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A contribution to the theory of devaluation

Todd Michael Sandler
State University of New York at Binghamton

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A CONTRIBUTION TO THE THEORY OF DEVALUATION

A Dissertation Presented

By

TODD MICHAEL SANDLER

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A CONTRIBUTION TO THE THEORY OF DEVALUATION

TABLE OF CONTENTS

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Any remaining errors are my own.

The following approval page bearing the signature of the chairman and all members of the student's committee and the chairman of the department occupies the page as follows:

A CONTRIBUTION TO THE

THEORY OF DEVALUATION

BY

TODD MICHAEL SANDLER

Approved as to style and content by:

(Chairman of Committee)

(Member)

(Chairman of Department

(Member)

(Member)

(Member)

April 1971

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PREFACE AND INTRODUCTION

Devaluation theory has been in and out of the economic spotlight for many years. Scores of articles have been written by some of the best theorists in economics. However, many unanswered questions have been left for future theorists and empirists to solve.

Devaluation theory has been out of the spotlight for the last ten to twelve years. Nevertheless, twelve years ago it was at the forefront of interest and numerous excellent articles were written on the subject. Someday in the near future devaluation theory might again occupy the spotlight.

This dissertation examines the effectiveness of devaluation in the hopes of indicating potentially important relationships previously uninvestigated. This dissertation will break new ground in its discussion of capital flows, the time period analysis, and the introduction of dynamics.

This dissertation is purely theoretical and makes no reference to empirical data. The main purpose of the dissertation is not to discover any simple device for determining whether a devaluation will be effective. Instead, the main purpose is to give a more thorough discussion on the question of effectiveness. Unfortunately, one must be selective in this endeavor and therefore not every problem will be discussed.

Chapter 1 will give a survey of the literature. In order to facilitate discussion, this survey will be divided into three sections. First, the literature on the elasticity approach will be dealt with. This will be followed by a presentation of the literature on the absorption approach. Thirdly, the literature written on the synthesis of the

elasticity and absorption approach will be presented. Wherever the analysis and results of previous articles seem questionable, it will be mentioned in the survey.

Chapter 2 sets up two basic models. One model is in terms of real income and real absorption, while the other model is in terms of money income and money absorption. Models presented in future chapters will refer to these two models.

The basic models, which are presented in chapter 2, are not complete models since the exact equational forms of the functional relationships are not specified. This is done because it will keep the mathematics simpler and, in addition, none of the basic relationships will be lost. The dissertation is primarily interested in determining what is occurring —this can be accomplished without exact mathematical formulations. This technique is the same one which is employed by Alexander in his absorption approach. The dissertation is primarily interested in pointing out changes and wherever possible the direction of change.

In addition to the development of the two basic models, chapter 2 will engage in a comparison of the real-term and money-term models in order to indicate the important differences and similarities. The two basic models presented are synthesis models, since substitution, price and income effects are all present.

A novel approach to devaluation theory is introduced in chapter 3. Chapter 3 examines the long-run versus the short-run effects of devaluation. Each individual effect of devaluation is discussed in regards to how it might change with time. One time sequence of effects that will hold in all instances cannot be derived. The best that can be done is

to indicate some of the usual tendencies. A second approach would be to specify all the different permutations of effects; this is not done in chapter 3.

Chapter 3 has three main purposes. First, this chapter indicates a probable sequence of effects occurring after a devaluation. This analysis points to the important conclusion that the effects of devaluation will interact with one another setting offchains of effects. In addition, it shows that price and substitution effects do not occur only in the initial period after a devaluation, but may operate many periods into the future.

A second main purpose of chapter 3 is to introduce a device which allows both the marginal propensities to absorb to differ for each effect and to differ for each period. The breakdown of the analysis of devaluation into a number of periods can be a useful teaching device for illustrating conceptually the complexity of the reactions and the interactions occurring whenever a devaluation is undertaken.

The third purpose of chapter 3 is to derive a means of understanding how the trade balance changes within the periods. This will enable one to understand both the trade balance change and the rate of change in the trade balance better. Both of these concepts are of utmost importance in understanding speculative capital flows which are introduced into the analysis in chapter 4.

The pattern of change in the trade balance, which is derived in chapter 3 under fairly restrictive assumptions, is tied in with the analysis of speculative capital flows. Using the pattern of change in the trade balance presented in chapter 3, the reactions of the specula-

tive capital flow is examined in chapter 4.

Chapter 4 transforms basic model 2, which is in money-terms, from a balance of trade model into a balance of payments model. First, a functional relationship for net speculative capital inflows is derived. In addition, changes in speculative capital inflows are examined in order to be able to determine the possible influence which changes in the exchange rate might have on speculative capital flows.

In addition to examining speculative capital inflows, chapter 4 also examines net transactional capital inflows. Both an equation for transactional capital inflows and an equation for transactional capital outflows are developed in chapter 4. In order to determine the net inflow, the inflow of transactional capital is subtracted from transactional capital outflows.

Chapter 4 compares and contrasts the influence which changes in the exchange rate and the change in the trade balance have on speculative capital flows as compared with the effects that they have on transactional capital flows.

Chapter 5 expands the discussion on capital flows by examining the change in long-term capital flows. Chapter 5 builds on the same model as is utilized in chapter 4, the only difference is that long-term capital flows are allowed to vary.

Both chapters 4 and 5 examine whether the introduction of capital flows makes stability easier or harder to achieve when a country devalues its currency.

Chapters 6 and 7 are quite different from the previous five chapters. Within these two chapters dynamic analysis is examined as opposed

to the comparative static analysis of the previous chapters. These two chapters examine the pattern of the income stream over time. In particular, the chapters are primarily interested in whether the income streams are stable or unstable. Actually the stability of both countries acting together is examined, rather than the stability of either country acting by itself. International trade ties two countries together so that the more adequate stability for inspection is the stability of the two-country system.

Chapter 6 does not deal directly with devaluation theory, instead it develops a model which suggests a model applicable to devaluation theory. The model, which is developed in chapter 6, is a two-country investment accelerator model. This model examines the influence which induced investment has on stability within a two-country system.

The consumer accelerator model is derived in chapter 7. This model is the first model which attempts to express Alexander's price expectations effect. The price expectations effect deals with speculative buying resulting from the fear of devaluation. Speculative consumption is shown to depend on the size of the deficit. The influence of speculative consumption on the stability of the two-country system is examined. This effect is shown to be a potentially important influence on whether devaluation will have to be undertaken.

Both chapters 6 and 7 examine the influence which all the parameters have for the stability of the two-country system.

Chapter 8 concludes with a summary of the implications of the dissertation. In addition, this chapter summarizes what differentiates the analysis of this dissertation from previous analyses of devaluation.

The chapter concludes with some ideas for future research on both the empirical and theoretical level.

Before the dissertation gets under way, it is necessary to indicate a couple of the practices used in this dissertation. First, a two-country model will be employed in which one country represents the devaluing country, while the other country represents the rest of the world. The devaluing country will be called country D, unless otherwise indicated, whereas the non-devaluing country will be called country N. Also, many references to the devaluing country are in terms of the domestic economy, whereas the non-devaluing country is referred to as the foreign economy.

CHAPTER I

THE SURVEY

Historically, the question of the effectiveness of a devaluation had been analyzed in terms of the Marshall-Lerner or elasticity approach. Later, the emphasis of analysis shifted away from the elasticity approach, which examined the substitution effect involved with a devaluation, to the absorption approach, which examined aggregate changes in income and expenditure.

Many theorists felt that neither the elasticity nor the absorption approach fully analyzed the process and result of devaluation. What was required was an analysis which allowed for both substitution effects and income changes. In order to accomplish this purpose, some theorists have developed a synthesis of the above two approaches.

The survey, which will be presented in this chapter, will be broken down into three parts. First, the various articles written on the elasticity approach will be analyzed. This will be followed by an analysis of the absorption approach literature. The last section will analyze literature which has synthesized these two approaches.

The following survey will be a critical survey; where possible errors and shortcomings in the literature occur they will be analyzed. In addition, any problems that the dissertation will deal with later will be explicitly mentioned in the forthcoming survey.

I. The Elasticity Approach

The first statement of the elasticity approach was derived both by Marshall and Abba Lerner. In their formula e_1 stands for the devaluing country's elasticity of demand for imports, while e_2 stands for the non-devaluing country's elasticity of demand for exports of the devaluing country. They derived the simple formula that $e_1 + e_2$ must be greater than one for the trade balance to improve with a devaluation.[1] If the sum of the two demand elasticities is less than one, then a devaluation will deteriorate the trade balance. A sum of exactly one will produce no change.

The elasticity approach of the Marshall-Lerner type assumed that the real income level of the economy remained constant after the devaluation. In addition, it was assumed that both the elasticity of foreign supply for imports and the elasticity of domestic supply for exports were infinitely elastic. Also, prior to devaluation, trade is assumed balanced.

Much of the literature which followed the original presentation of the Marshall-Lerner approach simply modified some of the assumptions presented above. Both Joan Robinson[2] and Gottfried Haberler[3] discussed further refinements of the elasticity approach. Joan Robinson examined both the demand and supply elasticities. Also, she no longer assumed that the domestic supply elasticity of exports and the foreign supply

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[1] A. P. Lerner, The Economics of Control, New York, MacMillan, 1944, p. 378.

[2] Joan Robinson, "The Foreign Exchanges," reprinted in Readings In the Theory of International Trade, AEA, Philadelphia, 1949, pp. 83-103.

[3] G. Haberler, "The Market for Foreign Exchange and the Stability of the Balance of Payments," Kyklos, Fasc. 2, 1949, pp. 193-218.

elasticity of imports were infinitely elastic. Hence imports and exports were no longer assumed to be produced under conditions of constant costs. Her analysis showed that the Marshall-Lerner stability condition, which required the sum of the demand elasticities to be greater than one, would be modified when supply was not perfectly elastic.

W.L. Smith also examined the influence of the supply elasticities. In his article, Smith makes the following statement:

> The greater the elasticity of foreign demand for exports and the elasticity of domestic demand for imports, the more favorable is the effect of depreciation. On the supply side, an increased elasticity of domestic supply of exports makes the effect of depreciation (a) more favorable if the elasticity of foreign demand is greater than unity and (b) less favorable if the elasticity of foreign demand is less than unity. Similarly, an increased foreign elasticity of supply of imports is (a) favorable if domestic demand is elastic and (b) unfavorable if domestic demand is inelastic.[4]

The above statement indicates that if the sum of the demand elasticities is less than one, then a low supply elasticity can still produce a stable situation.

Gottfried Haberler took the analysis one step further by assuming that the trade balance was initially unbalanced. Haberler stated that if the trade balance was initially unbalanced then the new Marshall-Lerner conditions for stability would be $(M/X)\ e_1 + e_2 > 1$.[5] The M and X stand for the value of imports and exports respectively, while e_1 is the domestic demand elasticity for imports and e_2 is the foreign demand elasticity for exports.

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[4] W.L. Smith, "Effects of Exchange Rate Adjustment on the Standard of Living," American Economic Review, December 1954, pp. 815-816.

[5] Haberler, Op. Cit., p. 209-212.

The above formula for the stability condition in the unbalance case is in terms of foreign currency. The greater the initial deficit, the smaller the sum of the two demand elasticities will have to be for stability to be achieved. If a deficit exists, then M/X will be greater than one. Since M/X is greater than one, then $(M/X)e_1$ will be greater than the value of the domestic demand elasticity for imports taken by itself. Hence, $e_1 + e_2$ can be less than one, yet $(M/X)e_1 + e_2$ can be greater than one. This can be seen with the example in which M/X is 2, e_1 is 2/5 and e_2 is 2/5.

Hence, the greater the initial deficit the easier it is to do something about it. The stability condition for the unbalance case assumes both supply curves are infinitely elastic and that real income remains constant.

Dr. A. O. Hirschman took the analysis one step forward by expressing the unbalanced situation in terms of both domestic and foreign currency.[6] His formulas were derived by assuming that imports in the devaluing country are a function of the foreign exchange rate, while exports are a function of the reciprocal of the foreign exchange rate. Hirschman went on to take the derivative of both the import and export functions with respect to the exchange rate. Next, the derivatives were expressed in terms of the elasticity of demand for imports and exports respectively. "For the foreign balance to improve upon devaluation, the certain decrease in imports must be larger than the possible decrease in

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[6] Hirschman, "Devaluation and the Trade Balance: A Note," Review of Economics and Statistics, February 1949, pp. 50-53.

exports: $dM/d(1/r) > dX/d(1/r)$; while the domestic balance will improve upon devaluation as long as the certain increase in exports is greater than the possible increase in imports: $dX/dr > dM'/dr$."[7] The M and X expressions are in terms of foreign exchange, while the M' and X' expressions are in terms of domestic currency. The exchange rate (r) is the number of units of domestic currency per unit of foreign currency. The domestic balance refers to the value of the trade balance expressed in terms of domestic currency.

Hirschman translated the expressions for $dX/d(1/r)$, $dM/d(1/r)$, dX'/dr, and dM'/dr into an expression in terms of the elasticity of demand.[8] Manipulation of these new expressions will yield the following two equations:

$$(1) \quad (M/X)e_1 + e_2 > 1$$

$$(2) \quad e_1 + (X/M)e_2 > 1$$

Equation (1) gives the condition for trade balance improvement in terms of foreign currency, while equation (2) gives the condition for trade balance improvement in terms of domestic currency. Equation (1) is exactly the same as Haberler's formula.

Equation (2) is quite interesting since it shows that in terms of domestic currency, the greater the initial deficit, then the greater must be the sum of the two demand elasticities, if the trade balance is to improve. If the deficit is very large then the X/M fraction will be

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[7] Hirschman, Op. Cit., P. 52.

