5-1998

Essays on the Impact of Foreign Aid on Economic Growth and Development: The Case of Jordan

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ESSAYS ON THE IMPACT OF FOREIGN AID ON ECONOMIC GROWTH AND DEVELOPMENT: THE CASE OF JORDAN

by

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A dissertation submitted in partial fulfillment of
the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Economics

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UTAH STATE UNIVERSITY
Logan, Utah

1998

ABSTRACT

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This dissertation examines the role of foreign aid in economic growth and development of Jordan. The flow of foreign capital takes two main forms: private foreign investment, mostly foreign direct investment by large multinational corporations, and public development assistance (foreign aid) from both individual national governments and multinational donor agencies. The distinguishing characteristic of foreign aid is the concessional element. In this dissertation, recent techniques and advances in time-series analysis are used in the empirical section of Chapters 2 and 3, i.e., vector autoregression (VAR), impulse response functions, and variance decompositions. In the fourth chapter, we use a nonlinear three-stage least square estimate to test the impact of foreign aid on the fiscal behavior of Jordanian government.

The results of this study indicate that foreign aid in its aggregated form exerted an overall short-run positive dynamic impact on Jordanian growth rate of output, while it had a severe and long-run negative dynamic impact on domestic saving rate. When foreign aid is decomposed into its two main components, i.e., foreign aid grants and foreign aid loans, we found that grants exerted a long-run positive dynamic impact on Jordanian output growth and a severe long-run negative impact on its domestic saving rate. On the other hand, foreign aid loans had a positive but short-run impact on output growth and a positive long-run dynamic impact on domestic saving rate. We also found that foreign aid significantly affects both the revenue and expenditure side of the Jordanian government budget.

Foreign aid grants positively affect public consumption expenditures while foreign loans had no significant impact on government consumption. We also found that tax revenues in Jordan are mainly used to finance public consumption expenditures and not public investment. Furthermore, in the presence of foreign aid (grants and loans), an increase in taxes leads to an increase in public consumption expenditures and vice versa. Finally, the results show that in the presence of foreign aid, the Jordanian public sector reduces its efforts to collect taxes.

(135 pages)

بسم الله الرحمن الرحيم

For my parents: Amneh and Ghazi, and the rest of the family, Nayfeh, Mohammed, Ziad, Zayed, Zuheir, Ahmad, Adnan, and my beloved kid sister Kholood.

I, perhaps I never will be, perhaps I was not able,
Never was, never saw, don't exist:
What is all this? In which June, in what wood
Did I grow until now, being born and born again?
I didn't grow, never grew, just went on dying?

In doorways, I repeated
The sound of the sea, of the bells:
I asked for myself, with wonder,
(and later with trembling hands),
with little bells, with water, with sweetness:
I was always arriving late.
I have traveled far from who I was,
I could not answer any questions about myself,
I had too often left who I am.

I went to the next house,
To the next woman,
I traveled everywhere asking for myself, for you, for everybody:
And where I was not there was no one,
Everywhere it was empty because it wasn't today,
It was tomorrow.
Why search in vain
In every door in which we will not exist
Because we have not arrived yet?
This how I found out
That I was exactly like you and like everyone.

Neruda, Pablo

ACKNOWLEDGMENTS

بسم الله الرحمن الرحيم

I would like to thank Dr. Basudeb Biswas for the continuous guidance and support during all this time, especially the rough ones, and we both know there were too many. Thanks for all the advice and for listening to me. I would like to thank Dr. Donald L. Snyder for giving me my first teaching assignment, and the chance to do what I love the most, teaching. I extend my thanks to the rest of my committee members, Dr. Chris Fawson, Dr. L. Dwight Israelsen, and Dr. Nazih Al-Rashid, for all their help and support. I would also like to thank Christine Forsgren for her technical assistance in preparing this dissertation, and all the friends I had in Logan.

It has been a very long journey that I sometimes forget, when did I start if I ever did? Was the start in the streets of that sad and quiet city of Irbid? Was it in that wonderful and eternal place which will always be in my mind, Yarmouk University? Was it on its streets and among its "small" trees? A very special thanks to the Yarmouk people for the wonderful memories and times, the laughter and the cries, the struggles and the triumphs. Thank you Assil, Layali, Azhar, Hanin, Lama, Tina, Ghaleb, Nazih, Barakat, and Hisham. A special thanks to Juan, Blanca, Michelle, and Walid.

Also, a special kind of appreciation to two of my brothers, Mohammed and Zuheir, for inspiring me all these years. Mohammad, you have been like a father besides being the brother you are, whom I learned so much from and whom I value dearly. Zuheir, thank you for teaching me my first alphabets and words. Your persistence, encouragement, and motivation have been guidance and an inspiration to me.

Finally, to you, Karla Dominguez, for being there for me through the difficult and easy times, for your love and understanding, and most importantly, for your patience, a special thanks and gratitude from the bottom of my heart.

Jamal G. Husein

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

In the field of development economics, both policy makers and economists have always considered the effects of foreign capital inflows, especially foreign aid, and domestic resources on economic growth of developing countries. Since the 1950s, there has been a steady stream of econometric analysis and tests attempting to quantify the effects of both of these resources on economic growth.

The international flow of financial resources takes two main forms. First is the official "public" development assistance (ODA) from individual national governments and multinational donor agencies, known as bilateral and multilateral development assistance. The objective of this kind of assistance must be noncommercial from the donor's point of view, and be characterized by concessional terms, i.e., the interest rate and repayment periods for borrowed capital are softer than market terms.[1] The concept of foreign aid encompasses currency and in-kind aid that transfers resources from developed countries (DCs) to less-developed countries (LDCs). Included in these transfers are those of the Organization of Petroleum Exporting Countries (OPEC) to other less-developed countries.[2] A second form of resources comes through foreign private investment, widely known as foreign direct investment (FDI), which is mostly done by large international corporations with headquarters mainly in developed countries. FDI

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[1] According to this definition, military aid qualifies as foreign aid (ODA), since it is both noncommercial and concessional. However, military aid is excluded from international economic measurements of foreign aid. See Todaro (1989).

[2] Foreign aid in this study is defined as net bilateral and/or multilateral transfers received by the government (grants), plus official long-term borrowing (loans).

represents normal commercial transactions and is highly dependent on projected profits and rates of return. Hence, it is not viewed as foreign assistance as it may or may not benefit the developing country.

In the calculation of actual foreign capital inflows, especially the foreign aid component, some conceptual and measurement problems have to be addressed. First, dollar values of loans and grants cannot be simply added together since each has a different significance to donors and recipients. Loans cost the donor and benefit the recipient by less than the nominal value of the principal loan. Ideally, the interest-bearing loans should be deflated or discounted before adding them to the value of outright grants. Second, aid can be tied to purchase donor country goods and services (tied by source), or funds can be used only on specific projects (tied by project), i.e., building roads, dams, hospitals, etc. As a result the real value of the aid is reduced because the source is most likely more expensive and/or the project may not be of highest priority to the recipient. If aid is further tied to import capital-intensive equipment, an additional real resource cost may be imposed in the form of higher unemployment in the recipient country. Third, nominal versus real values of foreign aid, i.e., when foreign aid inflows are calculated at nominal values, show a steady rise over time. However, when deflated, this may not be the case.

The main goal of this dissertation is to further investigate the economic impact of foreign aid on growth and gross domestic savings. In the second chapter, the relationship between foreign aid inflows and both economic growth and gross domestic savings (public and private) of Jordan is examined. Specifically, we will quantify this relationship by (1) examining the overall impact of foreign aid on the growth rate of

Jordanian output (gross domestic product (GDP)); (2) investigating the impact of overall foreign aid on Jordanian domestic savings (public and private); and (3) testing the impact of domestic savings on output growth and foreign aid. Towards this goal, we use macroeconomic time-series data for the Jordanian economy over the period 1964-95. In this chapter we use a dynamic structural simultaneous equation model (DSSM) to capture the dynamic interrelationships between foreign resources (aid), domestic resources, and economic growth. Specifically, a vector autoregression (VAR) methodology is used to analyze the relationship between growth, and both foreign resources and domestic resources.

Chapter three will provide further answers to how the various components of foreign aid affected both output growth and domestic savings. In this chapter we (1) disaggregate the components of foreign aid into its two main components, foreign aid grants, and foreign aid loans; and (2) measure how both of theses components (foreign aid grants and foreign aid loans) affected the Jordanian growth rate of output and domestic savings. In this chapter we also use a dynamic structural simultaneous equation model (DSSM) to measure the dynamic impact of both grants and loans. A VAR methodology is used again to analyze the relationship between economic growth, and both foreign resources and domestic resources. Specifically, we will quantify this relationship by measuring the dynamic effects of foreign resources (grants and loans) on both the growth rate of Jordanian output (GDP) and domestic savings (domestic resources)

Chapter four will answer the question of how foreign aid affects the public fiscal behavior. In Jordan, like most LDCs, the public sector's role in planning and implementation of developmental projects is considerable. The rising level of Jordanian public expenditures has been fueled by (1) capital inflows from public and private sources abroad and (2) the mobilization of domestic resources through taxation and domestic borrowing. This chapter will assess the effectiveness of the Jordanian government's development efforts, and the impact that foreign aid has on both the expenditure and the revenue side of the recipient (Jordan) government budget. The methodology we adopt here regards the government maximizing its own welfare in the face of budgetary constraints, and will use foreign aid as an instrument in the pursuit of that objective.

This dissertation attempts to explain the impact that foreign aid (foreign resources) had on the Jordanian economy. The statement of problem, objectives, and procedure of each chapter are stated below. Chapter 5 includes an overall conclusion plus a set of policy recommendations to the Jordanian government.

I. STATEMENT OF PROBLEM

Chapter two

The magnitude and time-path of the response of a country's domestic resources (domestic saving) and its real output growth (GDP) to foreign resources (foreign aid) have an important policy implication. The dynamic response of domestic saving and real output growth of Jordan is examined through VARs, impulse response functions (IRFs), and variance decompositions (VDCs), using annual time-series for the period 1964-95. Since the beginning of the 1960s, Jordan has received a large inflow of foreign aid from oil-rich Arab countries, the United States of America, and the European community, averaging more than 20% of real GDP over the study interval. In addition, Jordan was listed as the thirteenth top aid recipient among all less developed countries for 1990, providing a test case to examine the overall effectiveness of foreign aid in promoting and complementing growth and domestic resources, respectively.

Chapter three

Since chapter two in this dissertation provides an explanation of the impact of overall foreign aid on output growth and domestic saving, the next logical step would be to investigate further the impacts of the different components of foreign aid. Chapter three examines the dynamic impacts of the two main components of foreign aid, foreign aid grants and foreign aid loans. Considering the fact that various aid components may have differential impacts on a recipient country, we will investigate the dynamic effects of both of foreign aid's components on growth and domestic resources in Jordan. The dynamic response of domestic saving and real output growth of Jordan is examined via VAR, IRFs, and VDCs, using annual time-series for the period 1964-95. Foreign aid grants averaged more than 15.4% of Jordan's GDP for the time of the study, while foreign aid loans averaged about 6% of GDP for the same period. Thus, Jordan can also provide a test to examine the effectiveness of foreign aid grants and foreign aid loans in promoting growth.

Chapter four

In chapter four, we test the relationship between foreign aid and government fiscal behavior; specifically, the impact of foreign aid grants and foreign aid loans on Jordan's government budget is examined. The effectiveness of foreign aid grants and foreign aid loans in meeting the development efforts in Jordan is analyzed, and its impact on alternative aggregate public expenditures and domestic revenues is evaluated. The major work in the literature regarding this issue is Heller's (1975) paper, wherein he postulates a maximizing policy maker and derives consistent behavioral equations in order to estimate the impact of foreign aid grants and loans on various government expenditures and revenues. One problem with Heller and other earlier studies is that the data used were a pooled cross section of different countries with few time-series observations. Hence, to draw any valid conclusions about a single country from such data may be questionable. A structural simultaneous equation model for Jordan is derived from a maximizing framework and estimated using a nonlinear three-stage least square procedure.

II. OBJECTIVES

The main purpose of chapter 2 is to: (1) investigate the effects of overall foreign aid on economic growth as an indicator of economic performance in Jordan; (2) investigate further the impact of foreign aid on domestic resources (domestic saving), and to determine whether foreign and domestic resources are complementary or substitute inputs, and (3) prescribe some policy implications regarding foreign aid, which in return depends on the magnitude and direction of the impact on growth and domestic resources.

The objective of Chapter 3 is to: (1) investigate further the impact of foreign aid main components, foreign aid grants and foreign aid loans, on economic growth and domestic resources of Jordan; (2) determine the kind of relationship between domestic resources (domestic saving) and both of foreign resources (grants and loans), i.e., do they complement or substitute each other; and (3) draw some conclusions and policy prescription regarding both grants and loans for the case of Jordan.

The purpose of Chapter 4 is to: (1) analyze the relationship between foreign aid and government fiscal behavior for Jordan and (2) determine the effects of foreign aid components, i.e., loans and grants, on both the expenditure and the revenue side of the Jordanian government budget.

III. OVERVIEW OF JORDANIAN ECONOMY

The present Jordanian state compared to other states in the region (Middle East) is considered relatively new. The state's origin dates back to 1920-21, when the British appointed Prince Abdallah bin Al-Husayn, a member of the Hashemite clan, as a ruler of the British-controlled territories east of the Jordan River with the official name Transjordan. It became fully independent from Great Britain in 1946 and was renamed the Hashemite Kingdom of Jordan in 1950, following the unification with the Palestinian West Bank. Since 1953, it has been ruled by King Husayn bin Talal.

Jordan is considered to be one of the underdeveloped economies in the Middle East. In the path toward growth and development, Jordan has faced significant obstacles: a high 3.2% average annual growth rate of population for 1964-95, and a 4.9% urban average population growth for 1962-92 (World Bank, 1994; Human Development Report, 1994). Limited and underdeveloped domestic markets, scarcity of natural and capital resources (since Jordan is a non-oil producing country), and an agricultural sector that relies on rainfall makes investment in agriculture both risky and unfavorable. Therefore, the undeniable role of the public sector has been to ensure satisfactory structure and rate of capital formation. In this context, the government's need for some foreign assistance is easily recognized.

The external economic dependence of Jordan may be attributed to a desire for economic growth and development set by different official Jordanian plans (three-year development plan of 1973-75 and five-year development plans of 1976-80, 1981-86, 1981-85, 1986-90, and 1993-97), respectively. These plans had to overcome major obstacles: (1) a high population growth and a long-term saving gap; (2) a rising amount of expenditures for national and domestic security purposes related to 1967 and 1973 wars with Israel;[3] and (3) a foreign exchange gap since, for the time of the study, Jordan on average imports almost two times more than it exports (export-import imbalance); this gap needs to be filled by foreign capital.

With the 1967 war, Jordan lost control of the West Bank, and with it roughly one third of the kingdom's economy. Jordan also began to receive increasing levels of Arab economic aid. Between 1964 and 1995, foreign aid (grants and loans) on average accounted for no less than 48.9% of all government revenues and 20.9% of Jordan's real gross domestic product (GDP). Such levels of foreign assistance supported a growing public sector, with government recurrent expenditures representing on average one-third of GDP for the same period.

Jordan, for the last 40 years or so, and according to the five-year plan (1993-97), has been very successful in achieving most of its goals: a high level of growth in real GDP, the building and establishment of necessary infrastructure to accompany the

[3] The entry of more than a million Palestinian refugees to Jordan imposed an extra burden on the economy, especially the public sector.

development process, and the expansion and development of a set of services, i.e., education and health, that are vital to the development of human capital. Despite the claimed accomplishments, the economy suffered from the following drawbacks: (1) a deficit in both the balance of payment and the central government budget for the entire period of study; (2) a reduction in the growth rate of GDP for most of the 1980s; and (3) a high level of unemployment that reached 23.6% for those in the 20-to-29 year range and 17.1% for the entire economy in 1990 (five-year development plan 1993-97).

CHAPTER 2

THE IMPACT OF FOREIGN AID ON ECONOMIC GROWTH AND DEVELOPMENT WITH EVIDENCE USING VECTOR AUTOREGRESSION: THE CASE OF JORDAN

I. THEORETICAL BACKGROUND

During the 1950s, the United States, a capital-surplus nation, started a foreign assistance program to help the less-developed countries (LDCs) to grow. During the same period, many LDCs with shortages in capital adopted rapid economic growth as an important national economic goal. Many of these countries resorted to foreign capital acquisition to achieve this goal. Unfortunately, the failure of foreign aid to bring about prosperity led to a series of debates between economists and policy makers in both developed and less-developed countries on the role and effectiveness of foreign aid for economic development.

The debate has centered on the following viewpoints. Writers on the left (Griffin, 1970; Griffin and Enos, 1970; Weisskoff, 1972) believe that the purpose of aid is the perpetuation and extension of international capitalism. This radical or anti-aid view is based on the hypothesis that foreign aid (1) substitutes rather than complements domestic resources, (2) helps import redundant technology, (3) distorts income distribution, and (4) is biased toward bigger, inefficient, and largely corrupted domestic governments. This anti-aid view emerged as a result of the failing experiences of many capital-importing developing countries, accompanied by an empirical phenomenon that showed foreign resources substituted for domestic resources and exerted a negative effect on the recipient country. This view also argues that foreign aid, in part, supplements consumption (reduces domestic saving) if the level of income is given, or reduces the proportion of income saved if the level of income rises. Empirical support of the above hypothesis was derived from both time-series and cross-country analysis. Using a single equation method and relating aid inflows to saving rates or investment rates as the dependent variable, most empirical results reported a negative coefficient of aid on savings. These results are summarized in Table 1. Note that in cases where investment is considered the dependent variable, the coefficients are not negative, yet substantially less than one, indicating a marginal positive contribution of foreign aid to investment, but a substantial decrease in domestic savings, since savings is defined as investment minus foreign inflows in these studies.

In sharp contrast, writers on the right (Chenery and Bruno, 1962; Chenery and Strout, 1966; Papanek, 1972; 1973) argue that capital imports exert significant beneficial effects on the recipient country. This traditional or pro-aid view contends that foreign aid not only augments domestic resources of the capital deficient country, but also helps mitigate severe foreign exchange constraints, provides access to modern and new technology, improves management skills, and allows easier access to foreign markets, all of which contribute positively to economic growth. The pro-aid view is mainly based on the Harrod-Domar growth model. This model was developed independently during the 1940s by Roy Harrod (1939) and Evsey Domar (1947), primarily to explain the relationship between growth and unemployment in advanced capitalist societies, but has been used extensively in developing countries as a simple way of looking at the relationship between growth and capital requirements.

The underlying assumption of the model is that output of any economic unit, a firm, an industry, or the whole economy, mainly depends on the amount of capital invested in that unit. If we call output Y and the stock of capital K, the relationship between Y and K in the simplest form of the Harrod-Domar model can be written as follows:

$$Y = \frac{K}{v} \tag{1}$$

where v is the incremental capital output ratio (ICOR). Converting (1) into a statement about the growth rate of output, we obtain:

$$\frac{dY}{Y} = \frac{dK}{Y} \left(\frac{1}{v}\right) \tag{2}$$

where dY / Y is the growth rate of output, and dK is the incremental increase in capital stock that is net investment (I). Equation 2 can be rearranged as:

$$\frac{dK}{Y} = v \left(\frac{dY}{Y}\right) \tag{3}$$

such that investment-output ratio becomes the endogenous variable. According to Equation 3 above and given a particular incremental capital output ratio, v, and a given rate of output growth desired by any economy, the required investment rate to achieve the targeted (planned) output growth can be determined a priori. The investment rate needed to achieve a particular level of growth may be obtained from domestic savings (domestic resources), private capital inflows from abroad, i.e., foreign private investment, and/or from official foreign capital inflows. If domestic savings are low and there are no or limited prospects for foreign private investment, then foreign assistance (aid) may be given to achieve the desired rate of growth.

The above is simply the Rosenstein-Rodan (1961) savings gap approach to aid. They argue that aid is required to fill the saving gap, and that a transition to self-sustaining growth will eventually be achieved if the marginal propensity to save exceeds the average saving rate. Chenery and Strout (1966) formalized the savings gap model by adding one more constraint to growth, the foreign exchange shortage that is equal to the excess value of import requirements over export earnings. This constraint binds when the rate of export growth, which is assumed to be exogenous, is insufficient to keep pace with the growing demand for imports.[4]

Studies in which growth is regressed on aid (measured as a percentage of national income) as one or as the only explanatory variable yield varying results. Papanek (1972) derived a positive significant coefficient of 0.20, while the coefficient was insignificant in an analysis by Voivodas (1973), and negative in an analysis by Mosley, *et al.* (1987).

Considering the fact that aid is not the only source of capital accumulation, most of the above studies go about reestimating the equations, including the various components of capital accumulation, i.e., domestic saving and foreign saving (foreign aid and private inflows) on the right-hand side of the equation. The results show a differential impact of distinct sources of investments, but still not in a consistent manner. For example, Papanek's (1973) cross-section study of 34 countries for the 1950s and 51 for the 1960s found that aid had a higher significant positive impact on growth than either domestic saving or private capital inflows, though both domestic saving and private capital inflows were positive and significant. On the other hand, Mosley (1980) shows the opposite effect as given in Table 2. Almomani (1985), in a study about Jordan,

[4] For more on dual gap theory, see Chenery and Strout (1966), and for its critique, see White (1992).

determined that aggregated foreign aid (foreign resources) had a positive and significant impact on real GDP growth, had a positive but insignificant impact on domestic saving (domestic resources), while foreign aid loans had a negative but insignificant impact on growth. Almomani concluded that foreign aid loans have a negative impact on growth and they neither helped to foster the rate of growth in the economy nor relaxed its savings constraints. On the other hand, he also concluded that other foreign flows including foreign aid grants have a positive and significant impact on growth.

All of the above-mentioned empirical studies used a single equation approach. Whether the study is a pro- or anti-aid, it was attacked on a methodological basis. Over (1975) criticized the Griffin and Enos (1970) article in which they disputed the assumption that foreign capital relieves a country's savings constraint, thereby allowing and encouraging the country to invest more in capital goods than its domestic saving rate would ordinarily permit as mentioned earlier. Over disputed the exogeniety of foreign aid and stated that aid was endogenous to the system, such that aid influences and is influenced by the recipient country's level of income.

Mosley (1980), recognizing the simultaneity problem, as well, criticized Papanek's (1973) method and results on the grounds that OLS is inappropriate if the right-hand-side variables of the equation contain variables that are endogenous to the system under examination. Mosley's (1980) results showed that Griffin's negative relation between aid and saving still held, and he explicitly declared the collapse of the positive and significant relationship between aid and growth shown by Papanek (1973) and others, when applied to the less-developed countries as a whole. Table 2 summarizes some of the regression results of previous studies with method of estimation used, and with any additional explanatory variables added in the right-hand-side of the equation.

The following points summarize the theoretical framework by which foreign aid may affect gross domestic saving (public and private) of a recipient country: (1) If the recipient government has a fixed growth rate of output as an objective, then any resources for investment coming from overseas will induce the government to change its policies and programs, which may reduce domestic saving by an amount equal to the inflow, and (2) savings depend on investment opportunities available, and some of these will be pre-emptied by foreign investment (foreign aid). Hence, foreign inflows will be offset in part by a compensatory reduction in domestic saving. Foreign aid supplements consumption (reduce domestic saving) if the level of income is given, or reduces the saving rate (proportion of income saved) if income level rises.

