$D = f(S, R, W) \qquad (6\text{-}48)$$

Where S is a vector of variables that determine the government's demand, R is a vector of rates of returns that affect the private sector stock of foreign debt, and W is the private sector total wealth. This equation is to be estimated in the next section.

Alternatively, the two models (private and government) could be estimated jointly. Where we assume that the disturbances in the two models certainly include factors that are common to both sectors, as well as factors that are specific to the particular sector. Therefore, the following two models are to be jointly estimated:

$$D_g = f_g(S) \quad (6\text{-}49)$$

$$D_p = f_p(R,W) \quad (6\text{-}50)$$

Data and expected signs

The independent variables in the (best) government sector model and the (best) private sector model, for each country, are to comprise the independent variables in the combined model. All variables are as defined previously, and are used in the empirical estimations in their level forms.

The dependent variable is as follow. The government sector model used the public and publicly guaranteed debt (PPG) as its dependent variable. As for the private sector model, its dependent variable is calculated as the difference between the country's total stock of foreign debt and the (PPG). The combined model is to use the country's total stock of foreign debt as the dependent variable.

Since the combined model dependent variable is the sum of the government's debt and the private debt, the estimated coefficients in the combined model are then expected to show consistent signs with the two disaggregated models. This consistency will point to the model's stability as well.

Obviously, if this disaggregation of the data is accurate, the available data on the stock of the private sector foreign debt should coincide with the actual (unobserved) stock of debt. We argue that the magnitudes of the estimated coefficients in the combined model are expected to reflect each sector's relative size of the stock of foreign debt.

On the average, the private sector makes about 20% and 11% of total debt during the period 1975-1995 in Egypt and Tunisia respectively. In that case, the magnitudes of the estimated coefficients of the private sector variables, for example, are expected to be small in the combined model when compared with their magnitudes in the private sector model. Otherwise, if large coefficients, of the private sector variables, are estimated in the combined model this may be interpreted as an inaccuracy in the disaggregated data. Further, it could be

interpreted as that the actual debt of the private sector is much larger than what the available data indicates.

Estimation results

In the government sector model, two estimations have been carried out for each country. The best estimated government sector demand for debt model for each country is represented in Table 6-8. On the other hand, the estimated models in Table 6-12 are the private sector models for Egypt and Tunisia. However, no estimation has been performed for Morocco, because its data on (any of) the domestic interest rates is available for very short period only.

In this section, two estimation methods are to be used to examine the argument that the two sectors are interrelated. The first is OLS, which simply combine the two models and forms the country's demand for foreign borrowing. Hence, this "combined" model aims at explaining the country's total stock of foreign debt build up. The model is to be estimated by OLS using available data of each country for the period under study, 1977-1995 and 1975-1995 for Egypt and Tunisia respectively. Secondly, the two models are then jointly estimated. Here the disturbances in the two models are assumed to have factors that are common in the two sectors, as well as factors that are specific to the particular sector. Here the Seemingly Unrelated Regression Estimator (SURE) is to be used for the same set of data as defined above.

Tables 6-13 and 6-15 below show the estimation results of the combined model of Egypt and Tunisia, respectively.

Egypt's estimation

The period covered in the Egyptian estimation model is 1977-1995 as data on domestic real interest rates, R_4, is available from 1976 onward, and data on budget deficit to GDP ratio, B, is available up to 1995 only.

The third column in Table 6-13, model (1), shows the estimation results of Egypt's combined model where all variables that play significant roles in the government and private sector models are included. The functional form problem is detected in model (1), where we reject the null hypothesis of the absence of this problem at 99% level of significance.

Table 6-13 Egypt's OLS estimation of the combined model

Independent Variables		Total stock of debt A2^	
		model 1	model 2
Intercept	C	- 3.230 (0.354)	- 9.370 (4.866)*
Gross Domestic Investment / GDP	i6	0.088 (1.591)	0.075 (2.954)*
Budget deficit / GDP	B	- 0.096 (1.792)	- 0.081 (2.910)*
World (LIBOR) real interest rates	rw	12.90 (0.794)	6.700 (1.881)**
	rw(-1)	- 2.740 (0.198)	-
Inflation gap (Egypt - USA)	F4	3.390 (0.420)	-
(Exports+Imports) /GDP	Op	- 2.760 (0.705)	-
Domestic real interest rates	$R_4(-1)$	- 0.017 (0.482)	-
Domestic discount rates	$R_5(-1)$	0.067 (0.646)	0.041 (0.711)
Private sector wealth: Service V. A. / GDP	X6	0.097 (0.569)	0.207 (4.990)*
Interest Payment	int	1.474×10^{-10} (0.251)	-
Sample Size	Period	1977-1995	1976-1995
	# of Observations	19	20
R^2		0.882	0.898
Serial Correlation (LM)	$\chi^2(1)$	1.11 [0.29]	1.75 [0.19]
Functional Form (LM)	$\chi^2(1)$	*10.8 [0.00]*	1.88 [0.17]
Normality (LM)	$\chi^2(2)$	1.37 [0.50]	1.01 [0.60]
Heteroscedasticity (LM)	$\chi^2(1)$	0.94 [0.33]	0.49 [0.48]

t-ratios in parenthesis. Significant at 5% = *, 10% = **

^ = All coefficients are divided by 10^{10}.

However, with respect to the estimated coefficients' signs all, but the domestic discount rate, are consistent in the three estimations: government, private and combined. Although most of the estimated coefficients are statistically insignificant, this consistency in signs is a good indication of the model's ability in explaining the data. The insignificancy could be attributed to some problem of misspecification in the combined model, and that dropping some of the insignificant variables may improve the estimation results.

In fact, the combined model is re-estimated after omitting five of the insignificant variables, n, rw(-1), R_4(-1), F4, op and int, which as a result overcomes the functional form problem. The estimation results are reported in the fourth column of Table 6-13, titled model (2).
Egypt's estimated combined demand model for foreign debt is best represented by model (2), where the estimated model does not suffer from any type of specification problem, and were all estimated coefficients (with the exception of the discount rates, R_5(-1)) are statistically different from zero.

Therefore, the demand for foreign borrowing increases as the domestic investment ratio, the budget deficit ratio, the world real rates of interest, and the private sector wealth increase. The analysis of these relationships is the same as in the previous two sections.

To compare and analyse the estimated coefficients in the three models, government, private and combined, we represent the three estimations' results in Table 6-14 below. The world real rate of interest, rw, is an interesting variable because it overlaps the government and the private sector models. It consistently shows a positive (and statistically significant) relationship with the demand for foreign debt in the government, private and the combined models.
In fact, an increase in the world real interest rates, rw, may have two conflicting effects on the demand for foreign debt. An increase in interest rate usually reduces the demand for debt, as borrowing becomes expensive to finance consumption or even investment projects. On the other hand, it could increase the demand, of a debtor country, for (new) borrowing to service old debt, as a result of the increase in the debt service pressure on the economy. The final effect depends on which effect outweighs the other, after all.

The estimation results in Table 6-14 show that, the government sector's behaviour is similar to the private sector when responding to changes in the world rate of interest.

Table 6-14 Egypt's government, private and combined models

Independent Variables		Stock of debt of:		
		COMBINED	Government	Private
Intercept	C	- 9.370 (4.866)*	-	- 0.749 (1.165)
Gross Domestic Investment / GDP	i6	0.075 (2.954)*	0.054 (2.004)**	
Budget deficit / GDP	B	- 0.081 (2.910)*	- 0.097 (3.568)*	
World (LIBOR) real interest rates	rw	6.700 (1.881)**	7.170 (1.959)**	
	rw(-1)	-	-	3.700 (2.945)*
Inflation gap (Egypt - USA)	F4	-	4.660 (2.422)*	
(Exports+Imports) /GDP	Op	-	- 2.320 (2.501)*	
Domestic real interest rates	$R_4(-1)$	-	-	- 0.013 (2.191)*
Domestic discount rates	$R_5(-1)$	0.041 (0.711)	-	- 0.034 (2.975)*
Private sector wealth: Service V. A. / GDP	X6	0.207 (4.990)*	-	0.032 (2.096)**
Interest Payment	int	-	10.77×10^{-10} (2.439)*	-
Sample Size — Period		1976-1995	1975-1995	1977-1996
Sample Size — # of Observations		20	21	20
R^2		0.898	0.894	0.676
Serial Correlation (LM)	χ^2 (1)	1.75 (0.19)	1.89 (0.17)	0.48 (0.49)
Functional Form (LM)	χ^2 (1)	1.88 (0.17)	2.17 (0.14)	0.07 (0.79)
Normality (LM)	χ^2 (2)	1.01 (0.60)	1.01 (0.60)	6.72 (0.04)
Heteroscedasticity (LM)	χ^2 (1)	0.49 (0.48)	0.16 (0.69)	0.01 (0.91)

t-ratios in parenthesis. ^ = All coefficients are divided by 10^{10}. Significant at 5% = *, 10% = **

While the domestic real interest rate, $R_4(-1)$, and the measure of private sector wealth, X6, kept their signs unchanged, the domestic discount interest rates, $R_5(-1)$, changed its sign in the combined model. In fact, the estimated coefficients of these three, private sector variables, X6, $R_4(-1)$ and $R_5(-1)$, are statistically insignificant in model 1 in Table 6-13. However, model 2 in Table 6-13 shows that the wealth measure is positive and significant, but the discount rate is not.

As for the magnitude of the estimated coefficients are concerned, Table 6-14 shows some interesting results. On the one hand, two government sector coefficients (out of three), the budget deficit and the world interest rate, in the combined model have smaller magnitudes than they previously had in the government sector model. On the other hand, the two private sector variables, the domestic discount rate and the wealth measure, in the combined model have larger magnitudes than they previously had in the private sector model.

In fact, this result not only in line with the fact that, the actual stock of private's foreign debt is larger than the data used in the above estimations, but also points to the possibility that the difference between the actual and the available data is quite large. This result contradicts the expectation that, the estimated coefficients should reflect the size of debt in each sector according to the available data. However, it supports our suspicion that data inaccuracy is possibly large.

Tunisia's estimation

Tunisia's combined model includes all variables in Tables 6-8 and 6-12. The model is estimated by OLS using data covering the 1975-1995 period.
The estimation results are reported in Table 6-15, where model (3) belongs to the combined model, and model (4) is similar to model (3) but with three (insignificant) variables omitted. Dropping most of the insignificant variables in model (3) and estimate the new model we end up with model (4), which is continuing to be safe from any specification problem as model (3).

All variables in model (4) are statistically significant. Therefore, an increase in human capital, export growth, domestic discount rates, total wealth and interest payment will push the country to increase its stock of foreign debt.

When the last year's world interest rate is included in the combined model, it behaves the same as it does in the private model, positively. However, the variable is statistically insignificant in both models.

The significant coefficients of the human capital measure, in the combined and the government sector model, attract our attention. It has been found in many studies that, the role of human capital in economic growth is positive and important, which may imply that the larger the country's potential of human capital wealth the less the need to resort to foreign borrowing. However, the positive effects that our estimations show could be explained as follows. The building up of the country's human capital requires more expenditure, and hence possibly more foreign debt.

Table 6-15 Tunisia's OLS estimation of the combined model

Independent Variables		Total stock of debt A2^	
		model 3	model 4
Tax revenue / GDP	v3	- 0.021 (2.589)*	- 0.019 (3.371)*
Gross secondary enrolment ratio	h52	0.013 (3.033)*	0.011 (3.193)*
% change in terms of trade	T3	0.006 (2.945)*	0.005 (2.854)*
Population Growth	n	0.028 (1.186)	-
World (LIBOR) real interest rates	rw(-1)	0.057 (0.214)	-
Domestic discount rates	$R_5(-1)$	0.017 (1.991)**	0.018 (2.280)*
Private sector wealth: Service V. A. / GDP	X6	0.004 (1.220)	0.005 (1.941)**
Interest Payment	int	2.0×10^{-10} (1.503)	2.159×10^{-10} (1.792)**
Sample Size	Period	1975-1995	1976-1995
	# of Observations	21	20
R^2		0.990	0.989
Serial Correlation (LM)	χ^2 (1)	0.11 (0.74)	1.54 (0.22)
Functional Form (LM)	χ^2 (1)	*3.67 (0.06)*	*2.90 (0.09)*
Normality (LM)	χ^2 (2)	0.82 (0.67)	1.32 (0.52)
Heteroscedasticity (LM)	χ^2 (1)	0.42 (0.52)	0.12 (0.72)

t-ratios in parenthesis. Significant at 5% = *, 10% = **

^ = All coefficients are divided by 10^{10}.

In addition, one may argue that this measure of human capital, ratio of secondary school enrolment, is a good proxy of new job seekers in the country's labour force. When the government is unable to accommodate the new graduates by creating the required new jobs, unemployment rate will rise, which will have its detrimental effects on the economy, and may push the government to demand more debt from foreign sources to meet its domestic obligations, such as unemployment benefits.

In fact, the Tunisian government has been emphasising on the social sectors since independence in 1956. "Government priorities were the development of human capital and the provision of basic social services. ... Expenditures have been maintained at 5 to 6 percent of GDP for education and 2.2 percent of GDP for health, even during the strongest period of stabilisation-induced expenditure cuts. ... The government has made nine years of education compulsory, and primary net enrolment rates reach almost 100 percent"[34]. Therefore, these efforts and emphasis on social services in general and education in particular, and the

[34] Trends in Development; pp. 506, 508.

expected accompanied high levels of expenditures may explain the highly significant and positive relationship between the human capital measure and the stock of foreign debt.

Table 6-16 Tunisia's government, private and combined models

Independent Variables		Stock of debt of:		
		COMBINED	Government	Private
Tax revenue / GDP	v3	- 0.019 (3.371)*	- 0.006 (1.683)*	- 0.329 (2.939)*
Gross secondary enrolment ratio	h52	0.011 (3.193)*	0.009 (3.115)*	-
% change in terms of trade	T3	0.005 (2.854)*	0.003 (2.163)*	- 0.190 (1.528)
Population Growth	n	-	0.025 (1.391)	-
Interest Payment	int	2.159×10^{-10} (1.792)**	2.926×10^{-10} (3.996)*	-
World (LIBOR) real interest rates	rw(-1)	-	-	-
Domestic discount rates	$R_5(-1)$	0.018 (2.280)*	-	0.017 (10.070)*
Private sector wealth: Service V. A. / GDP	X6	0.005 (1.941)**	-	0.005 (2.446)*
Sample Size	Period # of Observations	1976-1995 20	1975-1995 21	1976-1996 21
R^2		0.989	0.989	0.872
Serial Correlation (LM)	χ^2 (1)	1.54 (0.22)	0.22 (0.64)	0.17 (0.68)
Functional Form (LM)	χ^2 (1)	*2.90 (0.09)*	2.61 (0.11)	0.03 (0.86)
Normality (LM)	χ^2 (2)	1.32 (0.52)	0.83 (0.66)	1.41 (0.50)
Heteroscedasticity (LM)	χ^2 (1)	0.12 (0.72)	0.05 (0.82)	0.04 (0.84)

t-ratios in parenthesis. ^ = All coefficients are divided by 10^{10}. Significant at 5% = *, 10% = **

Table 6-16 is established to make the comparison between the three Tunisian estimations easier. With exception of the interest payments, all the estimated coefficients, either belongs to the private or the government model, in the combined model are larger than (or similar to) their magnitudes when estimated in each sector's model separately. This result again supports our suspicion that the private sector debt is possibly larger than what is reported.