[8] Ibid, Ibid.

quite small--much smaller than 1. Hence, the value of e_2 will be multiplied by a number less than 1. Thus, the sum of the two elasticities of demand must be much greater than one, if $e_1 + e_2(X/M)$ is to be greater than 1.

Therefore, in terms of the condition for improvement in the trade balance, an initial deficit will make it easier to improve in terms of foreign currency but harder to improve in terms of domestic currency. One should realize from this that the final effects of a devaluation can be quite different when expressed in foreign currency terms as compared with the final effect expressed in domestic currency terms.

In later years more complex expressions of the elasticity formula were presented. In March 1959, S.S. Alexander presented in his article on the synthesis of the elasticity and absorption approach the complete elasticity formula.[9]

$$(3) \quad E_f = \left[K X_f \frac{e_3 (e_2 - 1)}{e_3 + e_2 (1-K)} + M_f \frac{e_1 (e_4 + 1)}{e_1 + e_4 (1-K)} \right]$$

The E_f in the above equation represents the change in the value of the trade balance measured in terms of the foreign currency. The X_f and M_f represent the value of imports and exports before devaluation in terms of foreign currency. Other symbols are as follows:

K is the devaluation proportion measured in terms of foreign currency
e_1 is the domestic demand elasticity for imports
e_2 is the foreign demand elasticity for exports
e_3 is the domestic supply elasticity of exports
e_4 is the foreign supply elasticity of imports

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[9] S.S. Alexander, "Effects of a Devaluation: A Simplified Synthesis of Elasticities and Absorption Approaches," American Economic Review, March 1959, p. 22. Please note that Alexander was not the first to derive this formula. This paper refers to his article because his appendix gives a step by step derivation, where other writers have just stated the result.

Alexander's formula reduces down to the usual Marshall-Lerner condition when the two supply elasticities become infinite. Alexander's equation is arrived at by assuming initial equilibrium. Taking a total differential of the value of imports minus the value of exports will give an expression for the change in the trade balance. Translation of the change in the value of exports and imports into elasticity terms, with the assumption of price equalization, will give equation (3).

Although the elasticity approach had achieved mathematical sophistication, many economists still had serious doubts as to the usefulness of the approach. The discussion of the elasticity split into two directions. The first direction was on the path of statistical analysis. Many economists felt that the elasticities which were being measured were inappropriate to the analysis. The statistical measures of demand and supply of imports and exports were for the most part very low, low enough that the sum of the two demand elasticities of many countries might be less than 1.

Dr. T. C. Chang ran multiple regression measurements on the value of the price elasticity of demand for imports in a number of countries. He found the following values for the price elasticity of demand for imports: [10]

United Kingdom	-.28
Germany	-.37
Switzerland	-.26
Italy	-.27
Japan	-.47
France	-.32
Norway	-.86
Czechoslovakia	-.23

[10] Tse Chun Chang, "International Comparison of Demand for Imports," Review of Economic Studies, 1945-1946, pp. 53-67.

The second direction which the elasticity approach took was the bringing of income changes into the analysis. In fact, the earliest writers on the elasticity approach, such as Gottfried Haberler and Joan Robinson, mentioned that the approach should allow real income to change because devaluation will cause real income to change since resource utilization and the terms-of-trade will change.

Dr. A.J. Brown was one of the first to include income analysis within the elasticity approach.[16] The initial effects of devaluation were analyzed in the usual confines of the elasticity approach. The initial effects were then modified by a multiplier, which incorporated both the income change and the elasticity of income. Dr. Brown felt that bringing income changes into the analysis would lessen the initial improvement of the trade balance. Hence, income effects would make improvements in the trade balance harder to achieve through a devaluation.

Others such as Polak and Chang[17] and Dr. W. Allen[18] took up similar discussions which pushed the elasticity approach onto the doorstep of the absorption approach. Still later, further refinements of including the elasticity approach within a setting where income was allowed to change led to complex models in which the two approaches were synthesized into one. Before these syntheses are discussed, one must first look at the absorption approach and its development. This will be done in the next section.

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[16] A. J. Brown, "Trade Balance and Exchange Stability," Oxford Economic Papers, April 1942, pp. 57-75.

[17] Polak, Chang, "Effect of Exchange Depreciation on a Country's Export Price Level," International Monetary Fund Staff Papers, February 1950, pp. 49-70.

[18] W.R. Allen, "A Note on Money Income Effects of Devaluation," Kyklos, Fasc. 3, 1956, pp. 372-383.

In an excellent article Guy H. Orcutt raised two main criticism about the statistical elasticity testing of export and import curves.[11] First, Dr. Orcutt mentioned the "identification problem." Since both supply and demand curves have been shifting over time, statistically fitted curves must adjust for these shifts in order to get an unbiased estimate of either the demand or the supply curve. Dr. Orcutt argued that the tendency for supply and demand curves for imports to shift up together had a tendency to underestimate the measured demand elasticities.[12] In addition to the identification problem, Dr. Orcutt also mentioned the problem of simultaneous equation bias. Simultaneous equation bias can be corrected either by employing indirect least squares or two-stage least square estimating procedures.[13]

Also, Dr. Orcutt objected to the estimation of short-run elasticities when he felt that long-run elasticities were more pertinent to the question of devaluation.[14] All in all, Dr. Orcutt felt that many economists were becoming unduly pessimistic about devaluation because the statistical estimates of the demand elasticities were quite low.

Others such as Fritz Machlup took up the same argument.[15] Hence, a small body of literature evolved within the elasticity approach which was concerned with the empirical testing and employment of the elasticity rule as a policy tool.

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[11] Guy Orcutt, "Measurement of Price Elasticities in International Trade," Review of Economics and Statistics, May 1950, pp. 122-23.

[12] Guy Orcutt, Op. Cit., p. 123.

[13] J. Johnston, Econometric Methods, New York, Mc-Graw-Hill, 1963, pp. 252-260.

[14] Guy Orcutt, Op. Cit., pp. 123-24.

[15] F. Machlup, "Elasticity Pessimism in International Trade," Economia Internazionale, February 1950, pp. 118-137.

Before the development of the absorption approach is traced out, a few words of criticism are in order. First, the elasticity approach allows devaluation to change the relative price of exports as compared to the price of imports but nothing is ever mentioned about the prices of other goods. Even if devaluation held income constant, the shifts in demand between imports and exports will also influence the demand and supply schedules and hence the prices of domestic goods.[19] The absorption approach which allows the general price level to change will partially correct for this, yet full correction still has not been achieved since this would require an analysis which accounts for demand and supply elasticities of all the sectors of the economy. The closest anyone has come to correcting for this problem is Dr. Brems, who breaks down the analysis into an Leontief input-output matrix.[20]

A second difficulty of the elasticity analysis arises from its static nature. No allowances have been made for shifts over time of the curves, or for changes in the elasticities of the curves. Chapter 3 of this dissertation will discuss a way of allowing in a number of periods for the effects of devaluation to work themselves out.

A third difficulty of the elasticity approach arises from its failure to analyze changes of income and the resulting changes in expenditure. Any change in income and/or expenditure will shift the curves and cause new changes in prices and new substitution effects. Although some of the later articles such as Dr. Brown's did allow for changes in income,

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[19] Clements, International Monetary Theory, New Jersey, Princeton University, 1967, p. 287.

[20] Brems, "Devaluation: A Marriage of the Elasticity and the Absorption Approaches," Economic Journal, March 1957, pp. 49-64.

his analysis never spelled out the possibility of an interaction between the substitution and income effects, where the income effects set off new relative prices which in turn set off new substitution effects. Chapter 3 of the dissertation will also discuss possible interaction patterns.

In addition, the elasticity approach never examined the effects of devaluation on the general price level and the effects of the general price level on expenditure. This was thoroughly discussed by the absorption approach.

Another difficulty of the elasticity approach was highlighted by Dr. Orcutt's analysis. This difficulty arises from the problems involved in getting adequate statistical estimates of the elasticities so that the approach can be used as a policy tool.

A last difficulty to be mentioned of the elasticity approach is also shared by the absorption approach; both the elasticity and the absorption approaches are too static. Expectations and/or accelerators are never entered into the analysis; chapters 6 and 7 of this dissertation will attempt to remedy this situation.

II. The Absorption Approach

The absorption approach really grew out of the elasticity approach. The absorption approach examined the changes in real income and real expenditures resulting from devaluation. Absorption is defined as the purchased consumption, investment and government goods of an economy.

In the attempt to allow the assumption of a constant income level to be dropped from the elasticity analysis, the absorption approach evolved.

The absorption approach simply derived the statement that the change in the trade balance was equal to the change in income minus the change in absorption. In order to get the above statement, the theorist reasons from definitional equations.

The first theorist to derive the absorption approach was S. S. Alexander. Alexander derived his equations by stating the income definition:[21]

$$(4) \quad Y = C + I + G + X - M$$

Equation four states that real income is equal to real consumption plus real investment plus real government expenditure plus real exports minus real imports. Dr. Alexander went on to define absorption of domestic goods as A, which he said was equal to C + I + G. In addition, the trade balance (B) was equal by definition to X-M.

Substituting A and B into equation (4) gives equation (5).

$$(5) \quad Y = A + B$$

Taking a total differential of equation (5) and rearranging terms gives equation (6).

$$(6) \quad dB = dY - dA$$

In order to get the final equation which Alexander works with, one must break down the dA term into its price effect component (Pe) and the income effect component (adY, where a is the marginal propensity to absorb).

$$(7) \quad dB = dY - adY - Pe$$

Equation (7) expresses the final equation which Alexander works with.

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[21] S. S. Alexander, "Effects of a Devaluation on the Trade Balance," International Monetary Fund Staff Papers, April 1952, pp. 265-266.

The marginal propensity to absorb is equal to the marginal propensity to consume plus the marginal propensities to invest and spend publicly. It is quite likely that the marginal propensity to absorb is greater than one.

Before the individual effects of the absorption approach are discussed, a slightly different way of looking at the absorption approach will be presented. Reasoning from the income equations one can derive equation 8.[22]

$$(8) \quad X + I = M + S$$

In equation 8, S represents savings. Equation 8 can be rearranged to yield equation 9.

$$(9) \quad X - M = S - I$$

Equation 9 shows that if a country is to have a trade surplus, then savings must be greater than investment.

Letting B represent X - M in equation 9 and taking the change of both sides gives equation 10.

$$(10) \quad dB = dS - dI$$

The change in the trade balance is equal to the difference between the change in savings and investment. Hence, if the trade balance is to improve, then savings must increase to a greater extent than investment. The excess amount of savings over investment is known as hoarding when money is assumed constant. Hence, equation 10 can also be represented as equation 11, since the difference between the change in saving minus the change in investment is the change in hoarding.

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[22] J. Black, "A Saving and Investment Approach to Devaluation," Economic Journal, June 1959, pp. 268-70.

(11) dB = dH where H is hoarding

Equation 11 succinctly sums up the absorption approach. If the balance of trade is to improve, then there must be net hoarding; if the trade balance is to deteriorate, then there must be dishoarding.

Returning to Alexander's formulation, which is equation 7, one must break Alexander's analysis into a number of income effects and price effects in order to see what is occurring.

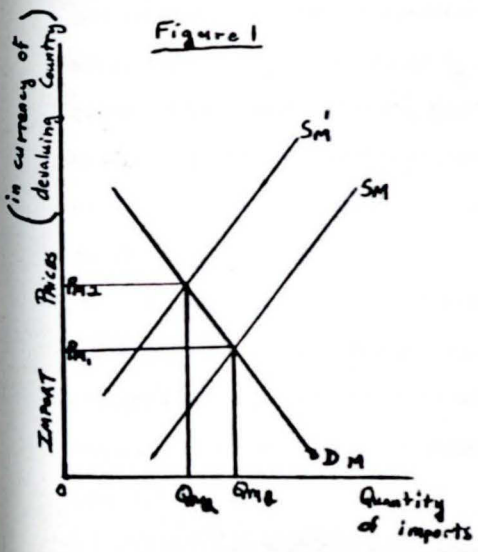
Alexander breaks down his analysis into two income effects in which devaluation changes the real output level of the economy and the real expenditure level. Also, Alexander analyzes three major price effects and two minor price effects. The price effects result from changes in absorption caused by the changed price level.

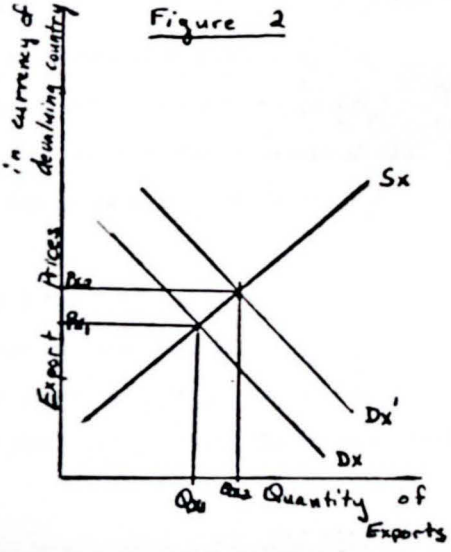
The first income effect discussed[23] by Dr. Alexander was the idle resource effect. Devaluation lowers the price of exports of the devaluing country by lowering the amount of foreign currency equivalent to one unit of domestic currency. In essence devaluation lowers the export's prices of the devaluing country and hence makes these exports more competitive. This lowering of export prices in terms of foreign currency will increase foreign demand for exports. If the export sector is to meet the increase in demand, then the export sector will require resources in order to allow an expansion. Hence, previously idle resources (when available) will be shifted to the expanding export sector. Employment of more resources will first increase income. The recipients

[23]The interpretation of all of Alexander's effects is that of this writer. All the effects mentioned are those of Alexander's, although a footnote won't be given for each effect separately.

of the increased income will take their income and spend some or all of it on absorption of goods and services. Whether the idle resource effect improves the real trade balance or not depends on whether the change in income more than covers the change in absorption. This can be seen by equation 6. The change in absorption induced by the income change will be equal to the marginal propensity to absorb times the change in income. As equation 7 indicates, if the marginal propensity to absorb is greater than one, then the real trade balance will deteriorate because the increase in absorption will outweigh the increase to income. When the marginal propensity to absorb is less than 1, then the trade balance will improve.