The precise channels through which an increase in foreign aid leads to a reduction in domestic savings can be explained as follows. First, public saving may decline due to a reduction in taxation, a reduction in the effort to collect taxes, and a change in the composite of government spending in favor of consumption. Second, private saving will decline due to the preemption of profitable opportunities, which would have generated saving by domestic investors. Foreign aid, according to the above, will supplement consumption and raise the capital-output ratio. This proposition can be shown as follows. Let $\frac{dY}{Y} = g$ where g is the growth rate of output, and $\frac{dK}{dY} = v$ (ICOR), $\frac{S}{Y} = s$ the saving ratio, and foreign aid to GDP ratio f, then from Equation 3 we have:

$$\frac{dY}{Y} = g = \frac{S/Y}{I/dY} = \frac{s}{v}$$

which is the growth rate of output without the additional foreign aid ratio, *f*. If a recipient country, i.e., Jordan, receives an amount of foreign aid (foreign saving) that adds a fraction to its GDP, *f*, then, if all this additional aid is saved ($\Delta s = f$) and there is no change in ICOR, then:

$$\Delta g = \frac{\Delta s}{\Delta v} = \frac{f}{\Delta v} \tag{4}$$

and g^*, the growth rate of output with the additional foreign aid (foreign saving), if it is all saved, becomes:

$$g^* = \frac{s + \Delta s}{v + \Delta v} = \frac{s^*}{v^*} \tag{5}$$

where s^* and v^* are the new saving and new capital-output ratio, respectively. If part of the additional foreign aid is consumed and part is saved, then:

$$g^* = \frac{s^* + (1-c)f}{v^*},$$

where c is the proportion of the additional foreign saving that is consumed. Hence, growth rate due to additional foreign aid, *f*, is:

$$g^* - g = \frac{s^* + (1-c)f}{v^*} - \frac{s}{v} \tag{6}$$

To illustrate the above, assume that foreign aid (foreign saving) adds 7.5% to current real GDP. If all of this foreign saving goes to investment, and if the ICOR is 3, then the growth rate of output will increase according to Equation 4 by 2.5%. Meanwhile if part of these 7.5% additional resources is saved (invested) and part is consumed, i.e., 70% is saved and the remaining 30% is consumed, and the ICOR remain unchanged, then the growth rate of output will increase by only 1.75%. According to Equation 6, the impact on growth can be positive if Δs is positive and c is small, and negative or even negligible if Δs is negative or very small, Δv is positive, and c is large. Incremental capital-output ratio, v, is likely to rise in the presence of foreign aid: (1) for political reasons, i.e., donor countries may concentrate their aid on large dramatic projects to show their generosity (monuments); (2) when aid is tied to the purchase of goods and services from donor countries, where their prices might be higher than the world price, or the purchase of technologically abundant goods, which in both cases the recipient will have a higher cost resource supply; and (3) it is usually the case that foreign aid changes the pattern of investment in the recipient country in favor of social overhead capital, i.e., infrastructure, which will result in a direct bias against directly productive activities.

Of all of the single factor approaches to growth, the concentration on capital formation "capital fundamentalism" is perhaps the most powerful and lasting for several reasons. First, the solid theoretical grounds based on the Harrod–Domar model which is explained earlier. This model sheds light on important aspects of growth and development by focusing on meeting the investment requirements for growth without inflation and unemployment. Second, most developmental plans of many LDCs since the 1950s coincided with aims and approaches of donor countries of the time, i.e., they provided a readily applicable basis for justifying aid where capital shortage is widely seen as the single most important barrier to growth. Accordingly, most LDC's development plans were planned in a frame that clearly identified and reflected this capital shortage. Finally, capital fundamentalism is lasting because its framework is flexible to incorporate new economic concepts such as the human capital formation.[5]

The critical role of saving and capital in output growth is well-established in industrial societies. Several studies showed that the expansion in physical capital is responsible for half of the growth in total income of nine developed countries prior to 1975. Other studies shows that the upper rates of per capita income growth in the U.S. in the 1970s is mainly due to the very low investment rates relative to Japan and other western Europe countries in the same period.[6]

II. THEORETICAL LINK, CONSUMPTION, FOREIGN AID, AND DOMESTIC SAVING [7]

For most issues in economics, especially development economics, as well as in this chapter, the aggregate behavior of the economy's consumers is more important than the behavior of any single individual consumer. How can the theory of consumer behavior and individual demand analysis be applied to aggregate demand, which is a "suitably defined sum of the demands arising from all economy's consumers (p. 105)"?[8] In what follows we will briefly investigate the relationship between consumption and saving at the individual "consumer" level where we will draw some conclusions that we hope will also hold in the aggregate. The question is when can aggregate demand be expressed as a function of prices and aggregate wealth as the individual Walrasian demand does? One aspect is the extent to which aggregate demand can be accurately

[5] See Levine and Renelt (1992) paper for a survey of the recent literature on growth.

[6] See Gillis *et al.* (1983) for two studies "The Source of Economic Growth in the U.S." and "Why Growth Rates Differ."

[7] This section is based on the analysis in Becker (1971).

[8] See Mas-Colell *et al.* (1995) for a detailed analysis of aggregation.

modeled as function of aggregate variables, such as aggregate or average consumer wealth. When an economy receives more resources (aid), this supplements its available income, part of which will be expended on increasing current and part on augmenting future consumption. With current consumption rising, at a given income, current domestic saving will fall; on the other hand, with a rising income, the proportion of income saved will fall. In this context, we will treat aggregate demand as if a "representative" consumer generated it and use the changes in this "fictional" individual behavior as a measure of aggregate behavior. The representative consumer in the economy needs to decide on an optimal time path for consumption given an intertemporal utility function. Assume that a representative agent's preferences at any moment in time will depend not only on current consumption, C_0, but also on consumption n periods in the future, C_1, C_2, …, C_n:

$$U = U(C_0, C_1, \dots, C_n) \tag{7}$$

where U is the present utility, and C_0, C_1, …, C_n are planned consumption n periods ahead. Define this agent's income, I, in each period as the sum of all earnings, receipts from ownership of property, and all other receipts from all other sources. If consumption in period i equals total income in that period, it follows that the Walrasian demand for this representative consumer is:

$$C_i = \frac{I_i}{P_i} \tag{8}$$

where P_i is the price of a unit of C_i, I_i is the income in period i, and the allocation of consumption over time in Equation 8 would be easy and straightforward.[9] Equation 8 implies that the consumer fully expends his income, but in a broader sense, it also implies that the consumer budget is an intertemporal one allowing for savings today to be used for tomorrow's consumption. What Walras's law says is that the consumer fully expends his resources over his lifetime. If we allow for the exchange between consumption at different times so that consumption may not be necessarily tied to income of the same period, a minor adjustment is necessary since dollars in period i are not comparable to those of period j, unless multiplied by a price that measures the number of dollars in period j considered equivalent to a dollar in period i. If current consumption, C_0, is reduced by one dollar, then $1 + r_0$ additional dollars will be available for consumption in period 1, where r_0 is the current real interest rate, and so on. Any combinations of expenditures are feasible as long as their present value (total cost) does not exceed the present value of receipts (total wealth)[10]:

$$P_0C_0 + \theta_1 P_1 C_1 + \ldots + \theta_n P_n C_n = I_0 + \theta_1 I_1 + \ldots + \theta_n I_n \leq W_0 \tag{9}$$

where W_0 is the agent's wealth, and the discount rate $\theta_1 = 1/1+r_0$, and so on. The representative agent is assumed to maximize utility in Equation 7 subject to the budget constraint in Equation 9 such as:

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[9] $\frac{MU_{c1}}{P_1} = \frac{MU_{c2}}{P_2} = \ldots = \frac{MU_{cn}}{P_n}$.

[10] This constraint requires that total spending does not exceed the consumer's available resources (wealth). We use wealth terminology to emphasize that the consumer's actual problem is indeed intertemporal, with consumption commodities purchased over time.

$$Max\, L = U(C_0,\ldots,C_n) - \lambda \left(\sum_{i=0}^{n} \theta_i P_i C_i - W_0\right) \tag{10}$$

and the first-order conditions are:

$$\frac{\partial L}{\partial C_i} = MU_i - \theta_i P_i \lambda = 0 \tag{11}$$

or

$$\frac{MU_i}{\theta_i P_i} = \lambda \tag{12}$$

where λ is the marginal utility of wealth. Hence, the optimal consumption path will equalize the marginal utilities of the last present dollar spent in consumption in each period:

$$\frac{\partial U}{\partial C_i} = \frac{MU_i}{\theta_i P_i} = \frac{MU_j}{\theta_j P_j} \qquad \text{for all i and j, or}$$

$$\frac{MU_i}{MU_j} = \frac{\theta_i P_i}{\theta_j P_j} \tag{13}$$

Simply, $\theta_i P_i / \theta_j P_j$ is the number of units of C_j (consumption in period j) that can be traded for a unit of C_i (consumption in period i) which equals the rate of exchange in utility between the two periods. Note that if a rise in the price of consumption between the two periods (P_i/P_j) is offset by an equal percentage decline in the value of the dollars between the two periods (θ_i/θ_j), the real terms of trade will not change between the two periods. The downward sloping demand curve assures that a compensated decline in $\theta_i P_i$ would increase consumption in period i at the expense of consumption in period j. Accordingly, an increase in wealth will tend to increase consumption in period i. Figure 1 illustrates the case of a representative consumer who is in equilibrium at e; at equilibrium, the agent consumes C_0 in the current period and C_1 in the next period, given his wealth and assuming for simplicity that $P_0=P_1=P$. In Figure 2 assume that the consumer's wealth increases and that causes the intertemporal budget line to shift outward, and the equilibrium position to change. What point on the new line will this consumer choose? Points e_1 and e_2 represent the limits of the consumer choice. If the consumer is free to choose, the equilibrium can be e_1, e_2, or e_3 or for that matter any point between e_2 and e_1. As long as the choice satisfies his/her relative taste for present and future consumption (any point outside this range will clearly sacrifice either current or future consumption).[11]

Point e_1 represents an equilibrium case where all that additional income is being consumed in current period (C_0) and none in the next period. Meanwhile equilibrium point e_2 represents the opposite case where all that additional income is put on hold (saved) for future consumption. Finally, all the points in between represent a combination of the two cases. Simple demand theory tells us that an increase in income will shift the demand curve for current consumption to the right unless current consumption (C_0) is an inferior good, and the size of the shift is mainly determined by the income (wealth) elasticity of demand for current consumption, C_0. The elasticity of the demand curve is inversely related to the curvature of the indifference curves and directly related to how easy it is to substitute future consumption, i.e., C_1 for current consumption, C_0 (elasticity of substitution). Thus, the larger the elasticity, the easier it is, in terms of utility, to reduce current consumption (increase current savings) in order to increase future consumption. Hence, current consumption is determined by the slopes of the indifference curves along a given ray from the origin. If the slopes are identical, then all wealth elasticities will

[11] The figure is adopted from Mosley (1980).

equal one (all additional income in current period will be consumed). If the slopes are larger (in absolute value) at higher levels of indifference curves, then current consumption, C_0, will have an elasticity less than one, and part of the additional income will be consumed in current period, and part in the future. Keynes' second law of consumption assumes that the marginal propensity to consume (MPC) is less than the average propensity to consume (APC) and, hence, the indifference curves between present and future consumption at higher preference levels are more biased toward future consumption.

To summarize, the rate of consumption growth between the current period and a single future one is inversely related to θ_1 (positively related to r_0) because a compensated increase in θ_1 will raise C_0 and reduce C_1. It also depends on two other parameters of the indifference curves, time preference and the elasticity of substitution between the two periods. Time preference measures whether an increase in current consumption increases current utility by a greater amount than an equal increase in future consumption. The diminishing marginal rate of substitution implies that marginal utilities of current and future consumption change symmetrically with the change of consumption level. If present and future consumption are equal, the shape of the indifference curves can be isolated from a movement along them by defining time preference by the marginal utilities (this is equivalent to defining it by a slope of an indifference curve along the 45-degree line in Figure 2). Preference is said to be for present, future, or neutral as the slope is less than, greater than, or equal to one, i.e., $\frac{MU_1}{MU_0} = -slope$, hence $-slope \overset{\prec}{\underset{\succ}{=}} 1$ as

$MU_0 \underset{\succ}{\overset{\prec}{-}} MU_1$, and in equilibrium $\theta_1 = \frac{MU_1}{MU_0}$. Preference for present consumption reduces the growth rate of consumption while preference for the future does the opposite. If $\theta_1=1$ (future dollars are as valuable as present ones), the consumption falls over time if the present is preferred, but increases if the future is. Alleged preferences for present have been used to explain the increase in current consumption at lower levels of income when income starts to rise, hence why some countries grow faster than others. If $\theta_1 < 1$ and preference is time neutral, the consumption will grow over time at a rate that depends on how fast the slope of an indifference curve declines as future consumption increases relative to the present, i.e., on the elasticity of substitution between present and future consumption.

III. METHODOLOGY AND THE MODEL

This section outlines the econometric modeling that we use in the second chapter. It uses a time-series data model to estimate the effects of foreign aid on the economic growth and domestic saving of Jordan. The econometric implications of this method are described in this section.

The mixed results reported previously regarding the impact of foreign aid on economic growth and domestic saving imply that the growth-aid relationship is not a simple one. Hence, a dynamic structural simultaneous equation model is built to capture the interrelationships between growth rate of Jordanian real output, domestic saving, and foreign aid.

A VAR method is used to study the relationships between growth rate of real output (GDP), gross domestic saving, and foreign aid in Jordan. This modeling technique allows the time path of each dependent variable to be influenced by the time path of all other variables in the model. When a single equation model cannot explain the relationship between economic variables in a dynamic system, a system of various dynamic equations may be required describing the data-generating process adequately. A VAR model is used to examine the dynamic effects of foreign aid on economic growth and domestic saving. This modeling technique is regarded as an important tool for economic analysis, since its introduction by Sims (1980). Innovation accounting analysis will be used to examine the interrelationships among the economic variables in the system. Specifically, impulse response functions (IRFs) and variance decomposition (VDC) are computed from these models to investigate the dynamic relationships among the model's variables.

As preliminary data analysis, all variables are checked for stationarity. If the series are nonstationary, results obtained from standard econometric techniques can be misleading. The Philips-Perron Zt(q) test for a unit root is performed on each series. This test is a generalization of the Dickey-Fuller procedure that allows a mild assumption regarding the distribution of the error term. Without going into detail, the Philips-Perron test statistics are modifications of the Dickey-Fuller t-statistics that take into account a less restrictive nature of the error process, and since the Philips-Perron test is the least restrictive, its results are reported and followed. Also, the critical values for the Philips-

Perron test statistics are the same as the Dickey-Fuller tests.[12]

Table 3 contains the results of the unit-root tests that were performed with the use of different values of the lag parameters: q = 1, 2, and 3. For output growth, Y_{1t}, gross domestic saving as a percentage of GDP, Y_{2t}, and foreign aid as a percentage of GDP, Y_{3t}, the hypothesis of the unit-root test can be rejected at either the 1%, 5%, or 10% significance level.

Consider the macroeconomic time-series variables, growth rate of real output (GDP) Y_{1t}, gross domestic saving (both public and private) as a percentage of GDP Y_{2t}, and foreign aid as a percentage of GDP Y_{3t}, respectively, where all are endogenous to the system. Since Y_{1t}, Y_{2t}, and Y_{3t} are jointly determined, a structural simultaneous equation model relating those three endogenous (jointly determined) vector Y_t to p predetermined variables and a vector of error terms U_t can be written as:

$$B_0 Y_t = k + B_1 Y_{t-1} + B_2 Y_{t-2} + \ldots + B_p Y_{t-P} + U_t \tag{14}$$

or in a compact form:

$$B_0 Y_t = K + B_s Y_t (L) + U_t \tag{14'}$$

where $Y_t = (Y_{1t}, Y_{2t}, Y_{3t})'$ a (3×1) vector of the dependent variables at time t, $K = (k_1, k_2, k_3)'$ a (3×1) vector of intercept terms, B_s = a (3×3) matrix of autoregressive coefficients, B_0 = a (3×3) matrix which captures the contemporaneous effects in the system.

$$B_0 = \begin{bmatrix} 1 & -B_{12} & -B_{13} \\ -B_{21} & 1 & -B_{23} \\ -B_{31} & -B_{32} & 1 \end{bmatrix}$$

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[12] See Enders (1995) and Hamilton (1994) for further analysis of the Philips-Perron unit-root test.

Y_t (L) = a matrix polynomial in the lag operator L of order P. $U_t = (U_{1t}, U_{2t}, U_{3t})'$ a (3×1) disturbance vector which is assumed to be a stationary process with E (U_t) = 0; E(U_t U_s') =0 for t ≠ s ; E(U_t U_t') = Ω .

The multivariable VAR in Equation 14 incorporates feedback in the system since Y_{1t}, Y_{2t}, and Y_{3t} are allowed to affect each other. For example, B_{12} is the contemporaneous effect of a unit change in Y_{2t} on Y_{1t}, B_{21} is the contemporaneous effect of a unit change in Y_{1t} on Y_{2t}, and B_{31} and B_{32} are the contemporaneous effects of Y_{1t} and Y_{2t} on Y_{3t} , respectively, and so on. Also, note that the U_t (error vector terms) are pure innovations in the dependent vector Y_t. Equation 14 is not a reduced form since the Y_t vectors have contemporaneous effects on each other. We can transform the system in Equation 14 into a more usable form. Premultiplying both sides of the system in Equation 14 by B_0^{-1} allows us to obtain the vector autoregressive (VAR) model in its standard form (reduced form):

$$Y_t = B_0^{-1}K + B_0^{-1}B_1Y_{t-1} + B_0^{-1}B_2Y_{t-2} + \ldots + B_0^{-1}B_pY_{t-p} + B_0^{-1}U_t \tag{15}$$

or

$$Y_t = C + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \ldots + \Phi_p Y_{t-P} + \varepsilon_t \tag{15'}$$

Equation 15′ in a compact form becomes:

$$Y_t = C + \Phi_s Y_t(L) + \varepsilon_t \tag{16}$$

where $C = B_0^{-1}$ K the standard (reduced form) VAR vector intercepts, $\Phi_s = B_0^{-1}B_s$ for s = 1, 2, 3, ...p (the reduced form VAR parameters), $\varepsilon_t = B_0^{-1}U_t$ (the standard "reduced form" innovation vector).

Assuming that U_t is a vector white noise, ε_t will be recognized as vector white noise and Equation 16 will be the vector autoregressive representation for the dynamic structural system (DSS) in Equation 15. Thus, a VAR can be viewed as the reduced form of a general dynamic structural model (GDSM). Note also that the vector error terms ε_t are composites of the shocks U_t .

IV. IDENTIFICATION PROBLEM

Since the structural VAR system in Equation 14 is underidentified and cannot be estimated directly due to the feedback inherent in the system (Enders, 1995), i.e.,Y_{2t} and Y_{3t} are correlated with U_{1t}, Y_{1t} and Y_{3t} are correlated with U_{2t} and finally Y_{2t} and Y_{3t} are correlated with U_{3t}, one way to solve this identification problem is to use the recursive system proposed by Sims (1980) and impose a priori restriction, which may be suggested by economic theory to restrict some coefficients in the contemporaneous parameter matrix (i.e., in a three-variable VAR, 3^2 - 3/2 restrictions are needed for identification). Using Sim's recursive system, we restrict $B_{21} = B_{31} = B_{32}$ = zero, given this restriction, B_0 and B_0^{-1} become:

$$B_0 = \begin{bmatrix} 1 & -B_{12} & -B_{13} \\ 0 & 1 & -B_{23} \\ 0 & 0 & 1 \end{bmatrix}$$

$$B_0^{-1} = \begin{bmatrix} 1 & B_{12} & (B_{12})(B_{23}) + (B_{13}) \\ 0 & 1 & (B_{23}) \\ 0 & 0 & 1 \end{bmatrix}.$$

The above restrictions imply that current output growth has no contemporaneous effect on current aid. It is likely the case that current aid is usually decided upon a period or two ahead through official negotiations between donors and recipients before it is actually disbursed. With the goal that aid will accelerate future targeted and planned rate of growth desired by the recipient country official plans, recipient official governments usually set a targeted level of growth a priori and direct their policies to obtain necessary funds "aid" to achieve that target growth. Meanwhile, current foreign aid will have a contemporaneous effect on output growth and, depending on how the recipient government utilizes this aid inflow (consumption vs. investment), the path of future growth will be affected.

The same logic can be applied to explain why current gross domestic savings have no contemporaneous effect on current foreign aid levels. Since current gross domestic saving is postulated to affect current output contemporaneously and "positively," current gross domestic saving will affect current output growth which in return will supposedly affect future foreign aid values disbursed to the recipient country. Hence, gross domestic savings have no contemporaneous effect on foreign aid.

The previous restrictions embody the explanation of the third and last restriction needed to recover the structural parameters. Foreign aid is assumed to facilitate and accelerate the process of output growth (raise income levels) which, in return, will generate a higher savings as a result of anticipated higher levels of income. This implies that foreign aid affects gross domestic saving contemporaneously. On the other hand, it is current domestic saving that impacts future aid disbursed, which depends on how current domestic saving reacts to foreign aid. All of this leads to the ordering of our Y_t, i.e., foreign aid is placed prior to both domestic saving and output growth, while domestic saving is placed prior to output growth.

In terms of innovations (shocks), the above restrictions imply the following innovation system:

$$\begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} = \begin{bmatrix} 1 & B_{12} & (B_{12})(B_{23}) + (B_{13}) \\ 0 & 1 & (B_{23}) \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} U_{1t} \\ U_{2t} \\ U_{3t} \end{bmatrix}$$

or

$$\varepsilon_{1t} = U_{1t} B_{12} U_{2t} + [(B_{12})(B_{23}) + (B_{13})] U_{3t}$$

$$\varepsilon_{2t} = U_{2t} + B_{23} U_{3t}$$

$$\varepsilon_{3t} = U_{3t}.$$

The above restrictions allow the recovery of the structural (primitive) VAR parameters. Since the model is just identified, full information maximum likelihood (FIML) estimates of the structural parameters can be obtained by maximizing the likelihood function with respect to standard VAR (reduced form) parameters, i.e., Φ_s and Σ_ε. Then we can use the unique mapping from the estimated reduced form parameters to recover the structural ones (Hamilton, 1994). Since the objective of this study is to examine the dynamic impact of foreign aid on both output growth and domestic resources, the focus will be on the impulse response functions (IRFs) and the variance decompositions (VDCs).

V. ISSUES OF VAR LAG LENGTH

The Akaike information criterion (AIC), Schwartz Bayesian criterion (SBC), Akaike final prediction error (FPE), and the Hannan-Quinn criterion will be used to identify the appropriate lag length P in equation (16). The order P is chosen so that the above-mentioned criteria are minimized. This test criterion is based on several criteria that have been proposed for estimating the order of a VAR process. Researchers have suggested minimizing Aikaike's final prediction error (FPE), Aikaike information criterion (AIC), Schwartz Bayesian criterion (SBC), or Hannan-Quinn (HQ) criterion. These criteria are defined as follows:

$$\mathrm{FPE}\ (n) = [(T + n\,M + 1) / (T - n\,M - 1)]^{M}\ \det \Sigma_n$$

$$\mathrm{AIC}\ (n) = \mathrm{Log}\ (\det (\Sigma_n) + 2\,M\,n^2$$

$$\mathrm{SBC}\ (n) = \mathrm{Log}\ (\det (\Sigma_n) + (\mathrm{Log}\ (T)/T)\ n\,M^2$$

$$\text{H-Q}\ (n) = \mathrm{Log}\ (\det (\Sigma_n)\,) + ((\,2 \log (\log (T)))/T)\ n\,M^2$$

where M = number of variables in the system, T = number of observations in the sample, n = order of the VAR process (n = 1, 2, ...P), and Σ_n = an estimate of the residual covariance matrix obtained with a VAR (n) process.

Clearly, adding additional regressors will reduce log (det (Σ_n)) at the expense of increasing N. The four above criteria will be estimated for a potential maximum number of lags, i.e., models with n = 0, 1, ..., P are estimated with P specified as an upper bound, and a VAR (n) model that minimizes the AIC, SBC, FPE and/or H-Q criterion will be selected. [13] (Note that in the procedure the sample size T has to be held fixed, i.e., in each estimation P observations are treated as presample values.)