The joint estimation of the two models

The government sector model and the private sector model are re-estimated using the SURE estimator. This exercise is another examination of the expected connection between the two sectors stock of foreign debt.

Table 6-17 Egypt's SURE estimation results

Independent Variables		SURE	
		Government	Private
Intercept	C	3.345 (5.906)*	- 0.767 (1.488)
Gross domestic Investment / GDP	i6	0.025 (1.525)	-
Budget Deficit / GDP	B	- 0.106 (5.988)*	-
World (LIBOR) real interest rates	rw	11.14 (4.124)*	-
	rw(-1)	-	2.277 (2.355)*
Inflation gap (Egypt - USA)	F4	5.418 (4.078)*	-
(Exports+Imports)/ GDP	Op	- 2.901 (4.077)*	-
Domestic real interest rates	$R_4(-1)$	-	0.0004 (3.605)*
Domestic discount rates	$R_5(-1)$	-	- 0.038 (4.311)*
Wealth: Service V. A. / GDP	X6	-	0.034 (2.841)*
Interest payments	int	3.2×10^{-10} (0.974)	-
Sample Size	**Period**	**1977-1996**	**1977-1996**
	# of Observations	**20**	**20**
R^2		**0.859**	**0.669**

t-ratios in parenthesis ^ = All coefficients are divided by 10^{10} Significant at 5% = *, 10% = **
Italic means the existence of corresponding diagnostic problem.

Tables 6-17 and 6-18 present the estimation results of the estimators, for Egypt and Tunisia respectively. In fact, in the two countries, the overall performances of the SURE and OLS estimations (Tables 6-14 and 6-16) are very similar.

In Egypt, Table 6-17, the estimated coefficients of two variables (the investment to GDP ratio and the domestic real interest rates) by SURE estimator are not the same as in the OLS estimation.

Although, the investment ratio variable had the same sign when estimated by SURE and OLS, it lost its significancy in the SURE estimation. The private sector variable, the domestic real interest rate, is significant in the two estimations. However, this variable changed its sign, and its estimated magnitude (in absolute term) becomes smaller in the SURE estimation.

Table 6-18 Tunisia's SURE estimation results

Independent Variables		SURE	
		Government	Private
Intercept	C	-	- 0.368 (4.080)*
Tax revenue /GDP	v3	- 0.007 (2.476)*	-
Gross secondary enrolment ratio	h52	0.011 (4.515)*	-
% change in terms of trade	T3	0.004 (3.248)*	-
Population Growth	n	0.026 (1.709)**	-
World (LIBOR) real interest rates	rw(-1)	-	0.196 (2.021)*
Domestic discount rates	$R_5(-1)$	-	0.017 (11.967)*
Wealth: Service V. A. / GDP	X6	-	0.005 (3.448)*
Interest payments	int	2.5×10^{-10} (4.052)*	-
Sample Size	**Period**	**1975-1995**	**1975-1995**
	# of Observations	**21**	**21**
R^2		**0.859**	**0.987**

t-ratios in parenthesis ^ = All coefficients are divided by 10^{10} Significant at 5% = *, 10% = **
Italic means the existence of corresponding diagnostic problem.

On the other hand, all variables, in the Tunisian case, kept their estimated signs and magnitudes consistent when using the two estimators. However, three variables become significant when estimated by the SURE estimator, namely the tax revenue ratio, the population growth and the last year's world real interest rate.

Overall performance

With respect to basic statistical tests such as t-ratio, R^2 and diagnostic tests, the combined model produced reasonably successful estimation results in the two countries. Furthermore, the model was able to produce good number of variables with consistent signs in the sector-version and in the combined-version estimations. In fact, the selected models for Egypt and Tunisia, model 2 and model 4 respectively, not only are able to explain high percentages of variations in the data, but also do not suffer from any specification problem. This points at the model's good ability to explain the data, and to its robustness and stability.

It has been argued, that the two countries demand foreign borrowing and increase their stock of foreign debt not only to meet planned expenditure, such as (changes in gross domestic investment, human capital and total wealth) but also to adjust to shocks (such as changes in budget deficits, world interest rates and exchange rate).

The estimations of the private, the government and the combined modes were interpreted to reflect the inaccuracy in the disaggregated data on the stock of foreign debt. The inaccuracy in data, here, could be attributed to several factors. One obvious reason is the fact that the data used for the stock of government debt is the public and publicly guaranteed debt (PPG) that surely contains some amount belongs in the private sector. However, the size of this amount is not known, to the researcher at least. Whether this amount accounts for a very large percentage of the (PPG), or whether it is a trivial amount that accounts for minimal percentage of (PPG), are only speculations. However, the estimation results using Egypt's data point at the possibility that the private share in the country's total stock of debt might be much larger than the reported information.

An alternative way to look at this "data inaccuracy" problem is as follows. It could be argued that the ability of the sector to borrow internationally depends on some observed and unobserved factors, such as the private sector's "hidden accounts" in international commercial banks. Suppliers of credit are expected to be able to disclose (and have access to) these unobserved "hidden accounts" factors, and accordingly determine the supply curve appropriate to this specific private sector.
In fact, the argument of the existence of an unobserved financial potential in the private sector and its relation to the sector's foreign borrowing behaviour, could add a new perspective to the hidden economy issue, which is beyond the scope of this thesis[35].

Finally, the SURE estimations of the two models show similar results as in the OLS estimations. Only one variable changed its sign, the domestic real interest

[35] See footnote #1 of this chapter.

estimations become significant when the SURE estimator is used in the Tunisian data.

Conclusion

The core aim of this chapter is to study how the stock of foreign debt accumulates in some selected Arab countries. This is somewhat similar to chapter five aims. Although the two chapters are overlapping, chapter five is more traditional. In chapter five, the standard roles and principles of economic are adopted, and the variables are selected in an ad hoc manner. On the other hand, this chapter, chapter six, is using the standard optimisation methodology. In addition, it follows the recent trend in the economic discipline. In this chapter a critical and rigorous model is built and specified.

Although, the core aim of this thesis is to study how the stock of foreign debt accumulates in some selected Arab countries. Chapter six looks at the problem from the borrower's side. Where the country's behaviour is examined in demanding foreign borrowing, consequently increasing its stock of foreign debt. Here, we have assumed that each borrower country is small in the international markets for capital and also in lenders' portfolio. In other words, borrowers are price takers and are supplied what they demand given a minimum level of creditworthiness. As a result, this chapter concentrates on the demand side, and try to explore the country's demand process.

In this chapter, it has been assumed that each country has two sectors that are able to borrow from the international capital markets, namely the government and the private sector. An objective function and a set of constraints are specified for each sector. Therefore, each sector has its own optimisation problem, from which two demand models were derived.
These two models are then empirically examined by OLS using data from the three Arab countries. The empirical results fairly support the theoretical basis of the model. The empirical sections show that each sector has a set of factors that drives its demand for foreign borrowing, which is different from the other sector.

In the government sector model, we have assumed that the government main objective is to remain in power. In order to achieve this objective it has to gain domestic and international acceptance. These could be achieved if the government can domestically provide certain levels of public services and internationally a reasonable degree of integration with the world economy.

A quadratic preference function is adopted to represent the government's objective function. The government maximises its objective subject to a set of constraints. Where the government has two interesting (non-controlled) variables, economic growth and government expenditure, and two controlled variables, foreign debt and exchange rate.

The estimation results of the government sector model show that the government in Egypt, Table 6-14, borrows to achieve higher levels of domestic investment and to finance increasing budget deficits, which are important efforts to gain domestic acceptance. The higher the degree of openness of the Egyptian economy, the better the government's debt position (more loans available, loans are in softer terms, easier debt relief agreements, etc.), as an indication of international acceptance. In fact, Egypt received huge amount of debt forgiveness in the early 1990s after the Gulf War II. The model also reflects the effects of world interest rates changes and exchange rate fluctuation on the stock of foreign debt.

In Morocco Table 6-4, however, the government try to gain domestic acceptance by incurring higher levels of foreign debt to finance education expenditure and budget deficits. This would imply that the government does not want to impose heavy tax burden on the people as this may lead to social unrest, which was the case in the late 1980s. On the other hand, the rate of export growth is considered as a good measure of the country's openness to the rest of the world. This variable plays a significant (positive) role in the government demand for foreign borrowing. Achieving international acceptance could lead to a better access to the capital markets, which implies a better debt position of the country. The model shows as well that, the stock of the Moroccan foreign debt decreases as a result of improvements in the terms of trade, increasing world interest rates and rising inflation.

With regard to the Tunisian estimation results, Table 6-16, the Tunisian government, similar to Moroccan, resorts to higher expenditure in education services to gain domestic acceptance. Gaining international acceptance might be captured by the positive (and significant) coefficient of the interest payments variable. To keep its international good reputation, Tunisia continues paying its debt obligations even when it increases as a result of a shock, such as the exchange rate fluctuation.

The empirical section of the government sector shows reasonable degree of stability in the model. In each country, many variables keep their signs unchanged across the four models, the exchange rate, the foreign debt, the economic growth and the government expenditure.

With respect to the private sector model, it has been assumed that the sector determines its demand for foreign borrowing through maximising expected returns, and minimizing risks, from its financial portfolio. The mean-variance approach has been adopted to model the sector's decision-making process for the optimal financial portfolio. Where it diversifies its portfolio to maximise the average returns and to reduce risks, which are measured by deviations from the mean.

Total wealth and assets' expected rates of returns are the factors that determine the optimal combination of financial assets that maximises the portfolio's total return. Although all assets are part of one system, a demand function for any of the assets, foreign borrowing for example, in the financial portfolio can be easily derived.

For the lack of data on domestic interest rates in Morocco we had to drop this country from our empirical estimation exercises. Total wealth of the private sector is found to play a significant role in determining demand for foreign debt, in Egypt and Tunisia. As one might expects, a positive relationship is found in both countries.

The demand for foreign borrowing increases as the domestic interest rates decreases, and as the world interest rates increase, Table 6-14, which implies that some of the domestic assets in Egypt are complements to the foreign assets, and others are substitutes. However, in Tunisia the domestic and foreign assets are appearing to be substitute assets.

It has been argued in this chapter that, the government and the private sector demand are interrelated. Consequently, the two sector models are combined together to form the country's total demand for foreign debt. The combined model is empirically examined using data from two of the three countries. The estimation results of the combined model (or the country's total demand) show very similar results to the two sector models.

In fact, the empirical estimations of the demand for foreign borrowing of the government, the private and the combined models show reasonable amount of stability in coefficients' signs. In addition, for each country, most of the variables in the two sectors models show the same direction of effect on the demand for foreign borrowing in the combined model.
The estimation results of the combined model point to the possibility that the private sector actual stock of foreign debt is much larger than the available data used in the estimations, in Egypt and Tunisia.

Finally, two models were jointly estimated using the SURE estimator, Tables 6-17 and 6-18. This exercise is to re-examine the connection between the two sector's stocks of foreign debt. Here, we assume that some factors that determine the stock of foreign debt are common in the two sectors, and some other factors are expected to be specific to the particular sector. In fact, the estimation results are very similar to the OLS.

CHAPTER 7 *Conclusion*

Conclusion

This study examined the foreign debt build up in the Arab countries, in an effort to explore the countries' borrowing behaviour. Here, three Arab countries were selected as case studies, Egypt, Morocco and Tunisia.
The core objective of the thesis is to model supply and demand behaviour in the international markets for capital in an effort to explain the accumulation of foreign debt in those countries.

We started by examining the role that foreign debt stock can play in the economies of the three Arab countries, particularly its effect on the current account. In addition, the monetary authorities policy reactions to changes in the stock of foreign debt and in some other economic variables are also examined.

In chapter four, a current account model and a monetary reaction function, that are specified by M. Fry (1993), have been estimated using data from the three countries under study for the period 1976-1996. However, our estimation results show "a stabilising" effect of the government and government guaranteed debt on the current account of the countries under study. In fact, this is contrary to what Fry found. Hence, the main argument of Fry[1] cannot be proved in our estimations. Another explanation could be suggested that the three Arab countries accumulate foreign debt to increase their holding of foreign reserves, perhaps to impress or to meet their lenders requirements.
Fry emphasised that his "estimates apply to a representative developing country in this sample rather than to any single country"[2], as his estimation is applied to a set of pooled data of 26 developing countries, for the 1960-1988 period. Different results are found for different countries in our time series estimations.

On the other hand, the estimation results of the monetary reaction function did show some evidence of systematic monetary reactions to changes in many economic variables in the model. Which does support Fry's conclusion that LDCs' monetary authorities do pursue monetary policies to encounter changes in

[1] That there is two types of foreign liabilities that have different effects on the current account.
[2] M. Fry (1993), p.67.

many macroeconomic variables. What is particular of our estimations results is the large magnitude[3] of the estimated coefficient of DDCGY. This may indicate that the monetary authorities in the three Arab countries, especially Egypt and Morocco, mainly concern with accommodating the government's credit requirements.

However, our estimations show that the monetary authority, especially in Egypt and Tunisia, seem to have no policy reactions to changes in the stock of the government's foreign debt.

Using the traditional principles of economics of supply and demand, chapter five examined the borrowing and lending activities in the international markets for capital. Here, we resorted to the simultaneous equation approach in order to examine the accumulation of foreign debt and its interaction with economic growth.

The two structural equations of demand and supply of foreign funds were established as follows. It has been assumed that the demand for foreign funds is derived by factors that affect the gap between national saving and domestic investment in the borrower country. The supply of loanable funds is assumed here to be driven mainly by factors that determine availability of loanable funds and by the lender's perception of the borrower's creditworthiness.

The exogenous variables are interest rates, exchange rates, terms of trade, saving rates in OECD countries, and an openness measure.

The system's endogenous variables are foreign debt and economic growth. It follows that the reduced form equations are then derivable from the two structural equations. These two reduced form equations were then empirically estimated simultaneously using the 3SLS estimator[4]. In the empirical section, the two reduced form equations were estimated for each country separately, and for the three countries pooled together.

[3] The estimated coefficient is larger than one.

[4] For comparison reason, the OLS and 2SLS estimators were used too, and the results are reported in Appendix 7.

From the estimation results of the foreign debt model, one can draw three interesting conclusions. First, the exchange rate variable exhibited a positive sign in all four estimations. From this we conclude that the IMF usual prescription (to devalue national currency in order to increase export earning, and consequently reduce foreign debt stock) is not working in the countries under study[5].