The second income effect of Alexander's absorption approach is the terms of trade effect. To best see the terms of trade effect, one must look at figure 1 which represents the import market and figure 2 which represents the export market.





In figure 1 the price of imports are measured on the vertical axis, while the quantity of imports are measured on the horizontal axis. The predevaluation domestic demand for imports is D_m, whereas S_m represents the predevaluation foreign supply schedule for imports. The intersection of these two curves gives the predevaluation equilibrium quantity and price of imports, which is Q_{m1}, P_{m1}, respectively. The price of imports is measured in terms of the currency of the devaluing country. After the devaluation, the supply of imports curve shifts to the left to S_m', because foreign suppliers now get a higher price in terms of the devaluing country's currency for a given amount of imports. The post-devaluation price is P_{m2}.

Figure 2 illustrates the situation in the export market. The horizontal axis measures the quantity of exports, while the vertical axis measures the price of exports in terms of the currency of the devaluing country. The pre-devaluation price and quantity is P_{x_1}, and Q_{x_1}, which are determined by the intersection of S_x and D_x. The foreign demand for exports is the D_x curve, while S_x is the domestic supply of exports curve. After devaluation the foreign demand curve shifts up to a D_x' because less of the foreign currency must be given for an export of the devaluing country. The post-devaluation price is P_{x2}, while the post-devaluation quantity is Q_{m2}.

The terms of trade is defined as the price of exports divided by the price of imports. The pre-devaluation terms of trade is P_{x1}/P_{m1}, whereas the post-devaluation terms of trade is P_{x2}/P_{m2}. As the two figures are drawn P_{x1}/P_{m1} is greater than P_{x2}/P_{m2}, hence the terms of trade have deteriorated.

It is important to remember that a deterioration of the terms of trade is not a necessity. In fact, if the domestic demand for imports is very elastic, then the terms of trade will probably improve. To be able to predict the direction of the movement of the terms of trade one must know the elasticities of all four curves.

In his analysis of the terms of trade effect, Alexander assumed that the terms of trade would deteriorate with a devaluation. Alexander expresses his reason in the following excerpt:

> It is usually presumed, frequently with justification, that a devaluation will result in a decline of export prices in foreign currency greater than the decline of import prices in foreign currency. This presumption is based on the fact that a country's exports are usually more specialized than its imports, so that the price of exports will be much more subject to the influence of devaluation than will the price of imports.[24]

The above quote may appear different than the analysis presented above because Alexander mentions prices falling whereas only price increases are mentioned above. The difference is quickly resolved when one realizes that figures 1 and 2 have been analyzing devaluation in terms of domestic currency, while Alexander is analyzing devaluation in terms of foreign currency.

It will be shown later in the chapter that a whole body of work was written by other theorists on the terms of trade change and the terms of trade effect. Some of the analysis was touched off by Alexander's assumption of a deterioration in the terms of trade.

Now that the groundwork has been laid, the terms of trade effect can be discussed quite quickly. If the terms of trade deteriorates, then

[24] S.S. Alexander, "Effects of a Devaluation on the Trade Balance," International Monetary Fund Staff Papers, April 1952, p. 268.

a given amount of exports in the devaluing country will be able to buy a smaller amount of imports after the devaluation. If a given amount of exports exchange for a smaller amount of imports, then the quantity of goods and services enjoyed will decline, i.e., real income falls. The fall of real income will induce a fall in absorption, since absorption is a function of real income. Whether the trade balance improves depends on whether the fall in absorption outweighs the fall in income. Given a marginal propensity to absorb of greater than 1, the real trade balance will improve.

Addition of the two income effects will give the total income effect. The final result cannot be ascertained without prior knowledge of the marginal propensities involved, the amount of idle resources, the movement of the terms of trade and many other things.

In order to ascertain the final result to devaluation Alexander added the price effects to the income effects. Dr. Alexander specified five price effects of devaluation. The price effects operated on changing absorption. The change in the price level caused by a devaluation changes absorption. The change in absorption causes a change in the trade balance. "The direct effect on absorption is any influence toward lower real expenditure as money income and money prices rise together as a result of the devaluation."[25]

The first price effect which will be discussed is called the real cash balance effect. Devaluation will raise the domestic price level because imports, import substitutes and exports will all rise in price

[25] S.S. Alexander, "Effects of a Devaluation on the Trade Balance," International Monetary Staff Papers, April 1952, p. 270.

after a devaluation. The real cash balance effect assumes that some people of every country save up in order to purchase something in the future or else to meet unexpected contingencies. If the price level rises, then the real value of these past savings will have diminished. Alexander assumed that many people will try to replenish some of their lost savings by saving more after a devaluation. The increase in savings or hoarding will decrease absorption by an equal amount. The decrease in absorption will improve the trade balance.

The money illusion effect is the second price effect. Devaluation will not only raise the price level, but also, after a lag will raise the money income of the people. If the people respond to the higher price level and feel poorer, then absorption will probably fall. However, if the people respond to the increase in money income and feel richer, then absorption will increase. To ascertain the final result of the money illusion effect one would have to determine the net result of those who responded to the higher price level as compared to those who respond to the higher money income level.

Another price effect of devaluation is the redistribution of income effect. The redistribution effect results because the higher price level will cause certain income groups to benefit at the expense of others. First, there will be a redistribution from creditors to debtors. Second, there will be a redistribution from fixed income recipients to the rest of the economy. Third, if money wages lag behind prices, then profit recipients may initially gain at the expense of wage earners. Lastly, the higher level of prices and money income will cause a higher level of

taxation which will redistribute income from taxpayers to government. If the gainers of the redistribution of income have a lower marginal propensity to absorb than the losers, then the absorption amount will decrease. The decrease in absorption will improve the trade balance. Needless to say, there can be very little specified about this effect on a priori grounds.

The high cost of investment is the fourth price effect of devaluation. Alexander felt that many people would cut their purchase of investment goods produced abroad after the devaluation. The devaluation would raise the price to the citizens of the devaluing country. The higher price will certainly discourage some of the purchases. In addition, purchases of imported raw materials will be cut somewhat because of the higher prices. Many producers will look to the domestic economy for substitutes. A more careful analysis of this effect would require a discussion of the elasticity of substitution of the isoquants; this will be touched on in Chapter 3.

The last price effect is the dynamic price expectation effect. If the people of the devaluing country either expect another devaluation or an increase in the price level, then they will spend their available cash now before their money is less valuable. This effect will operate to increase absorption and therefore will deteriorate the trade balance. In this writer's estimation this is the single most important effect of devaluation. This effect can single-handedly cause devaluation to fail. No explicit formulation of this effect has been given to date; Chapter 7 will attempt to derive an equation for this effect.

Adding up all of the effects of devaluation will give one the total change in real income and real absorption. The difference between the change in real income and absorption will give the change in the trade balance.

Alexander specified that the income effects would take some time to work themselves out and would only do so with a lag. Alexander went on to specify that the price effects would be of a transitory nature operating only in the initial periods. This statement of Alexander's will be shown later to be questionable. A more correct analysis must allow income effects to shift the demand and supply curves changing relative prices and causing additional price effects. Therefore, the price effects will not disappear immediately, but operate many periods into the future.

Alexander's absorption approach set off both a wave of criticism and a wave of praise. The wave of criticism stemmed from Alexander's failure to include substitution effects. Although Alexander examined changes in expenditure resulting from changes in the price level, he did not examine changes in the composition of expenditure resulting from changes in relative prices. This criticism stimulated the school of thought which tried to synthesize the elasticity approach with the absorption approach. This school of thought will be analyzed in the next section of this chapter.

An article by Fritz Machlup[26] which came out shortly after the Alexander absorption article, was very instrumental in starting the modi-

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[26] F. Machlup, "Relative Prices and Aggregate Spending in the Analysis of Devaluation" American Economic Review, June 1955, pp. 255-78.

fication of the absorption approach which ensue. Fritz Machlup brought out a number of important criticisms. First, Machlup criticized Alexander's approach for using real magnitudes when value magnitudes are really more important in a discussion of the stability of a currency and the question of devaluation. Machlup asks the pertinent question: "What is a real trade balance."[27] The change in the real trade balance can be quite different from the change in the money trade balance, which is the real trade balance multiplied by the price level. Machlup is pointing out that one should deal with equation (12) below.

$$(12) \quad db = dY - d\overline{A}$$

Equation (12) states that the change in the value of the trade balance is equal to the difference between the change in money income (Y) and the change in money expenditure ($\overline{A}$). The change in money income can be broken down to both a real income influence and a price influence.

Articles such as the one by Laursen and Metzler[28] reformulated the Alexander model in terms of value instead of real magnitudes. The basic models, which will be presented in the next chapter of this dissertation, will be in both value terms and real terms. A comparison of the two basic models presented will give an analysis of the differences arising in the two models. Others who formulated models similar to Alexander's but in value terms were R.W. Jones[29], J.E. Meade[30], and S.C. Tsiang.[31]

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[27] Ibid., p. 269.

[28] Laursen and Metzler, "Flexible Exchange Rates and the Theory of Employment," Review of Economics and Statistics, November 1950, pp.281-99.

[29] R.W. Jones, "Depreciation and the Dampening Effect of Income Changes," Review of Economics and Statistics, February 1960, pp. 74-80.

[30] J.E. Meade, The Balance of Payments, London, Oxford University Press, 1951, pp. 1-262.

[31] S.C. Tsiang, Op. Cit., pp. 912-35.

In the process of criticizing Alexander, Dr. Machlup added a new income effect of some importance.[32] The effect is the reallocation of resources effect. Machlup went on to point out that the increased demand for exports of the devaluing country will not only induce idle resources to move to the export sector, but it will also cause employed resources to move. The possibility of higher remuneration will induce employed resources to move to the expanding export sector. To the extent that reallocated resources are utilized more efficiently, this will induce an increase in real income. The expanding export sector can employ the latest technology since it will have to build new plants and machines in order to meet the increase in demand. Many of the reallocated resources will come from industries locked in with older technology because of the huge fixed costs involved in changing a production process. One can look at the reallocation of resources effect as a shifting out of the production possibility frontier, whereas the idle resource effect is a movement from a point inside the frontier to a point on the frontier.

Machlup also criticized Alexander for his failure to specify substitution effects as caused by the change in relative prices. In addition, Machlup criticized Alexander's approach for failing to account explicitly for the influence of the money supply and the interest rate on absorption. Dr. Tsiang corrects this fault in an article which will be discussed in the next section.

Alexander's failure to spell out the effects in the non-devaluing country was also severely rebuked by Machlup. Dr. H. Brems working within a Leontief input-output matrix was one of the first to express the

[32] F. Machlup, "Relative Prices and Aggregate Spending in the Analysis of Devaluation," American Economic Review, June 1955, p. 265.

effects in both countries.

Even before Alexander formulated his absorption approach, many theorists had specifically analyzed the terms of trade effect. Gottfried Haberler[33] and Joan Robinson[34] were among the first to discuss the terms of trade changing with a devaluation and the resulting change in real income.

Joan Robinson was among the first to predict that the terms of trade would usually deteriorate with a devaluation, since usually a country is more specialized in its exports and production than in its consumption and imports.[35] It should be evident that Joan Robinson's article strongly influenced Alexander.

After the publication of the Alexander article, Paul Streeten, Warren L. Smith, George Kleiner and Fritz Machlup, to name a few, all wrote articles about the terms of trade movement and effect.

Paul Streeten argued along similar lines as Joan Robinson. He concluded that usually the terms of trade moved adversely for the devaluing country.[36]

Warren L. Smith developed a formula for the terms of trade movement which was very similar to the formula of Alexander's expression of the elasticity approach in his synthesis article. He argued that if both countries were at full employment,then the supply elasticities would be

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[33] G. Haberler, "The Choice of Exchange Rates After the War," American Economic Review, June 1945, pp. 308, 317.

[34] J. Robinson, "Beggar-My-Neighbour Remedies for Unemployment," reprinted in Readings in the Theory of International Trade, Philadelphia,Blakeston 1949, p. 400.

[35] Ibid., Ibid.

[36] P. Streeten, "Elasticity Optimism and Pessimism in International Trade," Economia Internazionale, January 1954, p. 5.

low enough that a favorable movement of the terms of trade can be expected.[37]

A year later, George Kleiner[38] wrote an article in the same journal severely criticizing the results of Smith. Dr. Kleiner argued that even though both countries were at full employment, the terms of trade need not be expected to improve with a devaluation. Kleiner pointed out that although the devaluing country will be experiencing a depreciation and hence an impetus to increase real income, the opposite will be occurring in the non-devaluing country. The non-devaluing country will be experiencing an appreciation and a stimulus for real income to decrease. Hence, Kleiner argued that although the domestic export supply elasticity is likely to be low, the import supply curve will have a fairly high elasticity. Kleiner felt that the import supply elasticity would be high enough to cause the terms of trade to deteriorate.

Machlup[39] wrote the definitive article on the terms of trade effect. Machlup showed with the use of some simple examples that the terms of trade can either deteriorate or improve with a devaluation. In addition, he mentioned that it would be hard to predict on a priori grounds whether the terms of trade would move favorably or unfavorably.

Machlup argued the following:

(1) even if we knew in what direction and by how much the net terms of trade will change as a result of a devaluation, this

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[37] W. Smith, Op. Cit.,pp. 808, 820.