The lag structure is identified for each potential number of lags n = 0, .., P (due to the degree-of-freedom consideration, the maximum lag length entertained is set to five). The above four criteria are estimated for all potential lags entertained and the results are

[13] For more detailed analysis, see Lutkepohl (1993), Enders (1995), and Judge *et al.* (1988).

reported in Table 5. It can be seen from the results that both SBC and FPE criteria are minimized with a zero-lag, while both AIC and H-Q criteria are minimized at a one-lag VAR. To decide which lag model is more appropriate, the maximum chi-square procedure provides a maximum likelihood test statistic for evaluating whether increasing the order of a model significantly improves the fit. Sims (1980) suggested a test statistic measuring improved fit as:

$$S = (T\text{-}K)\ \{\text{Log}\ (\det\ (\Sigma_r) - \log\ (\det\ (\Sigma_u)\ \}$$

where T = number of observations in the sample, Det (Σ_r) & (Σ_u) = determinant of the covariance matrices of the residuals of both the restricted and unrestricted models, respectively, and K = a correction factor to improve small sample properties suggested by Sims (1980) and equals the number of parameters estimated per unrestricted equation $(1+Mn_1)$.

This statistic S has an a symptotic chi-square distribution and is used to test the null hypothesis that adding the $(n + 1)_{th}$ lag to the system does not significantly improve the model's fit. The test has M^2 $(n_1 - n_0)$ degrees of freedom. Since estimated S equals 32.5, which exceeds 14.68 (the 10% chi-squared critical value), the null hypothesis is rejected. The dynamics are not completely captured by a zero-lag; rather a one-lag VAR specification seems preferable. Hence, a model with n = 1 is chosen.

Given the assumptions in Equation 15 that the error vector Ut is white noise, it follows that ε_t the standard VAR error vector will have the same stochastic properties, i.e., the ε_t will have a mean zero and E $[\varepsilon_t] = 0$, ε_t ε_s are individually uncorrelated, i.e., E $[\varepsilon_t\ \varepsilon_s'] = 0$ for $t \neq s$, and E $[\varepsilon_t\ \varepsilon_t'] = \Sigma_\varepsilon$. Since the standard VAR is symmetric, the least squares estimator of the standard VAR is consistent, and joint estimation techniques do not increase estimation efficiency.

Because of the presence of many parameters and the difficulty of interpreting them in a standard VAR, Sims (1980) argued and made popular what has been called innovation accounting. The informational content of a VAR is better summarized by a moving average representation. Hence the next step in this chapter is to investigate the dynamic response of both growth rate of real output and domestic saving (resources) to innovations (shocks) in foreign aid.

The standard VAR system is triangulized using the Choleski decomposition so that the innovation (impulses) of the last variable (foreign aid) according to our ordering contemporaneously affects itself and the values of all other variables in the system, i.e., both output growth and domestic saving. While the innovation of the penultimate variable (variable before the last, i.e., domestic saving) contemporaneously affects itself, it also affects the values of all but the last variable in the system. In terms of innovations (shocks), the above Choleski decomposition implies the innovation system mentioned earlier in terms of the three shocks ε_{1t}, ε_{2t}, and ε_{3t}.

VI. IMPULSE RESPONSE FUNCTIONS

Just as an autoregression has a moving average representation, a VAR can be written as a vector moving average representation (VMA). The VMA is an important feature of Sims (1980) methodology, where it allows us to trace out the time path of different innovations on the variables contained in the VAR system. The VMA (∞) representation of Equation 6 can be written as follows:

$$Y_t = \mu + \varepsilon_t + \Psi_1 \varepsilon_{t-1} + \Psi_2 \varepsilon_{t-2} + \ldots = \mu + \Psi(L)\varepsilon_t \tag{17}$$

or in a compact form:

$$Y_t = \mu + \sum_{s=0}^{\infty} \Psi_s \varepsilon_t \tag{17'}$$

where $\mu = E[Y_t] = (I - \Phi_1 - \Phi_p)^{-1}$ c and Ψ_s can be computed recursively from Φ_i. Since Ψ (L) and Φ (L) are related such that $\Psi(L) = [\Phi(L)]^{-1}$ requiring that:

$$[I_n - \Phi_1(L) - \Phi_2 L^2 - \ldots - \Phi_p L^p][I_n + \Psi_1 L + \Psi_2 L^2 + \ldots = I_n$$

Setting the coefficient on $L^1 = 0$ gives us $\Psi_0 = I_n$, and setting the coefficient on $L^2 = 0$ gives us $\Psi_1 = \Phi_1$, and setting the coefficient on $L^3 = 0$ gives us $\Phi_1 \Psi_1 + \Phi_2$, and so on. In general and for L^s, Ψ_s can be computed as:

$$\Psi_s = \Phi_1 \Psi_{s-1} + \Phi_2 \Psi_{s-2} + \ldots + \Phi_p \Psi_{s-p} \qquad for\ s = 1, 2, 3, \ldots \tag{18}$$

The matrix Ψ_s in equation (18) has the interpretation:

$$\frac{\partial Y_{t+s}}{\partial \varepsilon_t'} = \Psi_s \tag{19}$$

which simply means that the row i, column j element of Ψ_s identifies the consequence of a one-unit change in the j_{th} variable's innovation at time t (ε_{jt}) for the value of the i_{th} variable at time t + s ($y_{i,\ t+s}$), while holding all other innovations at all times unchanged. If, for example, we change the first element of ε_t, i.e., an innovation to foreign aid by λ_1, the second element of ε_t changes by λ_2, and the n_{th} element by λ_n, the combined effects on the vector Y_t at time t + s would be given by:

$$\Delta Y_{t+s} = \frac{\partial Y_{t+s}}{\partial \varepsilon_{1t}} \lambda_1 + \frac{\partial Y_{t+s}}{\partial \varepsilon_{2t}} \lambda_2 + \ldots + \frac{\partial Y_{t+s}}{\partial \varepsilon_{nt}} \lambda_n = \Psi_s \lambda \tag{20}$$

where $\lambda = (\lambda_1, \lambda_2, \ldots, \lambda_n)'$. One way to find the numerical multipliers contained in the Ψ_s matrix is by simulation. If we set the values of $Y_{t-1} = Y_{t-2} = \ldots = Y_{t-p} = 0$, and set $\varepsilon_{it}=1$(i.e., $\varepsilon_{1t} = 1$ or one unit innovation to foreign aid) while all other elements of c and ε_t are equal to zero, we will be able to trace out the value of the vector Y_{t+s} for s periods ahead. The value of the vector Y_t at date t + s for example corresponds to the j_{th} column of the matrix Ψ_s. By simulating separate innovations for each element of ε_t, all the columns of Ψ_s can be computed. A plot of the row i, column j element of Ψ_s as a function of s is called the impulse response function (IRF).

Equation 19 above describes the effect of an innovation in the j_{th} variable on the future values of each of the variables in the system, and since $\varepsilon_t = B_0^{-1}U_t$, the VAR innovation ε_{jt} are linear combinations of the structural disturbances U_t. Viewed this way, it may not be clear why the magnitude in Equation 19 is of any interest.

$$\frac{\partial Y_{t+s}}{\partial U_t'} \tag{20'}$$

It will be of particular interest to us since it describes the dynamic consequences for the system as a result of a change in the structural innovation vector U_t. Towards that end, and given both the ordering of our variables and the restrictions we imposed on B_0 (the matrix that captures the contemporaneous effects of the system), such that B_0 is upper triangular, the multipliers in the system can be calculated from the moving average coefficients (Ψ_s) and the variance-covariance matrix of ε_t (Ω). Since Ω is positive definite, there exists a unique upper triangular matrix A and a unique diagonal matrix D with positive entries along the principal diagonal that satisfies Ω=A D A′. Based on this matrix A, we can construct a $(n \times 1)$ vector, call it U_t for now such that $U_t = A^{-1}\varepsilon_t$, where U_t takes all the properties of ε_t, i.e., it is uncorrelated with its own lags or with lagged values of Y_t, and they are not correlated with each other, i.e., $E(U_t U_t) = D$ "a diagonal matrix." Premultiplying both sides of $U_t = A^{-1}\varepsilon_t$ by A, we obtain $A\,U_t = \varepsilon_t$, which in the matrix form can be written as:

$$\begin{bmatrix} 1 & 0 & 0 & \dots & 0 \\ a_{21} & 1 & 0 & \dots & 0 \\ a_{31} & a_{32} & 1 & \dots & . \\ . & . & . & \dots & . \\ . & . & . & \dots & . \\ a_{n1} & a_{n2} & & \dots & 1 \end{bmatrix} \begin{bmatrix} U_{1t} \\ U_{2t} \\ U_{3t} \\ . \\ . \\ U_{nt} \end{bmatrix} = \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ . \\ . \\ \varepsilon_{nt} \end{bmatrix} \tag{21}$$

Thus, U_{1t} is ε_{1t}, and generally $U_{jt} = \varepsilon_{jt} - a_{j1}U_{1t} - a_{j2}U_{2t} - \dots - a_{j,j-1}U_{j-1,t}$. Hence, for a given observed sample of size T, the autoregressive coefficients $\hat{\Phi}_1, \hat{\Phi}_2, \dots, \hat{\Phi}_p$ will be estimated by ordinary least square (OLS), $\hat{\Psi}_s$ matrices will be simulated as explained previously, and an estimate of the variance-covariance matrix $\hat{\Omega}$ will be obtained. Both matrices $\hat{A}$ and $\hat{D}$ satisfying $\hat{A}\hat{D}\hat{A}' = \hat{\Omega}$ can be constructed. Also, the elements of $\hat{U}_t = \hat{A}^{-1}\hat{\varepsilon}_t$ are orthogonal by construction. Hence, our orthogonalized impulse response function will be given by:

$$\hat{\Psi}_s \hat{a}_j \tag{21'}$$

where $\hat{a}_j$ denotes the j_{th} column of the matrix $\hat{A}$. A plot of Equation 21′ as a function of s is our orthogonalized impulse response function, which is simply based on decomposing our standard VAR vector innovations ε_t, into a set of uncorrelated vector components U_t, and calculating the consequences for Y_{t+s} of a unit impulse in U_{jt} . Given the A matrix, the VMA (∞) representation of Y_t in Equation 17′ becomes:

$$Y_t = \sum_{s=0}^{\infty} \Psi_s A^{-1} A \varepsilon_t \tag{22}$$

Equation 22 is the Cholesky decomposition of $\hat{\Omega}$, and the impulse response functions in 21′ are the orthogonalized impulse response functions. From Equation 14′, our structural disturbance vector is U_t, which is related to the reduced VAR innovations ε_t by $U_t = B_0\ \varepsilon_t$, if by any chance our structural parameter matrix B_0, is found to be exactly equal to A^{-1}, then our orthogonalized innovations would be equal to the true structural disturbances, i.e., $U_t = B_0\ \varepsilon_t = A^{-1}\ \varepsilon_t$. If this is the case, the impulse response functions described in 21′ will help answer the question in 20′. Since A is upper triangular and B_0 is restricted to be upper triangular as well, and further it is assumed that the vector U_t are serially uncorrelated and uncorrelated with each other, i.e., E ($U_t\ U_s'$) = D "diagonal matrix" for t = s and 0 otherwise, and given that $B^{-1}{}_0\ U_t = \varepsilon_t$, the variance-covariance matrix of the reduced form VAR Ω implies:

$$\Omega = E(\varepsilon_t \varepsilon_t') = B_0^{-1} E(U_t U_t')(B_0^{-1})' = B_0^{-1} D (B_0^{-1})' \tag{23}$$

Since our structural model is just identified due to B_0 being upper triangular with unit coefficients along its principal diagonal and the D matrix is being diagonal, this necessarily implies that B_0^{-1} must be upper triangular with unit coefficients along its principal diagonal as well. Given our A matrix that satisfies Ω = A D A′, unique values for B_0^{-1} and D can be found to satisfy Equation 23, B_s can be estimated uniquely from B_0 and Φ_s, i.e., $B_s = -B_0\Phi_s$. Hence, given any estimated values for the reduced form parameters (B_0, Φ_s, Ω), there exist unique values for the structural parameters (B_0, B_s, D). FIML estimates of the structural parameters can be obtained by maximizing the likelihood function with respect to the standard VAR parameters (B_0, Φ_s, Ω) and using the unique mapping from the standard VAR estimates to recover the structural parameters (B_0, B_s, D). The maximum likelihood estimates of Φ_s are found by OLS regression, while the maximum likelihood of the variance-covariance matrix Ω is obtained from the residuals of those regressions. The estimates of $\hat{B}_0^{-1}$ and $\hat{D}$ are the ones found by Cholesky factorization of $\hat{\Omega}$. As a result, the estimate $\hat{A}$ described before is the same as the FIML estimate of B_0^{-1}. The orthogonalized residuals vector $U_t = A^{-1}\,\varepsilon_t$ corresponds to vector of structural disturbances, and most importantly, the orthogonalized impulse response coefficients give the dynamic consequences of the structural impulses represented by U_t.

VII. VARIANCE DECOMPOSITION

Understanding the properties of the forecast errors is helpful in explaining further the interrelationships among the variables in the system. Based on our estimations of the parameters C, Φ_s, and Ω in Equation 16, and if we want to forecast the various values of Y_{t+i} conditional on the observed values Y_t, the optimal (the forecast mean square error for each variable is minimized) forecast is the conditional expectation given all information up to the period in which the forecast is to be made. Assuming the VAR generating process is known to us as in Equation 16, the conditional expectation Y_t of Y_{t+s} given Y_{t-1}, Y_{t-2}, …, Y_{t-p} s periods ahead is given by:

$$Y_{t+s} = E[Y_{t+s}] = C + \Phi_1 E[Y_{t+s-1}] + \ldots + \Phi_p E[Y_{t+s-p}] \tag{24}$$

or

$$= C + \Phi_1 Y_t(s-1) + \ldots + \Phi_p Y_t(s-p) \tag{25}$$

where $Y_t(s-i) = Y_{t+s-i}$ for $i \geq s$ and $E[\varepsilon_{t+s}] = 0$ has been used. Equation 25 can be applied to computing S step forecasts for S = 1, 2, …, i.e., for a hypothetical VAR (1) process a three period forecast is obtained as:

$$Y_t(1) = C + \Phi_1 Y_t$$

$$Y_t(2) = C + \Phi_2 Y_t(1) = C + \Phi_1 C + \Phi_1^2 Y_t$$

$$Y_t(3) = C + \Phi_1 Y_t(2) = (I + \Phi_1 + \Phi_1^2) C + \Phi_1^3 Y_t$$

and so on. The mean square error matrix (MSE) is used as a measure of the forecast uncertainty, denoting the MSE matrix of an S step ahead forecast by MSE (S). We obtain:

$$MSE(S) = E[(Y_{t+s} - Y_t(S))(Y_{t+s} - Y_t(S))']\tag{26}$$

since the forecast $Y_t(S)$ is unbiased, i.e., $E[Y_{t+s} - Y_t(S)] = 0$, MSE (S) is the forecast error covariance matrix, it can be shown that the MSE matrix of the standard VAR in Equation 16 has the form:

$$MSE(S) = \Omega + \Psi_1 \Omega \Psi_1' + \Psi_2 \Omega \Psi_2' + \ldots + \Psi_{s-1} \Omega \Psi_{s-1}' \tag{27}$$

where $\Omega = E(\varepsilon_t \varepsilon_t')$. Ψ_s are computed recursively as shown in Equations 18 and 19 earlier. The question to answer now is how much of our orthogonalized innovation vector U_t contributes to the above MSE in Equation 27. From Equation 21 we have:

$$\varepsilon_t = AU_t$$

$$= a_1 U_{1t} + a_2 U_{2t} + \ldots + a_n U_{nt} \tag{28}$$

where a_j denotes the j_{th} column of the matrix A, which is defined earlier. Postmultiplying Equation 28 by its transpose and taking expectations yields:

$$\Omega = E(\varepsilon_t \varepsilon_t^{'})$$

$$= a_1 a_1^{'}.Var(U_{1t}) + a_2 a_2^{'}.Var(U_{2t}) + \ldots + a_n a_n^{'}.Var(U_{nt})$$

where VAR (U_{jt}) is the row j, column j element of the matrix D defined earlier. Substituting Equation 29 into 28, the MSE error of the S period ahead forecast can be written as:

$$MSE(S) = \sum_{j=1}^{n} \{Var(U_{jt}).[a_j a_j^{'} + \Psi_1 a_j a_j^{'} \Psi_1^{'} + \ldots + \Psi_{s-1} a_j a_j^{'} \Psi_{s-1}^{'}]\}. \qquad (30)$$

With Equation 16, we can calculate the contribution of any orthogonolized innovation to the MSE of the S period ahead forecast. For example, the S = 3 contribution of the innovation U_{1t} (foreign aid) to the MSE is:

$$Var(U_{1t}).[a_1 a_1^{'} + \Psi_1 a_1 a_1^{'} \Psi_1^{'} + \Psi_2 a_1 a_1^{'} \Psi_2^{'}].$$

The above forecast error variance decomposition simply tells us the proportion of the movements in a sequence or a vector Y_t due to its own innovations versus innovations of other variables in the system. If, for example, U_{1t} (foreign aid innovations) explains none of the forecast error variance of Y_{3t} (GDP growth) at all forecast horizon or S periods ahead, we can say that Y_{3t} is exogenous and its sequence would evolve independently of U_{1t} innovations and Y_{1t} (foreign aid). On the other hand, the other extreme case would be when U_{1t} innovations would entirely explain all the forecast error variance in the Y_{3t} sequence S periods ahead, so that Y_{3t} would be entirely endogenous.

VIII. DATA

To estimate the system of equations in (16), we use macroeconomic time-series data for the Jordanian economy during the period 1964-95. The sources of our data set are (1) Central Bank of Jordan (CBJ) and (2) International Monetary Fund (*International Financial Statistics*). The variables in this chapter are growth rate of real output, gross domestic saving (both public and private saving), and foreign aid. All data are in nominal terms and are transformed to real measures using the 1990 implicit GDP deflator.

IX. ESTIMATION RESULTS AND ANALYSIS[14]

We present below selected responses to one-time unit innovation (impulse) to particular variables. The impulse responses to one-unit innovation in Y_{3t} (foreign aid as a percentage of GDP) by Y_{1t} (output growth), Y_{2t} (gross domestic saving as a percentage of GDP), and Y_{3t} (foreign aid ratio) are depicted in Figures 7, 8, and 9. While the responses of output growth, domestic saving ratio, and foreign aid to a one-time unit innovation to domestic saving ratio are depicted in Figures 11, 12, and 13. Finally, output growth response, domestic saving ratio response, and foreign aid ratio response are depicted in Figures 15, 16, and 17, respectively.

Figure 7 presents the response of output growth to one-time unit innovation in foreign aid ratio. Instantly output growth declines by -1.73%. The period-by-period responses of output growth are positive for the first six simulated periods and approaches zero in the other simulated periods. As it can be seen from the figure, foreign aid in its

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[14] All estimations are programmed in GAUSS.

aggregated form exerted an overall short-run positive dynamic impact on Jordanian output growth.

Figure 8 depicts the dynamic response of gross domestic saving rate to one-time unit shock in foreign aid ratio. Initially, domestic saving rate declines by -2.62%, and it declines even further in the second period by -2.94%. Domestic saving rate starts to increase after the second period but remains negative in all simulated periods. Clearly, in the presence of foreign aid and in the case of Jordan, domestic saving rate tends to decline. The negative statistical relationship between foreign aid and domestic savings that was found in cross-country studies holds for a single country (Jordan) over time. Clearly, and as Figure 8 shows, the overall foreign aid ratio (foreign resources) did substitute for domestic savings (domestic resources) and elicit a substantial long-run decline in their levels. This dynamic long-run negative impact raises a serious concern for future Jordanian development and growth once foreign aid comes to a halt. The negative impact of foreign aid on domestic savings may be attributed to its impacts on interest rates, prices, government budgetary behavior, and/or public savings. Further investigation (the concern of the Chapter four) is required to fully explain the channels by which aid retards domestic savings. Levy (1984), for instance, found out that aid leads to a decline in domestic savings levels, as its impact on public savings is not fully offset by the positive impact on output growth.

Figure 11 presents output growth response to one-time unit innovation in domestic saving rate. As expected, domestic savings have a positive impact on output growth, but this impact dissipates after the first five simulated periods, an indication that domestic savings' effect on output growth is a short-run impact. It is clear that domestic saving's impact is greater in the initial simulated periods compared to the last ones. Initially output growth rises by 0.71% and by 0.53% in the second, and the impact remains positive until the end of the fourth period. After that it declines until it approaches close to zero for the rest of simulated periods.

Figure 13 depicts foreign aid ratio response to one-time unit innovation in domestic saving rate. As the figure shows, aid rate responds negatively to increases in domestic saving rate, especially in the first simulated periods. This response indicates that as domestic saving rates increase, the amount of future aid disbursed to Jordan tends to decline.

The variance decomposition analysis is presented in Tables 5, 6, and 7 and the corresponding graphs are in Figures 18, 19, and 20. Table 5 (Figure 18) is the variance decomposition of Jordanian output growth, and shows that the percentage of the variation in output growth is the highest due to foreign aid innovation (4.83%), and it increases over time to reach 8.5% in most of the remaining periods. On the other hand, a domestic saving innovation accounts for 0.82% of the variance, and declines over time to reach 0.12% at the end of the estimated period.

Table 6 (Figure 19) is the variance decomposition of Jordanian gross domestic saving rate and illustrates that a high percentage of the variance is due to foreign aid innovation. An aid innovation accounts for 20.52% of the variance in gross domestic saving rate, and this ratio increases over time to reach 25.41% and over 23% in most of the periods.

In the case of foreign aid ratio, Table 7 (Figure 20) presents its variance decomposition. Output growth explains no more than 1.1% of the variation in foreign aid ratio in most estimated periods. On the other hand, domestic saving rate explains 7.8% of the variance in foreign aid, and the percentage increases to reach more than 9.3% in all remaining periods.

X. CONCLUSION

This chapter has attempted to untangle the nature of the dynamic relationship between the growth rate of Jordanian output, its domestic saving rate, and foreign aid ratio. The VAR method, the impulse response functions (IRFs), and the variance decomposition (VDC) suggest, first, foreign aid in its aggregated form had a short-run positive impact on the growth rate of Jordanian output. Second, foreign aid has a larger negative long-run impact on domestic resources (domestic saving). The anti-aid view, which holds the position that foreign aid exerts negative impacts on domestic savings of recipient countries, is well maintained for the case of Jordan.

The above results contrast sharply with those obtained by Hammad's (1981) study of Jordan, which found out that "... the statistical results support our previous conclusions. Foreign aid was neutral with respect to gross domestic savings." These results match Over's (1975) analysis, which found a positive and significant relationship between foreign aid and domestic savings in his cross-country analysis. Also, our results contrast with Chenery and Strout's (1966) study in which a positive relationship between aid and domestic savings in a cross-country analysis was identified, and with El Shibly's (1984) work in which foreign aid had a negative impact on economic growth in his time-series analysis of the Sudan economy. Meanwhile, our results contrast partly with Mosley's (1980) positive conclusion regarding the impact of aid on growth.

Even though foreign aid ratio has a positive impact on Jordanian output growth, nevertheless the decline in Jordanian domestic saving rate as a direct result of foreign aid presence poses a serious problem on future development and growth. As such, government policy needs to focus more heavily on mobilizing domestic resources with the help of foreign resources for the economic transformation of the country. Also, government should rely more on an efficient allocation policy that, if possible, channels aid inflows to projects that are highly productive. Thus, output can accelerate and economic growth and development can be sustained. Infrastructure projects should be financed mainly with domestic investment (domestic resources), since these projects are not directly productive. Official foreign aid is the main form of foreign capital inflows to the country, and its ratio is overwhelming. Jordan should also consider encouraging other forms, i.e., foreign private investment, that will create more jobs and bring with them technical abilities and advice. Laws that provide a healthy and safe investment environment should be enacted to encourage foreign private investment, especially after the peace treaty in the region has been implemented.