The second is supporting the loan pushing argument in the foreign debt literature. We argue that, this argument holds in Egypt, and possibly in Morocco and Tunisia for the following three factors.
First, the estimation results show positive estimated coefficient for the interest rate variable in all four estimations[6]. We argued that, a positive sign implies that either the indebted Arab countries were able to convince lenders to lend them even at high rates of interest, or lenders were "careless" to extend extra credit to a risky borrower when interest rate increases. Secondly, a positive sign is estimated for the OECD saving rate variable in the four estimations. Thirdly, it has been shown that the net savings of the OECD countries exceeded the total stock of debt in all LDCs during most of the period under study.

The third interesting finding is the estimated coefficient of the degree of openness. This variable plays significant role in each country's stock of foreign debt. In fact, the negative sign of this variable in Egypt and Morocco, and the positive sign in Tunisia are consistent, we argue, with the degree of debt difficulties in these countries. While the financially sound country, Tunisia, is increasing its debt as it opens up to the world economy, countries with greater debt difficulties, Egypt and Morocco are reducing theirs, possibly through debt relief agreements.

Therefore, this chapter is able to reflect upon the factors behind foreign debt accumulation, and to point out some of the similarities and differences of the foreign debt position in the three countries.

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[5] This is supported by the insignificant estimated exchange rate coefficients in the three time series estimations of Fry's current account model in chapter four. The monetary reaction function also further supports this conclusion. Where it has been shown that the three countries do not pursue any monetary policies to changes in the exchange rate.
[6] Similar result is found in our model in chapter six.

However, the weak performance of the estimation of the other endogenous variable equation, economic growth[7], makes one more cautious when analysing and deriving conclusion(s) from the estimation results.

A critical and rigorous model for the demand for foreign borrowing is specified in chapter six. This chapter follows the standard optimisation approach in modelling debtor behaviour. It has been assumed that borrowers are price takers and are supplied what they demand given a minimum level of creditworthiness. In fact, the demand for foreign borrowing was disaggregated into the government and the private sectors demands.

With respect to the government's optimisation model, it has been assumed that its objective is to maximise an expected preference function. The objective function used is a quadratic preference function, which the government maximises subject to a set of constraints consisting of controllable and non-controllable variables. On the other hand, the private sector objective is to maximise the expected returns from a financial portfolio, subject to its total wealth. The optimisation problem here is built up using the portfolio approach and the mean-variance analysis.

The two demand models were then empirically estimated by OLS using data from the three Arab countries. In the empirical section, it has been assumed that the two models are inter-related. Hence, the two models were combined together to make the country's total demand model, which is empirically estimated by OLS too. Alternatively, the two models were jointly estimated using the SURE estimator to capture the possible connection between the two models.

The estimation results of the government sector model are, in fact, consistent with the general theory and hypothesis of the model. Where, the government's main objective is assumed to be retention of power. It is interested in two variables: the economic growth and the government expenditure to help it gaining domestic and international acceptance, and consequently remain in power.

[7] The economic growth model in chapter six shows similar weak results. However, the main concern of this thesis is not economic growth.

The estimation results show that the Egyptian government seems to borrow externally to increase domestic investment and to finance budget deficit to gain domestic acceptance. While the Moroccan and the Tunisian governments borrow externally to meet people's demand for more public (education) services. Similar to Egypt, the Moroccan government chose to borrow externally to finance its budget deficit, rather than to increase taxes.
As for gaining the international acceptance, the consistently significant coefficient of the openness measure in the foreign debt model indicates that the countries are willing (and have) to satisfy the international community. As a result, keeping their access to the international markets valid.

With respect to the empirical estimation of the private sector model, it shows satisfactory results. Obviously, total wealth plays a positive and significant role in determining the sector's foreign debt. The estimation results are able to shed light on the possible relationship between foreign and domestic assets.

It has been argued that the two models are interrelated. Hence, two empirical exercises were carried out to examine this argument. In the first exercise, the two models were combined and estimated as a single model. This exercise was able to raise some questions about the size of the private sector debt compared to the country's total foreign debt.
However, in the second exercise we jointly estimated the two models by the SURE estimator. This exercise shows that although each sector is affected by factors that are specific to that particular sector, the two sectors are also affected by some common factors. The SURE estimation results show some improvements upon the OLS, and in general support its results.

To conclude, we have argued that the stock of foreign debt accumulates as a result of changes in three main factors: the flow of new debt, changes in the world interest rates and changes in the exchange rate. The empirical estimations in chapters five and six are able to confirm this argument. The estimated coefficients of the interest rate, the exchange rate and the interest payment variables are positive in all three countries' estimations. This finding may support another

argument (which could be tested in future work) that foreign borrowing is highly vulnerable to factors that are beyond the debtor country's control.

Policy implications

The estimation results of the monetary reaction function in chapter four show evidence of no systematic reaction policies to changes in most of the economic variables in Morocco and Tunisia. As a result, one would suggest that systematic monetary policies in these two countries, in conjunction with fiscal policies, are, in fact, required to absorb some of the effects of the different shocks and to manage the economy prudently.

The estimation results of Egypt and Morocco in chapter six, Tables 6-2 and 6-4, imply that, the government expenditure in these two countries depends on deficit financing, and further on foreign borrowing to finance these deficits. This behaviour cannot continue forever, and when the government's stock of the foreign debt reaches a certain upper limit, the country may fall into a deep crisis. Therefore, a long run plan to overcome this vicious cycle is required.

Suggestions for further research

Several suggestions are related to data improvements. First, as the time series used in this study are short, no attempts have been made to take account of the data's stationarity when estimating the different models. If longer time series were available, one would improve the data by not only running unit root tests to have all variables of the same order of integration, but also to test for cointegration.

Second, more accurate disaggregated data of private sector and government sector foreign debt should improve this study's outcome and the policy implications. Third, long enough data on domestic interest rates of Morocco will make the estimation of the private sectors and the combined models possible.

The monetary reaction function estimations show serial correlation in Morocco. This indicates that the function is possibly misspecified in this country, and

suggests the re-specification of the model for future work. Hence, the correction of this misspecification problem may change the results and the conclusion.

The simultaneous equation model in chapter five should be re-specified, as the current growth equation shows very weak performance. One suggestion is to add to the model some long-term variables such as population and technology. Alternatively, one may use income in level form rather than income growth as the dependent variable.

The estimation results support our hypothesis that the government is keen to gain international acceptance. However, this hypothesis is examined only by introducing an exogenous variable, openness measure, to the model. A possible improvement to the model is to add a third endogenous variable to the model to better reflect the government's behaviour in creating a "business-friendly" environment.

In chapter six we found that the private sector stock of foreign debt is possibly much higher than the available data indicates. Here, we argue that the private sector may offered a line of credit that is higher than what it's observed potential suggests. Hence, the possible connections between foreign debt and the hidden economy literature are interesting and worth future research.

APPENDICES

Appendix 1

Table A1.1 Dependence on primary products

Country	Primary Products	% of Exports
Algeria	oil, gas & RP	96.3
Iraq	oil & RP	97
Kuwait	oil, gas & RP	100
Libya	oil, gas & RP	99.8
Qatar	oil & RP	84
S. Arabia	oil & RP	91
UAE	oil, gas & RP	68.7
Bahrain	oil & RP	66.1
Egypt	oil & RP	45.4
Jordan	phosphates, potash & FP	47.4
Lebanon	agriculture products	20
Morocco	phosphates & FP	51.4
Oman	oil & RP	83.6
Syria	oil, RP, FP & cotton	67.5
Tunisia	oil, RP, FP & phosphates	29.3
Djibouti	Re-exports	80
Mauritania	fisheries & iron ore	96.6
Somalia	animal, banana & hide	95.7
Sudan	cotton, agriculture &	75
Yemen	oil, RP & FP	94.6

Source: The Arab Economies: Structure and Outlook, Arab Banking Corporation, Manama - Bahrain,1994. RP: Refined Products, FP: Food Products

(% of GDP) Table A1.2 Origin of GDP 1992

Country	Agriculture	Manufacturing	Mining	Construction	Trade & Finance	Services
Algeria	12	10.1	25.9	13.3	17.9	20.8
Iraq	15	15	10	10	10	40
Kuwait	0.4	14.7	42.7	2	10.3	29.9
Libya	5.6	10	29.7	13.1	11	30.6
Qatar	0.9	13.9	35.8	4.1	17.5	27.8
S. Arabia	6.4	7.2	35	8.6	11.1	31.7
UAE	1.9	9.8	41.5	8.6	20.8	17.4
Bahrain	1	17	17.7	6.2	30.6	27.5
Egypt	16.5	17.1	10.6	6.4	22.8	26.6
Jordan	8	17.1	3.3	5.8	28.4	37.4
Lebanon	8.8	17.9	0.0	3.3	36.2	33.8
Morocco	14.4	25.8	1.8	5.1	33.8	19.1
Oman	3.3	6.1	42.4	4	17.6	26.6
Syria	29.8	16.6	0.0	3.8	27	22.8
Tunisia	17.7	18.7	6.6	5.5	0.0	51.5
Djibouti	2.8	16.7	0.0	4.5	26	50
Mauritania	27.1	12.1	12.2	5.2	12.4	31
Somalia	51	3	0.0	4	12	30
Sudan	33.8	10.7	0.1	5	15	35.4
Yemen	19.9	11.1	4.9	5	18.9	40.2

Table A1.3 Agriculture lands

(Million Hectares) 1993

Country	Total	Arable	Perm. CR	Perm. P.	Forest&W
Algeria	238.2	7.3	0.6	307	4
Iraq	43.8	5.3	0.2	4	0.2
Kuwait	1.8	0.005	0.005	0.137	0.02
Libya	176	1.8	0.4	13.3	0.8
Qatar	1.1	0.007	0.007	0.05	0.05
Saudi A.	215	3.7	0.09	120	1.8
UAE	8.4	0.03	0..01	0.2	0.003
Bahrain	0.07	0.001	0.001	0.004	
Egypt	100.1	2.5	0.4		0.03
Jordan	8.9	0.3	0.09	0.8	0.07
Lebanon	1.1	0.3	0.2	0.01	0.08
Morocco	44.7	9.3	0.7	20.9	9
Oman	212	0.06	0.2	1	1
Syria	18.5	5.8	5.1	8.1	0.7
Tunisia	16.4	3	2	3.1	0.7
Djibouti	2.3			0.2	0.006
Mauritania	102.5	0.2	0.003	39.3	4.4
Somalia	63.8	1	0.02	43	16
Sudan	250.6	12.9	0.08	110	44.2
Yemen	52.8	1.4	0.11	16.1	2
Comoros	0.2	0.08	0.02	0.02	0.04

Oil Group	684.3	18.1	1.3	444.7	6.9
% of Total	43.9	33	12.7	64.7	8.1
Middle Income Group	401.8	21.3	8.7	33.9	11.6
% of Total	25.8	38.7	85	4.9	13.6
Low Income Group	472.2	15.6	0.2	208.6	66.6
% of Total	30.3	28.3	2.3	30.4	78.3
Total	1558.3	55	10.2	687.2	85.1
% of Total	100	3.5	0.7	44.1	5.5

Source: FAO Production Vol.48, 1994.

Perm. CR Permanent Crops
Perm. P. Permanent Pasture
Forst&W Forest and Wood land
HA Hectare

Table A1.4 Exports of food and animal

(Million $)

Country	1970	1980	1985	1990	1994
Algeria	48.582	1.744	1.002	2.589	5.449
Iraq	30.653	-	-	-	-
Kuwait	-	7.238	7.371	3.346	2.29
Libya	0.105	-	-	3.124	1.567
Qatar		-	-	2.835	11.869
Saudi A.	2.334	0.72	0.902	3.117	3.297
UAE	-	16	8.756	51.626	38.865
Bahrain	-	1.362	0.118	0.648	0.648
Egypt	149.715	18.997	19.76	19.837	26.314
Jordan	13.303	175.013	97.744	97.288	151.422
Lebanon	50.354	-	-	-	-
Morocco	207.018	539.451	333.509	530.031	503.707
Oman	-	13.811	32.944	42.709	78.716
Syria	46.779	58.661	44.433	531.783	391.715
Tunisia	26.019	59.486	73.989	119.987	145.548
Somalia	26.451	114.516	103.183	69.855	65.505
Sudan	34.32	172.851	95.352	176.646	154.651
Yemen	-	-	-	-	-

Table A1.5 Imports of food and animal

(Million $)

Country	1970	1980	1985	1990	1994
Algeria	123.984	194.153	202.976	214.525	278.363
Iraq	70.026	-	-	-	-
Kuwait	-	82.378	90.363	49.881	97.989
Libya	109.361	111.618	97.167	115.493	85.434
Qatar	-	189.971	171.617	263.458	249.251
Saudi A.	189.757	36.148	34.313	34.525	27.904
UAE	-	73.033	72.296	148.484	151.322
Bahrain	-	177.53	205.183	223.97	241.093
Egypt	117.828	187.108	298.934	242.878	217.818
Jordan	53.519	458.631	490.337	639.452	612.268
Lebanon	114.171	-	-	-	-
Morocco	117.823	696.692	487.232	534.718	693.42
Oman	-	209.635	356.898	421.229	497.788
Syria	91.419	514.397	663.917	710.02	638.916
Tunisia	66.366	406.486	285.641	474.043	477.312
Somalia	11.569	99.638	95.19	71.558	79.59
Sudan	59.484	371.631	307.996	192.429	245.438
Yemen	-	681.777	593.957	-	-

Source: FAO Year Book, Trade Vol.48 1994.