[38] G. Kleiner, "Exchange Rate Adjustments and Living Standards," American Economic Review, December 1955, p. 944.

[39] F. Machlup, "The Terms of Trade Effects of Devaluation Upon Real Income and The Balance of Trade," Kyklos, Fasc. 4 1956, p. 420.

would not be enough for us to infer by how much and in what direction these changes in the terms of trade will affect real national income; and

(2) even if we knew in what direction and by how much real national income will change as a result of a change in the terms of trade due to devaluation, this would not be enough for us to infer by how much and in what direction these changes in real income will affect the balance of trade, even if the marginal propensities to spend and import could be assumed to be known.[40]

Dr. Machlup argues his first point along the lines that the wrong terms of trade concept is being used. Machlup felt that the "single factor" terms of trade or the "double factor" terms of trade, both of which allow for productivity increases, will give a better measure of the change in real income. Since devaluation can cause a reallocation of resources and an increased efficiency, one must use a measure which allows for productivity change.

The second point of Machlup has to do with not only the terms of trade effect but also the idle resource and reallocation of resource effects. Machlup argued that even if one knew the terms of trade effect on real income, one would also have to know the other two income effects as well in order to determine the total change in real income. Actually, this was also stated in Alexander's article and therefore Dr. Machlup wasn't adding anything new to the analysis.

Sometime after the controversy of the terms of trade effect, some economists criticized Alexander on his carefree assumption of the money supply. Only in his discussion of the real cash balance effect does Alexander specify that he is assuming that the money supply is kept constant. He carries through his analysis of the cash balance effect

[40] Ibid., Ibid.,

assuming that the increased desire for real cash savings will cause people to liquidate assets.[41] The liquidation of assets will lower the price of assets. As the price of assets such as bonds fall, because of the increased selling of bonds, this will raise the interest rate. The rising interest rate can check investment and therefore absorption which is comprised of investment and consumption. Hence, the real cash balance effect can influence the trade balance indirectly through the interest rate. However, Alexander failed to deal with the effect that changes in income can have on transactional money balances and the interest rate. Both Fritz Machlup[42] and S.C. Tsiang[43] raised an objection against Alexander for his money supply assumption.

Dr. Tsiang did more than raise the objection since he created a comprehensive model in which money absorption depended on money income, the exchange rate and the interest rate. Dr. Tsiang's conclusion was that the addition of the interest rate and the money market into the analysis would increase the stability of a given situation. Dr. Tsiang argued that the rate of interest would increase with a devaluation when the money supply is held constant because the increased money income would increase transactional demand. The increase in the interest rate will decrease absorption which helps improve the trade balance.

Others such as Dr. H.G. Johnson[44] also traced through the analysis with a constant money supply assumption. Dr. H. Johnson did not derive

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[41] S. Alexander, "Effects of a Devaluation on the Trade Balance," International Monetary Fund Staff Papers, April 1952, p. 272.

[42] F. Machlup, "Relative Prices and Aggregate Spending in the Analysis of Devaluation," American Economic Review, June 1955, pp. 255-278.

[43] S. Tsiang, Op. Cit., pp. 912-935.

[44] H. Johnson, "Towards a General Theory of the Balance of Payments," International Trade and Growth, Cambridge, Harvard University Press 1958, pp. 153-168.

his conclusion with a comprehensive model as did Tsiang.

Economists such as Svend Laursen, Beckerman and Stolper presented models in which a dynamic absorption approach was presented. Both Laursen and Beckerman objected to the failure of the absorption approach to allow income effects to change prices and hence cause additional price effects. Dr. Beckerman presented a system of difference equations which would allow for some time period analysis.[45] In the model of Dr. Beckerman the stability of income was examined. Although Dr. Beckerman did allow for prices to influence income over time, he did not specify what these influences might be and specifically how the various effects of devaluation may be changed. In addition, Dr. Beckerman did not allow for money illusion and similar reactions, since all his effects are in one direction. His analysis dealt with a stable marginal propensity to spend, but a more realistic analysis would allow the marginal propensity to spend to also react to price changes.

In an article, which is very similar to the Beckerman's article, Dr. Stolper presented a dynamic model which was to examine income reactions over time.[46] However, the article does not accomplish this purpose. With the use of difference equations Dr. Stolper derives both an income equation for country D and country N. Rather than solving the homogeneous parts of the two difference equation systems, Dr. Stolper only solves for the equilibrium solution. The equilibrium solution is

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[45] Beckerman, "Price Changes and the Stability of the Balance of Trade," Economia, November 1952, pp. 408-411.

[46] W. Stolper, "The Multiplier, Flexible Exchanges, and International Equilibrium," Quarterly Journal of Economics, November 1950, pp. 559-580.

referred to as the particular solution and it does not describe the movement of income towards or away from equilibrium.

What is lacking is a system of difference equations which would allow both expectational consumption and investment to enter into the analysis. The introduction of both a consumption and an investment accelerator would allow expectations to enter in a setting of international trade. Chapters 6 and 7 of this dissertation will present such a model. The consumption accelerator would allow for speculative consumption, which would occur when the country was in danger of a devaluation.

The absorption approach has also been criticized by Dr. Sparos. Dr. Sparos argued that the marginal propensity to absorb associated with the idle resource effect would not be the same as the one associated with the terms of trade effect.[47] This follows because the income recipients affected by a change in the terms of trade won't necessarily be the same ones that are affected by changes in idle resources. The third chapter will argue that this is a valid point. In addition, it will argue that the marginal propensities to absorb will change from one period to another since within each period different individuals will be influenced by each effect.

This brings to a close the survey on the absorption approach. There are a lot of other investigators who were of lesser significance than the ones mentioned. These investigators were not mentioned because their work closely paralleled another's.

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47 Sparos, "Consumers' Behaviour and the Conditions for Exchange Stability" Economica, May 1955, pp. 137-47.

The next section will deal with those who tried to synthesize the two approaches.

III. The Synthesizers

The first synthesizers were theorists who tried to show that with special assumptions the two approaches yield the same answers. These investigators were synthesizers because they showed that each approach could encompass the other under special circumstances.

Dr. Franz Gehrels showed that the elasticity approach of Polak could, under certain circumstances, act like the Alexander approach.[48]

Equation 13 through 15 express the initial equations of Dr. Polak.[49]

$$(13) \quad y = a + xP - m$$

$$(14) \quad a = \alpha y + a_o$$

$$(15) \quad m = \mu y + \epsilon \bar{m} P$$

y is real national income; a is domestic absorption; α is the marginal propensity to absorb; μ, the marginal propensity to import, and ϵ, the price elasticity of substitution between imports and home goods. m is real imports while x is real exports. a_o is a constant; P is the ratio of both home goods and export good's prices to import prices, whereas $\bar{m}$ is the initial import level.

Substituting within the above three equations will give the following expression for real imports.[50]

$$(16) \quad m = \frac{\mu}{1-\alpha+\mu} \quad xP - \epsilon \bar{m} P \quad + \quad \epsilon \bar{m} P + \mu y_o$$

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[48] Gehrels, "Multiplier and Elasticities in Foreign Trade Adjustments" Journal of Political Economy, February 1957, p.76.

[49] Ibid, p. 77.

[50] Ibid, pp. 76-78, This is all shown in Gehrel's article.

Taking a partial derivative of imports with respect to the price ratio gives equation 17.

$$(17)\quad \partial m/\partial P = \rho x + \varepsilon \bar{m} (1 - \rho)$$

From the chain rule of derivatives of an equation of more than one variable we know that the total derivative of imports with respect to the price ratio is the following:

$$(18)\quad dm/dP = \partial m/\partial P + \partial m/\partial x \quad dx/dP$$

Since the partial derivative of imports with respect to exports is simply ρ, substituting equation 17 into 18 gives us an expression into the trade balance derivative with respect to P gives Polak's final formulation.

$$(19)\quad d\beta/dP = x + \frac{dx}{dP} - \frac{dm}{dP} = x + \frac{dx}{dP} - \left[\rho x + \varepsilon \bar{m} (1 - \rho) + \rho \frac{dx}{dP}\right]$$

Dr. Gehrels also derived through a complicated process the following formula of the absorption approach.

$$(20)\quad dB/dP = dy/dP (1 - \alpha)$$

Equation 20 is slightly different than the usual formulation of the absorption approach because it is expressed above as a total derivative with respect to the price ratio, whereas usually it is expressed as a total differential or change.

Dr. Gehrel's main points hinge around the mathematical fact that as the marginal propensity to absorb becomes close to the value of one, both equations 19 and 20 are equal to zero. This is obvious in equation 20.

but it is not obvious in equation 19 until one realizes, if α is equal to 1, then ρ will be also 1. This is true because ρ is equal to the following $\frac{\mu}{1-\alpha+\mu}$. Hence, Gehrel states that if the marginal propensity is very close to one, then Alexander could ignore the substitution effect without serious repercussions.

Michael Michaely showed in a very similar article that under similar assumptions as those above, the results of the two models could be the same.[51]

The real question which arises, is what happens to the two approaches if the assumptions aren't the ones stated above? The obvious answer is that the results of the two approaches diverge with neither giving the correct answer.

The rest of this chapter will cover two of the earlier synthesizers, namely A. J. Brown and Metzler-Laursen. Although Gottfried Haberler and Meade had models of the combination type they will not be explicitly described because of their works being similar to the ones which will be described. Also four of the more recent synthesizers will be discussed; these include Brems, Alexander, Tsiang and Yeager.

Dr. Brown's article was far advanced for its time. Dr. Brown derives an elasticity approach similar to the others of the day. Dr. Brown modified the elasticity approach solution result by multiplying it by a multiplier which was less than 1.[52] "It also confirms the fact, obvious on

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51 M. Michaely, "Relative-Prices and Income-Absorption Approaches to Devaluation: A Partial Reconciliation," American Economic Review, March 1960, p. 144.

52 A. J. Brown, "Trade Balances and Exchange Stability", Oxford Economic Papers, April 1942, pp. 64-66.

general grounds, that the operation of the trade balance upon real incomes through the multiplier decreases the sensitivity of the trade balance to alterations in the exchange rates..."[53] One way of explaining the adverse effect that increases in income has on the trade balance is to realize that an increase in income will increase imports. Also, as income increases at home, it will be decreasing abroad because of an appreciation of foreign currency as compared to the devaluing country's currency. Hence, the decreased income abroad will cause a decreased amount of export demand, and therefore it will cause the devaluing country's export quantity to fall. The combination of falling exports and rising imports will hurt the initial improvement in the trade balance.

An excellent article written by Laursen and Metzler attempted a synthesis even before the absorption approach had been written. This model assumes an initial balance in trade, and the model is in value terms.[54]

The expenditure function depends on money income and the exchange rate as does the import function.[55]

(21) $y_1 = w_1 (y_1, \pi) + \alpha_1$ α_1 is an autonomous influence

(22) $y_2 = w_2 (y_2, {}^1/_\pi)$

(23) $({}^1/_\pi)\, v_1 (y_1, \pi) = v_2 (y_2, {}^1/_\pi)$

Equations 21 - 23 represent Laursen and Metzler's original system of equations, in which subscript 1 refers to the devaluing country, while

[53] Ibid., p. 66.

[54] Laursen-Metzler, Op. Cit., pp. 293-95.

[55] Ibid., p. 293.

subscript 2 refers to the non-devaluing country. The w functions are expenditure functions, while the v functions are import or export functions. π represents the exchange rate in the devaluing country, while $1/\pi$ represents the exchange rate in the non-devaluing country. Equation 23 indicates that trade is initially balanced. Taking a total derivative of each of the three equations with respect to α_1, which is the autonomous change, gives equation system 24.[56]

$$(24)\quad (1 - \partial w_{1}/\partial y_{1})\ dy_{1}/d\alpha_{1} - (\partial w_{1}/\partial \pi)\ d\pi/d\alpha_{1} = 1$$

$$(1 - \partial w_{2}/\partial y_{2})\ dy_{2}/d\alpha_{1} + (\partial w_{2}/\partial(1/\pi))\ d\pi/d\alpha_{1} = 0$$

$$-\partial v_{1}/\partial y_{1}\ dy_{1}/d\alpha_{1} + \partial v_{2}/\partial y_{2}\ dy_{2}/d\alpha_{1} +$$
$$(v_{1} - \partial v_{2}/\partial(1/\pi) - \partial v_{1}/\partial \pi)\ d\pi/d\alpha_{1} = 0$$

By setting up equation system 24 into a three by three matrix in which the variables in the multiplicative vector are $dy_{1}/d\alpha_{1}$, $dy_{2}/d\alpha_{1}$, and $d\pi/d\alpha_{1}$, one can solve by Cramer's rule for these three variables. These three variables will express changes in income and the exchange rate with respect to an autonomous change. Laursen and Metzler expand their analysis to include dynamic results by allowing demand and supply to diverge. In their dynamic section they examine the stability of the system in a truly dynamic context. Solution of their system gave the time paths of the two incomes and the exchange rate.

This model is considered a synthesis because not only were there income effect terms such as $(1 - \partial w_{1}/\partial y_{1})\ dy_{1}/d\alpha_{1}$, which is very similar to Alexander's $(1 - \alpha)$ dy term, but also there were terms such as

[56] Laursen-Metzler, Op. Cit., pp. 293-95.

$(\partial w_1/\partial \pi)\ d\pi/da_1$ which represents the change in expenditure when the relative prices of imports and exports change.

Dr. Brems also tried to synthesize the absorption and elasticity model. Dr. Brems sets up a two country model where each country produced only one commodity.[57] The model employed a Leontief input-output table. There were six sectors analyzed which were domestic firms, households, government and foreign firms, households and government. The model distinguished between ex ante and ex post concepts. The specific relationships between ex ante and ex post concepts are spelled out in the article.[57]

With the use of both the ex ante and ex post variables, Dr. Brems sets down thirty-eight unknowns.