Table 1. *The effect of resource inflows on saving or investment (summary of previous research)*

Study	No. of observations	Time-series or cross-country	Savings or investment	Regression coefficient
Griffin and Enos	32	C	S	-0.73
Griffin	32	C	S	-0.73
Areskoug	22	T	I	+0.40
Weiskopf	38	T	S	-0.23
Chenery (JPE)	16	T	S	+0.64
Chenery (EDR 148)	90	C	S	-0.49
Chenery (EDR 148)	90	C	I	+0.11
Rahman	31	C	S	-0.25

Source: Papanek (1972)

Table 2. *The effect of resource transfers on saving or investment (summary of previous research)*

Study	Dependent variables	Estimation method [1]	Aid	Foreign private invest-ment	Saving	Other flows	Other variables
Papanek (1972)	Growth (GDP)	OLS, T	0.39 (5.8)	_	0.2 (6.0)	0.19 (2.1)	_
Mosley (1980)	Growth (GDP)	2SLS, C	-0.94 (1.85)	_	0.029 (0.43)	-0.72 (0.59)	Export growth, Growth in adult literacy
Mosley *et al.* (1987)	Growth (GNP)	OLS, C	-0.049	_	0.043	-0.02	Export growth, Growth in adult literacy
El Shibly (1984)	Growth (GDP)	OLS, T	-1.18 (1.06)	-0.09 (2.23)	_	_	Export growth
	Investment	OLS, T	0.64 (0.15)	_	_	-0.24 (0.617	_
Hassan *et al.* (1995)	Investment	OLS, T	0.64	_	_	_	Per capita income, Export growth

[1] T for time-series analysis and C for cross-section analysis.
Summarized by present author.

Table 3. *Testing for stationarity using three variables*

Series	The Philips-Perron Z_t (q) test q = 1	q = 2	q = 3
Y_{1t} (Output growth)	-5.01[1]	-5.04[1]	-5.13[1]
Y_{2t} (Gross domestic saving rate)	-3.30[3]	-3.90[2]	-3.90[2]
Y_{3t} (Foreign aid ratio)	-3.00	-3.03	-2.70[3]

[1] Indicates significant at 1% level of significance.
[2] Indicates significance at 5% level of significance.
[3] Indicates significance at 10% level of significance.

Table 4. *Statistics for choosing the VAR lag length*

VAR order (n)	AIC (n)	SBC (n)	FPE (n)	H-Q (n)
0	11.27	11.27*	15.00*	11.27
1	10.31*	11.33	31.88	10.98*
2	10.74	12.21	76.77	11.51
3	11.23	12.57	193.8	11.52
4	12.24	12.89	588.9	11.49
5	14.24	13.62	2876	11.87

*Indicates minimum.

Table 5. *Variance decomposition of output growth*

Period	Output growth	Domestic saving	Foreign aid
1	94.34	0.82	4.83
2	90.58	1.23	8.18
3	90.22	1.23	8.54
4	90.19	1.23	8.58
5	90.19	1.23	8.58
6	90.19	1.23	8.58
7	90.19	1.23	8.58
8	90.19	1.23	8.58
9	90.19	1.23	8.58
10	90.19	1.23	8.58
11	90.19	1.23	8.58

Table 6. *Variance decomposition of domestic saving*

Period	Output growth	Domestic saving	Foreign aid
1	0	79.48	20.52
2	0.33	74.26	25.54
3	0.26	75.55	24.18
4	0.23	76.02	23.74
5	0.21	76.3	23.49
6	0.2	76.46	23.34
7	0.2	76.56	23.24
8	0.19	76.63	23.18
9	0.19	76.67	23.14
10	0.19	76.95	23.18
11	0.19	76.97	23.16

Table 7. *Variance decomposition of foreign aid*

Period	Output growth	Domestic saving	Foreign aid
1	0	0	100
2	1.113	7.863	91.02
3	1.109	9.144	89.75
4	1.105	9.144	89.56
5	1.104	9.336	89.53
6	1.104	9.369	89.52
7	1.104	9.375	89.52
8	1.104	9.376	89.52
9	1.104	9.376	89.52
10	1.104	9.376	89.52
11	1.104	9.376	89.52

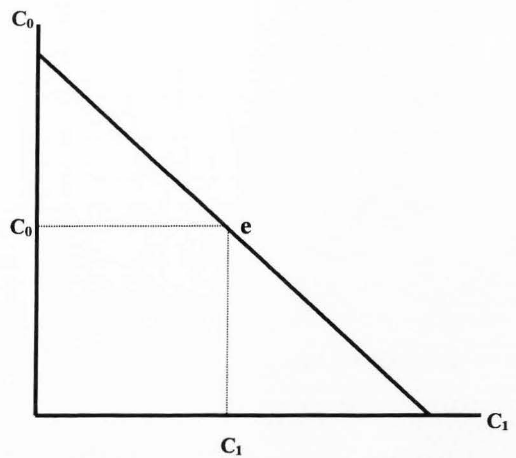

Fig. 1. *Consumer in equilibrium*

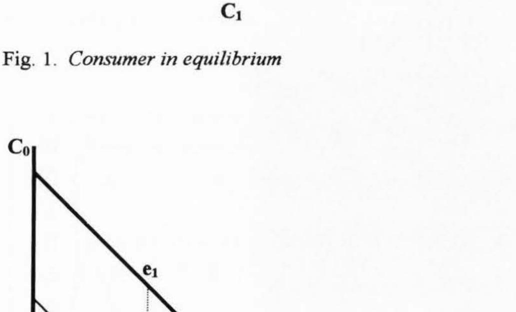

Fig. 2. *Consumer with increase in wealth*

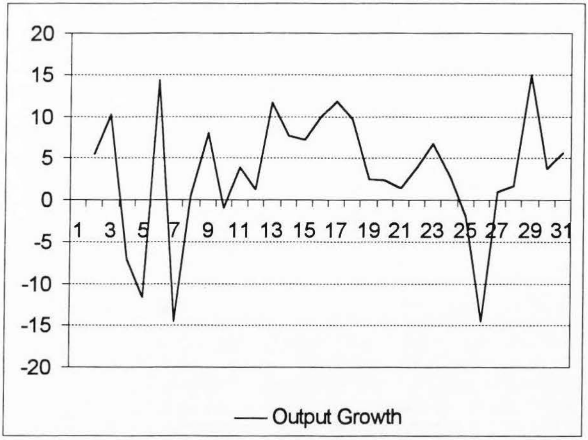

Fig. 3. *Data plot of Jordanian growth rate of output*

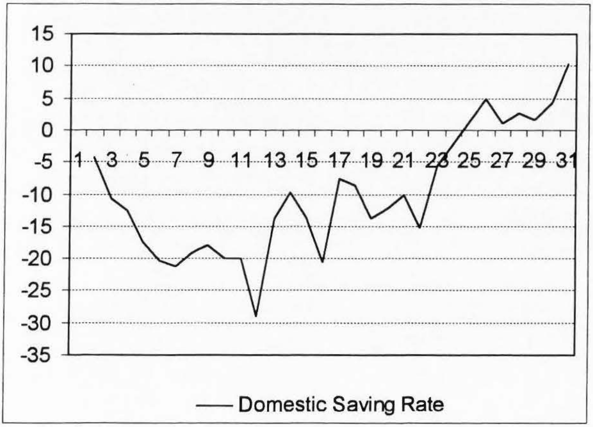

Fig. 4. *Data plot of Jordanian domestic saving rate*

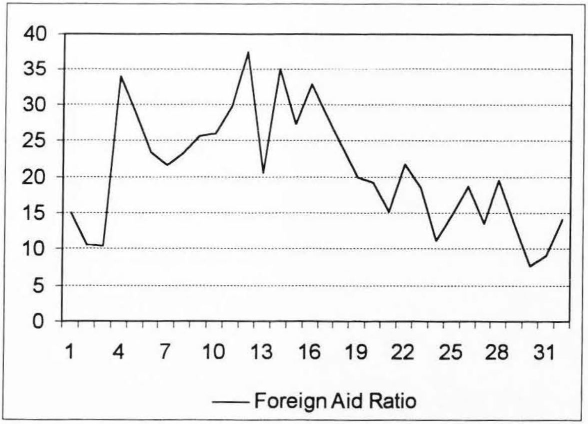

Fig. 5. *Data plot of foreign aid ratio*

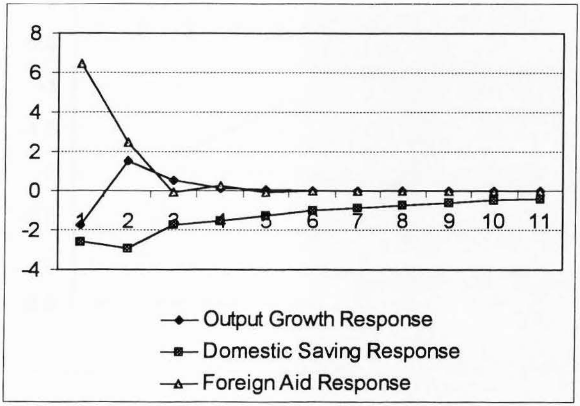

Fig. 6. *Combined impulse responses of output growth, domestic saving, and foreign aid to one unit innovation to foreign aid*

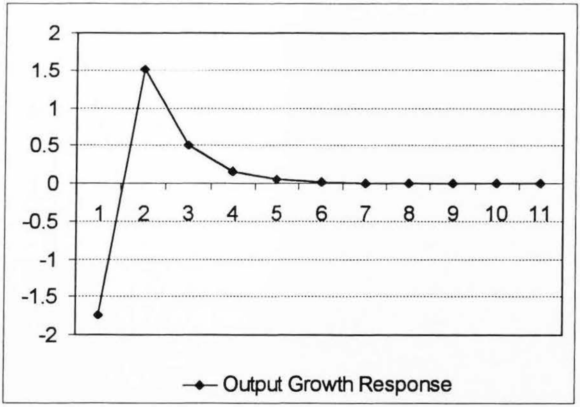

Fig. 7. *Impulse response of output growth to one unit innovation to foreign aid*

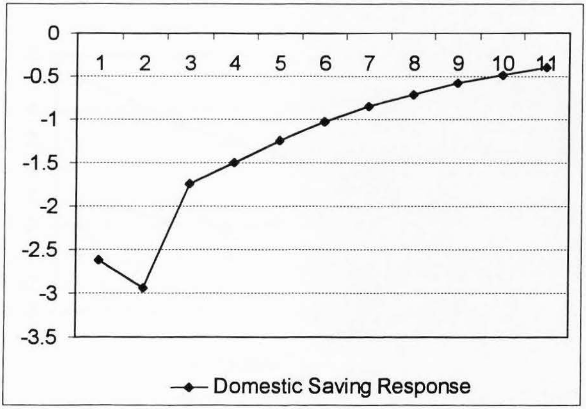

Fig. 8. *Impulse response of domestic saving to one unit innovation to foreign aid*

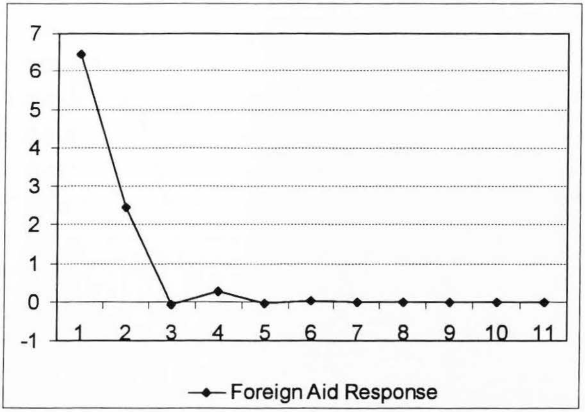

Fig. 9. *Impulse response of foreign aid to one unit innovation to foreign aid*

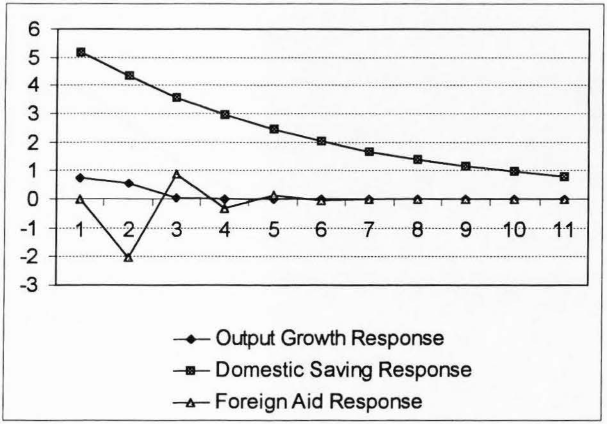

Fig. 10. *Combined responses of output growth, domestic saving and foreign aid to one unit innovation to domestic saving*

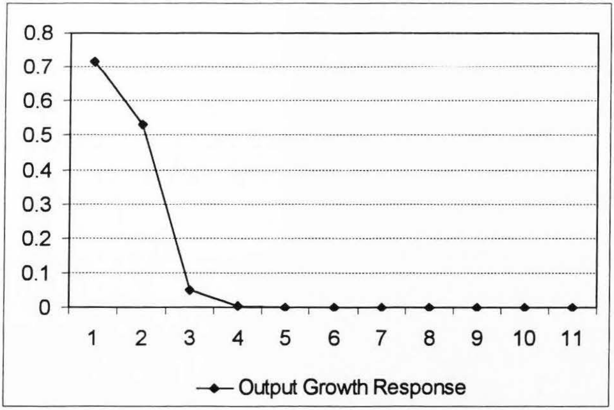

Fig. 11. *Impulse response of output growth to one unit innovation to domestic saving*

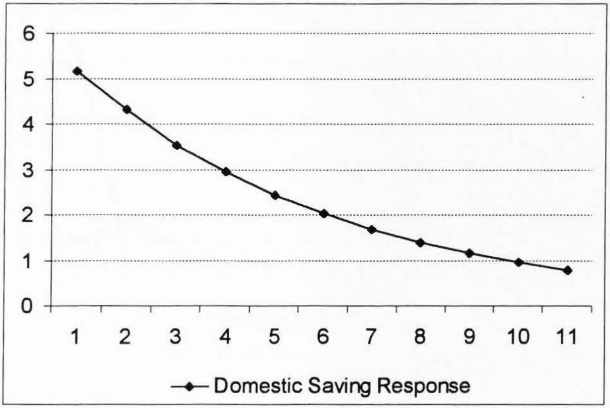

Fig. 12. *Impulse response of domestic saving to one unit innovation of domestic saving*

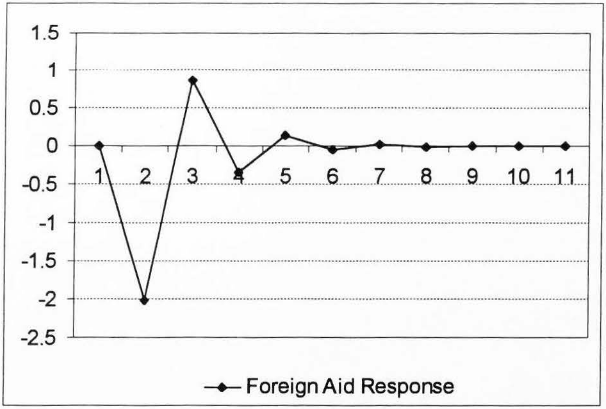

Fig. 13. *Impulse response of foreign aid to one unit innovation to domestic saving*

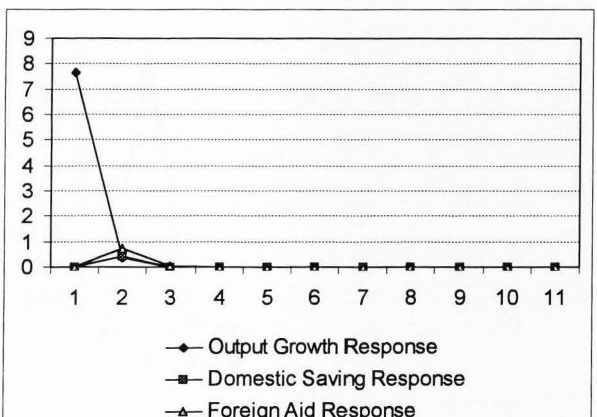

Fig. 14. *Combined responses of output growth, domestic saving, and foreign aid to one unit innovation to output growth*

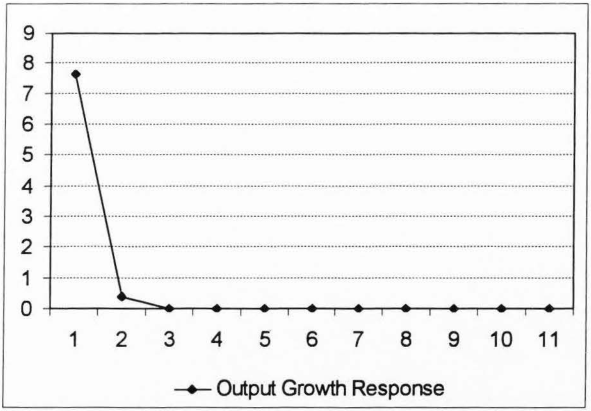

Fig. 15. *Impulse response of output growth to one unit innovation to output growth*

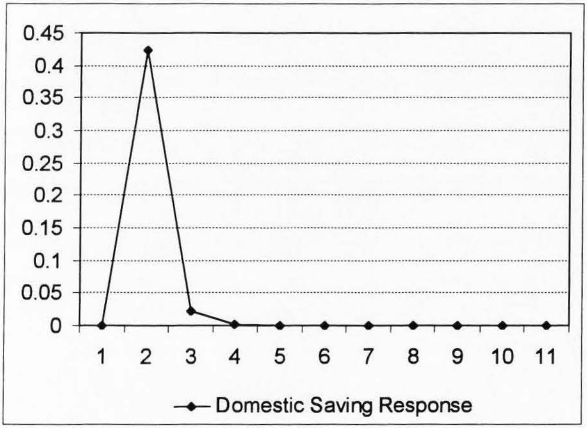

Fig. 16. *Impulse response of domestic saving to one unit innovation to output growth*

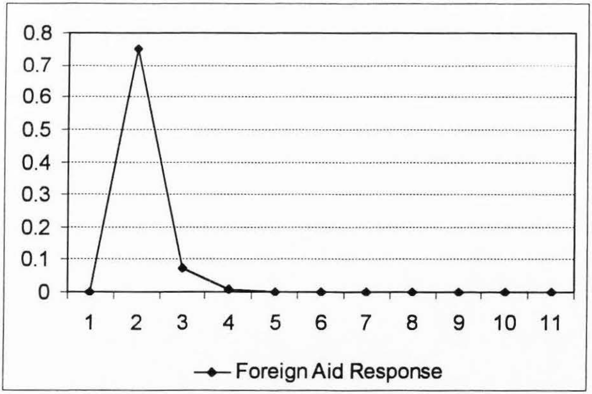

Fig. 17. *Impulse response of foreign aid to one unit innovation to output growth*

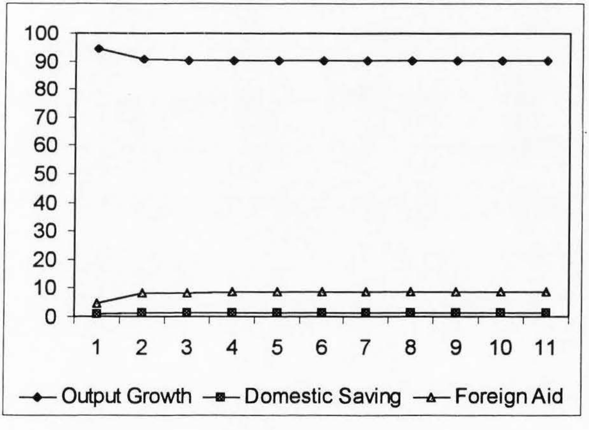

Fig. 18. *Variance decomposition of output growth*

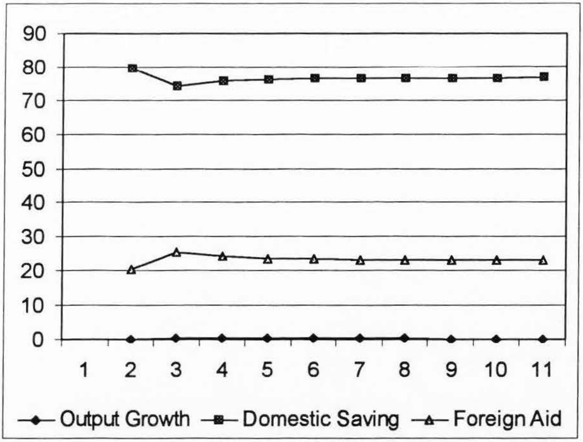

Fig. 19. *Variance decomposition of domestic saving*

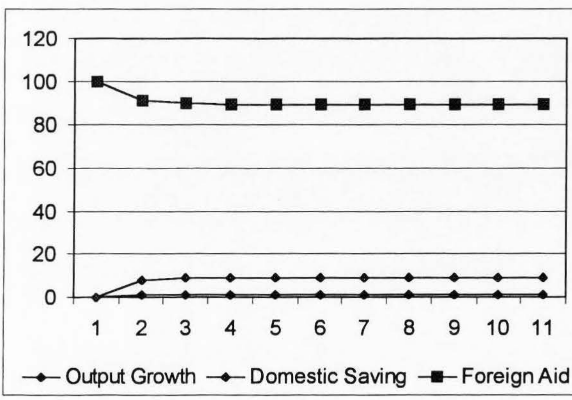

Fig. 20. *Variance decomposition of foreign aid*

CHAPTER 3

THE DYNAMIC IMPACT OF FOREIGN AID GRANTS AND FOREIGN AID LOANS ON ECONOMIC GROWTH AND DEVELOPMENT: THE CASE OF JORDAN

I. INTRODUCTION

Since various components of foreign aid may have differential impacts on output growth and the gross domestic saving rate, we attempt in this chapter to disaggregate foreign aid into its two main components, foreign aid grants and foreign aid loans, in order to precisely find out each component's effect. One of Papanek's (1972) criticisms of anti-aid studies was that they combined all capital inflows. Papanek sets the precedent for later studies by disaggregating aid and other possible capital inflows into their main components, i.e., foreign aid grants, foreign aid loans, foreign private investment, and private transfers.

II. METHODOLOGY

A VAR method is used to examine the dynamic relationships between Jordanian output growth Y_{1t}, gross domestic saving rate Y_{2t}, foreign aid loans as a percentage of GDP Y_{4t}, and foreign aid grants as a percentage of GDP Y_{5t}. All properties described in Chapter 2 for our three variable VAR will hold for our four-variable VAR.

Again, as preliminary data analysis, the new data series, i.e., foreign aid loans and foreign aid grants ratios, are checked for stationarity using the Philips-Perron Zt (q) unit root test statistic. Table 9 contains the results of the unit-root test that was performed with the use of different values of the lag parameter: q = 1, 2, and 3. For both foreign aid loans ratio Y_{4t}, and foreign aid grants ratio Y_{5t}, the hypothesis of a unit root test can be rejected at the 5% and 1% level of significance, respectively.

Consider the macroeconomic time-series variables, growth rate of real output Y_{1t}, gross domestic saving Y_{2t}, foreign aid loans as a percentage of GDP Y_{4t}, and foreign aid grants as a percentage of GDP Y_{5t}, respectively, where all are endogenous to the system. Since the above four variables are jointly determined, a structural simultaneous equation model relating Y_{1t}, Y_{2t}, Y_{4t}, and Y_{5t}, can be written as:

$$B_0 Y_t = k + B_1 Y_{t-1} + B_2 Y_{t-2} + \ldots + B_p Y_{t-P} + U_t \tag{31}$$

or in a compact form:

$$B_0 Y_t = K + B_s Y_t(L) + U_t \tag{31'}$$

where $Y_t = (Y_{1t}, Y_{2t}, Y_{4t}, Y_{5t})'$ a (4×1) vector of the dependent variables at time t, $K = (k_1, k_2, k_3, k_4)'$ a (4×1) vector of intercept terms, B_s = a (4×4) matrix of autoregressive coefficients, B_0 = a (4×4) matrix, which captures the contemporaneous effects in the system.

$$B_0 = \begin{bmatrix} 1 & -B_{12} & -B_{13} & -B_{14} \\ -B_{21} & 1 & -B_{23} & -B_{24} \\ -B_{31} & -B_{32} & 1 & -B_{34} \\ -B_{41} & -B_{42} & -B_{43} & 1 \end{bmatrix}$$

$Y_t(L)$ = a matrix polynomial in the lag operator L of order P. $U_t = (U_{1t}, U_{2t}, U_{4t}, U_{5t})'$ a (4×1) disturbance vector which is assumed to be a stationary process with $E(U_t) = 0$; $E(U_t U_s') = 0$ for $t \neq s$; $E(U_t U_t') = \Omega$.