Table A1.6 Average annual growth rate of real GDP

1995 = 100

Country/ Group	61-64	65-69	70-74	75-79	80-84	85-89	90-97
Algeria	1.72	6.02	7.23	7.08	4.26	1.54	0.58
Iraq *	7.30	5.83	5.36	15.64	-5.71	-7.51	-40.65
Kuwait	6.20	5.46	0.18	4.45	-7.26	5.66	14.56
Libya *	30.63	20.96	-5.57	11.13	-6.10	-3.88	
Saudi	10.32	9.26	12.97	9.30	-0.69	1.58	3.19
UAE *			14.50	12.48	4.36	-1.57	17.88
Bahrain					-0.37	1.71	4.21
Egypt	7.11	4.09	2.85	9.64	7.43	4.41	4.15
Jordan				15.24	8.35	-0.39	5.17
Morocco *	4.01	5.16	4.35	6.02	3.92	4.87	1.70
Oman	6.48	35.89	4.37	9.32	13.61	4.37	6.20
Syrian	8.99	5.08	9.34	8.31	4.19	1.48	6.37
Tunisia	7.25	4.28	8.08	6.29	4.57	2.54	4.99
Comoros					4.79	1.06	0.24
Djibouti *				3.31	4.39	-1.95	0.19
Mauritania	10.49	6.28	4.13	1.16	1.00	3.42	3.31
Somalia *	3.40	5.02	-5.09	12.20	0.33	3.17	-1.48
Sudan	0.74	1.60	3.04	5.53	1.78	0.96	6.39
Yemen							3.68

Average OIL	11.23	9.50	5.78	10.01	-1.86	-0.70	-0.89
Average Middle	6.77	10.90	5.80	9.14	5.96	2.71	4.69
Average Low	4.88	4.30	0.69	5.55	2.46	1.33	2.05
Average ALL	8.05	8.84	4.70	8.57	2.38	1.19	2.26

* 1987 =100. For these countries the nineties average covers 1990-1995 period only.
Source: Calculated from Real GDP (100=1987, US$), The World Bank CD-ROM

Appendix 2

Sources of external debt data

Four main sources of data on external debt could be mentioned. The first is from The Bank for International Settlements who publishes three publications, namely International Banking and Financial Market Developments (quarterly), Maturity Distribution of International Bank Lending (Half-yearly) and Statistics for External Indebtedness: Bank and Trade-Related Non-Bank External Claims on Individual Borrowing Countries and Territories (half-yearly). The second source is the OECD who produces three publications, namely External Debt Statistics EDS (annual), Statistics on External Indebtedness: Bank and Trade-Related Non-Bank External Claims on Individual Borrowing Countries and Territories (half-yearly) and Financing and External Debt of Developing Countries FEDDC (annual).
The third is the IMF who produces debt statistics in five publications, namely Balance of Payments Statistics, Government Finance Statistics Year Book, IFS, International Capital Markets: Development and Prospects and World Economic Outlook. The World Bank is the fourth source of debt statistics. It publishes the Global Development Finance GDF, which took over the old World Debt Tables WDT since 1998, and the World Development report.

Different definitions for external debt

OECD source define external debt as: "They cover, in principle, all types of debt (public and private, bilateral and multilateral, concessional and non-concessional), with the exceptions of debt with original maturity of less than one year, ..., military debt financed by official creditors, ..., debt to the IMF (other than to the IMF Trust Fund) and debt in local currencies" p. 78 External debt of Developing countries 1983 Survey, OECD Paris 1984.

Table A2.1 Total external debt

(Millions $)

Country[1]	71	75	82	85	90	93	96
Algeria	1261	4633	17642	18260	27877	25965	33260
Iraq	na	na	na	11632	22851	23287	21985
Kuwait	na	na	na	8907	10938	9538	7538
Libya	na	na	na	3203	4938	3893	3319
Qatar	na	na	na	658	1363	2105	7726
Saudi	na	na	na	14221	14967	18801	15866
UAE	na	na	na	9360	11630	10842	10883
Subtotal	1,261	4633	17642	66,241	94,564	94,431	100,577
% of total	19	27	21	42	44	44	43
Bahrain	na	96	560	1112	1675	2313	2392
Egypt	2349	4835	27332	36102	32924	30575	31407
Jordan	155	345	2752	4022	8177	7609	8118
Lebanon	68	46	721	861	1779	1345	3996
Morocco	1128	2353	12073	15753	23675	20887	21767
Oman	0	364	957	2329	2736	2657	3415
Syria	342	786	6188	10843	17068	19976	21420
Tunisia	672	1109	3773	4884	7691	8702	9887
Subtotal	4,714	9,934	54,356	75,906	95,725	94,064	102,402
% of total	72	58	59	48	44	44	44
Comoros	1	5	69	134	187	185	206
Djibouti	3	12	32	144	205	228	241
Mauritania	39	188	1139	1457	2107	2138	2363
Somalia	84	229	1222	1639	2370	2501	2643
Sudan	396	1599	7169	8955	14762	15837	16972
Yemen	49	440	2403	3339	6346	5923	6356
Subtotal	572	2,473	12,034	15,668	25,977	26,812	28,781
% of total	9	15	13	10	12	12	12
Total	6,547	17,040	84,032	157,815	216,266	215,307	231,760

[1] All data for Bahrain, Iraq, Kuwait, Libya, Qatar, Saudi A. and UAE are from OECD (External Debt Statistics), which include use of IMF credit. For the rest of the countries data are from GDF or WDT.

Table A2.2 Current account % of GDP

Country	1971	1975	1982	1985	1990	1993
Algeria	-3.52	-10.76	-0.36	1.73	2.37	1.61
Iraq	4.77	18.46				
Kuwait	40.38	55.92	26.00	24.84	43.78	11.69
Libya	19.13	4.36	-5.06	7.13		
Qatar	35.08	46.80	16.92			
Saudi A.	17.77	37.44	9.89	-11.17	0.27	
UAE		39.50	24.98	26.28		
Oil Group	18.93	27.39	12.06	9.76	15.47	6.65
Bahrain			6.78	2.40	-6.26	-25.11
Egypt	-5.74	-21.21	-9.89	-9.25	-4.88	0.53
Jordan				-19.86	-28.53	-17.67
Tunisia	-1.19	-4.91	-8.74	-7.67	-5.71	-6.98
Lebanon					-47.60	-45.35
Morocco	-2.16	-6.10	-13.23	-7.77	-2.01	-2.55
Oman		-7.15	5.86	0.13	11.04	-9.56
Syria	-3.06	-8.22	-10.11	-13.22	11.62	
Middle Income	-3.04	-9.52	-4.89	-7.89	-9.04	-15.24
Djibouti				-27.49	-25.89	-41.01
Mauritania	-4.84	-30.50	-49.37	-36.60	-10.90	-25.54
Somalia	-4.94	-14.11	-43.95	-35.04	-37.73	
Sudan	-1.87	-11.00	-16.47	-6.24	-13.50	
Yemen					5.72	-30.82
Low Income	-3.88	-18.54	-36.60	-26.34	-16.46	-32.46
Arab World	6.91	5.90	-4.45	-6.99	-6.76	-15.90

Source: World Bank CD-ROM.

Table A2.3 Debt relief agreements

Year	Multilateral Debt Relief Agreements	
	Official	Commercial
1980	none	none
1981	none	Sudan
1982	Sudan	Sudan
1983	Sudan, Morocco	Sudan
1984	Sudan,	none
1985	Somalia, Morocco, Mauritania	Sudan
1986	Mauritania	Morocco
1987	Morocco, Mauritania,	Morocco
1988	Morocco	none
1989	Mauritania, Jordan	Jordan, Jordan
1990	Morocco	Morocco
1991	Egypt	none
1992	Morocco, Jordan	Algeria
1993	Mauritania	Jordan
1994	Jordan, Algeria	none
1995	Mauritania, Algeria	Algeria

Table A2.4 Number of Arab countries used in calculating the averages of the debt ratios

	EDT / EXP				EDT / GNP				TDS / EXP			
Year	mid	oil	low	total	mid	oil	low	total	mid	oil	low	total
1971	1	0	1	2	5	1	4	10	1	0	1	2
1972	1	0	1	2	5	1	4	10	1	0	1	2
1973	1	0	1	2	6	1	4	11	1	0	1	2
1974	2	0	1	3	6	1	4	11	2	0	1	3
1975	4	4	2	10	6	7	4	17	4	0	2	6
1976	5	4	2	11	6	7	4	17	5	0	2	7
1977	6	5	3	14	6	7	4	17	6	1	3	10
1978	6	5	3	14	6	7	4	17	6	1	3	10
1979	6	5	3	14	6	7	4	17	6	1	4	11
1980	7	5	4	16	7	7	4	18	6	1	4	11
1981	7	5	4	16	7	7	4	18	6	1	4	11
1982	7	5	4	16	7	7	4	18	6	1	4	11
1983	7	7	4	18	7	7	4	18	6	1	4	11
1984	7	7	4	18	7	7	4	18	7	4	4	15
1985	7	7	4	18	7	7	4	18	7	4	4	15
1986	7	7	4	18	7	7	4	18	7	4	4	15
1987	7	7	4	18	7	7	4	18	7	4	4	15
1988	7	7	4	18	7	7	4	18	7	4	4	15
1989	8	7	4	19	8	7	4	19	8	4	4	16
1990	8	4	4	16	8	6	5	19	8	4	4	16
1991	8	7	4	19	8	6	4	18	8	4	4	16
1992	8	7	5	20	8	6	5	19	8	4	5	17
1993	8	4	5	17	8	5	4	17	8	4	5	17
1994	8	4	5	17	8	5	3	16	8	4	5	17
1995	8	3	5	16	8	5	3	16	8	3	5	16
1996	8	3	5	16	7	3	3	13	8	3	5	16

The ratios were calculated for Bahrain, Iraq, Kuwait, Libya, Qatar, Saudi and UAE. For these countries EDT and TDS data are form the OECD sources, where GNP and Export data, both current US$, are from World Bank Development Indicators CD-ROM 1999.
The ratios for the rest of the Arab countries, 14, were taken directly from the GDF CD-ROM 1998.

Appendix 3

Measures of debt sustainability and convergence

$(g+h-t) + rb = b` + m`$ $\qquad b` = (g+h-t) + (r-k)b - m`$

to stabilise b, we set $b`=0$ and $m` = 0$

$(r-k)b = s$ $\qquad b = [r-k]^{-1} . s$

$\therefore s^* = b^* [r-k]$ $\qquad$ sustainability gap $= s^* - s$

Where

g = government expenditure to GDP
h = transfers
t = taxation level
r = real interest rate
b = number of bonds issued
b` = change w.r.t time
m = money stock
m`= change w.r.t. time
k = GDP growth rate

Then McAdam used a simple debt model to illustrate the problems and potential conflicts inherent in large-scale fiscal contraction. Assuming income grows at constant rate:

$$Y = Y_o e^{k.t} \qquad (1)$$

Y, Y_o = Current and initial income level,

k = Growth rate, $\qquad t$ = time

The debt dynamics was represented by:

$$\overset{o}{B} = \alpha . Y \qquad (2)$$

Where

$$\overset{o}{B} = \frac{\partial B}{\partial t}, \qquad B = \text{Level of debt,}$$

McAdam presented the solution to the first-order differential equation in debt as:

$$b = e^{-kt}\left(b_o - \frac{\alpha}{k}\right) + \frac{\alpha}{k} \qquad (3)$$

Equation (3) solved for t:

$$t = -\frac{1}{k} . Ln \left(\frac{b - \frac{\alpha}{k}}{b_0 - \frac{\alpha}{k}} \right) \qquad (4)$$

t = time required $\qquad k$ = Growth rate,

$\alpha = \frac{deficit}{income} \qquad b = \left(\frac{Debt}{Income}\right) \qquad b_0$ = Initial level

Which is used to calculate the number of years required, for each country, to achieve the Maastricht Treaty's target, given assumed defaults of growth and real interest rates.

Equation (3) solved for α:

$$\alpha = k\left(\frac{b - e^{-k.t}b_o}{1 - e^{-k.t}}\right) \qquad (5)$$

Equation (5) was used to find the $\frac{deficit}{income}$ ratio, α, required for debt convergence, within a time span, t=7 years from 1993-99.

Table A3.1 Debt convergence

Interest rate = 5%

Country	Current Account Balance / GDP			Time required	Debt / GNP	
	Present	Required	Gap		1993	1997
Djibouti	-12.9	3.4	16.3	-1	47	59
Saudi	-13.5	0.3	13.8	-3	15	15
Kuwait	-8.6	-2.2	6.4	-1.5	40	26
Bahrain	-3.8	0.8	4.6	-1.6	51	46
Libya	-2.4	1.4	3.8	-80	16	17
Algeria	0.06	2.4	2.5	-25	54	74
Oman	-1.4	-0.2	1.2	-8	29	44

Appendix 4

Tables of current account deficits and sources of finance

Periods	Current account Deficit	Table A4.1 Sources of financing current account deficits (Averages)											
		Δ in Gross International Reserves		Non-Debt Creating Flow		IMF Credit		Δ in Long Term Debt Stock		Δ in Short Term Debt Stock		Net Errors & Omissions	
	$	$1	%	$	%	$	%	$	%	$	%	$	%
Egypt													
77-98	**0.63**	**0.81**	**239**	**0.78**	**203**	**-0.01**	**13.3**	**1.17**	**802**	**0.04**	**173**	**0.02**	**104**
77-79	1.32	0.10	7.79	0.68	52.5	0.08	6.78	1.18	115	0.76	114	0.04	3.04
80-84	1.35	0.04	31.6	0.79	111	-0.04	5.19	2.65	393	0.40	43.8	0.11	15.4
85-89	1.32	0.16	51.8	1.05	165	-0.02	9.77	1.72	548	0.42	101.5	0.27	93.1
90-94	-1.45	2.39	583	0.59	423	0.002	20.0	-0.10	2010	-1.19	441	0.16	259
95-98	0.93	1.16	474	0.74	204	-0.07	28.0	-0.71	472	0.21	92.8	-0.60	110
Morocco													
77-98	**0.77**	**0.18**	**101**	**0.13**	**32.9**	**-0.02**	**30.1**	**0.91**	**403**	**0.02**	**34.5**	**-0.04**	**36.0**
77-79	1.55	0.03	4.93	0.01	1.02	0.05	3.56	1.36	87.5	0.17	10.6	-0.67	46.4
80-84	1.39	-0.10	7.91	0.06	4.18	0.20	13.6	0.91	68.5	0.08	7.00	0.05	3.97
85-89	0.25	0.09	40.0	0.07	15.2	-0.12	52.1	1.85	667	-0.17	76.4	0.01	9.98
90-94	0.46	0.77	256	0.41	91.4	-0.15	40.3	0.05	340	0.04	16.8	-0.008	2.77
95-98	0.44	0.02	174	0.04	41.6	-0.05	30.4	-0.01	1207	0.07	78.6	0.24	143
Tunisia													
77-98	**0.54**	**0.07**	**45.7**	**0.23**	**38.0**	**0.004**	**9.48**	**0.34**	**143**	**0.03**	**17.6**	**0.09**	**26.6**
77-79	0.44	0.07	22.7	0.08	18.8	0.009	1.65	0.57	143	0.03	22.3	0.04	14.2
80-84	0.56	-0.03	10.7	0.23	45.2	-0.006	1.78	0.14	39.9	-0.004	4.41	0.09	16.7
85-89	0.25	0.11	131	0.08	58.2	0.05	27.5	0.44	359	0.04	23.0	0.03	54.3
90-94	0.78	0.10	31.2	0.34	42.9	0.0004	8.90	0.29	56.7	0.09	18.5	0.18	33.8
95-98	0.63	0.10	18.6	0.37	12.1	-0.04	3.21	0.36	76.6	-0.03	27.6	0.11	4.78