Basically, Dr. Brems is allowing income to change within a context of an elasticity model. Each change in income will cause new price changes which will in turn set up new substitution effects. Dr. Brems is in essence expressing the effects of devaluation as a series of substitution effects instead of just one substitution effect. The main determinant of the final result is still the price elasticities. As Brems has his model set up, he has income elasticities as the sum of two price elasticities which he states will be equal to one.[58]

Actually Brems has improved upon the old elasticity approach because he has allowed income to enter in and set up secondary substitution effects. However, does Dr. Brems really synthesize the two approaches? The answer is probably not, because income changes can influence expendi-

[57] Brems, Op. Cit., pp. 49-50.

[58] Ibid., p. 51.

ture through the marginal propensity to absorb. Nowhere in his analysis does Brems mention the marginal propensity to absorb or import. Nowhere does Brems allow people to increase hoarding or to start to dishoard.

Brems has really accomplished a further refinement of the elasticity approach so as to allow for secondary substitution effects induced by income changes. Just by analyzing income changes in terms of elasticities does not mean that one has synthesized the two approaches. Brems needed to go further and show the interaction of the substitution effect on income, and still further to bring expenditure and hoarding explicitly into the picture.

Dr. Alexander, the man who had created the absorption approach was the next to try to synthesize the two approaches. Dr. Alexander assumed that the trade balance was initially balanced, however, in his appendix the results are modified so that initial balance is no longer assumed.[59] Dr. Alexander derived equation 25 in his article.

$$(25)\quad E_f = K\left[X_f \frac{e_3 (e_2 - 1)}{e_3 + e_2(1-K)} + M_f \frac{e_1(e_4 + 1)}{e_1 + e_4 (1-K)} \right]$$

Equation 25 represents the change in the trade balance in terms of the elasticities. This term is the substitution effect in terms of the currency of the foreign currency. The individual symbols were explained when this equation was presented as equation 3 at the beginning of the chapter.

According to Alexander this equation represents the initial effect of devaluation.[60] In order to find out the final results of devaluation

[59] S. Alexander, "Effects of a Devaluation: A Simplified Synthesis of Elasticities and Absorption Approaches," American Economic Review, March 1959, pp. 34-36.

[60] Ibid., pp. 24-25.

one must take into account the income effects. Alexander considers that the increase in income can lead to an increase in hoarding and to a deterioration of the foreign trade balance. The symbol h represents country one's (devaluing country's) marginal propensity to hoard, whereas f represents country one's marginal propensity for the trade balance to deteriorate. The marginal propensity for the trade balance to deteriorate arises because some of the increase in money income will be used to buy imports and export substitutes so as to hurt the trade balance.

With the use of what Alexander calls reversal factors, a multiplier is developed which when applied to E_f above, which is the initial change in the trade balance, will give the final change in the trade balance. A key assumption in Alexander's analysis is that "any change in exports and imports is matched by the money value of corresponding changes in expenditure on domestic output...The principal content of this assumption is that the reduction of money demand for imports represents a shift of money demand from imports to domestic goods, and not from imports into hoarding."[61]

Alexander derives by the multiplier analysis that total money income in the devaluing country will increase by $\frac{1}{h_1 + f_1}$, while hoarding will increase by $\frac{h_1}{h_1 + f_1}$ and the induced deterioration of the foreign trade balance will be $\frac{f_1}{h_1 + f_1} = F_1$.[62]

In order to derive his multiplier, Alexander has the initial improve-

[61] Alexander, "Effects of a Devaluation: A Simplified Synthesis of Elasticities and Absorption Approaches," American Economic Review, March 1959, p. 28.

[62] Ibid., p. 29.

ment (E_f) in the trade balance modified by subtracting out F_1E_f, which represents the income induced trade balance deteriorating spending. Hence, after round one the trade balance is $E_f - F_1E_f$. Country two will then experience an induced increase in income because of country one's increase in income. Hence, country two will have a deterioration in the foreign trade of F_2. This deterioration in country two's balance will improve country one's balance slightly to $F_1F_2E_f$. "The improvement of $F_1F_2E_f$ will lead to additional deterioration of F_1 times $F_1F_2E_f$." The idea is that whole series of actions and reactions are set up so that the final trade balance change is equation 26.[63]

$$(26) \quad dB_f = \frac{H_1H_2E_f}{1 - F_1F_2}$$

Substituting the marginal propensities into equation 26 gives equation 27.[64]

$$(27) \quad dB_f = \frac{E_f}{1 + f_1/h_1 + f_2/h_2}$$

Equation 27 shows that in order to determine the final change in the trade balance one must multiply the initial change, which is determined by the elasticity approach (E_f), by a multiplier which is determined by the marginal propensities to hoard and for the trade balance to deteriorate.

The f_1/h_1 term is the ratio of the marginal propensity for the

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[63] Alexander, "Effects of a Devaluation: A Simplified Synthesis of Elasticities and Absorption Approaches," American Economic Review, March 1959, p. 28.

[64] Ibid., Ibid.

trade balance to deteriorate over the marginal propensity to hoard in country 1. The other ratio represents this ratio in country 2. Therefore, if the marginal propensity to hoard in country 1 is zero then f_1/h_1 is infinite and the final trade balance change is zero.

It is interesting to note that in a little known article written by William R. Allen, three years prior to Alexander, the same result had been developed. Allen also felt that the initial effect of devaluation would be the substitution effect.[65] In order to determine the final outcome of devaluation, the following multiplier had to be used:[66]

$$(28)\quad k = \frac{1}{1 + m_a/s_a + m_b/s_b}$$

m_a, m_b are the marginal propensities to import in country a and b, respectively

s_a, s_b are the marginal propensities to save or hoard in country a and b, respectively.

Allen's marginal propensity to import is analogous to Alexander's marginal propensity for the trade balance to deteriorate whereas Allen's marginal propensity to save is analogous to Alexander's marginal propensity to hoard.

Actually, Alexander's and Allen's synthesis was far from complete. Neither analysis allowed for secondary substitution and price effects which would arise from the changes in income. Also, one must allow for changes in the income effects induced by the secondary substitution effects ad infinitum. In addition, Alexander did not allow for secondary price effects and the series of effects which they will set off.

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[65] W. Allen, "A Note on the Money Income Effects of Devaluation," Kyklos, Fasc. 3, 1956, pp. 375-76.

[66] Ibid., Ibid.

Dr. Tsiang's model which will be presented shortly will solve the first of these problems because he will allow for secondary substitution effects generated by the income change. "Dr. Tsiang will accomplish this by making imports a function of expenditure instead of income and by including a variable which allows for substitution response of import demand with respect to the price ratio of imports to domestic goods."[67]

Before the Tsiang model is examined it is noteworthy that the multiplier of Alexander's analysis was determined by the absorption approach, while his multiplicand was determined by the elasticity approach.

Improving upon the Meade model, Dr. Tsiang presented the best attempt to synthesize the two models. Tsiang uses an expenditure function which has expenditure as a function of money income, the terms of trade and the interest rate.[68] Within his model Dr. Tsiang explicitly examines the influence of money. Both the situation of a Keynesian neutral money supply and the situation of an orthodox neutral money supply are examined. A Keynesian neutral money supply assumes that the monetary authorities increase the money supply so as to keep the interest constant.[69] This is usually the implicit assumption of those devaluation models which ignore the money supply. The orthodox neutral money supply keeps the money supply constant, causing the interest rate to adjust with changes in money demand. Devaluation will cause money income to increase which in turn will increase the domestic transactional demand for money.

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[67] Clements, Op. Cit., p. 331.

[68] S. Tsiang, Op. Cit., p. 918.

[69] Ibid., p. 928.

With a constant supply of money an increase in the transactional demand for money will raise the interest rates. A rise in the interest rate will lower expenditure because investment and consumption expenditure will decline.[70] Hence, when the money supply is held constant an improvement in the balance of trade is easier to achieve.

Dr. Tsiang tries to synthesize the two models by including the terms of trade in the expenditure function. In addition, he has an import function which is a function of expenditure rather than income. This assumption allows income changes and expenditure changes to change the terms of trade which in turn will change imports and expenditure. Whereas Alexander only allows substitution effects to occur during the first period, Tsiang's model allows for substitution effects at any time. Therefore, Tsiang has allowed for the income effect to set off secondary substitution effects. In order to obtain a complete synthesis one must also allow substitution effects to cause secondary income effects. In addition, one must allow for price effects such as the cash balance effect. One must also allow for price effects to interact with the other two categories of effects.

The most recent attempt of reconciliation and synthesis of the two approaches was by Leland Yeager in Economica in February 1970.[71] Dr. Yeager sums up his contribution in the following statement:

> Earlier attempts to reconcile the two kinds of analysis went astray in looking only for ways in which an exchange-rate adjustment alters propensities to absorb out of income. They overlooked the key point of the present reconciliation--- divergence between private and national views of the size of

[70] S. Tsiang, Op. Cit., p. 930.

[71] L. Yeager, "Absorption and Elasticity: A Fuller Reconciliation," Economica, February 1970, pp. 68-77.

the real national income available to cover absorption.[72]

Dr. Yeager deals with the fact that over-valuation of currency leads to import subsidizing, while under-valuation will subsidize exporters. However, when a currency is not valued correctly then there is a divergence between private and national points of view in regards to real income. "On the export side, currency over-valuation tends to raise real income from the national point of view by raising export prices to foreign buyers in foreign currency, while reducing incomes from the private point of view of home exporters."[73] Just the opposite would be true for imports, over-valuation would increase real income from the private point of view by giving the people more imports for their currency, while from the national point of view real incomes would decline since domestic production would be curtailed as more imports are brought.

Without the use of fancy formulas Dr. Yeager presents a table of various elasticities showing how they would strengthen or weaken the "normal" tendency of currency over-valuation to cause over-absorption.

As a synthesis model Dr. Yeager's model is far from satisfactory. First, his "revolutionary key" of the differences in the national and private points of view has always been recognized although not in the explicit form that he uses. Most of the theories of devaluation derive their conclusion both in terms of foreign currency and in terms of domestic currency. The foreign currency terms represent the national point of view whereas the domestic currency terms represent the private point of view. Machlup and others have clearly expressed that these

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[72] Ibid., p. 68.

[73] Ibid., p. 72.

will usually be different.

Secondly, simply translating income effects in terms of the elasticities of imports and exports is not a synthesis of the two approaches. As has been said a number of times, a synthesis requires a series of interactions between changes in relative prices, the price level and income.

Fewer superfluous articles would have been published by others if Alexander had specified how the various elasticities come into play within his absorption approach. Probably the reason he didn't was that he wanted to differentiate his absorption approach from the elasticity approach as much as he could. Also, as the next chapter will show, by dealing in real terms elasticities don't play such an all-important role as they do when value terms are employed.

There still remains the two biggest omissions of all. First, the capital flows must be added to the analysis so that one can discuss the balance of payments rather than the balance of trade. The balance of trade only covers the current account of the balance of payments. Especially when one starts to manipulate the interest rate, capital flows must be brought into the analysis, since a change in the interest rate will change the interest rate differential and induce capital flows.

Also, to the extent to which the balance of trade and changes in the balance of trade determine short-term capital flows, there will be an interaction between the current account and the capital account. Capital flows will be discussed in chapter 4 in terms of a number of models.

The second thing that is lacking from the models in the literature is dynamism. Except for Beckerman, Metzler and Laursen, and a few others, everything is put in terms of comparative statics. The system must be

put in dynamic terms so as to determine whether the system converges or diverges from equilibrium.

CHAPTER II

THE BASIC MODEL

This chapter presents (in two forms) the basic model employed in this dissertation. The first form is in real terms, while the second form is in money terms. For the sake of simplicity of exposition, the model in real terms is referred to as Model 1, whereas the model in money terms is referred to as Model 2.

The two basic models are synthesis models, since the influence of income changes and substitution effects are analyzed. Model 1 is similar to the Alexander absorption model except for the addition of a term which allows for substitution effects. Model 2 is very similar to the models of Tsiang[1] and Metzler-Laursen.[2]

In order to make the models presented in this chapter into true mathematical models, in which the number of unknowns and the number of equations are equal, one would have to specify the exact form of the functional relationships presented in this chapter. This is not accomplished here since Tsiang has already accomplished this in his article[3]--the reader is referred to his work for the complete model. Instead of presenting a complete model, the skeleton of the model is presented so

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1 S. Tsiang, "The Role of Money in Trade Balance Stability: Synthesis of the Elasticity and Absorption Approach", American Economic Review, December 1961, pp. 912-923.

2 Metzler & Laursen, "Flexible Exchange and the Theory of Employment", Review of Economics and Statistics, November 1950, pp. 292-97.

3 S. Tsiang, Op. Cit., pp. 912-923.

that the relationships and the effects which are involved can be conceptually understood.

This chapter has two main purposes. First, it explains the actions and reactions of the balance of trade when a devaluation occurs. In order to achieve this, the basic relationships of a synthesis model are explained. This model is an augmentation of the Alexander absorption model which was examined in the last chapter. A clear understanding of the reaction of the balance of trade must be realized before the model can be expanded in Chapters 4 and 5 to allow for capital flows. The addition of capital flows means that the balance of payments will be analyzed later in the dissertation.

The second purpose of this chapter is to clear up some of the confusion about whether any difference arises when the model is in real or money terms. This chapter compares and contrasts the basic synthesis model when expressed in real terms as opposed to the model expressed in money terms. This is an important contribution since no detailed comparison has been written to date.

Before the chapter begins, two things must be established. First, the income effects dealt with in devaluation theory are not the usual micro-economic concepts. Since one is dealing with macro-economic concepts when working with devaluation theory, the income effects discussed cause shifts in the demand curves for imports and exports. In macro-economic analysis, changes in relative prices produce such great income changes that it is necessary to shift the demand curve, whereas in micro-economic analysis one would move along a stable demand curve. It should be realized that the income effects of a devaluation are really income changes.