The multivariable VAR in Equation 31 incorporates feedback in the system since Y_{1t}, Y_{2t}, Y_{4t}, and Y_{5t} are allowed to affect each other. For example, B_{12} is the contemporaneous effect of a unit change in Y_{2t} on Y_{1t}, B_{21} is the contemporaneous effect of a unit change in Y_{1t} on Y_{2t} , and B_{31} and B_{32} are the contemporaneous effects of Y_{1t} and Y_{2t} on Y_{3t}, respectively, and so on. Also, note that the U_t (error vector terms) are pure innovations in the dependent vector Y_t. Equation 31 is not a reduced form since the Y_t vectors have contemporaneous effects on each other. We can transform the system in Equation 31 into a more usable form. Premultiplying both sides of the system in Equation 31 by B_0^{-1} allow us to obtain the vector autoregressive (VAR) model in its standard form (reduced form):

$$Y_t = B_0^{-1}K + B_0^{-1}B_1Y_{t-1} + B_0^{-1}B_2Y_{t-2} + \ldots + B_0^{-1}B_pY_{t-p} + B_0^{-1}U_t \tag{32}$$

or

$$Y_t = C + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \ldots + \Phi_p Y_{t-P} + \varepsilon_t \tag{32'}$$

Equation 15 in a compact form becomes:

$$Y_t = C + \Phi_s Y_t(L) + \varepsilon_t \tag{33}$$

where $C = B_0^{-1}\ K$ the standard (reduced form) VAR vector intercepts, $\Phi_s = B_0^{-1}B_s$ for s = 1, 2, 3, ...p (the reduced form VAR parameters), and $\varepsilon_t = B_0^{-1}U_t$ (the standard "reduced form" innovation vector)

Assuming that U_t is a vector white noise, then ε_t will be recognized as vector white noise and Equation 33 will be the VAR representation for the dynamic structural system (DSS) in Equation 31. Thus, a VAR can be viewed as the reduced form of a general dynamic structural model (GDSM). Note also that the vector error terms ε_t are composites of the shocks U_t .

III. IDENTIFICATION PROBLEM

To identify the system in Equation 31, which is underidentified and cannot be estimated directly due to the feedback inherent in the system (Enders, 1995), we use the recursive system proposed by Sims (1980) and impose any a priori restrictions which may be suggested by economic theory to restrict some coefficients in the contemporaneous parameter matrix, i.e., in a four-variable VAR, 4^2 - 4/2 restrictions are needed for identification. Using Sim's recursive system, we restrict $B_{21} = B_{31} = B_{41} = B_{32} = B_{42} = B_{43} =$ zero. Given this restriction, B_0 and B_0^{-1} become:

$$B_0 = \begin{bmatrix} 1 & -B_{12} & -B_{13} & -B_{14} \\ 0 & 1 & -B_{23} & -B_{24} \\ 0 & 0 & 1 & -B_{34} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$B_0^{-1} = \begin{bmatrix} 1 & B_{12} & (B_{12})(B_{23}) + (B_{13}) & (B_{12})(B_{23})(B_{34}) + ((B_{12})(B_{24}) + (B_{13})(B_{34}) + (B_{14}) \\ 0 & 1 & (B_{23}) & (B_{23})(B_{34}) + (B_{24}) \\ 0 & 0 & 1 & (B_{34}) \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

The above restrictions imposed on B_0 are explained the same way as in our three-variable VAR from Chapter 2. The only addition to these restrictions is that foreign aid grants affect foreign aid loans contemporaneously. This restriction implies that recipient countries in general will seek to obtain foreign aid grants first, to achieve the desired level of growth rate set a priori (since foreign aid grants require no repayment by recipient governments). And depending on how successful the recipient government in raising the necessary funds through grants, the level of necessary loans is determined.

In terms of innovations (shocks), the above restrictions imply the following innovation system:

$$\begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{bmatrix} = (B_0^{-1})'(U_{1t}, U_{2t}, U_{4t}, U_{5t})'$$

The above restrictions allow the recovery of the structural (primitive) VAR parameters. Since the model is just identified, full information maximum likelihood (FIML) estimates of the structural parameters can be obtained by maximizing the likelihood function with respect to standard VAR (reduced form) parameters, i.e., Φ_s and Σ_ε. Then we can use the unique mapping from the estimated reduced form parameters to recover the structural ones (Hamilton, 1994). Since the objective of this study is to examine the dynamic impact of foreign aid on both output growth and domestic resources, the focus will be on the impulse response functions (IRFs) and the variance decompositions (VDCs).

IV. ISSUES OF VAR LAG LENGTH

The Akaike information criterion (AIC), Schwartz Bayesian criterion (SBC), Akaike final prediction error (FPE), and Hannan-Quinn (HQ) criterion will be used to identify the appropriate lag length P in Equation 16. The order P is chosen so that the above-mentioned criteria are minimized. This test criterion is based on several criteria that have been proposed for estimating the order of a VAR process. Researchers have suggested minimizing FPE, AIC, SBC, or HQ criterion. These criteria are defined as follows:

$$\text{FPE (n)} = [(T + n^*M + 1) / (T - n^*M - 1)]^M \det \Gamma_n$$

$$\text{AIC (n)} = \text{Log } (\det (\Gamma_n) + 2 (M\, n^2)/T$$

$$\text{SBC (n)} = \text{Log (det } (\Sigma_n) + (\text{Log(T)/T}) \, n^*M^2$$

$$\text{H-Q (n)} = \text{Log (det } (\Sigma_n)\,) + ((\,2 \log (\log (T)))/T) \, n \, M^2$$

where M = number of variables in the system, T = number of observations in the sample, n = order of the VAR process (n = 1, 2, ...P) , and Σ_n = an estimate of the residual covariance matrix obtained with a VAR (n) process.

Clearly, adding additional regressors will reduce log (det (Σ_n)) at the expense of increasing N. The four above criterion will be estimated for a potential maximum number of lags, i.e., models with n = 0, 1, ..., P are estimated with P specified as an upper bound and a VAR (n) model that minimize the AIC, SBC, FPE, and/or HQ criterion will be selected.[15] (Note that in the procedure the sample size T has to be held fixed, i.e., in each estimation P observations are treated as presample values.)

The lag structure is identified for each potential number of lags n = 0, .., P (due to the degree-of-freedom consideration, the maximum lag length entertained is set to four). The above four criteria are estimated for all potential lags entertained and the results are reported in Table 9. It can be seen from the results that both SBC and FPE criteria are minimized at with a zero-lag, while both AIC and HQ criteria are minimized at a four-lag VAR. To decide which lag model is more appropriate, the maximum chi-square procedure provides a maximum likelihood test statistic for evaluating whether increasing the order of a model significantly improves the fit. Sims (1980) suggested a test statistic measuring improved fit as:

$$S = (T\text{-}K)\ \{\text{Log (det } (\Sigma_r) - \log (\det (\Sigma_u)\ \}$$

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[15] For more detailed analysis, see Lutkepohl (1993), Enders (1995), and Judge *et al.* (1988).

where T = number of observations in the sample, Det (Σ_r) & (Σ_u) = determinant of the covariance matrices of the residuals of both the restricted and unrestricted models respectively, and K = a correction factor to improve small sample properties suggested by Sims (1980), and it equals the number of parameters estimated per unrestricted equation ($1+Mn_1$).

This statistic S has an asymptotic chi-square distribution and is used to test the null hypothesis that adding the $(n + 1)_{th}$ lag to the system does not significantly improve the model's fit. The test has M^2 (n_1 - n_0) degrees of freedom. Since estimated S equals 83.17, which exceeds 79.5 (the 10% chi-squared critical value), the null hypothesis is rejected. The dynamics are not completely captured by a zero-lag; rather a four-lag VAR specification seems preferable. Hence, a model with n = 4 is chosen.

Given the assumptions in Equation 31, that the error vector Ut is white noise, it follows that ε_t the standard VAR error vector, will have the same stochastic properties, i.e., the ε_t will have a mean zero, $E[\varepsilon_t] = 0$, ε_t ε_s are individually uncorrelated, i.e., $E[\varepsilon_t \, \varepsilon_s'] = 0$ for $t \neq s$, and $E[\varepsilon_t \, \varepsilon_t'] = \Sigma_\varepsilon$. Since the standard VAR is symmetric, the least squares estimator of the standard VAR is consistent and joint estimation techniques do not increase estimation efficiency.

Because of the presence of many parameters and the difficulty of interpreting them in a standard VAR, Sims (1980) argued and made popular what has been called innovation accounting. The informational content of a VAR is better summarized by a moving average representation. Hence, the next step in this chapter is to investigate the dynamic response of both growth rate of real output and domestic saving (resources) to innovations (shocks) in both foreign aid grants and foreign aid loans.

The standard VAR system is triangulized using Choleski decomposition so that the innovation (impulses) of the last variable (foreign aid grants) according to our ordering contemporaneously affects itself and the values of all other variables in the system, i.e., output growth, domestic saving, and foreign aid loans. While the innovation of the penultimate variable (variable before the last, i.e., foreign aid loans) contemporaneously affects itself, it also affects the values of all but the last variable in the system. In terms of innovations (shocks), the above Choleski decomposition implies the innovation system mentioned earlier in terms of the four shocks ε_{1t}, ε_{2t}, ε_{4t}, and ε_{5t}.

V. ESTIMATION RESULTS AND ANALYSIS[16]

We present below selected responses to one-time unit innovation (impulse) to particular variables. The impulse responses to one-unit innovation in Y_{5t} (foreign aid grants as a percentage of GDP) by Y_{1t} (output growth), Y_{2t} (gross domestic saving as a percentage of GDP), and Y_{4t} (foreign aid loans ratio) are depicted in Figures 23, 24, and 25. The responses of output growth, domestic saving rate, and foreign aid grants ratio to a one-time unit innovation to foreign aid loans ratio are depicted in Figures 28, 29, and 30. Output growth response, foreign aid loans response, and foreign aid grants response to a one-time unit innovation to domestic saving are depicted in Figures 33, 34, and 35, respectively. Finally, the impulse responses to one-time unit innovation to output growth by domestic saving rate, foreign aid loans, and foreign aid grants are presented in Figures 38, 39, and 40, respectively.

[16] All estimations are programmed in GAUSS.

Figure 23 presents the dynamic response of output growth to the one-time unit innovation in foreign aid grants ratio. Initially, output growth declines by –2.1%, recovers in periods 2 and 3, and declines slightly in periods 4 and 5. The period-by-period responses of output growth are positive in all remaining simulated periods. Clearly, as the figure shows, foreign aid grants exerted a positive long-run dynamic impact on Jordan's rate of output growth.

Figure 24 depicts the dynamic response of gross domestic saving rate to one-time unit shock in foreign aid grants. Instantly, domestic saving rate declines by –4.11% and remains negative in all simulated periods. Clearly, and as the figure shows, foreign aid grants exerted a severe long-run negative impact on the Jordanian domestic saving rate. This negative impact shows that foreign aid grants did substitute for domestic saving (domestic resources) and elicited a substantial decline in their levels. The negative effect of foreign aid grants on domestic saving rate can be attributed to its possible impact on government budgetary behavior and its savings. (This issue will be explored in the fourth chapter.) Also, foreign aid grants may affect the interest rate and overall prices in the economy.

The response of foreign aid loans to one-time unit innovation to foreign aid grants is presented in Figure 25. As the figure indicates, the response is consistent with most less-developed countries' (LDCs) behavior. The more foreign aid grants a country succeeds in obtaining, the less foreign aid loans that it may seek in the future. Clearly, in the case of Jordan, the increase in foreign aid grants results in a decline of foreign aid loans as indicated by the negative response of foreign aid loans to foreign aid grants innovation.

Figure 28 depicts output growth response to one-time unit innovation to foreign aid loans. Output growth highly and positively responds to foreign loan innovation in the first five periods, and declines slightly in periods six, seven, nine, and ten. It starts to recover in the tenth period and after where it starts to become slightly in the positive region. It can be seen from the figure that foreign aid loans had a positive short-run dynamic impact on Jordanian output growth, where this impact tends to dissipate after the sixth simulated period.

Jordanian domestic saving rate response to one-time unit innovation to foreign aid loans is depicted in Figure 29. Instantly, the domestic saving rate increases by 2.22%, declines in the second and third period to –1.2% and –0.5%, and increases afterwards and remain highly positive in all remaining simulated periods. As the figure shows and in the case of Jordan, foreign aid loans and domestic savings are complementary inputs as indicated by the long-run positive dynamic impact foreign aid loan has on domestic saving rate. The above result contrasts sharply with a similar study on the Jordanian economy by Almomani (1985), who found that foreign aid loans have a negative but insignificant impact on growth. Almomani concludes that "... external borrowing has either helped to foster the rate of growth in the economy nor [sic] relaxed its savings constraint" (p. 114).

In Figure 30, the response of foreign aid grants to one-time unit innovation to foreign aid loans is depicted. As the impulse response function graph shows, foreign aid grants tend to decline when foreign aid loans rise. Again, as we explained previously, this result is consistent with most less-developed countries' government behavior.

Obtaining more loans is a direct result of a decline in foreign aid grants that Jordan wishes to solicit to achieve the desired rate of growth.

Figures 33, 34, and 35 depict output growth, foreign aid loans, and foreign aid grant responses to one-time unit innovation to domestic saving rate, respectively. When foreign aid is decomposed to grants and loans, domestic saving has a neutral impact on output growth compared to its positive impact in our previous model. This result can be attributed to the severe negative impact that foreign aid grants had on the domestic saving rates, which we found earlier where grants have depressed and replaced Jordanian domestic savings. The evidence is even clearer by the high positive dynamic impact foreign grants had on output growth as shown by Figure 23. Foreign loans' response as shown in Figure 34 shows that as domestic saving rates rise, foreign aid loans tend to decline. A rising domestic saving ratio is not "rewarded" by aid donors with greater future loans disbursed on a "matching" principle.[17] Figure 35 depicts the response of foreign aid grants to domestic saving one-time unit innovation. Again and similar to the case of foreign aid loans, the figure shows a negative dynamic impact from domestic saving to foreign aid grants and no evidence that a rising domestic saving rate is "rewarded" by aid donors in the form of greater amounts of future grants.

Figures 38, 39, and 40 show the dynamic response of domestic saving rate, foreign aid loans, and foreign aid grants to one-time unit innovation to the growth rate of output. The domestic saving dynamic response in Figure 38 indicates that in Jordan when the level of income rises, the proportion of income saved tends to decline. Again, in the

[17] The "matching" principle reflects donor countries and agencies willingness to reward "match" the increase in domestic saving rate with greater future aid inflows.

presence of foreign aid, any additional income tends to increase current consumption at the expense of current savings. Figures 39 and 40 depict the dynamic responses of both foreign aid loans and foreign aid grants to one-time unit innovation to output growth, respectively. Foreign aid loans' dynamic response is highly negative for the initial three periods, slightly positive for periods five through ten, and then starts to decline afterwards. The overall impact of an increase in output growth on foreign aid loans is slightly negative for the simulated periods, an indication that as the economy grows, donor countries and agencies extend less of future aid in the form of loans to Jordan. It may also indicate that as the Jordanian economy grows, the Jordanian government reduces its efforts to obtain more future foreign aid loans. On the other hand, the dynamic impact of an innovation to output growth on foreign aid grants is highly positive (Figure 40). The period-by-period dynamic responses are positive except for periods three and five. As the growth rate of output increases, donor countries extend additional grants to Jordan (reward) or the growth may indicate that the Jordanian government succeeds in soliciting additional foreign aid grants. The serious problem imposed here is that foreign aid grants exerted a serious negative impact on domestic resources (foreign aid grants did substitute rather than complement domestic resources). Donors should extend fewer foreign aid grants; Jordan should solicit to extend the amount of foreign aid loans rather than grants, if future growth and development are to be sustained.

The variance decomposition analysis is presented in Tables 10, 11, 12, 13, and the corresponding graphs are in Figures 41, 42, 43, and 44. Table 10 (Figure 41) is the variance decomposition of Jordanian output growth, showing that the percentage of the variation in output growth is the highest due to foreign aid loans and foreign aid grants at

55.99% and 16.04% in the initial period, respectively. Variation due to foreign aid grants increases to reach a high of 72% and 64% in some periods, while foreign aid grants explain 23.9% and a high of 26.98% in some periods, while domestic saving explains no more than 3.9% at most of the variation of output growth. The variance decomposition of output growth provides us with another evidence of how foreign resources contribute the most to the variation in the Jordanian output growth, especially the loan component (another evidence that most of the growth of Jordanian output is mainly attributed to foreign resources).

Table 11 (Figure 42) is the variance decomposition of Jordanian gross domestic saving rate, showing that a high percentage of the variance is due to foreign aid grants and foreign aid loans innovations. Foreign aid grants innovation accounts for 79% of the variation in domestic savings, and this ratio decreases over time to reach a high of 68.75%. Foreign aid loans account for 10.73% of the variance in domestic saving, and this ratio increases over time to reach 21.81%, while output growth explains no more than 3.81% initially and no more than 7% of the variance in domestic saving in most of remaining periods.

Tables 12 and 13 (Figures 43 and 44) are the variance decomposition of foreign aid loans and foreign aid grants, respectively. Foreign aid grants innovation accounts for 0.38% of the variation in foreign loan initially, but this ratio increases significantly afterwards to reach 21% at the end of the period. Domestic savings explain no more than 0.66% of the variance in foreign loans in the first period and that ratio increases slightly to 1.47% at the end. Output growth explains 2.26% of the variance in loans, and that percentage increases over time to reach 6.7%. Finally, 2.5% of the variance in foreign aid grants is explained by foreign loans, and that ratio increases over time to reach 18.9%. Meanwhile, output growth and domestic savings explain 0.01% and 0.00002% in the variance of grants, respectively, and their respective ratios increase over time to reach 1.49% and 3.98%.

VI. CONCLUSION

This chapter has attempted to explain further the nature of the dynamic relationship between the two main components of foreign aid, namely, foreign aid loans and foreign aid grants with the growth rate of Jordanian output, and its domestic saving rate. The VAR method, the impulse response functions (IRFs), and the variance decomposition (VDC) suggest the following. First, foreign aid grants contribute positively to the growth rate of Jordanian output. Second, foreign aid loans have a large dynamic long-run positive impact on Jordanian domestic savings (domestic resources), which indicates that in the case of Jordan foreign aid, loans and domestic savings (resources) are complementary inputs. The anti-aid view, which holds the position that foreign aid exerts negative impacts on the domestic savings of recipient countries, is not maintained in the case of foreign loans for Jordan. Third, a negative relationship between foreign aid loans and foreign aid grants exists, i.e., an increase in the levels of foreign aid loans obtained from donor countries tends to decrease the levels of future foreign aid grants received. This might be an indication that, one, when Jordan fails to obtain the necessary funds for growth and development through grants, the government resorts to foreign public borrowing and vice versa, and two, when Jordan receives additional amounts of foreign aid loans, donor countries extend fewer foreign grants. The opposite will also hold.

Foreign aid grants exerted a positive long-run dynamic impact on Jordan's rate of output growth, while it also had a severe long-run negative impact on her gross domestic saving rate as indicated by Figure 24. Thus, if the purpose of foreign aid is to augment domestic savings, donor countries should not extend foreign aid grants to Jordan as the evidence indicates that grants will have an adverse effect on the Jordanian domestic savings rate. Jordan should extend its efforts to solicit more foreign aid loans, if necessary, and less or none of grants to help its economy to develop and grow. The serious problem faced by Jordan is that most of its growth in the last thirty years or so can be easily attributed to foreign resources (particularly foreign grants). That raises the question of how the economy and domestic resources will respond if foreign aid received from donors comes to a halt.

Again, the above results contrast with those obtained by Hammad's (1981) study of Jordan, which found out that "...the statistical results support our previous conclusions. Foreign aid was neutral with respect to gross domestic savings" (p. 154), and those of Over (1975), who found a positive and significant relationship between foreign aid and domestic savings in his cross-country analysis. Our results are also in contrast to Chenery and Strout's (1966) study in which a positive relationship was found between aid and domestic savings in a cross-country analysis, and with El Shibly's (1984) study, which found a negative impact of foreign aid on economic growth in his time-series analysis of the Sudanese economy. Finally, our results contrast partly with Mosley *et al.* (1987), who concluded that aid had a positive impact on growth.

Even though foreign aid grants and foreign aid loans ratios have a positive impact on Jordanian output growth, nevertheless the decline in Jordanian domestic saving rate as a direct result of the presence of foreign aid grants poses a serious problem to future development and growth. As such, government policy needs to focus more heavily on mobilizing domestic resources with the help of foreign resources, especially foreign aid loans for the economic transformation of the country and the augmentation of domestic resources. Also, government should rely more on an efficient allocation policy that, if possible, channels aid inflows to projects that are highly productive. Thus, output can accelerate and economic growth and development can be sustained. Infrastructure projects should be financed mainly with domestic investment (domestic resources), since these projects are not directly productive. Official foreign aid (grants and loans) is the main form of foreign capital inflows to the country, and its ratio is overwhelming. Jordan should also consider encouraging other forms, i.e., foreign private investment, that will create more jobs and bring with them technical abilities and advice. Laws that provide a healthy and safe investment environment should be enacted to encourage foreign private investment, especially after the peace treaty in the region has been implemented.

Table 8. *Testing for stationarity using four variables*

Series	The Philips – Perron Z_t (q) test q = 3	q = 2	q = 1
Y_{1t} (Output growth)	-5.01^1	-5.04^3	-5.13^3
Y_{2t} (Domestic saving rate)	-3.30^3	-3.90^2	-3.90^2
Y_{4t} (Foreign aid loans rate)	-3.07^2	-2.68^3	-2.89^2
Y_{5t} (Foreign aid grants rate)	-3.80^2	-3.80^2	-3.89^2

[1] Indicates significance at 1% significance level.
[2] Indicates significance at 5% significance level.
[3] Indicates significance at 10% significance level.

Table 9. *Statistics for choosing the VAR lag length with four variables*

VAR order (n)	AIC (P)	SBC (P)	FPE (P)	HQ (P)
0	13.08	13.08*	18.53*	13.08
1	11.71	13.54	66.53	12.95
2	10.93	13.90	260.4	12.72
3	11.27	14.63	1358	12.58
4	10.33*	13.49	9427	11.13*

* Indicates minimum.