Periods	Current account	Table A4.2 Sources of finance of current account deficits (Total)											
		Δ in Gross International Reserves		Non-Debt Creating Flow		IMF Credit		Δ in Long Term Debt Stock		Δ in Short Term Debt Stock		Net Errors & Omissions	
	$	$	%	$	%	$	%	$	%	$	%	$	%
Egypt													
77-98	**13.8**	**17.9**	**130**	**17.2**	**125**	**-0.23**	**1.69**	**23.5**	**170**	**0.83**	**5.99**	**0.44**	**3.17**
77-79	3.96	0.29	7.32	2.03	51.2	0.25	6.27	3.55	89.6	2.27	57.3	0.12	2.98
80-84	6.74	0.21	3.07	3.97	58.8	-0.20	3.02	13.2	196	1.99	29.5	0.54	7.98
85-89	6.58	0.78	11.9	5.27	80.1	-0.09	1.42	8.61	131	2.10	31.9	1.37	20.9
90-94	-7.23	12.0	165	2.96	40.9	0.01	0.14	-0.48	6.61	-5.95	82.3	0.81	11.2
95-98	3.72	4.64	125	2.96	79.6	-0.20	5.24	-1.42	38.3	0.42	11.2	-2.41	64.6
Morocco													
77-98	**16.9**	**3.97**	**23.5**	**2.90**	**17.2**	**-0.35**	**2.08**	**18.1**	**107**	**0.37**	**2.17**	**-0.79**	**4.68**
77-79	4.64	0.09	1.94	0.04	0.95	0.15	3.15	4.09	88.2	0.50	10.8	-2.00	43.1
80-84	6.97	-0.51	7.29	0.28	4.09	0.99	14.3	4.54	65.2	0.40	5.73	0.24	3.43
85-89	1.23	0.44	35.7	0.33	27.1	-0.58	47.4	9.26	752	-0.86	69.5	0.05	4.33
90-94	2.29	3.86	169	2.07	90.7	-0.76	33.1	0.26	11.4	0.18	8.09	-0.04	1.82
95-98	1.76	0.08	4.74	0.17	9.66	-0.15	8.61	-0.02	1.27	0.13	7.67	0.96	54.3
Tunisia													
77-98	**11.8**	**1.48**	**12.6**	**4.99**	**42.3**	**0.09**	**0.76**	**6.82**	**57.9**	**0.68**	**5.76**	**2.09**	**17.7**
77-79	1.33	0.21	16.1	0.25	18.6	0.03	2.11	1.72	130	0.10	7.32	0.11	8.48
80-84	2.80	-0.17	6.17	1.15	40.9	-0.03	1.12	0.72	25.6	-0.02	0.74	0.45	16.2
85-89	1.25	0.56	44.5	0.41	32.6	0.25	20.3	2.19	176	0.21	16.5	0.15	11.8
90-94	3.90	0.50	12.8	1.70	43.7	0.002	0.05	1.46	37.5	0.46	11.9	0.92	23.6
95-98	2.52	0.39	15.4	1.49	59.1	-0.16	6.44	0.73	28.9	-0.07	2.66	0.46	18.1

Definitions and ways of calculating tables A4.1 and A4.2

1) Both tables:
   a- % = percentage ratio.
   b- $ = billions of US dollars.
   c- $\Delta = X_t - X_{t-1}$.

   d- non-debt creating flow
   = {[Direct investment inflow - direct investment abroad] + [(gold, according to country valuation)$_t$ - (gold, according to country valuation)$_{t-1}$)] + [(holding of SDRs, in US$)$_t$ - (holding of SDRs, in $US)$_{t-1}$]}

   e- positive signs in the "net error & omissions" column means unreported capital outflow.
   f- for the current account deficit column: positive sign means deficit, while negative sign means surplus.
   g- the (%) columns disregard the minus signs.

2) In table A1:
   a- the ($) columns mean the period's average percentage ratio of each item.
   b- the (%) columns mean the average percentage ratio. This is calculated as the total annual percentages divided by the numbers of years.

3) In table A2:
   a- the ($) column mean the period's accumulated amount of each item in billions of US$.
   b- the (%) columns mean the period's accumulated percentage ratio. This is calculated as the accumulated amount of each item divided by the corresponding accumulated current account deficits.

Table Data Source:
Calculated from: IMF CD-ROM, and latest issues of the International Financial Statistics.

Three figures for the current account balance to GNP

Figure 1 Egypt's current account to GNP

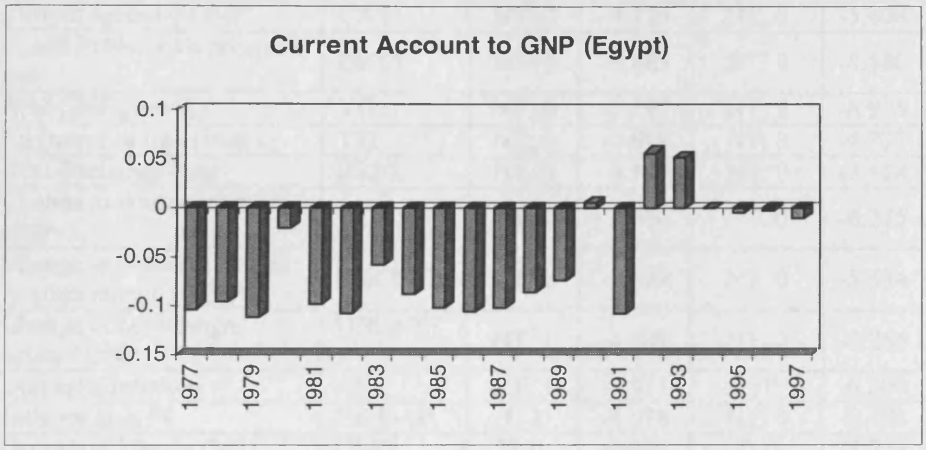


Figure 2 Morocco's current account to GNP

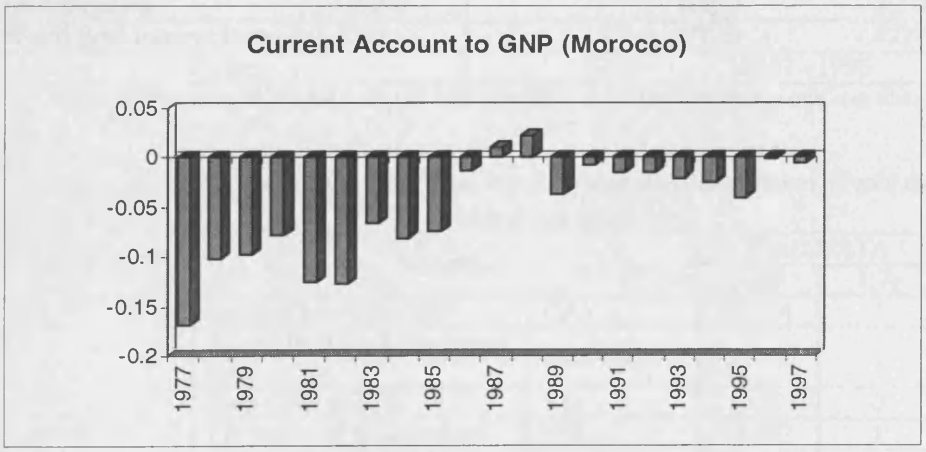


Figure 3 Tunisia's current account to GNP

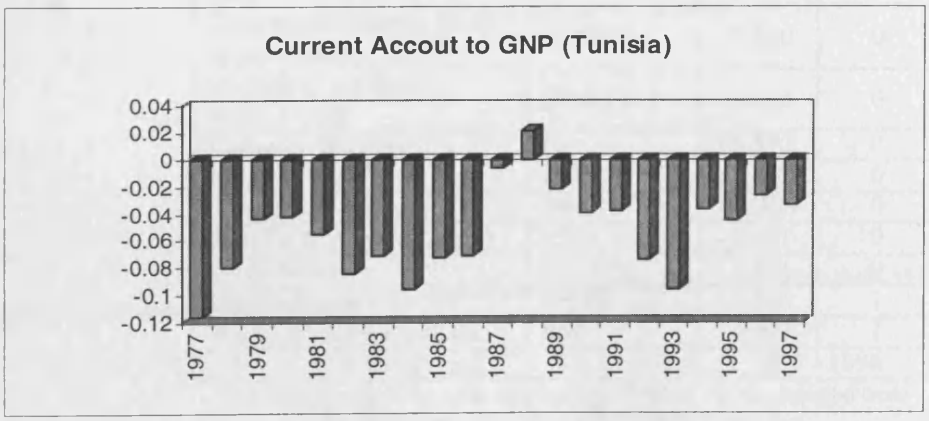


Table A4-3 Stationarity test results (Panel data)[2]
(Intercept included)

Variables		Egypt		Morocco		Tunisia	
		T/NT; Lags	ADF	T/NT; Lags	ADF	T/NT; Lags	ADF
Current account/ GNP	CAY	NT; 2	-4.125	NT; 0	-5.408	NT; 5	-3.401
P. and Publicly Guaranteed debt	DETY	NT; 1	-8.865	NT; 0	-8.586	NT; 2	-4.887
Real GNP growth	YG	NT; 0	-7.397	NT; 0	-8.975	NT; 0	-5.104
Ln (terms of trade index)	TTL	NT; 0	-2.809	NT; 0	-4.777	NT; 0	-4.483
Real Exchange Rate	REXL	NT; 0	-3.187	NT; 0	-3.124	NT; 0	-4.168
Change in domestic credit / GNP	DDCY1	NT; 0	-3.960	NT; 0	-6.275	NT; 0	-3.715
Change in domestic credit to government / GNP	DDCGY1	NT; 0	-4.529	NT; 0	-5.534	NT; 0	-3.873
Change in net foreign assets / GNP	DNFAY11	NT; 1	-4.449	NT; 0	-2.256	NT; 2	-3.967
Domestic inflation	F3	NT; 1	-3.971	T; 0	-6.500	T; 5	-4.054
Inflation gap F4	INFGAP	T; 1	-4.078	NT; 0	-5.408	NT; 5	-2.568
Growth in Money (M2)	DM2	T; 0	-3.763	T; 0	-3.774	T; 4	-3.777
Real GDP growth: OECD	RYO	NT; 2	– 3.401				
Oil Inflation	DOILPL	NT; 0	– 4.321				
USA inflation	USINF	NT; 0	– 4.216				
World Real Interest Rate	RW	NT; 0	– 4.097				
Period		1977 - 1996					

The ADF tests in Table A4.3 are to be used in Table A4.4 to calculate the unit root tests for panel data.

Table A4-4 Stationarity test results and order of integration (Panel data)
(Intercept included)

Variables		Panel DATA	
		ADF	I(?)
Current account/ GNP	CAY	-5.014	1
P. and Publicly Guaranteed debt	DETY	-10.807	2
Real GNP growth	YG	-10.575	0
Ln (terms of trade index)	TTL	-4.597	1
Real Exchange Rate	REXL	-3.698	1
Change in domestic credit / GNP	DDCY1	-5.869	0
Change in domestic credit to government / GNP	DDCGY1	-5.860	0
Change in net foreign assets / GNP	DNFAY11	-3.753	0
Domestic inflation	F3	-5.310	0
Inflation gap F4	INFGAP	-4.162	0
Growth in Money (M2)	DM2	--3.158	0
Real GDP growth: OECD	RYO	– 3.401	0
Oil Inflation	DOILPL	– 4.321	0
USA inflation	USINF	– 4.216	1
World Real Interest Rate	RW	– 4.097	1
Period		1977 - 1996	

The critical values for t stat for N=3 and T=20 at 1% is calculated from:
So Im, Pesaran and Shin (1997) Table 4. such that:
$t_{(3,20)} = -2.67 = \{-2.50 + [-2.50-(-2.33)]\}$

[2] See Appendix 11 for a summery of the ADF test.

Table A4-5 Stationarity test results (Time series data)
(Intercept included)

Variables		Egypt		Morocco		Tunisia	
		T/NT; Lags	ADF	T/NT; Lags	ADF	T/NT; Lags	ADF
Current account/ GNP	CAY	T; 0	-3.899	NT; 0	-5.408	NT; 5	-3.401
Accumulated current account /GNP	FLY	NT; 5	-3.229	NT; 0	-6.311	NT; 5	-4.023
P. and Publicly Guaranteed debt	DETY	NT; 1	-9.195	T; 0	-4.773	NT; 2	-4.887
Real GNP growth	YG	NT; 0	-7.113	NT; 0	-8.370	NT; 0	-5.104
Ln (terms of trade index)	TTL	NT; 0	-3.414	NT; 0	-4.664	NT; 0	-4.483
Real Exchange Rate	REXL	NT; 0	-3.589	NT; 0	-3.219	NT; 0	-4.168
Change in domestic credit / GNP	DDCY1	NT; 0	-4.436	NT; 0	-6.292	NT; 0	-3.715
Change in domestic credit to government / GNP	DDCGY1	NT; 0	-4.992	NT; 0	-5.635	NT; 0	-3.873
Change in net foreign assets / GNP	DNFAY11	NT; 1	-4.742	NT; 0	-6.496	NT; 2	-3.967
Domestic inflation	F3	NT; 1	-4.560	T; 0	-5.664	NT; 0	
Inflation gap F4	INFGAP	T; 1	-4.426	NT; 1	-9.024	NT; 0	-4.508
Growth in Money (M2)	DM2	T; 0	-3.689	T; 0	-3.902	T; 4	-3.777
Real GDP growth: OECD	RYO	NT; 0	-3.472	NT; 0	-3.688	NT; 2	-3.401
Oil Inflation	DOILPL	NT; 0	-4.960	NT; 0	-4.457	NT; 0	-4.321
USA inflation	USINF	NT; 0	-3.873	NT; 0	-4.183	NT; 0	-4.216
World Real Interest Rate	RW	NT; 0	-4.021	NT; 0	-4.138	NT; 0	-4.097
Period		1972 - 1996		1976 - 1996		1977 - 1996	

T=The ADF test includes a linear trend NT=the test does not include a linear trend.

The critical values for ADF test for 5% is between –3.645 and –2.985. All reported variables are stationary at 5%.