The second thing which must be established is a matter of definition. Real income is considered as the physical quantity of goods and services produced by a nation. Real income is exactly equal to output. In addition, it is assumed that money income (Y) is a function of the price level (P) and real income (y). If prices or real income rise, then money income will rise.

I. The Basic Models

This section is divided into two sub-sections; section (i) presents the basic model in real terms, whereas section (ii) deals with the basic model in money terms. The assumptions employed are the same in both models. Namely, the money supply is adjusted by the monetary authorities so that the interest rate remains constant, i.e. a Keynesian neutral monetary policy is assumed in both the devaluing and the non-devaluing country. A two country model is employed in which the non-devaluing country represents the rest of the world.

(i) Basic Model 1

This model examines how a real trade balance will change when there is a devaluation. There are two key variables to examine. First, one must examine real income, and second, one must examine real absorption of goods and services.

This model employs the same definition for the trade balance in real terms that was employed by Alexander. The trade balance is equal to the difference between real income and real absorption. The change in the trade balance is equal to the difference between the change in real income and the change in real absorption (equation 1).

(1) $dB = dy - dA$

To be able to separate out the effects of devaluation one must determine the change in absorption. The absorption of goods and services is assumed to be a function of the price level of the economy, real income and the exchange rate (e). As the price level changes, the physical quantity of goods and services which the people of a country want to buy alters. This will result because of redistribution effects and the real cash balance effect, to name two. Many purchases of consumption and investment goods are made with the price level in mind. Hence, real absorption is assumed to be a function of the price level. Usually the partial derivative of absorption with respect to the price level ($\partial A/\partial P$) is negative; a rise in the price level will cause some people to cut down on real expenditure.

Real income is also an influence on absorption because as the physical quantity of goods and services produced in a country increases, there is more available to consume or invest domestically. The partial derivative of absorption with respect to real income ($\partial A/\partial y$) will be positive.

The exchange rate is defined as the number of units of the domestic currency which is equivalent to one unit of the foreign currency. As the exchange rate changes, this, in essence, changes the relative prices of imports and exports. A change in the relative prices of imports and exports induces both a change in absorption and a change in the composition of absorption. The changes in absorption, which the change in the exchange rate causes, is known as the substitution effect. This change can be called a substitution effect because relative prices are allowed to change while all other things are held constant. The partial deriva-

tive of absorption with respect to the exchange rate ($\partial A/\partial e$) is negative.

The decrease in the exchange rate will increase the price of imports as compared to the price of exports in terms of domestic currency. Fritz Machlup points out that as the relative price of imports increases, people of the devaluing country will substitute their purchases to the domestic market.[4] This substitution of purchases will increase demand for domestic goods which will bid up the price level. The bidding up of the price level will lower the quantity of goods which can be absorbed.

> And the increased demand for import-substitutes together with the reduced supply of domestic goods from the production of which resources have been diverted cannot but cause relative price movements which are apt to reduce the real value of aggregate absorption even if total money expenditures should be somewhat higher than before.[5]

All of the above can be put together by writing real absorption as a function of real income, the price level and the exchange rate.

$$(2) \quad A = A(y, P, e,)$$

Taking a total differential of the absorption function gives an expression for all the influences on absorption. Equation 3 expresses this differential.

$$(3) \quad dA = \partial A/\partial y \; dy + \partial A/\partial p dP + \partial A/\partial e \; de$$

The last term of equation 3 represents the important difference between the synthesis model now being presented as compared with the Alexander model presented in the last chapter. This term allows for changes in absorption resulting from the change in relative prices. In order to

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4 F. Machlup, "Relative Prices and Aggregate Spending in the Analysis of Devaluation", American Economic Review, June 1955, p. 267.

5 F. Machlup, Op. Cit., p. 267.

get a more exact representation for this term, it is necessary to know the elasticities of domestic and foreign demand and supply for imports and exports. This substitution effect analyzes only the physical quantity changes in absorption, since the model is in real terms.

By substituting equation 3's expression for the change is absorption into equation 1, an expression for the change in the balance of trade in terms of real income change, the price level change and exchange rate change is derived.

$$(4) \quad dB = dy - {}^{\partial A}/_{\partial y}dy - {}^{\partial A}/_{\partial pdP} - {}^{\partial A}/_{\partial e}\, de$$

Equation 4 indicates that the influence of changes in real income, changes in the price level and changes in the exchange rate must be accounted for in order to get a complete picture of how the real trade balance changes with a devaluation.

A table of effects associated with Model 1 can be made up, as illustrated below.

Table 1

1. Income Effects--idle resources, terms of trade, reallocation of resources
2. Price Effects--real cash balance, money illusion, redistribution of income, dynamic price expectation, high cost of investment
3. Substitution Effects

It must be emphasized that all the effects listed in Table 1 deal with physical changes in quantity with respect to income or absorption. Herein, lies the first important difference between the effects of Model 1 listed in Table 1 as compared with the effects of Model 2 which will be listed in Table 2. Many of the effects of Model 2 have the same name as those of

Model 1, however, the effects of Model 2 are in value terms. This difference requires a consideration of the demand elasticity of domestic goods with respect to the price level in order to determine the direction of the direct effects.

Model 1 has been derived in real income terms, which does not really tell much about what is going to happen to the stability of the currency. Knowing what happens to the real balance of trade is of less concern than the money balance of trade. Alexander has been severely criticized because he expressed everything in real terms.

(i) Basic Model 2

Model 2 examines the change in the money trade balance resulting from devaluation of the domestic currency. Model 2 is analogous to Model 1 except for a few minor differences. Instead of dealing with real income and real absorption, money income and money absorption are dealt with. Although on the surface the switch from real to money terms will not change the equations very much, in reality the underlying analysis will be much more complex and different.

The money trade balance is defined as the difference between money income and money absorption. The change in the money trade balance (db) is equal to the change in money income (dY) minus the change in money absorption (or domestic expenditure) ($d\bar{A}$). This relationship is expressed in equation 7 below.

$$(7) \quad db = dY - d\bar{A}$$

As in Model 1, the change in income and the change in absorption must be examined closely in order to determine the change in the trade balance.

Money income depends on both changes in real income and on changes in the price level. Hence, one can express money income as the following function:

$$(8) \quad Y = Y(y, P).$$

By taking a total differential of money income equation 9 is derived which shows that the change in money income has two components. The first component ($^{\partial Y}/_{\partial y} dy$) indicates that any change in output or real income will directly change money income. There is a direct relationship between money income and output which means that $^{\partial Y}/_{\partial y}$ is positive. In addition, the second component ($^{\partial Y}/_{\partial P} dP$) indicates that changes in the price level will also affect money income. As the price level rises, so will the money income level, if output remains constant. Thus, $^{\partial Y}/_{\partial P}$ will be positive.

$$(9) \quad dY = {}^{\partial Y}/_{\partial y} dy + {}^{\partial Y}/_{\partial P} dP$$

The money absorption of the country is a function of both the money income level and the exchange rate. Absorption still depends on the price level, but this does not need to be mentioned explicitly since money income allows for both the influence of output and the price level on absorption. The absorption can be written in the following form.

$$(10) \quad \bar{A} = \bar{A}(Y, e)$$

Taking a total differential of equation 10 gives an expression for the change in money absorption.

$$(11) \quad d\bar{A} = {}^{\partial \bar{A}}/_{\partial Y} dY + {}^{\partial \bar{A}}/_{\partial e} de$$

The change in money absorption depends on both the change in money income and the change in the exchange rate. When money income increases, more money reaches the hands of consumers and investors. This increase in

income allows for greater expenditure on consumption and investment. Therefore, the $\partial\bar{A}/\partial Y$ term is assumed positive.

With the devaluation, the relative price of imports rises, which induces people to substitute into domestic goods. The increased demand for domestic goods raises the price level and lowers real absorption. However, the final direction of movement of money absorption is anyone's guess since the decrease in real absorption is offset by an increase in the price level. In order to calculate the substitution effect within the money-term model, the values of the elasticities of supply and demand for domestic goods, imports and exports must be known. The sign of $\partial\bar{A}/\partial e$ is indeterminate without further assumptions. The second noticeable difference between Model 1 and Model 2 is that the substitution effect can go either way in Model 2, whereas it was positive in Model 1.

Substitution of equation 11 into equation 7 gives a more complete expression for the change in the money trade balance.

$$(12) \quad db = dY - \partial\bar{A}/\partial Y dY - \partial\bar{A}/\partial e \; de$$

Substituting equation 9 into equation 12 gives equation 13.

$$(13) \quad db = \partial Y/\partial y dy + \partial Y/\partial p dP - \partial\bar{A}/\partial y \; dy - \partial\bar{A}/\partial p dP - \partial\bar{A}/\partial e \; de$$

Equation 13 is the full statement of Model 2. The $-\partial\bar{A}/\partial p dP$ term represents the change in domestic expenditure resulting from the change in the price level. This term is similar to the price effect term in Model 1, except now the price level is influencing the money value of absorption and not the physical quantity of absorption. Both the decrease in the quantity of absorption and the increased price level must be accounted for in order to determine whether this effect will be favorable or unfavorable. If the increased price level outweighs the decrease in ab-

sorption quantity, then money absorption will increase and the trade balance will deteriorate. If, on the other hand, the decrease in real absorption outweighs the increased price level, then money absorption will fall, which will improve the trade balance. In order to be able to determine which way price effects will go, more must be known about the elasticities of demand and supply for imports, exports and domestic goods. Hence, although the price effect term in Model 2 appears to be like Model 1's price effect, in essence, they are quite different.

The $\partial Y/\partial y dy - \partial \bar{A}/\partial y\, dy$ terms are very similar to the terms in Model 1 which expressed the real income effects. The first term ($\partial Y/\partial y dy$) indicates that devaluation will change output or real income. The term states further that a change in output will change money income. Output will change money income because a different quantity of goods will have to be valued at a constant price level to determine the new money income level. Notice that in Model 1 the analogous term was just (dy) which stood for the change in real income. The influence of changes in output on money income and not just changes in output are of interest. The $\partial \bar{A}/\partial y dy$ term represents the change in absorption which is induced by the change in real income. Actually, a better expression for this term is the following $\partial \bar{A}/\partial Y \partial Y/\partial y dy$. The compound term indicates that a change in output will change money income. The change in money income will go on to change money absorption, since as people have a change in income received they will change expenditure accordingly. The final result of the real income effect in Model 2 is arrived at by subtracting the change in money absorption (induced by the output change) from the change in money income (induced by the output change). If output increases, then

the induced increase in money income must outweigh the increase in money absorption whenever the real income effect is to have a favorable effect on the trade balance. If output decreases, then the induced decrease in money income must be outweighed by the decrease in money absorption if the trade balance is to improve.

Notice that although the real income effects might be called by the same name in both Model 1 and Model 2, they are not the same thing and they can move in different directions.

The $\partial Y/\partial pdP$ term of equation 13 represents the one term of Model 2 which has no counterpart in Model 1. The term represents the change in money income resulting from the change in the price level. Since everything was in real terms in Model 1, this term did not arise.

As the price level rises, a fixed amount of output will be valued at a higher price level. This means that as the price level rises, money income will rise. Therefore, $\partial Y/\partial pdP$ will indicate a favorable influence on the trade balance if the price level rises. Since devaluation leads to a rising price level, this term will be a positive influence on the trade balance. This term will be called the income-price effect, to indicate that it is a type of effect which has the price level influencing money income.

The following table of effects of devaluation which will occur in Model 2 can be made.

Table 2

1. Income Effects—idle resource, terms of trade, reallocation of resources
2. Income-price effect

3. Price Effects--real cash balance, money illusion, redistribution of income, dynamic price expectation, and high cost of investment effects--all effects work on money absorption

4. Substitution Effect--in terms of money absorption

Table 2 is quite similar to Table 1, yet as has been shown, this similarity is superficial. The effects of devaluation are quite different in money terms as compared to real terms. Therefore, the situation can arise where in real terms the balance improves while in money terms it deteriorates. The money trade balance is the more important of the two, since it will tell what will be happening to the stability of the currency.

The bulk of the dissertation will make reference to Model 2 rather than Model 1. This is because the stability of the currency is the primary question at hand.

III. Summary and Conclusions

This chapter has presented both of the basic models of devaluation analysis to which the future chapters will make reference. The two models differ greatly from one another, although on the surface they appear to be quite similar.

The real term model analyzes the real trade balance by examining changes in output and changes in real absorption. The model in money terms analyzes the trade balance in money terms by analyzing the changes in money income and money absorption.

The following important points have been made.

1. Although the two models appear to be quite alike, they will give different answers to the question of the effectiveness of devaluation.

2. The price and substitution effects are much more difficult to analyze in the money term model, because one must account for both changes in the price level and changes in quantity of absorption.
3. The elasticities of demand and supply of import, export and domestic goods must be known so that the price and substitution effects can be fully analyzed in Model 2.
4. Model 2's real income effect also differs from that of Model 1 since money income and money absorption are now being analyzed.
5. Model 2 also adds in the extra income-price effect not found in Model 1.

The next chapter deals with a separation of the basic model into a series of time periods. Thus, it will analyze the long and short-run effects of devaluation in order to determine whether they are different.

CHAPTER III

THE LONG AND SHORT-RUN EFFECTS OF DEVALUATION

When playing a slot-machine, a person decides whether or not to drop his quarter into the slot. Once the decision is made, the rest is simply a matter of pulling the lever. Instantly, the swirl of cherries, lemons, and bells determines the final irreversible outcome.