Table 10. *Variance decomposition of output growth*

Period	Output growth	Domestic saving	Foreign aid loans	Foreign aid grants
1	27.95	0.021	55.99	16.04
2	22.48	0.256	51.48	25.79
3	10.98	0.192	76.13	12.7
4	11.75	1.15	74.26	12.83
5	12.01	3.51	72.02	12.46
6	11.84	3.49	66.47	18.19
7	10.04	3.77	64.28	21.91
8	10.53	3.67	64.81	20.99
9	10.09	3.84	62.16	23.9
10	9.89	3.86	62.35	23.9
11	10	3.93	59.08	26.98

Table 11. *Variance decomposition of domestic saving*

Period	Output growth	Domestic saving	Foreign aid loans	Foreign aid grants
1	0.00	10.23	10.73	79.04
2	3.81	9.57	11.86	74.74
3	7.00	8.47	10.98	73.54
4	6.51	6.40	24.65	62.43
5	5.16	4.46	23.70	66.67
6	5.22	3.74	20.07	70.95
7	4.83	3.55	19.78	71.83
8	4.44	3.19	19.64	72.72
9	4.07	2.99	19.56	73.38
10	3.75	2.82	20.25	69.62
11	3.45	2.75	21.81	68.75

Table 12. *Variance decomposition of foreign aid loans*

Period	Output growth	Domestic saving	Foreign aid loans	Foreign aid grants
1	0.00	0.00	99.62	0.38
2	2.26	0.66	86.58	10.48
3	5.52	0.69	74.11	19.67
4	6.43	1.30	71.97	20.29
5	6.30	1.29	71.08	21.32
6	6.28	1.28	70.47	21.97
7	6.49	1.37	70.21	21.92
8	6.69	1.39	70.00	21.91
9	6.71	1.37	70.27	21.64
10	6.71	1.38	70.52	21.68
11	6.7	1.47	70.46	21.67

Table 13. *Variance decomposition of foreign aid grants*

Period	Output growth	Domestic saving	Foreign aid loans	Foreign aid grants
1	0.0000	0.00	0.00	100.0
2	0.0002	0.01	2.52	97.46
3	0.0800	0.13	1.96	97.82
4	0.0800	0.37	1.96	97.58
5	0.8000	1.36	11.21	86.63
6	0.9700	1.66	10.46	86.91
7	1.3500	1.94	12.79	83.91
8	2.1200	1.73	16.37	79.77
9	2.8100	1.79	18.58	76.81
10	3.5800	1.59	19.17	75.65
11	3.9800	1.49	18.93	75.60

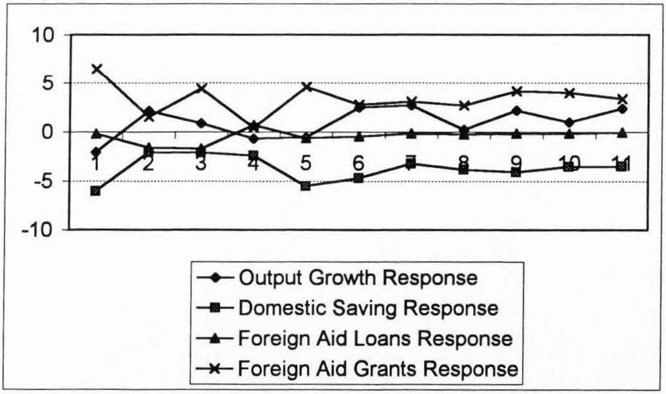

Fig. 21. *Combined impulse responses to one unit innovation to foreign aid grants*

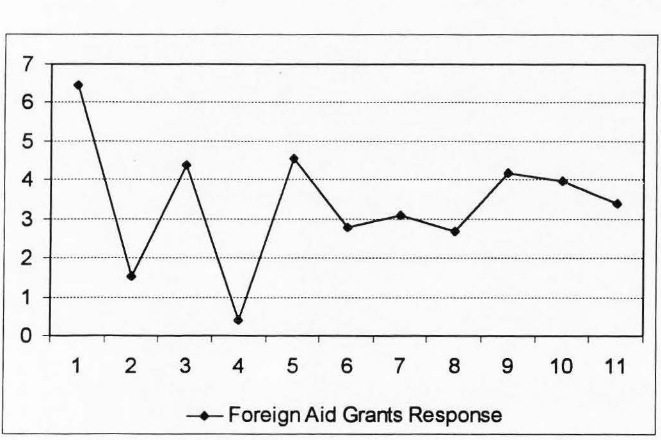

Fig. 22. *Impulse response of foreign aid grants to one unit innovation to foreign aid grants*

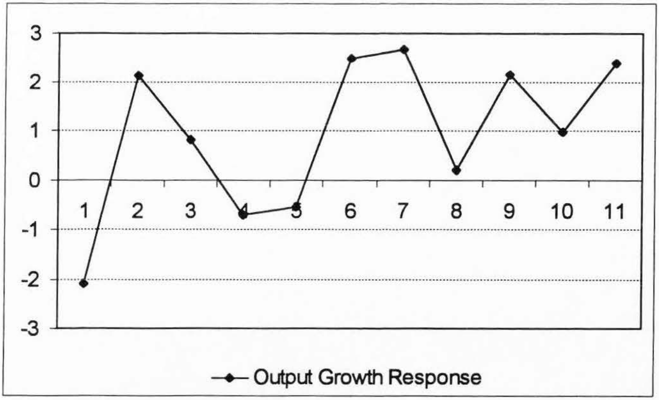

Fig. 23. *Impulse responses of output growth to one unit innovation to foreign aid grants*

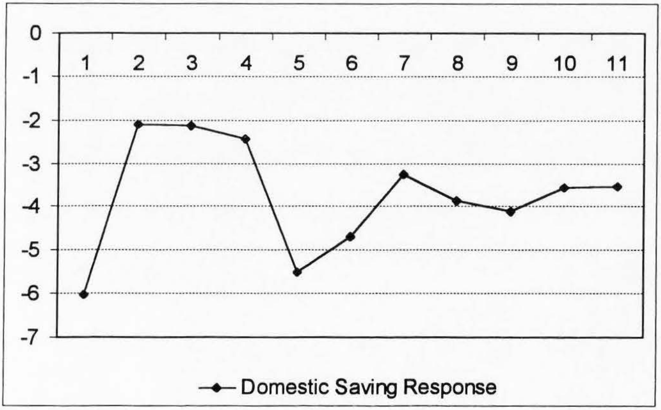

Fig. 24. *Impulse response of domestic saving to one unit innovation to foreign aid grants*

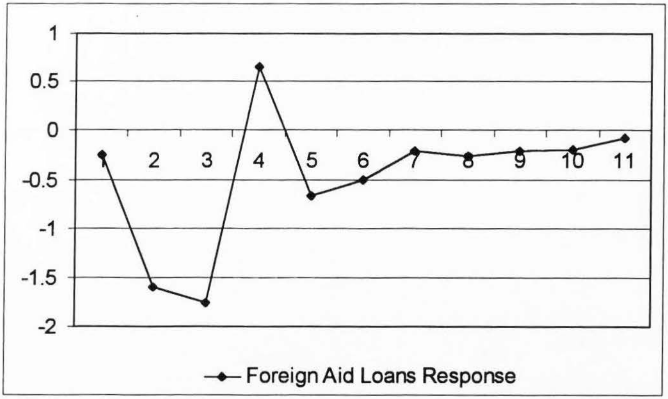

Fig. 25. *Impulse response of foreign aid loans to one unit innovation to foreign aid grants*

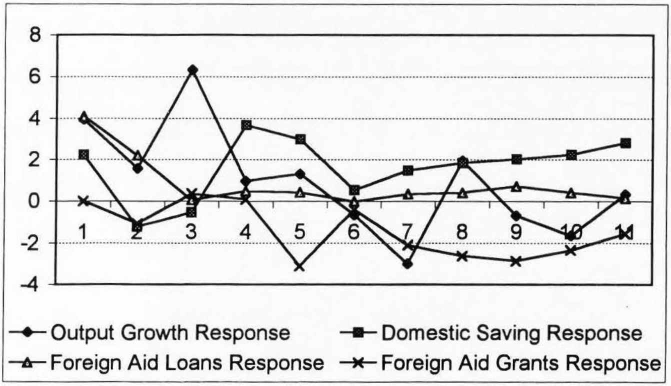

Fig. 26. *Combined impulse responses to one unit innovation to foreign aid loans*

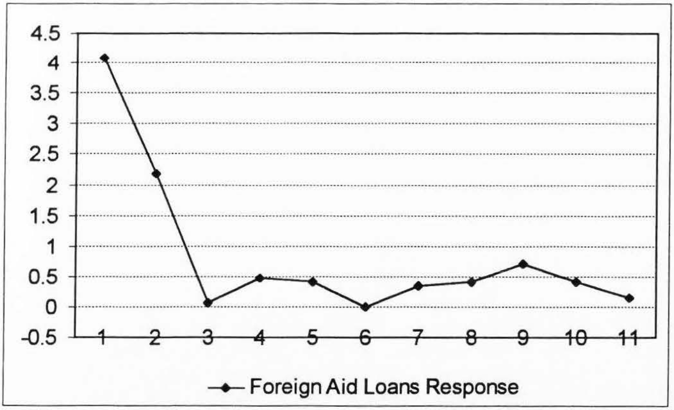

Fig. 27. *Impulse response of foreign aid loans to one unit innovation to foreign aid loans*

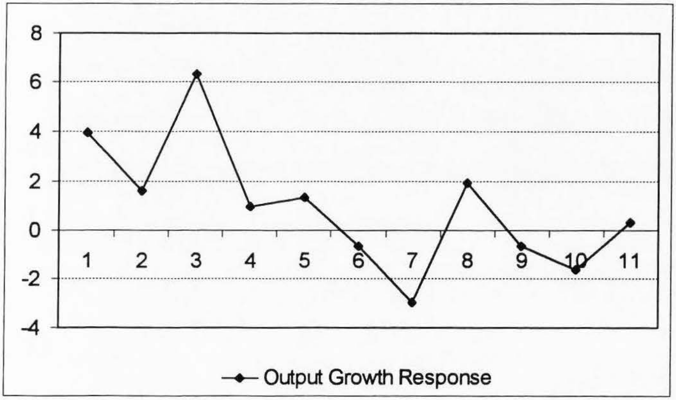

Fig. 28. *Impulse response of output growth to one unit innovation to foreign aid loans*

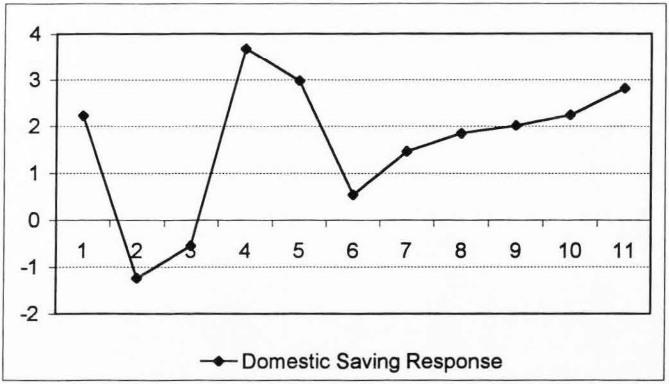

Fig. 29. *Impulse response of domestic saving to one unit innovation to foreign aid loans*

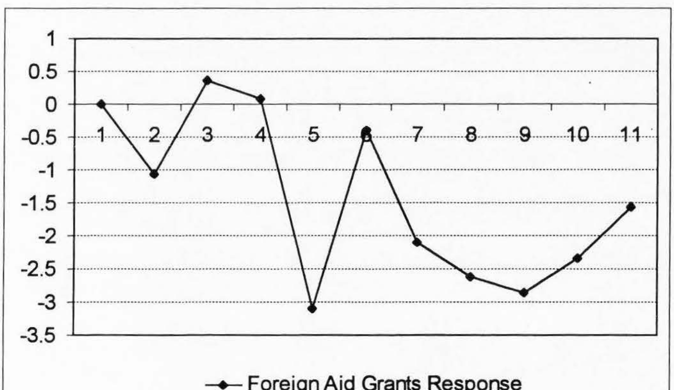

Fig 30. *Impulse response of foreign aid grants to one unit innovation to foreign aid loans*

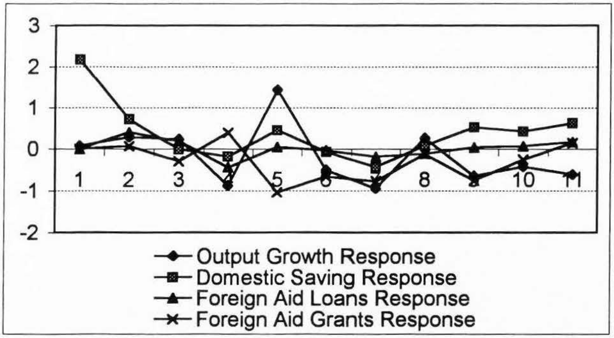

Fig. 31. *Combined responses to one unit innovation to domestic saving*

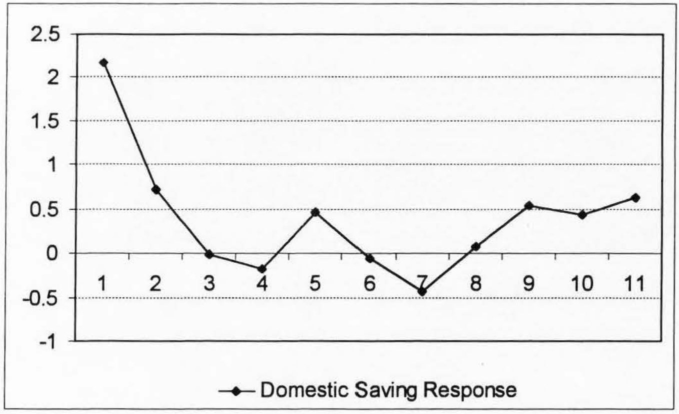

Fig. 32. *Impulse response of domestic saving to one unit innovation to domestic saving*

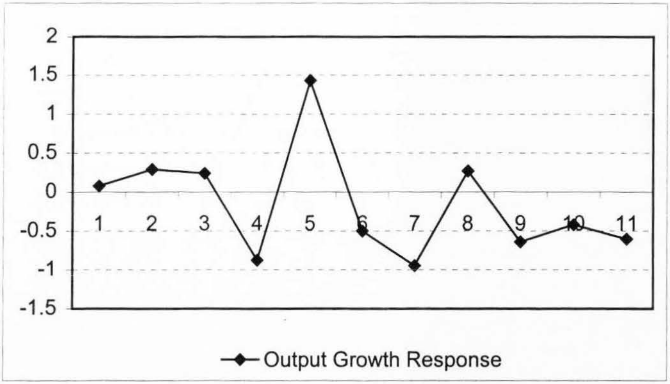

Fig. 33. *Impulse response of output growth to one unit innovation to domestic savings*

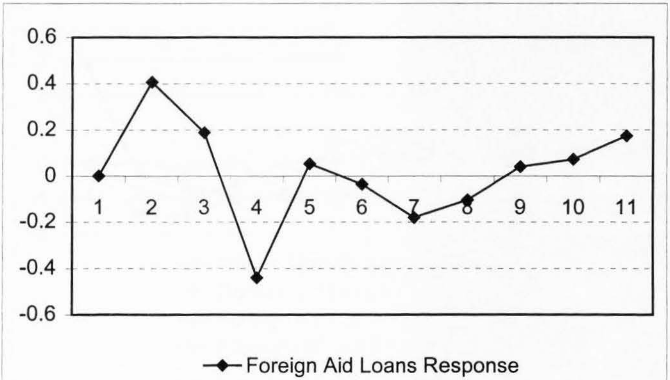

Fig. 34. *Impulse response of foreign aid loans to one unit innovation to domestic savings*

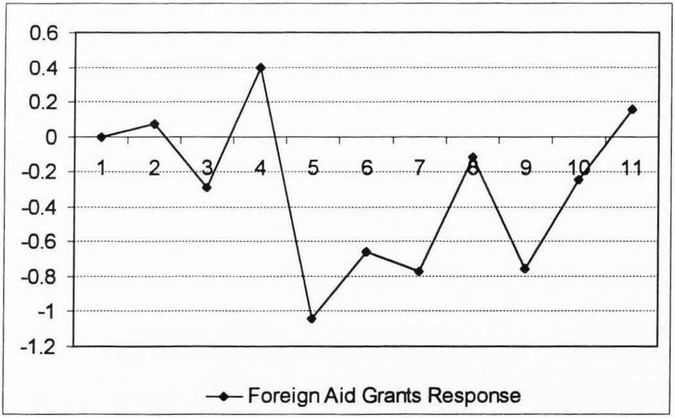

Fig. 35. *Impulse response of foreign aid grants to one unit innovation to domestic saving*

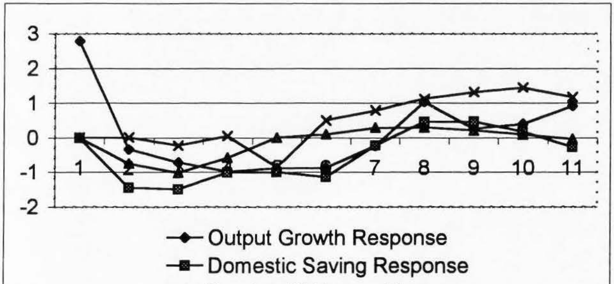

Fig. 36. *Combined response to one unit innovation to output growth*

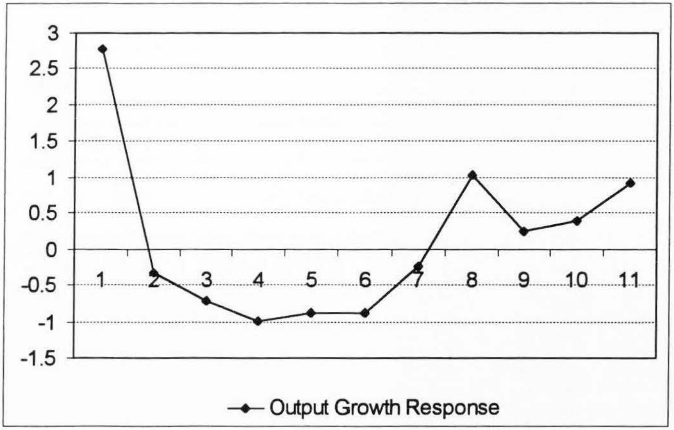

Fig. 37. *Impulse response of output growth to one unit innovation to output growth*

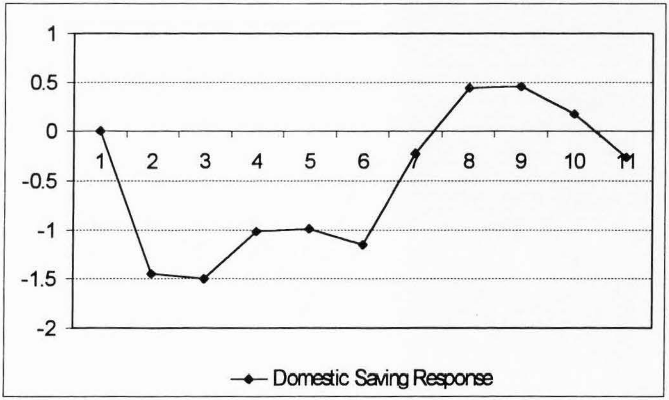

Fig. 38. *Impulse response of domestic saving to one unit innovation to output growth*

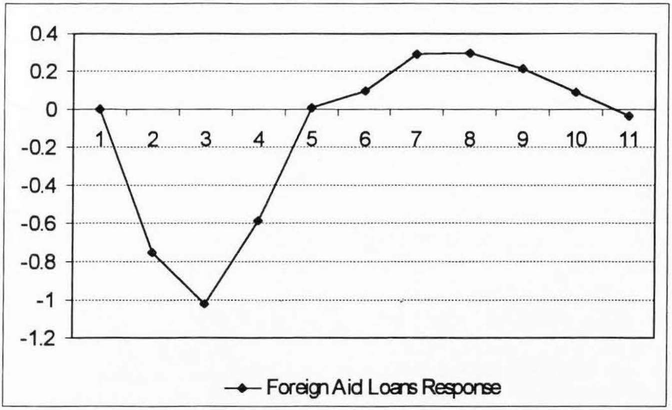

Fig. 39. *Impulse response of foreign aid loans to one unit innovation to output growth*

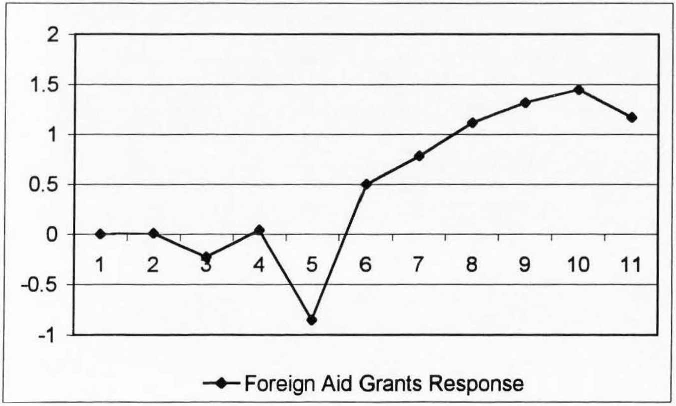

Fig. 40. *Impulse response of foreign aid grants to one unit innovation to output growth*

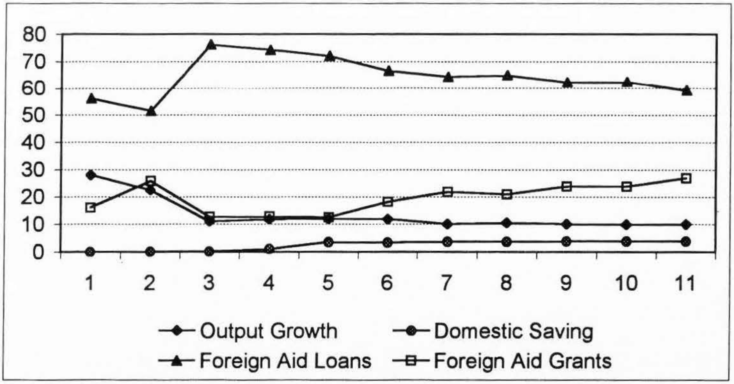

Fig. 41. *Variance decomposition of output growth*

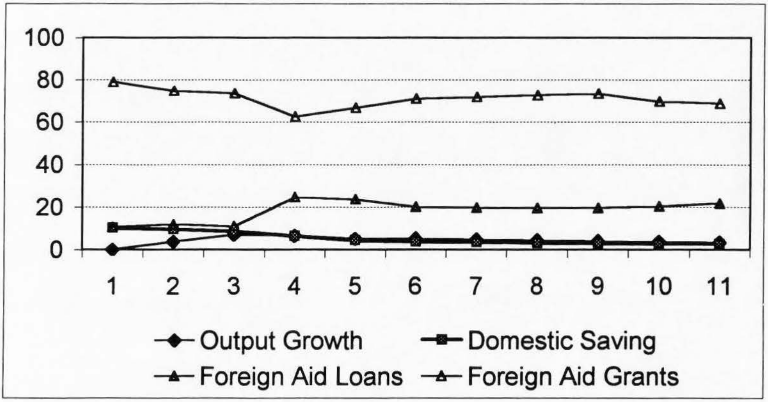

Fig. 42. *Variance decomposition of domestic saving*

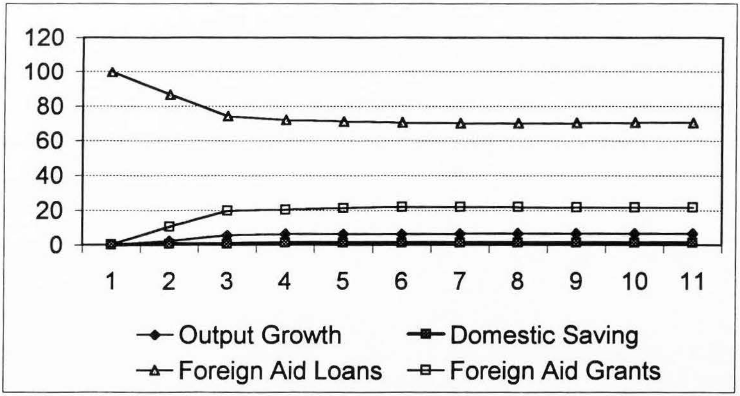

Fig. 43. *Variance decomposition of foreign aid loans*

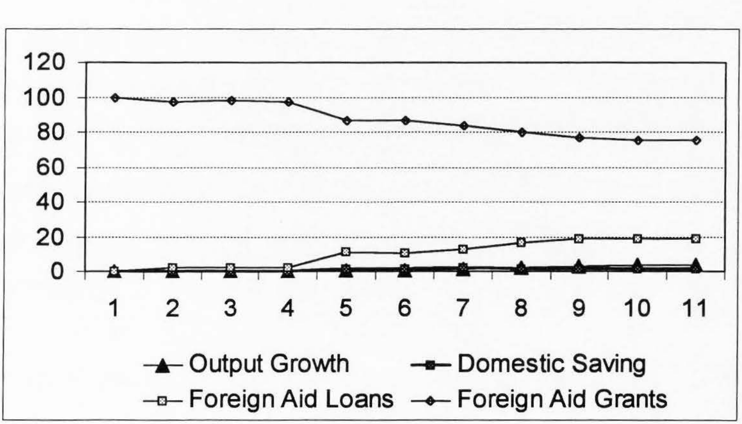

Fig. 44. *Variance decomposition of foreign aid grants*

CHAPTER 4

FOREIGN AID AND THE GOVERNMENT FISCAL BEHAVIOR: THE CASE OF JORDAN

I. INTRODUCTION

In most less-developed countries (LDCs), the government plays a considerable role in the planning as well as the implementation of most development projects. Evidently, a large proportion of foreign capital, especially foreign aid, is channeled through the public sector. The rising level of public expenditures in Jordan has been fueled mainly by capital inflows from both public and private sources abroad and by mobilizing domestic resources through taxation and local borrowing. Recently, government's development efforts and its effectiveness have been cast in doubt. Critics argue that foreign aid inflows have resulted in increased public and/or private consumption rather than increased investment and that they have contributed less or none to growth. Various researchers (Papanek, 1973; Weisskoff, 1972; El Shibly, 1984) found evidence suggesting a leakage out of aid to consumption. Others (Griffin, 1970; Heller, 1975) suggest that the higher tax burden has been squandered on non-productive forms of public spending.