Table A4-6 Order of integration (Time series data)
(From Table A4.5)

Variable Name		Order of Integration		
		Egypt	Morocco	Tunisia
Current account/ GNP	CAY	0	1	1
Accumulated current account /GNP	FLY	2	2	2
P. and Publicly Guaranteed debt	DETY	2	1	2
Real GNP growth	YG	0	0	0
Ln (terms of trade index)	TTL	1	1	1
Real Exchange Rate	REXL	1	1	1
Change in domestic credit / GNP	DDCY1	0	0	0
Change in domestic credit to government / GNP	DDCGY1	0	0	0
Change in net foreign assets / GNP	DNFAY11	0	1	0
Domestic inflation	F3	0	0	0
Inflation gap F4	INFGAP	0	1	1
Growth in Money (M2)	DM2	0	0	0
Real GDP growth: OECD	RYO	0	0	0
Oil Inflation	DOILPL	0	0	0
USA inflation	USINF	1	1	1
World Real Interest Rate	RW	1	1	1

Appendix 5 Variables' definitions and source of data

Variable Definition	Notation	Source
Total stock of debt	A2	GDF
Public and publicly guaranteed debt	A4	"
Private sector debt, calculated: A5 = A2 - A4	A5	-
Public and publicly guaranteed debt / GNP	DETY	-
Real GNP growth (1995 = 100)	Y2 or YG	WDI
Real GNP	Y8	"
Real GDP growth (1995 = 100)	Y6	"
Ln (terms of trade index) (1995 = 100)	ttl or T3	WB
OECD saving ratio = Net OECD savings / Real GDP (1990 = 100)	nsy	OECD
Real rate of growth in OECD output (1990 = 100)	ryo	"
Crude oil spot prices inflation = $Ln(oil)_t - Ln(oil)_{t-1}$	DOILPL	IEA
Inflation gap = F3 - USINF (1990 = 100)	INFGAP or F4	WDI
Domestic inflation = Ln (GDP deflator)$_t$ - Ln (GDP deflator)$_{t-1}$ (1990 =100)	F3	"
USA inflation = Ln (GDP deflator)$_t$ - Ln (GDP deflator)$_{t-1}$ (1990 =100)	USINF	"
Real exchange rate = Ln [domestic GDP deflator / USA Wholesale price index / domestic currency per 1$] (1990 = 100)	REXL or e4	IFS
USA wholesale price index (1990 = 100)	USW	"
Domestic currency per 1US$	e3	"
Average interest rate of external borrowing	r	GDF
Domestic real deposit interest rates	r4	WDI
Domestic discount rates	r5	IFS
World real interest rate = rw11 - USI; continuously compounded	rw	-
London Interbank Offer Rate, 6-month US deposits	rw1	IFS
Ln = $[(1+rw1/2)^2]$	rw11	-
USA inflation = Ln (USW)t - Ln (USW)t-1 (1990=100)	USI	IFS
Population growth	n	WDI
Openness = (exports + imports) / GDP, calculated	op	"
Export growth = [Ln (export)$_t$ - Ln (export)$_{t-1}$]*100, calculated	ex	"
Tax revenue / GDP	v3	"
Overall budget deficit including grants / GDP	B	"
Services, etc. Value added to GDP	X6	"
Gross domestic investment to GDP	i6	"
Current account balance / GNP	CAY	IFS
Stock of cumulated current account deficit over time / GNP (BoP definition)	FLY	"
Change in domestic credit / GNP	DDCY*	"
Change in net domestic credit to the government / GNP	DDCGY*	"
Change in net foreign assets of the banking system / GNP **	DNFAY*	"
Money (M2) annual growth = $Ln(M2)_t - Ln(M2)_{t-1}$	DM2	WDI

* Transferred from local currency to US$ by using average period exchange rate (IFS)
** DNFAY1 = Monetary survey

GDF = Global Development Finance, CD-ROM WDI = World Development Indicator, CD-ROM.
WB = World Bank's Internet site IFS = International Financial Statistics; issues.
OECD = National Account - main aggregate-OECD, 1998.
Using the category: total OECD countries, and based on exchange rate.
IEA = International Energy Agency-OECD; 1999.

Appendix 6

Table A6.1 2SLS estimation results of CAY (Panel data)
Dependent Variable: CAY

Independent Variables		Fry (1993) 3SLS	Model (1) 2SLS
Intercept		*not reported*	0.069 (0.572)
Country Dummies	Egypt	*not reported*	- 0.072 (3.593)*
	Morocco		- 0.208 (3.920)*
FLY_{t-1}		0.112 (24.359)*	0.019 (0.529)
$DETY_{t-1}$		-	0.292 (1.946)**
$DETY^2_{t-1}$		- 0.081 (17.709)*	- 0.138 (1.369)
DDCY		- 0.037 (6.888)*	- 0.007 (0.380)
TTL		0.019 (10.161)*	- 0.037 (1.440)
YG		- 0.001 (0.093)	0.253 (1.626)
RW		- 0.056 (6.503)*	- 0.551 (3.781)*
$REXL_{t-1}$		- 0.004 (1.895)*	- 0.082 (3.671)*
CAY_{t-1}		0.655 (36.199)*	0.317 (2.566)*
Sample Size	Countries	26	3
	Period	1960-1988[3]	1977-1996
	# of Obs.	597	60
Adjusted	R^2	0.685	0.657
Serial Correlation (LM)			0.24 (0.62)
Functional Form (LM)			1.54 (0.22)
Normality (LM)			3.22 (0.20)
Heteroscedasticity (LM)			0.50 (0.48)

t-ratios in parenthesis. Significant at 5% = *, 10% = **

[3] Varies from country to country, see Fry (1993a).

Estimated Correlation Matrix of Variables

	RESEGY	RESMOR	RESTUN
RESEGY	1	- 0.10	- 0.21
RESMOR		1	- 0.11
RESTUN			1

RESEGY = Egypt's disturbance term in its current account estimation,
RESMOR = Morocco's disturbance term in its current account estimation,
RESTUN = Tunisia's disturbance term in its current account estimation.

Table A6.2 OLS estimation results (Panel data)
Dependent Variable: CAY

Independent Variables		Fry (1993) 3SLS	OLS Re-estimations of Fry's Model	
Intercept		*not reported*	- 0.001 (0.009)	0.069 (0.572)
Country Dummies	Egypt	*not reported*	- 0.074 (4.378)*	- 0.072 (3.593)*
	Morocco		- 0.214 (4.652)*	- 0.208 (3.920)*
FLY_{t-1}		0.112 (24.359)*	-	0.019 (0.529)
$DETY_{t-1}$		-	0.229 (1.750)**	0.292 (1.946)**
$DETY^2_{t-1}$		- 0.081 (17.709)*	- 0.096 (1.053)	- 0.138 (1.369)
DDCY		- 0.037 (6.888)*	- 0.010 (0.625)	- 0.007 (0.380)
TTL		0.019 (10.161)*	- 0.018 (0.863)	- 0.037 (1.440)
YG		- 0.001 (0.093)	0.164 (2.180)*	0.253 (1.626)
RW		- 0.056 (6.503)*	- 0.602 (4.525)*	- 0.551 (3.781)*
$REXL_{t-1}$		- 0.004 (1.895)*	- 0.085 (4.422)*	- 0.082 (3.671)*
CAY_{t-1}		0.655 (36.199)*	0.311 (3.236)*	0.317 (2.566)*
Sample Size	Countries	26	3	3
	Period	1960-1988[4]	1977-1996	1977-1996
	# of Obs.	597	60	60
Adjusted	R^2	0.685	0.674	0.656
Serial Correlation (LM)			1.09 (0.30)	0.24 (0.62)
Functional Form (LM)			1.55 (0.21)	1.54 (0.22)
Normality (LM)			2.72 (0.26)	3.22 (0.20)
Heteroscedasticity (LM)			0.28 (0.60)	0.50 (0.48)

t-ratios in parenthesis. Significant at 5% = *, 10% = **

[4] Varies from country to country, see Fry (1993a).

Table A6.3 2SLS estimation results (Time series data)

Dependent Variable: CAY

Independent Variables		2SLS Estimation of Fry's model		
Intercept		0.019 (0.068)	0.690 (0.139)	- 1.215 (1.773)
FLY_{t-1}		0.463 (2.002)**	- 0.003 (0.019)	- 0.233 (2.042)**
$DETY_{t-1}$		1.011 (1.998)**	0.423 (1.806)**	- 0.772 (1.498)
$DETY^2_{t-1}$		- 0.597 (1.918)**	- 0.085 (0.223)	1.175 (2.510)*
DDCY		- 0.057 (1.720)	0.027 (0.054)	0.099 (0.473)
TTL		- 0.048 (0.959)	- 0.159 (0.157)	0.225 (1.503*
YG		0.175 (0.821)	- 0.023 (0.039)	- 0.133 (0.280)
RW		- 0.586 (1.265)	- 0.702 (1.231)	0.053 (0.100)
$REXL_{t-1}$		- 0.049 (0.967)	0.112 (0.787)	0.309 (2.275)*
CAY_{t-1}		- 0.411 (1.034)	0.105 (0.272)	- 0.117 (0.508)
Sample Size	Countries	Egypt	Morocco	Tunisia
	Period	1972-1996	1976-1996	1977-1996
	# of Obs.	25	21	20
Adjusted	R^2	0.525	0.812	0.754
Serial Correlation (LM)		0.12 (0.73)	0.35 (0.56)	0.89 (0.35)
Functional Form (LM)		0.02 (0.88)	0.004 (0.95)	0.73 (0.39)
Normality (LM)		1.82 (0.40)	0.23 (0.89)	2.19 (0.33)
Heteroscedasticity (LM)		1.68 (0.20)	0.36 (0.55)	0.50 (0.48)

t-ratios in parenthesis. Significant at 5% = *, 10% = **

The instruments used as follows.

For Egypt: C FLY DETY $DETY^2$ DDCY1(-1) TTL(-1) TG(-1) RW REXL DDCGY1 DOILPL RYO CAY(-1)

For Morocco and Tunisia: C FLY(-1) DETY(_1) $DETY^2$(-1) DDCY1(-1) TTL(-1) TG(-1) RW REXL(-1) DDCGY1 DOILPL RYO CAY(-1)

When FLY is dropped from the model, it is (FLY) also dropped from the set of instruments.

Table A6.4 OLS estimation results (Time series data)

Dependent Variable: CAY

Independent Variables		OLS Estimation of Fry's model		
Intercept		0.141 (0.623)	- 0.588 (0.548)	- 0.915 (1.959)**
FLY_{t-1}		-	-	-
$DETY_{t-1}$		0.128 (0.662)	0.515 (3.716)*	- 0.078 (0.195)
$DETY^2_{t-1}$		- 0.068 (0.460)	- 0.196 (1.554)	0.614 (1.399)
DDCY		- 0.022 (0.771)	0.095 (0.377)	- 0.120 (0.679)
TTL		- 0.055 (1.261)	0.093 (0.430)	0.150 (1.448)
YG		0.208 (1.125)	0.106 (0.735)	- 0.226 (1.132)
RW		- 0.328 (0.853)	- 0.518 (1.844)**	0.060 (0.173)
$REXL_{t-1}$		- 0.090 (2.138)*	0.062 (0.856)	0.177 (1.754)
CAY_{t-1}		0.252 (1.094)	- 0.026 (0.144)	- 0.160 (0.739)
Sample Size	Countries	Egypt	Morocco	Tunisia
	Period	1972-1996	1976-1996	1977-1996
	# of Obs.	25	21	20
Adjusted	R^2	0.516	0.852	0.669
Serial Correlation (LM)		0.52 (0.47)	0.78 (0.38)	*0.77* (0.38)
Functional Form (LM)		1.00 (0.32)	0.75 (0.38)	*2.68 (0.10)*
Normality (LM)		0.30 (0.86)	0.22 (0.90)	0.32 (0.85)
Heteroscedasticity (LM)		*6.09 (0.01)*	0.47 (0.49)	1.94 (0.16)

t-ratios in parenthesis. Significant at 5% = *, 10% = **

Table A6.5 2SLS estimation results of DDCY (Panel data)
Dependent Variable: DDCY

Independent Variables		Fry (1993) 3SLS	Model (2) 2SLS
Intercept		*not reported*	0.019 (0.176)
Country Dummies	Egypt	*not reported*	- 0.021 (0.568)
	Morocco		- 0.173 (1.515)
FLY_{t-1}		- 0.071 (22.241)*	0.056 (0.850)
$DETY_{t-1}$		0.082 (29.333)*	0.155 (0.465)
$DETY^2_{t-1}$		-	- 0.132 (0.565)
DNFAY		- 0.221 (24.068)*	1.059 (3.326)*
$DNFAY_{t-1}$		0.060 (7.046)*	0.348 (1.638)~
INFGAP		0.086 (35.578)*	- 0.849 (2.282)*
$INFGAP_{t-1}$		- 0.025 (12.266)*	0.467 (1.818)**
DOILPL		0.018 (11.713)*	- 0.027 (0.744)
$DOILPL_{t-1}$		0.016 (9.671)*	0.061 (1.776)**
$REXL_{t-1}$		- 0.016 (19.432)*	- 0.076 (1.565)
DDCGY		0.732 (87.255)*	1.826 (14.641)*
$DDCGY_{t-1}$		0.025 (2.686)*	0.388 (3.574)*
Sample Size	**Countries**	**26**	**3**
	Period	**1960-1988[5]**	**1976-1996**
	# of Obs.	**644**	**60**
Adjusted	**R^2**	**0.802**	**0.931**
Serial Correlation (LM)			**1.11 (0.29)**
Functional Form (LM)			**0.01 (0.92)**
Normality (LM)			**0.191 (0.91)**
Heteroscedasticity (LM)			**0.63 (0.43)**

t-ratios in parenthesis. Significant at 5% = *, 10% = **
~ = [Pr(t>1.638) =0.108]

The instrumental variables are the following 21 instruments:

Intercept, two country dummies, FLY_{t-1}, $DETY_{t-1}$, $DETY^2_{t-1}$, $REXL_{t-1}$, TTL_{t-1}, $DDCY_{t-1}$, YG_{t-1}, RW, DDCGY, $DDCGY_{t-1}$, DOILPL, $DOILPL_{t-1}$, RYO, $DNFAY1_{t-1}$, $INFGAP_{t-1}$, $DM2_{t-1}$, USINF and CAY_{t-1}.

[5] Varies from country to country, see Fry (1993a).

Table A6.6 OLS estimation results (Panel data)

Dependent Variable: DDCY

Independent Variables		Fry (1993) 3SLS	OLS Re-estimation of Fry's Model	
Intercept		*not reported*	- 0.025 (0.257)	- 0.026 (0.267)
Country Dummies	Egypt	*not reported*	- 0.017 (0.492)	- 0.026 (0.736)
	Morocco		- 0.139 (1.276)	- 0.150 (1.364)
FLY_{t-1}		- 0.071 (22.241)*	-	0.060 (0.947)
$DETY_{t-1}$		0.082 (29.333)*	0.200 (0.711)	0.283 (0.958)
$DETY^2_{t-1}$		-	- 0.201 (0.984)	- 0.232 (1.121)
DNFAY		- 0.221 (24.068)*	1.013 (5.746)*	1.019 (5.772)*
$DNFAY_{t-1}$		0.060 (7.046)*	0.379 (1.843)**	0.357 (1.723)**
INFGAP		0.086 (35.578)*	- 0.510 (2.132)*	- 0.497 (2.076)*
$INFGAP_{t-1}$		- 0.025 (12.266)*	0.421 (1.808)**	0.424 (1.819)**
DOILPL		0.018 (11.713)*	- 0.025 (0.725)	- 0.029 (0.832)
$DOILPL_{t-1}$		0.016 (9.671)*	0.066 (1.963)**	0.063 (1.867)**
$REXL_{t-1}$		- 0.016 (19.432)*	- 0.063 (1.361)	- 0.068 (1.444)
DDCGY		0.732 (87.255)*	1.836 (18.651)*	1.839 (18.651)*
$DDCGY_{t-1}$		0.025 (2.686)*	0.389 (3.997)*	0.386 (3.962)*
Sample Size	**Countries**	**26**	**3**	**3**
	Period	**1960-1988[6]**	**1977-1996**	**1977-1996**
	# of Obs.	**644**	**60**	**60**
Adjusted	**R^2**	**0.802**	**0.935**	**0.935**
Serial Correlation (LM)			**0.15 (0.70)**	**0.52 (0.47)**
Functional Form (LM)			**0.52 (0.47)**	**0.35 (0.56)**
Normality (LM)			**0.37 (0.83)**	**0.28 (0.87)**
Heteroscedasticity (LM)			**1.22 (0.27)**	**0.50 (0.48)**

t-ratios in parenthesis. Significant at 5% = *, 10% = **

[6] Varies from country to country, see Fry (1993a).