Many of the models appearing in the literature of devaluation theory behave in much the same manner as the slot machine. Once the decision to devalue is made, the formula grinds out the final result. Reversals over time of the initial effects of devaluation are seldom mentioned.[1] The reversals that are mentioned, usually take the form of a multiplier that is applied to an initial effect determined by the elasticity approach.[2]

The models previously employed in dealing with the effectiveness of devaluation do not fully explain what is happening. The long-run effects of devaluation are much different than the short-run effects. In fact, if the amount of time following a devaluation is broken into a number of time periods, different post-devaluation effects for each period would be found.

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1 Notable exceptions are S. C. Tsiang, S. S. Alexander reversal equations. However, these do not give a complete analysis over time.

2 S. Alexander, "Effects of a Devaluation; A simplified synthesis of elasticities and absorption approaches," American Economic Review, March 1959, pp. 22-42.

This chapter will discuss each effect of devaluation in terms of its performance in the short, middle and long-run. The effects which are discussed are the ones derived in the basic model presented in the last chapter.

In addition to the discussion of the performance of the various effects over time, this chapter will discuss the influence of changes in elasticities with time. Also, lagged shifts in the export and import curves, occurring because of lagged changes in absorption and income, will be discussed.

Basically, this chapter will show that devaluation does not set up price effects, income effects and substitution effects alone. Instead, devaluation sets up a whole series of price, income, and substitution effects which interact with each other causing new chains of effects.

This chapter first discusses the influence of the changes in the elasticities for the supply and demand for imports and exports within the different runs. Also, the effect of delayed shifts in the curves due to delayed income and absorption changes are discussed.

The second section presents a pictorial device for separating the various effects within the different time periods. The following section discusses what the effects are expected to be like within the time periods. The fourth section sums up the results in order to give a qualitative picture of what is happening.

This chapter will be very important in what is to follow, since this chapter gives a way of understanding the acceleration of the trade balance. The accelerator of the trade balance will be of utmost impor-

tance when short-term speculative capital flows are discussed in the next chapter. Since changes in the trade balance and the level of the trade balance are indicators of the stability of a currency, it will be assumed in the next chapter that speculative short-term capital flows are a function of these two variables. Changes in speculative capital flows will result from changes in the trade balance and changes in the change in the trade balance (acceleration of the trade balance). Hence, the acceleration in the trade balance will be instrumental in changing short-run speculative capital flows.

I. Elasticity Changes and Shifts in the Curves

Elementary economic theory gives the number of substitutes and the number of uses as two determinants of demand elasticity. Two determinants of supply elasticity are the number of fixed factors and the type of technology employed. The greater the number of fixed factors, the sooner diminishing returns will set in. If diminishing returns set in quickly, then increasing marginal cost will also set in quickly. The marginal cost curve behaves exactly opposite to the way in which the marginal product curve behaves. As the marginal product curve is rising, the marginal cost curve is falling. When the marginal product curve is falling, as a result of diminishing returns, then the marginal cost curve is rising, because of increasing costs. Since the marginal cost curve is the supply curve in perfect competition, diminishing returns will determine the elasticity of the supply curve under perfect competition. Technology will also determine the shape of the supply curve, since it determines the shape and position of the total product curve.

Long-run supply elasticities are usually larger than short-run supply elasticities, because all factors of production are variable in the long-run. The variability of all the factors of production would mean less constraints in production. In addition, a technology may be available in the long-run which would forestall the onset of diminishing returns.

In addition, long-run demand elasticities have a tendency to increase over time because of the greater number of available substitutes and the greater number of possible uses for the product. Time allows new uses for a product to be discovered.

In many places in the literature, economists have stated time after time that the demand and supply elasticities of imports and exports would increase in the long-run. In his 1949 article in Kyklos[3], Haberler stated that a longer reaction time allows for greater elasticities. Guy H. Orcutt emphasizes that both the short and long-run elasticities must be analyzed in order to achieve a better answer to the devaluation question. In addition, Orcutt points out that short-run elasticities tend to be smaller than long-run elasticities.[4] Austin Peck also indicated that the elasticity of demand would be greater in the long-run.[5] MacDougall also argues, in his book, The World Dollar Problem, that there is a natural tendency for elasticities to increase

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3 G. Haberler, "The Market for Foreign Exchange and the Stability of the Balance of Payments," Kyklos, Fasc. 3, 1949, pp. 208-09.

4 G. Orcutt, Op. Cit., pp. 123-26.

5 H. A. Peck, International Economics, New York, Crowell, 1957, pp. 126-27.

Figure 1

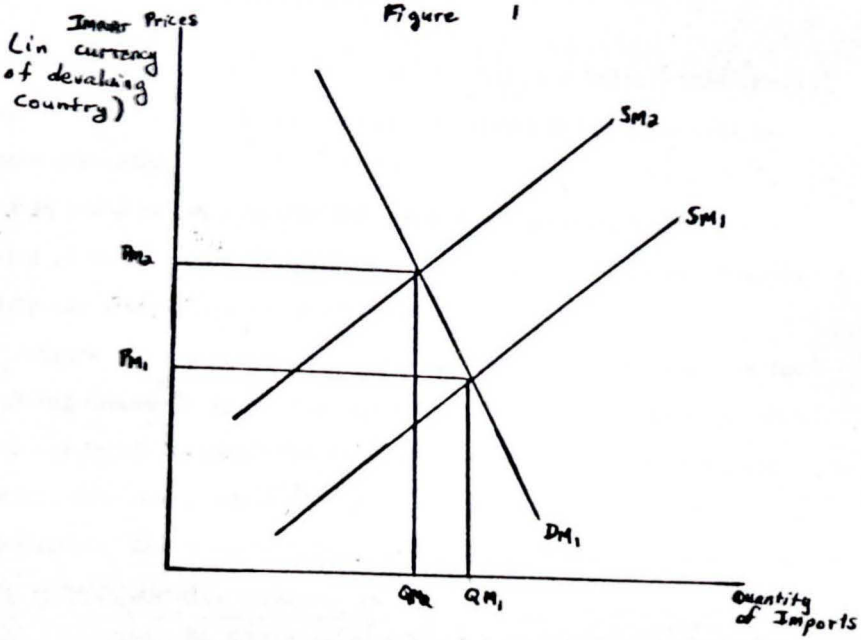
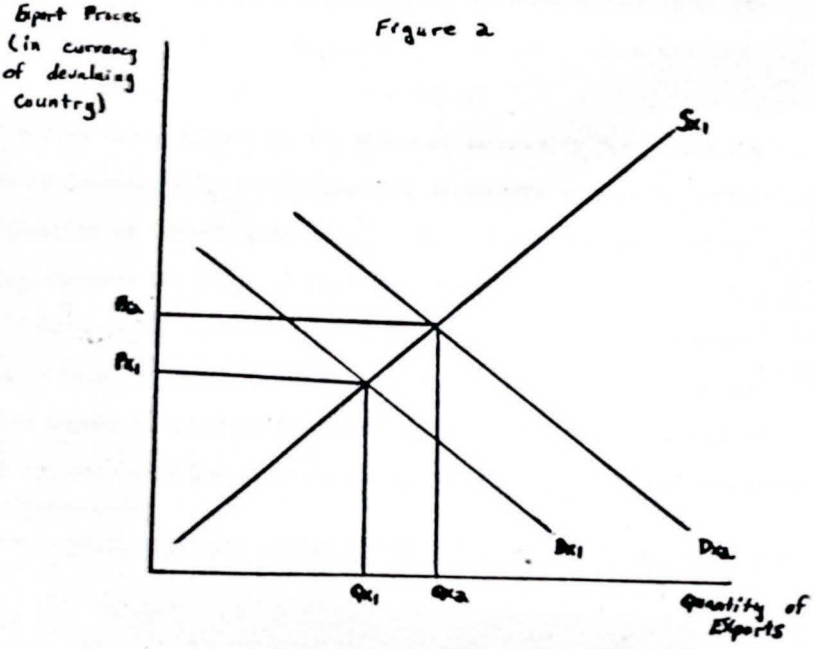


Figure 2



over time.[6] These are a few examples of those who believe that the elasticity of the supply and demand for exports and imports will increase with time.

In order to see what the influence of an increase in the elasticities of the respective curves can be, the import and export diagrams previously presented must be examined.

Figure 1 represents the market for imports, in which D_{M1} is the devaluing country's demand for imports, while S_{M1} is the foreign country's supply of imports. The price of imports is measured along the vertical axis, while along the horizontal axis the quantity of imports is measured. The price of imports is denominated in terms of the currency of the devaluing country. In figure 2, D_{X1} represents the foreign demand for exports, while S_{X1} represents the domestic supply of exports. As before, the vertical axis measures the price of exports in terms of the devaluing country's currency, while the horizontal axis measures the quantity of exports.

Before the devaluation, the price of exports is P_{X1}, while the price of imports is P_{M1}. The quantity of imports sold is Q_{M1}, while the quantity of exports sold is Q_{X1}. The value of exports sold is $P_{X1}Q_{X1}$, whereas the value of imports is $P_{M1}Q_{M1}$.

A devaluation will make exports more attractive to foreigners, since in terms of their currency less money must be given for a particular export than before the devaluation. Since a given amount of their currency will buy a larger amount of the exports of the devaluing

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6 D. MacDougall, The World Dollar Problem, London, MacMillan, 1957, p.320.

country after the devaluation, the foreign demand for exports will shift upwards to D_{X2} in figure 2. Export prices will rise to P_{X2} with an increased quantity of Q_{X2}.

In the market for imports, the devaluation raises the price of imports in terms of domestic currency. Hence, suppliers in the non-devaluing country are, in essence, asking a higher price for each quantity than before. A devaluation can be compared to a tax on imports. Thus, devaluation shifts the supply curve up to the left in figure 1 to S_{M2}. Now, the price of imports is raised to P_{M2}, while the quantity of imports is lowered to Q_{M2}. The final substitution effect of devaluation, in terms of the value of exports and imports, depends on the elasticities involved.

In order to see the influence that an increase in the elasticities of the demand and supply curves can have on the equilibrium price and quantity, one must focus on the possible changes in the equilibrium situation in the import and export markets. For the sake of brevity, only the import market will be analyzed. It will be noted that the analysis of the export market is analogous. In addition, it is assumed that the short-run equilibrium is not consistent with the long-run equilibrium. This is a necessary assumption, since without it a change in the elasticity of supply would not change the long-run equilibrium position as compared to the short-run equilibrium. Figure 3 illustrates the situation in which the long-run and short-run equilibriums are consistent with each other. In this case the equilibrium quantity and price of imports doesn't change in the long-run as compared with the short-run equilibrium.