The major work in the literature regarding this issue is Heller's (1975) paper, in which he postulates a maximizing policy maker and derives consistent behavioral equations in order to estimate the impact of foreign aid on various government expenditures and revenues. One problem with Heller's and other earlier studies is that the data used are a pooled cross section of different countries with a few time-series observations. Hence, to draw any valid conclusions about a single country from such data may be questionable. In this chapter, we employ a similar framework as Heller (1975) and use consistent time-series data for Jordan. Furthermore, the full system of simultaneous equations is estimated using a three-stage least square procedure, which will be discussed later.

In this chapter, the effectiveness of foreign aid in meeting the development efforts in Jordan is analyzed in a model which decomposes the effect of various foreign aid components on alternative aggregate public expenditures and domestic revenues. This study will shed some light on how the fiscal behavior of one developing country may compound its debt repayment problem and eventually reach a debt crisis. This model will distinguish between types of foreign aid (grants vs. loans).

II. METHODOLOGY

One approach to the understanding of the fiscal behavior of the public sector is to assume that it reflects the actions of a set of public decision-makers (i.e., Council of Ministers). The government attempts to maximize its own welfare in the face of budgetary constraints, i.e., the alternative uses of public resources, and will use foreign capital inflows, especially foreign aid, in the pursuit of that objective.

Following Heller (1975), Mosley *et al.* (1987), and Otim (1996), for any period t, we assume the following utility function of the decision-maker:

$$U = F\,(I_g,\, G_c,\, G_s,\, T,\, B,\, A) \tag{34}$$

where U = welfare of public-sector decision-makers, I_g = public investment expenditures for development purposes, G_s = public socioeconomic expenditures, G_c = public civil (administrative expenditures), T = total tax revenues collected by the government (it includes both direct and indirect taxes), B = public borrowing from domestic sources; and A = total net foreign grants received by the government A_1, plus total net foreign loans to the government from all sources A_2.

Public expenditures can be decomposed into three main categories: civil consumption in the public sector (G_c), socioeconomic consumption (G_s), and public investment (I_g). Civil consumption includes public sector spending relating to the fundamental needs of the state to function and maintain its political existence. It includes expenditures, capital and recurrent, for government administration, diplomatic and international affairs, and preserving internal and external security (police and armed forces). Also, a fraction is for subsidies and transfers to households and non-governmental agencies. Socioeconomic expenditures include all current non-capital spending for socioeconomic ends, including spending on schools, hospitals, and health centers, for maintenance of roads and communication networks. Public investment expenditures, I_g, are the public sector's contribution to gross capital formation (i.e., buildings and construction, transport equipment, agricultural mechanization, etc.). Theoretically, it might be expected that both G_s and I_g have an impact on growth, but from a policy-maker's perspective, G_s is usually not regarded as investment but instead as a form of consumption with no developmental impacts.

Public expenditures can be financed by two means, domestic and/or foreign sources. Domestic sources will include taxation and domestic borrowing. However, increases in taxes may become increasingly difficult for the public decision-maker to advocate both because of the increased administrative difficulty of collecting the taxes and the economic cost and political resistance found in low-income countries such as in Jordan. Since the choice of a tax rate is a policy instrument available to public decision-makers, it follows that T is endogenous. Borrowing locally constitutes an alternative of resource mobilization, but it will also yields disutility to the public decision-maker. The net increase in the public sector's long-term domestic-debt is traditionally seen as fiscal irresponsibility if it occurs in more than limited amounts and unless it is used to finance public investment. Finally, capital inflows from abroad to the public sector are assumed to be exogenous. These inflows are controlled by aid-giving agencies, which are motivated by political and economic factors. Although it is possible for a government to reject aid impaired by heavy political and economic implications, we shall assume, at least for the case of Jordan, that this is uncommon. A further plausible assumption is that the government is not in a position to significantly increase the level of capital inflows beyond what is actually offered.

The welfare function is defined as a "loss function" that is quadratic in deviations of the various "intermediate targets" from their desired values. The further the variables stray from their targets, the lower the level of public utility. In microeconomics, this is analogous to risk-averting behavior involving choice under uncertainty. Thus, the public policy-makers are assumed to maximize the following quadratic objective function:

$$U=\beta_0+\beta_1 (I_g-I_g^*)-(\frac{\beta_2}{2}) (I_g-I_g^*)^2+\beta_3 (G_c-G_c^*)-(\frac{\beta_4}{2})(G_c-G_c^*)^2+$$

$$\beta_5(G_s-G_s^*)-(\frac{\beta_6}{2})(G_s-G_s^*)^2-\beta_7(T-T^*)-$$

$$(\frac{\beta_8}{2})(T-T^*)^2-\beta_9(B-B^*)-(\frac{\beta_{10}}{2})(B-B^*)^2 \tag{35}$$

where the variables are as defined previously, $\beta_i \geq 0$, and *asterisks* denote desired values of intermediate targets. These targets are the expenditures and receipts that policy-makers plan to meet, and deviating from them is undesirable.

We now turn to formulate the economic and institutional constraints to which this maximization problem is subject. The first constraint is budgetary. All government expenditures must, one way or another, be financed. The simplest way to formulate this constraint is by balancing all outflows by inflows:

$$T + B + A_1 + A_2 = I_g + G_c + G_s \tag{36}$$

However, in most LDCs, as is the case in Jordan, it is uncommon for recurrent government expenditures (G_s + G_c) to be financed by domestic borrowing. Hence, we postulate both of these expenditures to be mainly financed from tax revenues and aid receipts alone:

$$G_c + G_s = \beta_{13}T + \beta_{14}(A_1) + \beta_{15}(A_2) \tag{37}$$

Thus,

$$I_g = B + (1-\beta_{13})T + (1-\beta_{14})A_1 + (1-\beta_{15})A_2 \tag{38}$$

where $0 \leq \beta_{ij} \leq 1$, i = 1, 2, 3, and j = 3, 4, 5. The level of (1 - β_{13}) reflects the government's belief as to the maximum it can realistically "save" from the current budget, and that enters as a constraint on its decision, but it is not an additional policy variable. On the other hand, (1 - β_{14}) and (1 - β_{15}) are the fractions of foreign grants (A_1) and foreign loans (A_2) going to government investment, respectively. The second constraint (38) allows for the possibility that I_g, can be financed partly by taxes and domestic borrowing as well as by different types of foreign aid. Also, the first constraint

(37) allows for foreign aid not used in public investment to go towards socioeconomic and civil expenditures in addition to the portion of taxes that is not invested. As a result, a trade-off exists between I_g, and both G_c and G_s, and, more generally, between more and less productive resources (in terms of fostering growth) of all government revenues. The direction of the impact of foreign aid on G_c, G_s, I_g, and T will be evaluated once the parameters of the model are specified and estimated.

Based on planning behavior of most developing countries, as is the case with Jordan policy-makers, we assume that the desired values of target variables G^*_c, G^*_s, I^*_g, T^*, and B^* are derived from observable macroeconomic data according to the following relationships:

$$I_g^* = \alpha_{10} + \alpha_{11} I_{g,t-1} + \alpha_{12} Y_t + \alpha_{13} Y_{t-1} + \alpha_{14} I_{p,t-1} + \alpha_{15} W_t + \varepsilon_{1t} \tag{39}$$

$$T^* = \alpha_{20} + \alpha_{21} T_{t-1} + \alpha_{22} Y_{t-1} + \alpha_{23} M_{t-1} + \alpha_{24} W_t + \varepsilon_{2t} \tag{40}$$

$$G_c^* = \alpha_{30} + \alpha_{31} G_{c,t-1} + \alpha_{32} Y_{t-1} + \alpha_{33} W_t + \varepsilon_{3t} \tag{41}$$

$$G_s^* = \alpha_{40} + \alpha_{41} G_{s,t-1} + \alpha_{42} Y_t + \varepsilon_{4t} \tag{42}$$

$$B^* = 0 \tag{43}$$

where I_p is investment spending by the private sector, Y is real gross domestic product, M_{t-1} is lagged imports, and W_t is a war time dummy variable, which captures periods of turmoil, political unrest, and war for the Jordanian state. The rationale behind each specification is as follows. The target level of public investment I^*_g is derived mainly from, first, a target rate of growth for the economy's GDP (most developmental plans in LDCs set a target rate a priori, as the case in Jordan). Second, an assumption about current period's level of private investment and finally, an assumption about the capital-output ratio, where public investment is planned in order to provide the "residual" needed to derive up the actual growth rate to its target level. In a Harrod-Domar framework, we can postulate that for a given target growth rate, I^*_g will be related positively to output in previous periods, and inversely to private investment (I_g and I_p can have a positive relationship if such investments are complementary in technology). Finally, it is expected that in periods of political unrest and wars, this targeted level will decline, since the state will allocate extra funds to higher priorities, i.e., military and internal security spending.

Target level of tax revenue T^* is derived from estimates of the two bases for taxation, income and international trade (imports). Targeted taxes are expected to be adversely affected in periods of war. The desired level of civil consumption target G^*_c consists in normal years of a standard increment on its last period's value and previous level of income, but it is expected to take a sharp upward jump in years when the country is at war. Similarly, the socioeconomic spending target G^*_s is planned to grow in proportion to previous income and its past values. Finally, it is assumed that *ex ante*, the target for domestic borrowing B^*, is equal to zero. This would not preclude a positive level of domestic borrowing.

III. EMPIRICAL FRAMEWORK

From Equations 35, 37, and 38, the following Lagrangian function is formulated:

$$Max\, L = \beta_0 + \beta_1(I_g - I_g^*) - (\frac{\beta_2}{2})(I_g - I_g^*)^2 + \beta_3(G_c - G_c^*) - (\frac{\beta_4}{2})(G_c - G_c^*)^2$$

$$+ \beta_5(G_s - G_s^*) - (\frac{\beta_6}{2})(G_s - G_s^*)^2 - \beta_7(T - T^*) - \beta_9(B - B^*)$$

$$-(\frac{\beta_{10}}{2})(B-B^{*})^{2}+\lambda_{1}\{I_{g}-B-(1-\beta_{13})T-(1-\beta_{14})A_{1}-(1-\beta_{15})A_{2}\}$$

$$+\lambda_{2}\{G_{s}+G_{c}-\beta_{13}T-\beta_{14}A_{1}-\beta_{15}A_{2}\} \tag{44}$$

where λ_1 and λ_2 are the Lagrangian multipliers associated with constraints (4) and (5), respectively. From Equation 44, the first-order conditions are:

$$\frac{\partial L}{\partial I_{g}}=\beta_{1}-\beta_{2}(I_{g}-I_{g}^{*})+\lambda_{1}=0 \tag{45}$$

$$\frac{\partial L}{\partial G_{c}}=\beta_{3}-\beta_{4}(G_{c}-G_{c}^{*})+\lambda_{2}=0 \tag{46}$$

$$\frac{\partial L}{\partial G_{s}}=\beta_{5}-\beta_{6}(G_{s}-G_{s}^{*})+\lambda_{2}=0 \tag{47}$$

$$\frac{\partial L}{\partial T}=\beta_{7}-\beta_{8}(T-T^{*})-\lambda_{1}(1-\beta_{13})-\lambda_{2}\beta_{13}=0 \tag{48}$$

$$\frac{\partial L}{\partial B}=-\beta_{9}-\beta_{10}(B-B^{*})+\lambda_{1}=0 \tag{49}$$

$$\frac{\partial L}{\partial \lambda_{1}}=I_{g}-B-(1-\beta_{13})T-(1-\beta_{14})A_{1}-(1-\beta_{15})A_{2}=0 \tag{50}$$

$$\frac{\partial L}{\partial \lambda_{2}}=G_{s}+G_{c}-\beta_{13}T-\beta_{14}A_{1}-\beta_{15}A_{2}=0. \tag{51}$$

Letting $B^{*}=0$, substituting the λ_{s} and rearranging the first order conditions, we get:

$$G_{s}=\frac{(\beta_{5}-\beta_{3})}{(\beta_{6}+\beta_{6})}-(1-\frac{\beta_{6}}{\beta_{6}+\beta_{4}})(G_{c}^{*})+\frac{\beta_{6}}{(\beta_{6}+\beta_{4})(G_{s}^{*})}+\beta_{13}(1-\frac{\beta_{6}}{(\beta_{6}+\beta_{4})})(T)$$

$$+\beta_{14}(1-\frac{\beta_{6}}{(\beta_{6}+\beta_{4})})(A_{1})-\beta_{15}(1-\frac{\beta_{6}}{(\beta_{6}+\beta_{4})}(A_{2}) \tag{52}$$

$$G_c = -\frac{(\beta_5 - \beta_3)}{(\beta_6 + \beta_4)} + (\frac{(1-\beta_6)}{(\beta_6 + \beta_4)}).(G_c^*) - \frac{\beta_6}{(\beta_6 + \beta_4)(\beta_{13})(T)}$$

$$+ \frac{\beta_6}{(\beta_6 + \beta_4)(\beta_{14})(A_1)} + \frac{\beta_6}{(\beta_6 + \beta_4)(\beta_{15})(A_2)} \tag{53}$$

$$T = \frac{[(\beta_3)(\beta_{13}) - (\beta_7) + \beta_9(1-\beta_{13})]}{[(\beta_8 + \beta_{10}(1-\beta_{13})^2]} + \frac{(\beta_{13})(\beta_4)}{((\beta_8 + \beta_{10}(1-\beta_{13})^2)(G_c - G_c^*)}$$

$$\frac{\beta_8}{(\beta_8 + \beta_{10}(1-\beta_{13})^2)(T^*)}$$

$$+ \frac{\beta_{10}}{((\beta_8 + \beta_{10}(1-\beta_{13})((I_g - (1-\beta_{14})(A_1) - (1-\beta_{13})(A_2))} \tag{54}$$

$$I_g = \frac{(\beta_1 - \beta_9)}{(\beta_2 + \beta_{10})} + \frac{(1-\beta_{10})}{(\beta_2 + \beta_{10})(I_g^*)}$$

$$+ \frac{\beta_{10}}{(\beta_2 + \beta_{10})[(1-\beta_{13})(T) + (1-\beta_{14})A_1 + (1-\beta_{15})A_2]} \tag{55}$$

Let:

$$\Phi_1 = \frac{(\beta_5 - \beta_3)}{(\beta_6 + \beta_4)} \quad ; \quad \Phi_2 = \frac{\beta_6}{(\beta_6 + \beta_4)}$$

$$\rho_1 = \beta_{13} \; ; \; \rho_2 = \beta_{14} \; ; \; \rho_3 = \beta_{15}$$

$$\Phi_3 = \frac{(\beta_3)(\rho_1) - \beta_7 + (\beta_9)(1-\rho_1)}{\beta_8 + \beta_{10}(1-\rho_1)^2}$$

$$\Phi_4 = \frac{\beta_4}{\beta_8 + \beta_{10}(1-\rho_1)^2}$$

$$\Phi_5 = \frac{\beta_8}{\beta_8 + \beta_{10}(1-\rho_1)^2}$$

$$\Phi_6 = \frac{\beta_{10}}{\beta_8 + \beta_{10}(1-\rho_1)^2}$$

$$\Phi_7 = \frac{\beta_1 - \beta_9}{\beta_2 + \beta_{10}}; \quad and$$

$$\Phi_8 = \frac{\beta_{10}}{\beta_2 + \beta_{10}} \cdot$$

Then our structural equations to be estimated are:

$$G_s = \Phi_1 - (1-\Phi_2)G_c^{\bullet} + \Phi_2 G_s^{\bullet} + \rho_1(1-\Phi_2)T$$
$$+ \rho_2(1-\Phi_2)A_1 - \rho_3(1-\Phi_2)A_2 \tag{56}$$

$$G_c = -\Phi_1 + (1-\Phi_2)G_c^{\bullet} - \Phi_2 G_s^{\bullet} + \Phi_2\rho_1 T + \Phi_2\rho_2 A_1 + \Phi_2\rho_3 A_2 \tag{57}$$

$$T = \Phi_3 + \rho_1\Phi_4(G_c^{\bullet} - G_c) + \Phi_5 T^{\bullet} + \Phi_6(1-\rho_1)[I_g - (1-\rho_2)A_1 - (1-\rho_3)A_2] \tag{58}$$

$$I_g = \Phi_7 + (1-\Phi_8)I_g^{\bullet} + \Phi_8[(1-\rho_1)T + (1-\rho_2)A_1 - (1-\rho_3)A_2] \tag{59}$$

V. DATA AND ESTIMATION

To estimate Equations 39 through 42, and the system of structural Equations 56, 57, 58, and 59 (simultaneous equations), we use macroeconomic time-series data for the Jordanian economy during the period 1964-95. The sources for the data set are (1) The Central Bank of Jordan, (2) International Monetary Fund, and (3) the United Nations National Accounts Statistics. All data are expressed in logarithms, and as preliminary data analysis, all series are first checked for stationarity. The Philips-Perron test for a unit root is performed on each series and the results are reported in Table 14. Structural Equations 56 through 59 are estimated using nonlinear three-stage least square

(NL3SLS), following guidelines in Judge *et al.* (1988). By fitting regression Equations 39 though 42, the target values of the dependent variables are derived by using the ordinary least square (OLS) procedure. To test for the presence of autocorrelation, the Breusch-Godfrey test, which is a Lagrangian multiplier (LM) test, is applied.[18] On the basis of the above test, we fail to reject the null hypothesis of no autocorrelation for Equations 39, 40, 41, and 42 at the 1% significance level. A nonlinear three-stage least square (NL3SLS) procedure using a GAUSS-NEWTON algorithm estimates the simultaneous equation system, Equations 56 through 59. To briefly summarize the nonlinear least square estimation and the above algorithm, we consider a simple single parameter model, where we can generalize the results to several parameter cases. Consider the following model:

$$Y_t = f(X_t, B) + U_t$$

$$= \mathrm{B}_1 X_{t1} + B_2 X_{t2} + U_t \tag{60}$$

where $\mathrm{B}_2 = \mathrm{B}_1^2$, U_t are independent and identically distributed random variables with $E(U_t) = 0$, and $E(U\,U') = \sigma^2$, Y_t is the dependent variable, and X_t is the explanatory variable, X_{t1} and X_{t2}, respectively. The nonlinear least square estimate for B will be the value of B that minimizes the residual sum of squares R(B):

$$R(B) = \sum_{t=1}^{T} [Y_t - f(X_t, B)]^2 \tag{61}$$

the minimum value of B occurs where $\frac{d\,\mathrm{R(B)}}{d\mathrm{B}} = 0$:

$$\frac{dR}{dB} = -2\sum_{t=1}^{T} [\mathrm{Y}_t - f(\mathrm{X}_t, \mathrm{B})]\left(-\frac{\mathrm{df(X_t, B)}}{\mathrm{dB}} \right) = 0\,. \tag{62}$$

[18] For more details on the Breusch-Godfrey test (LM), see Green (1990).

Solving Equation 62, we find that the least squares estimate b must satisfy:

$$= 2b^3\sum_{t=1}^{T} X_{t2}^2 + 3b\sum_{t=1}^{T} X_{t1}X_{t2} + b\left(\sum_{t=1}^{T} X_{t1}^2 - 2\sum_{t=1}^{T} X_{t2}Y_t\right)$$

$$-\sum_{t=1}^{T} X_{t1}Y_t = 0 \tag{63}$$

Equation 63 is a cubic equation in the parameters B, and its solution yields three different possible results. The nonlinear least square estimate b is the solution, which minimizes the residual sum of squares R(B), which is known as the global minimum. The primary difficulty lies in: (1) finding an analytical expression that solves Equation 63 and an estimate for b, and (2) the existence of three possible solutions that satisfy Equation 63 since it is a cubic function. Generally, it is not possible to use the first-order conditions for a minimum to derive an analytical expression for the nonlinear least square estimator. To find a single nonlinear least squares estimate b for the single parameter B, a numerical method must be used. One possible procedure is to use the GAUSS-Newton algorithm. This algorithm begins with some initial value for B, which might be a guess or can be suggested by an estimate of an approximate linear model. The sum of squares function R(B) is computed for such an initial value. Then, we change the initial parameter value in a direction that will lead to a further reduction in R(B). A new parameter value is found and the process is repeated until a point is reached where a change in the parameter will not reduce R (B) any further. At this point the algorithm has converged. The question that arises is whether this point is a global or a local minimum. The usual and best way of increasing the probability of locating the global minimum is to carry out the process with as many different initial values. If convergence to the same point occurs over time, there is a good chance that the global minimum has been reached. The algorithm main goal is to find a value of B that satisfies Equation 63. Replacing $f(X_t, B)$ by a first-order linear Taylor series approximation and beginning with some initial value for B, i.e., B_1, the first-order approximation can be written as:

$$f(X_t, B) \cong f(X_t, B_1) + R_t(B_1).(B - B_1) \tag{64}$$

where $R_t(B_1) = \frac{df(X_t, B)}{dB}$ evaluated at B_1, and $R_t(B_2)$ would be evaluated at B_2, and so on. Using this notation and substituting the Taylor series approximation in Equation 64 into the residual sum of squares function in Equation 61 yields:

$$R(B) = \sum_{t=1}^{T}[Y_t - f_{t1} - R_t(B_1)(B - B_1)^2]$$

$$= \sum_{t=1}^{T}[\overline{Y}_t(B_1) - R_t(B_1).B]^2 \tag{65}$$

where $f_{t1} = f(X_t, B_1)$, f_{t2} would be $f(X_t, B_2)$, and so on, and $\overline{Y}_t(B_1) = Y_t - f_{t1} + R_t(B_1).B_1$. Hence, for a given value of B_1, both $\overline{Y}_t(B_1)$ and $R_t(B_1)$ are observable. The residual sum of squares in Equation 65 can be viewed as that which needs to be minimized to find the least squares estimate for B from the linear model:

$$\overline{Y}_t(B_1) = R_t(B_1).B + U_t \tag{66}$$

and the least squares estimate from Equation 66 is given by:

$$B_2 = \frac{\sum_{t=1}^{T}\overline{Y}_t(B_1).R_t(B_1)}{\sum_{t=1}^{T}R_t(B_1)^2} \tag{66`}$$

$$= [R(B_1)' R(B_1)]^{-1} R(B_1)\overline{Y}(B_1) \tag{67}$$

where

$$R(B_1) = \begin{bmatrix} R_1(B_1) \\ R_2(B_2) \\ \cdot \\ \cdot \\ \cdot \\ R_T(B_1) \end{bmatrix} \qquad \text{and} \qquad \overline{Y}(B_1) = \begin{bmatrix} \overline{Y}_1(B_1) \\ \overline{Y}_2(B_1) \\ \cdot \\ \cdot \\ \cdot \\ \overline{Y}_T(B_1) \end{bmatrix}.$$

The above shows that if we begin by an initial value or a guess for B, i.e., B_1, and approximate the function f_{t1} by a first-order Taylor series approximation around B_1, then a second estimate for B, i.e., B_2, is found by applying least square a new linear model as in Equation 66. We can continue this process using B_2 to construct another linear model, which will lead the least squares estimate B_3; continuing the process leads to a sequence of estimates B_4, B_5, …, and the $(n+1)_{th}$ from the n estimate can be written as:

$$\mathrm{B}_{n+1} = [\mathrm{R}(\mathrm{B}_n)']^{-1}\mathrm{R}(\mathrm{B}_n)'\overline{\mathrm{Y}}(\mathrm{B}_n)$$

$$= [\mathrm{R}(\mathrm{B}_n)'\mathrm{R}(\mathrm{B}_n)]^{-1}\mathrm{R}(\mathrm{B}_n)'[\mathrm{Y} - \mathrm{f}(\mathrm{X},\mathrm{B}_n) + \mathrm{R}(\mathrm{B}_n)\,.\,\mathrm{B}_n$$

$$= \mathrm{B}_n + [\mathrm{R}(\mathrm{B}_n)\mathrm{R}(\mathrm{B}_n)]^{-1}\mathrm{R}(\mathrm{B}_n)'[\mathrm{Y} - \mathrm{f}(\mathrm{X},\mathrm{B}_n)] \qquad (68)$$

where f (X,B) = [f(X_1, B), f(X_2, B), …, f(X_T, B)] , and the first-order condition for a minimum can be written in matrix notation as:

$$\mathrm{R}(\mathrm{B})'[\mathrm{Y} - \mathrm{f}(\mathrm{X},\mathrm{B})] = 0 \qquad (69)$$

If two successive estimates are equal, i.e., $B_{n+1} = B_n$, it follows from Equation 68 that $R(B_n)'[Y - f(X,B_n)] = 0$. Hence B_n satisfies the necessary condition for a minimum. Thus, starting with an initial value B_1, and repeatedly applying Equation 68 until convergence occurs, we have reached a solution that satisfies the first-order conditions in Equation 69. The solution may converge to a local rather than a global minimum. One possibility of locating the global minimum, or at best increasing the probability of identifying it, is carrying out the process for a number of different starting values. If different starting values lead to a different minimum, the one with the least residual sum of squares is the solution to the nonlinear squares estimate.