Table A6.7 2SLS estimation results (Time series data)

Dependent Variable: DDCY

Independent Variables		2SLS Estimation of Fry's model		
Intercept		- 0.114 (1.169)	0.076 (0.408)	0.107 (0.493)
FLY_{t-1}		0.177 (0.751)	- 0.020 (0.326)	0.397 (2.191)**
$DETY_{t-1}$		0.574 (0.920)	0.192 (1.712)	1.099 (1.137)
$DETY^2_{t-1}$		- 0.381 (0.842)	- 0.155 (2.007)**	- 1.238 (1.308)
DNFAY		1.421 (4.777)*	- 0.014 (0.045)	1.185 (1.485)
$DNFAY_{t-1}$		0.438 (1.119)	0.284 (0.936)	1.602 (2.689)*
INFGAP		- 0.827 (1.570)	0.103 (0.381)	- 0.876 (1.644)
$INFGAP_{t-1}$		0.818 (1.729)	- 0.245 (1.307)	- 0.790 (1.628)
DOILPL		0.011 (0.170)	- 0.014 (0.714)	- 0.073 (2.229)**
$DOILPL_{t-1}$		0.151 (2.222)**	- 0.037 (1.147)	- 0.082 (2.195)**
$REXL_{t-1}$		- 0.040 (0.349)	0.062 (0.602)	- 0.417 (1.774)
DDCGY		1.945 (11.802)*	1.039 (3.736)*	- 0.245 (0.165)
$DDCGY_{t-1}$		0.539 (3.280)*	- 0.220 (0.816)	- 0.257 (0.237)
Sample Size	Countries	Egypt	Morocco	Tunisia
	Period	1972-1996	1976-1996	1977-1996
	# of Obs.	25	21	20
Adjusted	R^2	0.947	0.820	0.371
Serial Correlation (LM)		0.02 (0.89)	*5.17 (0.02)*	*7.14 (0.01)*
Functional Form (LM)		0.72 (0.40)	0.18 (0.67)	0.01 (0.92)
Normality (LM)		1.38 (0.50)	1.03 (0.60)	0.12 (0.94)
Heteroscedasticity (LM)		1.12 (0.29)	0.11 (0.74)	0.29 (0.59)

t-ratios in parenthesis. Significant at 5% = *, 10% = **

The instruments used are as follows.

For Egypt: C, FLY, DETY, $DETY^2$, TTL(-1), DDCY1(-1), YG(-1), RW, RYO, DNFAY11(-1), INFGAP(-1), DOILPL, DOILPL(-1), REXL(-1), USINF, CAY(-1), DM2(-1), DDCGY1, DDCGY1(-1).

For Morocco: C, FLY(-1), DETY(-1), $DETY^2$(-1), TTL(-1), DDCY1(-1), YG(-1), RW, RYO, DNFAY11(-1), INFGAP(-1), DOILPL, DOILPL(-1), REXL(-1), USINF, CAY(-1), DM2(-1), DDCGY1, DDCGY1(-1).

For Tunisia: C, FLY, DETY(-1), $DETY^2$(-1), REXL(-1), TTL(-1), DDCY1(-1), YG(-1), RW, DDCGY1, DDCGY1(-1), DOILPL, DOILPL(-1), RYO, DNFAY11(-1), INFGAP(-1), DM2(-1),USINF, CAY(-1).

Table A6.8 OLS estimation results (Time series data)

Dependent Variable: DDCY

Independent Variables		OLS Estimation of Fry's model		
Intercept		- 0.124 (1.307)	0.013 (0.093)	0.099 (0.376)
FLY_{t-1}		-	-	-
$DETY_{t-1}$		0.342 (0.876)	0.204 (2.079)**	- 0.137 (0.144)
$DETY^2_{t-1}$		- 0.255 (0.789)	- 0.161 (2.218)**	- 0.046 (0.048)
DNFAY		1.228 (4.601)*	- 0.0009 (0.004)	0.099 (0.130)
$DNFAY_{t-1}$		0.311 (0.927)	0.258 (0.919)	1.255 (1.796)
INFGAP		- 0.831 (1.900)**	0.049 (0.208)	- 0.138 (0.276)
$INFGAP_{t-1}$		0.786 (1.843)**	- 0.213 (1.486)	- 0.136 (0.290)
DOILPL		0.015 (0.230)	- 0.012 (0.675)	- 0.068 (1.726)
$DOILPL_{t-1}$		0.127 (2.018)**	- 0.029 (1.021)	- 0.044 (1.089)
$REXL_{t-1}$		- 0.078 (0.898)	0.027 (0.354)	- 0.008 (0.047)
DDCGY		1.931 (12.855)*	1.079 (4.186)*	1.480 (0.967)
$DDCGY_{t-1}$		0.466 (3.033)*	- 0.198 (0.791)	- 0.170 (0.129)
Sample Size	Countries	Egypt	Morocco	Tunisia
	Period	1972-1996	1976-1996	1977-1996
	# of Obs.	25	21	2
Adjusted	R^2	0.947	0.839	0.067
Serial Correlation (LM)		0.52 (0.47)	*4.09 (0.04)*	0.48 (0.49)
Functional Form (LM)		1.19 (0.27)	0.00 (0.98)	0.73 (0.39)
Normality (LM)		0.31 (0.86)	0.71 (0.70)	0.20 (0.91)
Heteroscedasticity (LM)		0.48 (0.49)	0.03 (0.86)	1.57 (0.21)

t-ratios in parenthesis. Significant at 5% = *, 10% = **

Appendix 7

OLS estimation results

Table A7.1 OLS estimation results of the growth model

Dependent Variable: Real GNP growth = YG

Independent Variables		Egypt	Morocco	Tunisia	Pooled
Constant	C	0.347 (0.856)	0.103 (0.138)	0.208 (0.310)	0.145 (0.838)
interest rate on debt (π_{11})	r	- 0.232 (0.250)	0.653 (0.649)	- 0.084 (0.113)	0.097 (0.247)
OECD: savings / GNP (π_{12})	nsy	- 0.370 (0.326)	0.966 (1.131)	- 0.440 (0.485)	- 0.111 (0.309)
exchange rate (π_{13})	el	- 0.014 (0.653)	- 0.005 (0.723)	- 0.040 (0.566)	0.012 (1.338)
openness (π_{14})	op	0.051 (0.398)	- 0.216 (1.160)	0.018 (0.146)	- 0.54 (1.007)
terms of trade index (π_{15})	ttl	- 0.054 (0.729)	- 0.008 (0.048)	- 0.023 (0.168)	- 0.011 (0.326)
Sample Size		**25**			**75**
Period		**1972-1996**			
Method of estimation		**3SLS**			
R^2		**0.054**	**0.096**	**0.137**	**-0.035**
DW		**2.687**	**2.640**	**2.534**	**2.447**

Table A7.2 OLS estimation results of the foreign debt model

Dependent Variable: Total debt stock = D

Independent Variables		Egypt	Morocco	Tunisia	Pooled
Constant	C	12.90 (2.801)	- 6.610 (1.851)**	3.140 (2.997)*	- 3.810 (1.038)
interest rate on debt (π_{11})	r	59.40 (5.654)*	11.20 (2.320)*	1.020 (1.039)	18.00 (2.271)*
OECD: savings / GNP (π_{12})	nsy	24.20 (1.878)**	17.90 (4.362)*	1.910 (1.350)	51.90 (6.477)*
exchange rate (π_{13})	el	0.398 (1.602)	0.235 (6.9260)*	0.585 (5.342)*	- 0.123 (2.041)*
openness (π_{14})	op	- 2.260 (1.545)	- 1.540 (1.715)**	0.651 (3.373)*	- 5.010 (4.656)*
terms of trade index (π_{15})	ttl	- 2.970 (3.563)*	1.100 (1.443)	- 0.802 (3.695)*	0.805 (1.133)
Sample Size		**25**			**75**
Period		**1972-1996**			
Method of estimation		**3SLS**			
R^2		**0.795**	**0.911**	**0.965**	**0.402**
DW		**1.533**	**1.485**	**1.551**	**1.834**

Please note that all coefficients are divided by 10^{10}. Significant at 5% = *, 10% = **

Appendix 7

OLS estimation results

Table A7.1 OLS estimation results of the growth model

Dependent Variable: Real GNP growth = YG

Independent Variables		Egypt	Morocco	Tunisia	Pooled
Constant	C	0.347 (0.856)	0.103 (0.138)	0.208 (0.310)	0.145 (0.838)
interest rate on debt (π_{11})	r	- 0.232 (0.250)	0.653 (0.649)	- 0.084 (0.113)	0.097 (0.247)
OECD: savings / GNP (π_{12})	nsy	- 0.370 (0.326)	0.966 (1.131)	- 0.440 (0.485)	- 0.111 (0.309)
exchange rate (π_{13})	el	- 0.014 (0.653)	- 0.005 (0.723)	- 0.040 (0.566)	0.012 (1.338)
openness (π_{14})	op	0.051 (0.398)	- 0.216 (1.160)	0.018 (0.146)	- 0.54 (1.007)
terms of trade index (π_{15})	ttl	- 0.054 (0.729)	- 0.008 (0.048)	- 0.023 (0.168)	- 0.011 (0.326)
Sample Size		**25**			**75**
Period		**1972-1996**			
Method of estimation		**3SLS**			
R^2		**0.054**	**0.096**	**0.137**	**-0.035**
DW		**2.687**	**2.640**	**2.534**	**2.447**

Table A7.2 OLS estimation results of the foreign debt model

Dependent Variable: Total debt stock = D

Independent Variables		Egypt	Morocco	Tunisia	Pooled
Constant	C	12.90 (2.801)	- 6.610 (1.851)**	3.140 (2.997)*	- 3.810 (1.038)
interest rate on debt (π_{11})	r	59.40 (5.654)*	11.20 (2.320)*	1.020 (1.039)	18.00 (2.271)*
OECD: savings / GNP (π_{12})	nsy	24.20 (1.878)**	17.90 (4.362)*	1.910 (1.350)	51.90 (6.477)*
exchange rate (π_{13})	el	0.398 (1.602)	0.235 (6.9260)*	0.585 (5.342)*	- 0.123 (2.041)*
openness (π_{14})	op	- 2.260 (1.545)	- 1.540 (1.715)**	0.651 (3.373)*	- 5.010 (4.656)*
terms of trade index (π_{15})	ttl	- 2.970 (3.563)*	1.100 (1.443)	- 0.802 (3.695)*	0.805 (1.133)
Sample Size		**25**			**75**
Period		**1972-1996**			
Method of estimation		**3SLS**			
R^2		**0.795**	**0.911**	**0.965**	**0.402**
DW		**1.533**	**1.485**	**1.551**	**1.834**

Please note that all coefficients are divided by 10^{10}. Significant at 5% = *, 10% = **

2SLS estimation results

Table A7.3 2SLS estimation results of the growth model

Dependent Variable: Real GNP growth = YG

Independent Variables		Egypt	Morocco	Tunisia	Pooled
Constant	C	- 0.030 (0.054)	- 0.092 (0.091)	0.891 (1.029)	- 0.480 (2.077)*
interest rate on debt (π_{11})	r	1.827 (1.278)	1.088 (0.789)	0.051 (0.054)	0.611 (0.896)
OECD: savings / GNP (π_{12})	nsy	- 1.025 (0.595)	0.246 (0.207)	- 1.362 (0.984)	- 0.676 (1.388)
exchange rate (π_{13})	el	0.037 (1.072)	- 0.003 (0.320)	- 0.043 (0.480)	0.007 (1.469)
openness (π_{14})	op	- 0.065 (0.402)	0.108 (0.340)	0.090 (0.532)	0.166 (1.780)**
terms of trade index (π_{15})	ttl	0.011 (0.113)	- 0.0005 (0.002)	- 0.167 (0.926)	0.087 (1.934)**
Sample Size		**25**			**75**
Period		**1972-1996**			
Method of estimation		**3SLS**			
R^2		**- 0.321**	**0.073**	**0.046**	**- 0.399**
DW		**2.454**	**3.036**	**2.367**	**2.251**

Table A7.4 2SLS estimation results of the foreign debt model

Dependent Variable: Total debt stock = D

Independent Variables		Egypt	Morocco	Tunisia	Pooled
Constant	C	8.65 (1.405)	- 7.520 (1.636)	4.170 (3.122)*	- 1.460 (0.242)
interest rate on debt (π_{11})	r	82.70 (5.246)*	15.20 (2.434)*	1.000 (0.681)	44.00 (2.466)*
OECD: savings / GNP (π_{12})	nsy	25.70 (1.352)	18.50 (3.430)*	1.690 (0.791)	126.0 (9.917)*
exchange rate (π_{13})	el	0.768 (2.015)**	0.246 (6.310)*	0.504 (3.656)*	- 0.438 (3.958)*
openness (π_{14})	op	- 2.890 (1.620)	- 1.980 (1.380)	0.769 (2.957)*	- 12.20 (5.021)*
terms of trade index (π_{15})	ttl	- 2.410 (2.209)*	1.260 (1.305)	- 1.020 (3.677)*	- 0.026 (0.022)
Sample Size		**25**			**75**
Period		**1972-1996**			
Method of estimation		**3SLS**			
R^2		**0.729**	**0.906**	**0.962**	**-0.459**
DW		**2.196**	**1.746**	**1.583**	**1.204**

* Please note that all coefficients are divided by 10^{10}. Significant at 5% = *, 10% = **

12 instrumental variables are used:
intercept, r(-1), NSY(-1), REXL(-1), OP(-1), TTL(-1), RYO(-1), D(-1), YG(-1), DOILPL(-1), INFGAP(-1), USINF.

Appendix 8

Identification conditions applied to the structural model

The order condition

The two equations are over-identified since:

the model has 2 endogenous variables.

three variables are missing from the demand equation.

two variables are missing from the supply equation.

The rank condition

The two equations are identified since:

It can be seen that neither the demand nor the supply equation can be obtained as a linear combination of the other equation.

Appendix 9

The objective function

An optimal portfolio is said to have the greatest expected return for a give level of risk (variance), and simultaneously the smallest variance (risk) for a given expected return. Therefore, the form of the utility function used in the mean-variance model needs to satisfy two basic criterions: "Absolute Risk Aversion" (ARA) and "Relative Risk Aversion" (RRA). For the discussions of how to satisfy these two criteria see Bhattacharyya (1978) p. 40-42.

With respect to the objective function, Bhattacharyya compared different approaches that are able to derive similar general objective functions for the mean-variance model. The Hillier (1969)[7] approach is presented below.
Hillier (1969) assumed a negative exponential utility function, U(Z), which satisfies both measures of risk aversion, ARA and RRA:

$$U(Z) = b_0 + b_1 Z - b_2 e^{-b_3 Z}$$

where

$b_0 b_1 b_2 b_3$ are positive constants, and

Z is total returns and that, $Z \sim N(\mu, \sigma^2)$.

Using Taylor series expansion, and applying some assumptions, and after linear transformation Bhattacharyya derived the following general form

$$E[U(Z)] \Rightarrow \left(\mu - \frac{b}{2}\sigma^2\right)$$

[7] See Bhattacharyya (1978), p. 44.

The covariance matrix

$$\sigma^2 = E(Z - E(Z))^2$$
$$\sigma^2 = V'\Sigma V$$

Where:

$$\Sigma = \begin{pmatrix} \Sigma_{11} & \Sigma_{12} & . & . & \Sigma_{1k} \\ \Sigma_{21} & \Sigma_{ss} & . & . & \Sigma_{2k} \\ . & . & . & . & . \\ . & . & . & . & . \\ \Sigma_{k1} & \Sigma_{k2} & . & . & \Sigma_{kk} \end{pmatrix}$$

Σ is the subjective variance covariance k X k matrix, whose elements are the system's parameters. Where, $\Sigma_{ij} = \Sigma_{ji}$, then

$$ss_{ij} = E\{(R_i - E(R_i))(R_j - E(R_j))\}$$

Inverse of a partitioned matrix

To solve the FOC $\begin{pmatrix} V \\ \lambda \end{pmatrix} = \begin{pmatrix} b\Sigma & I \\ I' & 0 \end{pmatrix}^{-1} \begin{pmatrix} E(R) \\ W \end{pmatrix}$ we need to find the inverse of the partitioned matrix. The partitioned inverse of a general 2.2 matrix is shown in Greene (1993, p.27) as:

$$\begin{pmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{pmatrix}^{-1} = \begin{pmatrix} A_{11}^{-1}(\mathrm{I} + A_{12}FA_{21}A_{11}^{-1}) & -A_{11}^{-1}A_{12}F \\ -FA_{21}A_{11}^{-1} & F \end{pmatrix}$$

Where $F = (A_{22} - A_{21}A_{11}^{-1}A_{12})^{-1}$

Applying the above inverse form to our FOC:

1) $F = (0 - I'b\Sigma^{-1}I)^{-1}$ $\quad F = -(I'b\Sigma^{-1}I)^{-1}$ $\quad$ Let $F_{22} = -(I'\Sigma^{-1}I)^{-1}$

2) $$A_{11}^{-1}(\mathrm{I} + A_{12}FA_{21}A_{11}^{-1}) = b\Sigma^{-1}\left(\mathrm{I} + I\left(-(I'b\Sigma^{-1}I)\right)^{-1}I'b\Sigma^{-1}\right)$$
$$= b\Sigma^{-1}\left(\mathrm{I} - I(I'b\Sigma^{-1}I)^{-1}I'b\Sigma^{-1}\right)$$
$$= b\Sigma^{-1} - b\Sigma^{-1}I(I'b\Sigma^{-1}I)^{-1}I'b\Sigma^{-1}$$

$$= b\Sigma^{-1} - \frac{b\Sigma^{-1}(II'b\Sigma^{-1})}{I'b\Sigma^{-1}I} \qquad = b\Sigma^{-1} - \frac{(\Sigma^{-1}II'b\Sigma^{-1})}{(I'\Sigma^{-1}I)}$$

$$= b\Sigma^{-1} - \frac{b(\Sigma^{-1}II'\Sigma^{-1})}{(I'\Sigma^{-1}I)}$$

$$A_{11}^{-1}(\mathrm{I} + A_{12}FA_{21}A_{11}^{-1}) = \frac{1}{b}\left(\Sigma^{-1} - \frac{\Sigma^{-1}II'\Sigma^{-1}}{I'\Sigma^{-1}I}\right)$$

Let $F_{11} = \left(\Sigma^{-1} - \frac{\Sigma^{-1}II'\Sigma^{-1}}{I'\Sigma^{-1}I}\right)$

3) Let $F_{12} = -A_{11}^{-1}A_{12}F$

$$F_{12} = -b\Sigma^{-1}I(-I'b\Sigma^{-1}I)^{-1} = \frac{b\Sigma^{-1}I}{bI'\Sigma^{-1}I}, \qquad F_{12} = \frac{\Sigma^{-1}I}{I'\Sigma^{-1}I}$$

4) Let $F_{21} = -FA_{21}A_{11}^{-1}$ $\qquad F_{21} = \frac{I\Sigma^{-1}}{I'\Sigma^{-1}I}$

∴From 1, 2, 3, and 4 we get that:

$$\begin{pmatrix} b\Sigma & I \\ I' & 0 \end{pmatrix}^{-1} = \begin{pmatrix} \frac{1}{b}\left(\Sigma^{-1} - \frac{\Sigma^{-1}II'\Sigma^{-1}}{I'\Sigma^{-1}I}\right) & \frac{\Sigma^{-1}I}{I'\Sigma^{-1}I} \\ \frac{I\Sigma^{-1}}{I'\Sigma^{-1}I} & -\frac{1}{I'b\Sigma^{-1}I} \end{pmatrix} = \begin{pmatrix} \frac{1}{b}F_{11} & F_{12} \\ F_{21} & \frac{1}{b}F_{22} \end{pmatrix}$$

Therefore, finding the inverse of the partitioned matrix in the FOC (6-39) will solve to problem, such that:

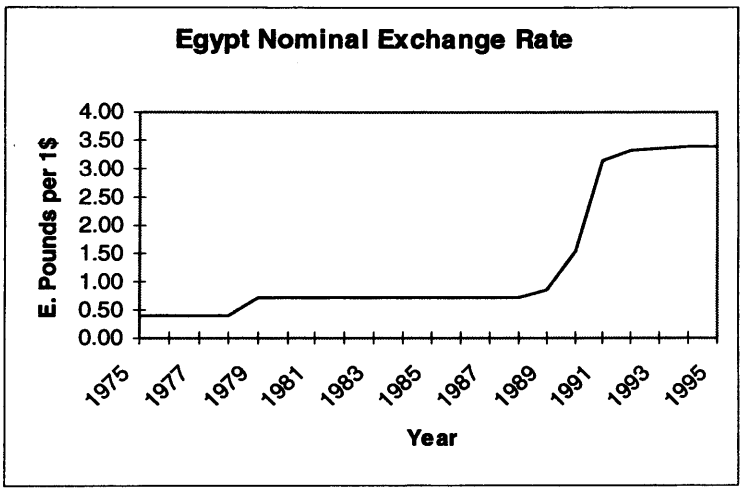
$$\begin{pmatrix} V \\ \lambda \end{pmatrix} = \begin{pmatrix} \frac{1}{b}F_{11} & F_{12} \\ F_{21} & \frac{1}{b}F_{22} \end{pmatrix} \begin{pmatrix} E(R) \\ W \end{pmatrix}$$

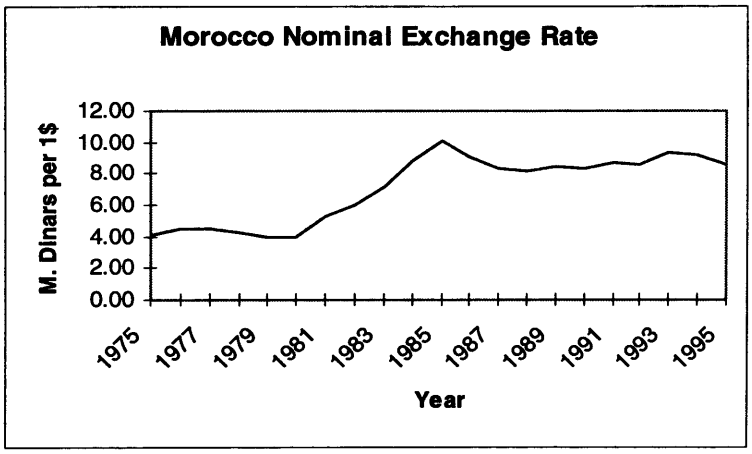
∴ The private sector demand function for financial assets is:

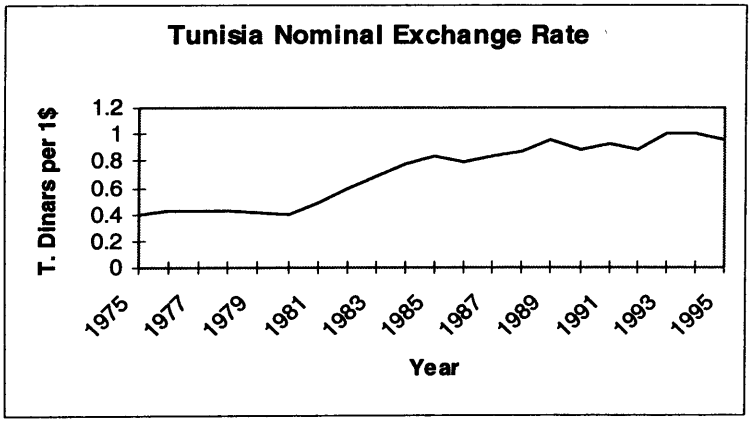
$$V = \frac{1}{b}F_{11}E(R) + F_{12}W$$

Appendix 10

Three figures for the nominal exchange rates







Appendix 11 Unit root test

Applying the Augmented Dickey Fuller (ADF) methodology to the following model:

$$\Delta y_t = \mu + \alpha t + \delta^* y_{t-1} + \sum_{i=1}^{m} \delta_i \Delta y_{t-i} + \varepsilon_t$$

Where μ is a constant (or drift), Δy_t is the first difference of y_t,

t is a linear time rend.

The ADF test is carried out by testing either H_0: $\delta^* = \alpha = 0$ or H_0: $\delta^* = 0$. The Microfit V.4 statistical package is used to perform the test. Where we started by assuming m=5, and then the optimal lag length is chosen by the AIC. The following table presents the unit roots test results for each variable:

Table A11.1 Stationarity Test results
Each test includes an intercept and covers the period 1975 - 1995

Variables		Egypt		Morocco		Tunisia	
		T/NT; Lags	ADF	T/NT; Lags	ADF	T/NT; Lags	ADF
Total Debt Stock; A2	DA2	NT; 0	-3.126	T; 0	-4.269	NT; 1	-4.502
Public & P. G. Debt; A4	DA4	NT; 0	-3.124	NT; 5	-3.351	NT; 5	-3.290
Private S. Debt; A5	DA5	NT; 0	-3.944	T; 0	-4.759	NT; 0	-3.215
R. GDP Growth; Y6	Y6	T; 0	-5.074	NT; 0	-6.606	NT; 0	-4.757
R. GNP; Y8	Y8	T; 0	-4.685	T; 0	-4.561	-	-
	DY8	-	-	-	-	NT; 0	-5.758
Gov Exp / GDP; G2	G2	T; 4	-4.070	-	-	-	-
	DG2	-	-	NT; 0	-4.058	NT; 0	-4.453
Exchange Rate; E1	DE1	-	-	-	-	NT; 0	-4.149
	DDE1	NT; 0	-4.952	NT; 0	-4.727	-	-
G. D. Inv / GDP; i6	Di6	NT; 0	-5.599	NT; 5	-3.209	NT; 3	-4.418
G. Second E. Ratio; h52	Dh52	NT; 0	-4.698	-	-	-	-
	DDh52	-	-	NT; 0	-5.851	NT; 1	-4.852
Tax Revenue / GDP; v3	v3	-	-	T; 0	-3.822	T; 0	-3.904
	Dv3	NT; 0	-5.656	-	-	-	-
Budget Deficit/ GDP; B	B	-	-	T; 0	-4.323	-	-
	DB	-	-	-	-	NT; 1	-4.473
	DDB	NT; 2	-10.981	-	-	-	-
Population Growth; n	n	T; 2	-5.014	T; 5	-3.801		
	Dn	-	-	-	-	NT; 0	-5.514
Δ Terms of Trade; T3	T3	-	-	NT; 1	-4.978	NT; 0	-4.784
	DT3	NT; 0	-5.583	-	-	-	-
Rate of Inflation; F3	F3	NT; 1	-4.560	T; 0	-5.664	NT; 0	-4.314
Inflation Gap; F4	F4	T; 1	-5.181	NT; 0	-5.865	NT; 5	-4.856
Export Growth ex	ex	T; 0	-4.195	NT; 0	-4.581	NT; 0	-4.330
(Ex +Im) / GDP; op	Dop	NT; 0	-4.012	NT; 0	-3.852	NT; 0	-2.462
Service VA / GDP; X6	X6	-	-	T; 0	-3.719	-	-
	DX6	NT; 0	-5.226	-	-	NT; 0	-5.020
Domestic Discount rate; r5	Dr5	NT; 0	-3.950	NT; 0	-5.280	NT; 0	-3.880
LIBOR; rw1	Drw1	NT; 0	-3.082				
R.W. Interest Rate; rw	Drw	NT; 0	-3.956				

T=The ADF test includes a linear trend NT=the test does not include a linear trend.

The critical values for ADF test for 5% is between –3.735 and –3.012. All reported variables are stationary at 5%, with the exception of Dop in Tunisia.

Table A11.2

Variable Name		Order of Integration		
		Egypt	Morocco	Tunisia
Total Debt Stock	A2	1	1	1
Public & Publicly Guaranteed. Debt	A4	1	1	1
Private S. Debt	A5	1	1	1
Real GDP Growth	Y6	0	0	0
Real GNP	Y8	0	0	1
Government Expenditure / GDP	G2	0	1	1
Exchange Rate	E1	2	2	1
Gross Domestic Investment / GDP	i6	1	1	1
Gross Secondary Enrolment Ratio	h52	1	2	2
Tax Revenue / GDP	v3	1	0	0
Budget Deficit / GDP	B	2	0	1
Population Growth	n	0	0	1
Δ Terms of Trade	T3	1	0	0
Rate of Inflation	F3	0	0	0
Inflation Gap	F4	0	0	0
Export Growth	ex	0	0	0
(Export +Import) / GDP	op	1	1	1
Service VA / GDP	X6	1	0	1
Domestic Discount Rate	r5	1	1	1
LIBOR	rw1	1		
Real World Interest Rate	rw	1-		

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