VI. EMPIRICAL RESULTS

Table 15 presents OLS regression estimates obtained in fitting the equations of the target values of the dependent variables. These equations fit well as the adjusted coefficient of determination ($\overline{R}^2$) suggest. The coefficients for the two lagged consumption expenditures G_c and G_s are positive and statistically significant at the 1% level as expected. These coefficient estimates are consistent with policy-makers' behavior in the third world in general and in Jordan in particular. Also, expected levels of lagged real output Y, are positive and significant in both G_c and G_s equations at the 5% and 10% levels, respectively. This is another indication that in planning the targeted level of both of these expenditures, the previous year's level of income is important. On the other hand, the war dummy variable is insignificant in the G_c equation, an indication that war has no impact at least in the case of Jordan at the targeted G_c expenditures.

The results of the OLS estimates of the target values of the two consumption expenditures are also similar to those obtained for the two target values tax, T, and government investment, I_g. A positive and significant coefficient at the 10% level is found for lagged GDP, and a positive and significant coefficient is found for lagged imports, which are the two main bases for taxation in Jordan. This is an indication that an increase in both real income and imports leads to higher target taxation for increasing revenues. Also, a negative and significant coefficient at the 10% level is found for the war dummy variable, another indication that periods of war and political instability in Jordan lead to a decline in target taxation efforts.

Finally, the estimated coefficients for the target value of government investment are also statistically significant at the 1% and 5% level of significance. Both lagged government investment and lagged GDP are positive and significant as expected. Note that the coefficient on lagged private investment is positive and statistically significant at the 5% level of significance. This is an indication that an increase in government investment does not crowd out private investment and vice versa. In Jordan an increase in government investment leads to higher private investment spending. This may be explained by the possibility of a positive linkage between government and private investment if both are technologically complementary. A positive and significant coefficient at the 1% level of significance on the dummy war variable indicates that in periods of war the Jordanian government pulls funds from investment towards other ends. In this particular case, the reduction in government investment due to wartime can be explained by a reduction in the tax efforts in the tax equation due to the same reason.

Table 16 provides our estimates for the budgetary impact of foreign aid grants and loans to Jordan. The crucial budget constraint parameters showing both consumption expenditures (G_C and G_S) responses to increases in tax revenues, grants, and loans are p_1, p_2, and p_3, respectively. The proportion of tax revenues that remain in the Jordanian current budget as shown by p_1 is 140%, and that coefficient is significant at the 1% level of significance. This implies that in Jordan, tax revenues are not used to finance any investment projects, and when the tax burden is raised there is a tendency to pull funds out of investment projects to supplement other consumption expenditures ($p_1 > 1$). It is important to note, however, the possibility that p_1 is unity because of foreign aid; if these additional resources (aid) are nonexistent, the Jordanian government may indeed finance public investment from current taxation. The results on foreign aid grants indicate that 50% of total official grants received by the Jordanian government leak into consumption as shown by the significant coefficient, p_2, at the 1% level. On the other hand, the foreign aid loans coefficient, p_2, is insignificant, which implies that foreign aid loans do not have any significant effect on government consumption, while domestic resources and foreign aid grants are used to finance such consumption expenditures.

The tax coefficients indicate that the presumption that domestic resources (tax and non-tax revenues) are usually used for the daily expenses of running a country is true and holds for Jordan. Thus, in the presence of foreign aid, all tax revenues leak into consumption. On the other hand, almost half of the grants received by the government leak into consumption, which can be explained by the fact that grants are considered to be outright gifts from donor countries that entail no future repayment. Finally, all loans are used to finance public investment, which can be explained by (1) tying conditions to specific projects that allow for no fungubility in loans, and (2) loans are to be paid back, which requires future stream of income from those loans to enable the government to do so in the future. The differential impact of loans and grants is not surprising. Grants have a more stimulative impact on government consumption, and a weaker one on government investment. The above results contrast sharply with those obtained by Otim's (1996) cross-country study of three low-income Asian countries and mildly with Gang and Khan's (1991) study based on Indian data. Otim's (1996) study finds the proportion of tax revenues (p_1) that remain in the current budget to be –0.37, the share of foreign aid grants (p_2) that remain in the current budget to be 0.344, and the share of foreign aid loans allocated to government consumption to be 0.18. Gang and Khan (1991) find the proportions of the three budget constraint parameters p_1, p_2, and p_3, to be 1.08, -0.79, and –0.03, with the last two to be insignificant where they conclude that foreign aid grants and loans do not have any statistically significant impact on government consumption. On the other hand, our results coincide more to those of Heller's (1975) cross-country study data of nine African countries. He finds the proportion of tax revenues (p_1) that remain in the current budget to be 78%, the share of grants allocated to government consumption (p_2) to be 65%, and the share of foreign aid loans allocated to government consumption to be insignificant.

The ϕ_s tell us something about the functioning of the Jordanian public sector. ϕ_2 relate public socioeconomic consumption to both the revenue side and targeted expenditures of the current budget. For targeted expenditures, a positive and significant ϕ_2 at the 1% level of significance implies that setting a higher targeted G_s leads the Jordanian public sector to proportionally allocate more funds to G_s and less to G_c. Also, it implies that by setting a higher targeted G_c, less will be devoted to G_s (since G_c and G_s are competing expenditures in the government budget). On the revenue side, ϕ_2 indicate what proportion of foreign aid and taxes that go to G_s and G_c. For example, out of the 50% of grants that go to consumption, 35.5% go to G_c while only 14.5% go to G_s. Also, a higher proportion of tax revenue is pulled out for G_c (104%) compared to that pulled out for G_s (40%).

ϕ_4 and ϕ_5 explain the link between targeted and actual expenditures and the tax burden. By assuming that targeted civil and administrative expenditures, G_c^*, exceed the actual expenditures, G_c, with p_1 greater than one and ϕ_4 greater than zero, indicates the tax burden is increased, since the authorities need to increase taxes to cover unintended expenditures. On the other hand, if G_c^* is less than G_c, with p_1 greater than zero and positive ϕ_4, the tax burden is reduced . ϕ_5 close to one (0.94) indicates that in the case of Jordan higher targeted taxes translate directly to actual taxes by the authorities. A positive and significant ϕ_6 at the 1% level of significance indicates that the presence of foreign aid reduces the public sector taxation effort. This result again contrasts sharply with Otim's (1996) and Gang and Khan's (1991) results in this regard. Finally, the estimate ϕ_8 indicates that public investment is closely related to targeted investment decisions and not so much by revenues since it is not significantly different from zero.

VI. CONCLUDING REMARKS

The purpose of this study was to examine the impact of foreign aid grants and loans on a developing country (Jordan). The limitations of earlier studies that used pooled cross-section data and inappropriate methods of estimation motivated this work. We have used time-series data for a single country, i.e., Jordan, and attacked the estimation problem by employing a method of estimation for a system of simultaneous equation with non-linearity in the parameters. The results we found contrast with earlier work regarding the impact of foreign aid (grants and loans) on the fiscal behavior. The results confirm that foreign aid affects both the revenue and the expenditure side of the Jordanian government budget. On the consumption side, we found out that foreign aid grants are treated as an increase in income, and given positive income elasticity in the public sector, consumption expenditures will rise. On the other hand, foreign aid loans have no significant impact on government consumption so that the income elasticity with respect to foreign aid loans is said to be very close to zero. Thus, if the purpose of aid is to generate higher investment levels, donor countries ought to extend more foreign aid loans to Jordan than grants since loans lead to more investment and hence more future growth and income. The results also indicate that domestic tax revenue is used to finance both civil and socioeconomic consumption expenditures, and in the presence of foreign aid grants and loans, an increase in taxes leads to an increase in consumption and vice versa. Hence, the propensity to consume out of additional taxes is much higher in Jordan in the presence of foreign aid. Accordingly, any increase of consumption in Jordan will be financed largely out of increased taxes and out of foreign aid grants and not out of loans as indicated earlier.

The results also show that in the presence of foreign aid, Jordan's public sector reduces its efforts to collect taxes. Hence, countries extending foreign aid to Jordan should stress the necessity of programs for mobilizing government saving by either raising the ratio of tax collection to GDP (the tax ratio), through reforms in the tax structure or via increases in existing tax rates. This can be achieved if donors to Jordan utilize tax ratios and tax effort indices as main indicators of national commitment where more aid is possible only if that commitment by Jordan is met.

Given the above, the Jordanian government needs to focus heavily on mobilizing domestic resources and on increasing its tax efforts. Also an efficient allocation policy is called for that channels foreign aid inflows to projects that are highly productive if the purpose is to increase investment and raise future income. Additional research in this area can be conducted by further isolating the effects of foreign aid into short-term versus long-term, and multilateral versus bilateral.

Table 14. *Testing for stationarity using 17 variables*

Series	The Philips – Perron Z_t (q) test		
	q = 3	q = 2	q = 1
G_c^*	3.76[1]	1.76[2]	2.03[2]
G_s^*	2.27[2]	1.88[3]	3.24[1]
T^*	2.31[2]	2.79[1]	3.03[1]
I_g^*	-2.10	-2.09[3]	-2.10
GDP	2.13[2]	2.38[2]	2.48[2]
I_g	-2.59	-2.59	-2.66[3]
I_p	1.79[3]	1.63[3]	1.52
T	4.76[1]	2.31[2]	3.18[1]
M	1.96[2]	2.10[2]	2.40[2]
G_c	2.75[1]	1.43	1.50
G_s	2.86[1]	1.76[3]	2.05[2]
A_1	-2.95[2]	-2.90[3]	-2.46
A_2	-4.08[1]	-4.00[2]	-4.16[2]

[1] Indicates significance at 1% significance level.
[2] Indicates significance at 5% significance level.
[3] Indicates significance at 10% significance level.

Table 15. *OLS regression estimates of the target values of the dependent variables*[1]

Regressors	Dependent variables			
	I_g	T	G_c	G_s
Constant	3.69 (1.03)	-1.36 (1.25)	-0.26 (0.83)	-1.23 (0.73)
GDP_{t-1}	-0.51 (0.20)	0.32 (0.28)	0.36 (0.19)	
$I_{g, t-1}$	0.64 (0.09)			
$I_{p, t-1}$	0.34 (0.14)			
T_{t-1}		0.45 (0.23)		
M_{t-1}		0.31 (0.13)		
$G_{s, t-1}$				0.59 (0.14)
$G_{c, t-1}$			0.61 (0.14)	
W_t	-0.46 (0.10)	-0.14 (0.07)	-0.05 (0.10)	
$\bar{R}^2$	0.87	0.95	0.82	0.89

[1] Standard errors are in parentheses below the coefficients.

Table 16. *Nonlinear three-stage least squares (3SLS) estimates of the fiscal impact of foreign aid grants and loans to Jordan (number of observations = 30)*

Parameter	Coefficient	Standard error	t "Ratio"	Approximate prob. > $\lvert t \rvert$
p_1	1.44	0.04	35.54	0.000
p_2	0.50	0.04	11.5	0.000
p_3	-0.01	0.01	-0.55	0.576
ϕ_1	-0.04	0.03	-1.13	0.257
ϕ_2	0.71	0.03	23.1	0.000
ϕ_3	0.11	0.14	0.79	0.428
ϕ_4	0.08	0.09	0.98	0.324
ϕ_5	0.94	0.02	33.7	0.000
ϕ_6	0.17	0.07	2.25	0.026
ϕ_7	0.05	0.05	1.13	0.257
ϕ_8	0.18	0.06	2.69	0.008

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

The impact of foreign resources (foreign aid) on the growth and development of recipient countries, the least to say, is controversial. In the 1950s, the United States, a capital surplus nation, started foreign assistance programs to help many LDCs to grow. In the same period, many LDCs resorted to foreign capital acquisition, especially foreign aid, to achieve desired rates of output growth. The failure of foreign aid to bring about prosperity and growth to some LDCs led to a series of debates between economists and policy-makers regarding the impact of foreign resources on growth and development.

Many empirical studies were conducted and the results obtained were not conclusive, whether those studies used cross-country or time-series approaches. Needless to say, most of the literature cited previously focused on a static relationship rather than a dynamic one among aid, domestic savings, and output growth. Since we have found that foreign resources (foreign aid) exerted an overall negative impact on domestic resources (domestic saving) in Jordan, the results obtained raise the concern over the possible recovery of domestic saving once foreign aid ceases. If we assume that the domestic saving ratio will recover once foreign aid is withdrawn, then it would be difficult to argue that foreign resources could have a harmful effect on growth.

If foreign aid did reduce the domestic saving ratio (as we have found), and if that ratio recovers instantly, aid-receiving Jordan could hardly be worse off, in a sense of having a lower growth rate as a direct result of obtaining foreign aid. On the other hand, if the public sector raises its consumption expenditures to unsustainable levels, lowers its taxes or the effort to collect taxes, and relies heavily on foreign resources as an available substitute to finance public expenditures, aid-receiving Jordan will be worse off. In the case of Jordan, we found that the Jordanian public sector relaxed its efforts to collect taxes, and in the presence of foreign aid the Jordanian government had less incentive to raise taxes as one way of increasing the domestic saving ratio. This by itself may lead the government to delay some necessary measures such as privatization, subsidy removal, and a possible restructure of the government personnel and behavior. Examples of the above may be reduction in the number of civil servants, reduction in the size of the army, and more importantly a reduction in government conspicuous spending such as acquiring ostentatious buildings and expensive luxury automobiles for public officials. Since aid prompted the public sector to increase most, if not all, of the above-mentioned expenditures, the country is stuck with these actions long after aid is terminated and the country will consume a larger share of the budget at the expense of public savings. Because the above expenditures were originated in a period when foreign resources paid the bill, these expenditures could become a serious drag on the economy after donor support comes to a halt.

By focusing on the issue of the relative contribution of domestic resources versus foreign resources in promoting economic growth in Jordan, it appears that foreign resources performed better than domestic ones in promoting growth. With respect to the contribution of the components of foreign aid, namely, foreign aid grants and foreign aid loans, we found that both grants and loans contributed positively to output growth, with foreign aid loans being the factor behind fostering a short-run positive impact on output growth, while foreign aid grants fostered a long-run positive impact on growth. We also found that foreign aid grants and domestic resources are substitute inputs (grants exerted a negative long-run dynamic impact on domestic savings), while foreign aid loans and domestic resources are complementary inputs (loans exerted a positive long-run dynamic impact on domestic savings). In the case of Jordan, it appears that loans are more effectively utilized while grants are not, since grants need not be repaid. It is possible that the government authorities may have allowed various administrative slack and perhaps tolerated a greater degree of corruption in grant utilization.

We also found the following: (1) Foreign aid (grants and loans) affects the revenue and the expenditure side of Jordanian government budget; (2) foreign aid grants are treated as an increase in income and, given a positive income elasticity in the public sector, the presence of foreign grants will raise public consumption expenditures at the expense of public investment; (3) foreign aid loans have no significant impact on government consumption expenditures, so that income elasticity with respect to foreign loans is said to be zero; (4) domestic tax revenues are used to finance public consumption expenditures and not public investment; (5) in the presence of foreign aid grants and loans, an increase in taxes leads to an increase in public consumption expenditures and vice versa. Hence, any increase in public consumption will be financed mainly by increased taxes and foreign grants; (6) the presence of foreign resources prompted the Jordanian government to reduce its efforts to collect taxes; and (7) the negative statistical relationship between foreign grants and public savings does hold for Jordan.

The government of Jordan may consider: (1) focusing more heavily on mobilizing domestic resources with the help of foreign resources, especially foreign aid loans that helped augment domestic resources of Jordan, for the economic transformation of the country; (2) relying more on an efficient allocation that if possible, channels aid inflows to projects that are highly productive; (3) financing infrastructure projects mainly with domestic resources (domestic investment), since most of these projects are not directly productive; (4) encouraging other forms of foreign capital inflows to Jordan, i.e., foreign private investment, which will bring technical abilities and advice as well as the possibility of creating more domestic jobs; (5) enacting laws that provide a healthy and safe investment environment to encourage both foreign and domestic investment; and (6) increasing its efforts to force some institutional changes and taking some measures that may seem controversial (privatization, restructuring of government personnel, subsidy removal, reduce or eliminate government conspicuous spending, etc.).

Finally, countries extending foreign aid to Jordan should consider and stress the necessity for mobilizing government savings by either raising the ratio of tax collection to GDP (the tax ratio), through reforms in the tax structure, or via increases in existing tax rates. This can be achieved if donor countries utilize tax ratios and effort indices as main indicators of Jordan's commitment where future aid is possible only if that commitment by Jordan is fulfilled.

REFERENCES

Almomani, R. (1985) External borrowing and economic development: the case of Jordan, Manuscript. Utah State University, Logan.

Becker, G. (1971) *Economic Theory*, Alfred A. Knopf, New York.

Central Bank of Jordan, *Annual Report*, Amman, Jordan, various issues.

Chenery, H. and Bruno, M. (1962) Development alternatives in an open economy: the case of Israel, *Economic Journal,* **77**, 79-103.

Chenery, H. and Strout, W. (1966) Foreign assistance and economic development, *American Economic Review*, **66**, 679-733.

Domar, E. D. (1947) Expansion and employment, *American Economic Review*, **37**, 34-37.

El Shibly, M. (1984) Foreign capital inflows, domestic savings and economic growth: the experience of the Sudan (1960/61-1974/75), *Journal of Economic Development*, **9**, 125-45.

Enders, W. (1995) *Applied Econometric Time Series*, John Wiley & Sons, New York.

Gang, I. and Khan, H. (1991) Foreign aid, taxes and public investment, *Journal of Development Economics*, **34**, 355-369.

Gillis, M., Perkins, D., Roemer, M., and Snodgrass, D., (1983) *Economics of Development* W.W Norton and Company, New York.

Green, W. (1990) *Econometric Analysis*, MacMillan Publishing Company, New York.

Griffin, K. (1970) Foreign capital, domestic savings and economic development, *Bulletin of the Oxford University Institute of Economics and Statistics*, **32**, 99-112.

Griffin, K. and Enos, J. (1970) Foreign assistance: objectives and consequences, *Economic Development and Cultural Change,* **18**, 313-27.

Hamilton, J.D. (1994) *Time Series Analysis*, Princeton University Press. Princeton, NJ.

Hammad, K. (1981) Foreign aid and economic development: the case of Jordan, Ph.D. dissertation, Southern Illinois University, Carbondale.

Harrod, R. (1939) An essay in economic theory, *Economic Journal*, **49**, 14-33.

Hassan, F., Ismail, A., and Kimenyi, M., (1995) Stabilization, Structural Adjustment, Liberalization, and Economic Growth in the Sudan, *Journal of Economic Development,* **20**, 113-129.

Heller, P. (1975) A model of public fiscal behavior in developing countries: aid, investment, and taxation, *American Economic Review*, **65**, 99-112.

Human Development Report, 1994, Oxford University Press, Oxford, Published for the United Nations Development Programme (UNDP)

International Monetary Fund, *International Financial Statistics*, IMF Publications, Washington DC, (various issues).

Judge, G., Hill, R., Griffiths, W., Lutkepohl, H. and Chao-Lee, T. (1988), *Introduction to the Theory and Practice of Econometrics*, John Wiley & Sons, New York.

Levine, Ross and Renelt, D. (1992) A sensitivity analysis of cross-country growth regressions, *American Economic Review*, **82**, 942-63.

Levy, V. (1984) The savings gap and the productivity of foreign aid to a developing economy: Egypt, *Journal of Developing Areas*, **19**, 21-34.

Lutkepohl, J. (1993) *Introduction to Multiple Time Series Analysis*, Springer-Verlag, Berlin.

Mas-Colell, A., Whinston, M. and Green, J. (1995) Microeconomic theory, *Oxford University Press*. New York.

Mosley, P. (1980) Aid, savings and growth revisited, *Oxford Bulletin of Economics and Statistics*, **42**, 79-91.

Mosley, P., Hudson, J. and Horrell, S. (1987) Aid, the public sector and the market in less developed countries", *Economic Journal*, **97**, 616-41.

Otim, S. (1996) Foreign aid and government fiscal behavior in low-income South Asian countries, *Applied Economics*, **28**, 927-33.

Over, A. M., (1975) An example of the simultaneous equation problem: A note on foreign assistance: objectives and consequences, *Economic Development and Cultural Change*, **24**, 751-6.

Papanek, G. (1972) The effect of aid and other resource transfers on savings and growth in less developed countries, *Economic Journal*, **82,** 935-50.

Papanek, G. (1973) Aid, foreign private investment, savings, and growth in less developed countries, *Journal of Political Economy*, **81**, 120-30.

Rosenstein-Rodan, P.N. (1961) International aid for underdeveloped countries, *Review of Economics and Statistics*, **43**, 107-38.

Sims, C. (1980) Macroeconomics and reality, *Econometrica*, **48**, 1-48.

Todaro, M.P. (1989) *Economic Development in the Third World*, 4th edition, Longman, New York.

United Nations National Accounts Statistics (various), *United Nation Publications*, New York, (various issues).

Voivodas, C.S. (1973) Exports, foreign capital inflows and economic growth, *Journal of International Economics*, **3**, 337-49.

Weisskoff T. (1972) Impact of foreign capital inflows on domestic savings in underdeveloped countries, *Journal of International Economics*, **2**, 25-38.

White, H. (1992) The macroeconomic impact of development aid: a critical survey, *The Journal of Development Studies*, **28**, 163-240.

World Bank (1994) *World Tables*. The Johns Hopkins University Press, Baltimore, MD.

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Utah State University Arab Student Association (President) 1994-1995
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Western Economic Association (member)

AWARDS and HONORS:

International Teaching Assistant of the Year Award Finalist (1995, 1996)
USU Dean's List (Spring 1998)