Figure 3

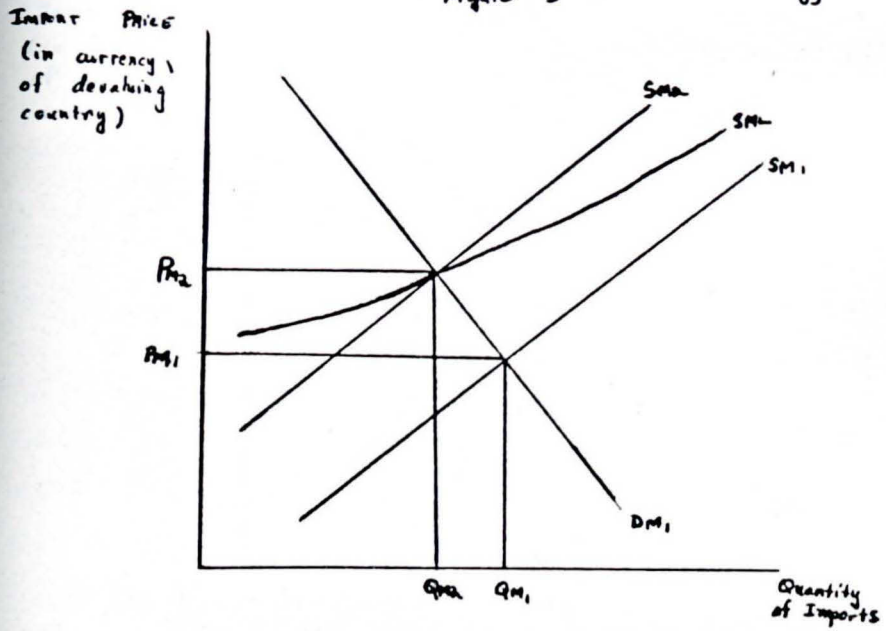


Figure 4

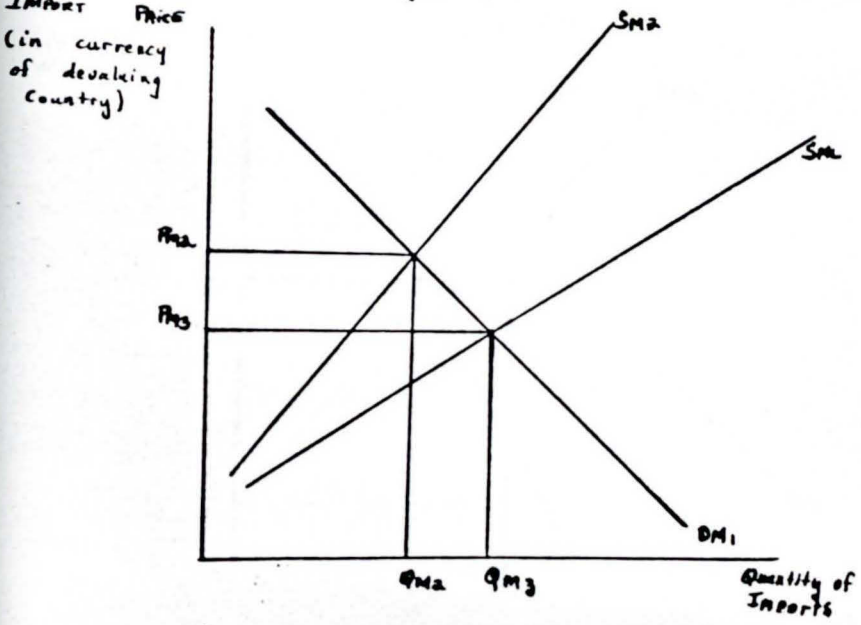


Figure 5

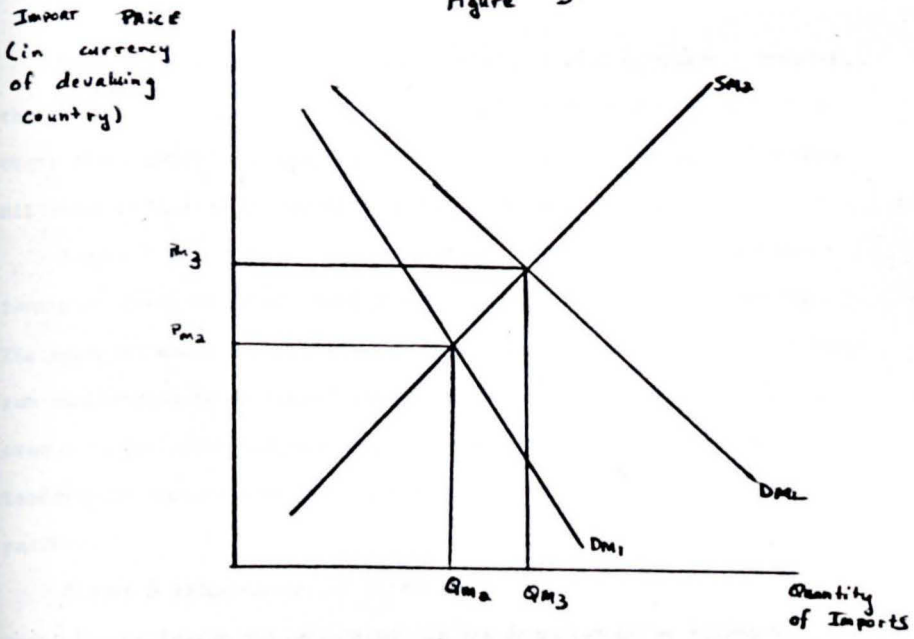
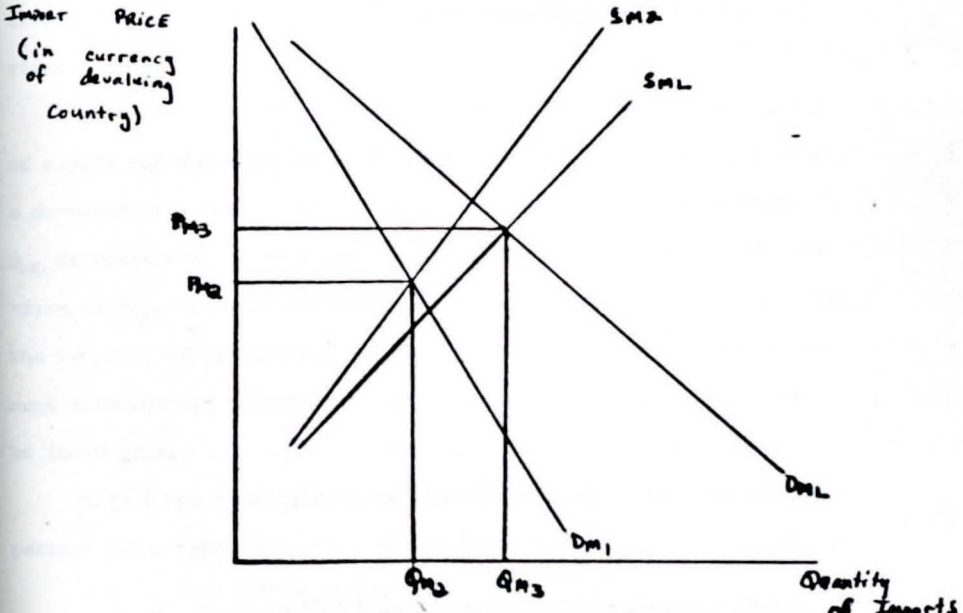


Figure 6



Whether this assumption is realistic is a moot question. However, there are times when the two equilibriums aren't consistent and it is these times which this chapter is concerned with analyzing, since this situation will lead to secondary effects of devaluation.

Figure 4 illustrates the situation in which the S_{M2} curve experiences an increase in elasticity in the long-run so as to become S_{ML}. The apparent shift downward in the supply curve arises because the long-run equilibrium is different than the short-run equilibrium. This increase in the elasticity of the supply of imports curve will have a tendency to lower price and increase the quantity of imports, ceteris paribus.

Figure 5 illustrates the situation in which the import demand curve D_{M1} increases its elasticity in the long-run so as to become D_{ML}. The increase in the demand elasticity will raise price and increase the quantity of imports. Price rises to P_{M3}, while quantity rises to Q_{M3}.

Figure 6 illustrates the situation in which both the elasticity of supply and the elasticity of demand increase in the long-run after a devaluation. Hence, the new long-run equilibrium point is where D_{ML} intersects S_{ML}. In figure 6, price rises to P_{M3}, while quantity rises to Q_{M2}. This is not always the case. If price is to rise, then the tendency of the increase in the demand elasticity to raise price must outweigh the tendency of the increase of the supply elasticity to lower price.

Whether the elasticities increase or decrease with time is unimportant. The important point of the above analysis is that any change

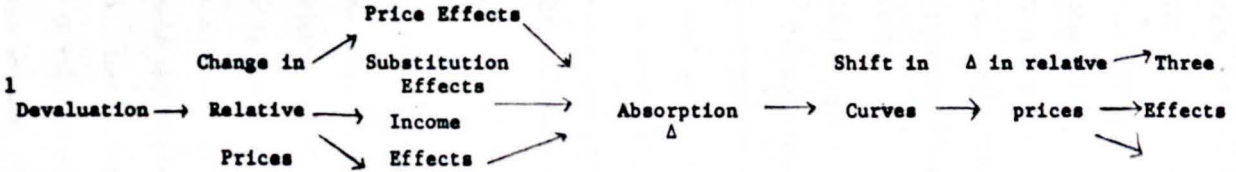
in the elasticities which changes the short-run equilibrium will cause additional changes in the prices of imports and exports. These secondary changes will cause additional long-run substitution effects previously unaccounted for in past articles. In addition, the new change in relative prices will set off new price and income effects in the long-run. Hence, the tendency for the elasticities to change can set off a whole string of new effects.

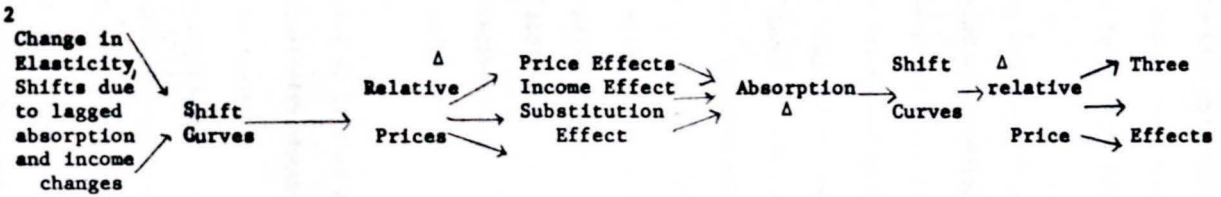
The idle resource and the reallocation of resources income effects operate with a lag, since resources need a certain amount of time to become mobile. These income effects will change the income level of the devaluing country to such an extent as to cause a shift in the demand and supply schedules for imports and exports. These shifts will establish a new equilibrium with a new set of relative prices. Hence, income effects will cause lagged changes in relative prices, which in turn will set up secondary income, price and substitution effects.

Lagged income changes will change absorption. The change in absorption will in turn set up new relative prices, since the demand and supply curves will shift again. In fact, anything which causes a secondary shift in the supply or demand curves for imports and exports will cause relative prices to change. The change in relative prices will set off new price and substitution effects. In addition, the change in relative prices will also set off income effects because of the resulting shift of resources.

Diagram 1 illustrates the causation involved. In period one, devaluation sets off the chain reaction by first changing relative prices. The change in relative prices causes price effects, substitution effects

Diagram 1


1
Devaluation
Change in Relative Prices
Price Effects
Substitution Effects
Income Effects
Absorption Δ
Shift in Curves
Δ in relative prices
Three Effects


2
Change in Elasticity, Shifts due to lagged absorption and income changes
Shift Curves
Δ Relative Prices
Price Effects
Income Effect
Substitution Effect
Absorption Δ
Shift Curves
Δ relative prices
Three Effects

and income effects. The income effects will influence absorption and thus will shift the export and import curves and cause further changes in relative prices, which will further cause minor price, substitution and income effects.

The price effects and substitution effects will also change absorption. Price effects alter absorption or expenditure because many expenditure decisions are made with the price level in mind. Changes in the price level will alter these decisions and therefore will change expenditure. Substitution effects are quite different than price effects. Substitution effects will not occur if both the price of imports and exports rise by the same proportion. In other words, a change in the general price level will not cause substitution effects. Substitution effects will cause expenditure shifts between goods whose relative prices have changed. Hence, the price and substitution effects will also influence absorption, which will cause additional shifts in the curves and secondary changes in relative prices. This secondary change in relative prices will also cause additional secondary price effects, substitution and income effects.

The above causation occurs in period 1; if time is given for further adjustments, then the effect of elasticity changes and the lagged changes in absorption and income must be examined.

As diagram 1 shows, if the longer-run change in elasticity changes the demand and supply for imports and exports equilibrium position, then this will lead to a secondary change in relative prices. This secondary change in relative prices will lead to further income, price and substitution effects. These effects will all change absorption and hence

cause additional shifts in the curves. These shifts in the curves will induce further effects and so on.

Since many income effects of devaluation, such as the reallocation of resources effect, operate with a lag, there will be lagged shifts in the demand and supply curves for imports and exports that will need to be examined. These lagged changes in income will lead to additional lagged changes in absorption. As diagram 1 indicates in the second row, lagged changes in absorption and income will shift the curves. These shifts in the curves will change relative prices, which will in turn set up another chain reaction.

The important point of the analysis is to indicate that devaluation effects interact with one another making it difficult to separate each effect individually. Each lagged effect of devaluation is capable of setting up a whole chain reaction.

Therefore, any analysis of devaluation which analyzes only the immediate effects of devaluation is inadequate. What is required is a flexible system of equations, which would allow for changes that would occur over time. One cannot talk about just an idle resource effect, but one must refer to the period in which the idle resource effect would be occurring. As will be shown shortly, the idle resource effect in period 1 is quite different from the idle resource effect in period 2. In fact, it is conceivable that initially no idle resources are available, however, in some later period they come into existence. Then the idle resource effect would occur, but it would be lagged by a number of periods.

The next section will suggest a device which could be used to give a better time analysis.

II. Time Analysis

Chapter 2 presented two basic models--a money-term model and a real-term model. These models indicated that there were certain effects resulting from devaluation. These effects do not all occur at the same time, but are spread over a number of periods. In addition, some effects occur more than once because they interact setting off new effects. The following pictorial device allows for a series of effects over time.

(1)

$$\Delta B_1 = (1-\alpha_{11})\Delta y_{11} + (1-\alpha_{12})\Delta y_{12} + (1-\alpha_{13})\Delta y_{13} + \Delta A_{11} + \ldots + \Delta A_{15} + \Delta S_1$$

$$\Delta B_2 = (1-\alpha_{21})\Delta y_{21} + (1-\alpha_{22})\Delta y_{22} + (1-\alpha_{23})\Delta y_{23} + \Delta A_{21} + \ldots + \Delta A_{25} + \Delta S_2$$

$$\Delta B_n = (1-\alpha_{n1}\Delta y_{n1}) + (1-\alpha_{n2})\Delta y_{n2} + (1-\alpha_{n3})\Delta y_{n3} + \Delta A_{n1} + \ldots + \Delta A_{n5} + \Delta S_5$$

(2)

$$\Delta b_1 = (1-\alpha_{11})\Delta Y_{11} + (1-\alpha_{12})\Delta Y_{12} + (1-\alpha_{13})\Delta Y_{13} + \Delta YP_1 + \Delta\bar{A}_{11} + \ldots + \Delta\bar{A}_{15} + \Delta\bar{S}_1$$

$$\Delta b_2 = (1-\alpha_{21})\Delta Y_{21} + (1-\alpha_{22})\Delta Y_{22} + (1-\alpha_{23})\Delta Y_{23} + \Delta YP_2 + \Delta\bar{A}_{21} + \ldots + \Delta\bar{A}_{25} + \Delta\bar{S}_2$$

$$\Delta b_n = (1-\alpha_{n1})\Delta Y_{n1} + (1-\alpha_{n2})\Delta Y_{n2} + (1-\alpha_{n3})\Delta Y_{n3} + \Delta YP_3 + \Delta\bar{A}_{n1} + \ldots + \Delta\bar{A}_{n5} + \Delta\bar{S}_n$$

The first subscript in the two equation systems represents the time period of the change examined. Hence, a subscript 2 would indicate the change occurring between period 2 and period 1. The second subscript refers to the effect being measured. The delta sign indicates change. The α term is the marginal propensity to absorb. In equation system 1, the marginal propensity to absorb is the change in real absorption resulting from a change in real income, while in equation system 2, the marginal propensity to absorb is the change in money absorption resulting from a change in money income.

ΔA stands for a price effect, which represents the change in absorption resulting from the influence of a change in the price level. A bar over the A indicates the price effect in terms of money absorption. Hence, a ΔA term indicates the net effect of the influence of a price level change on absorption from the beginning of one period to the end of that period. Each of the five price effects has a different subscript associated with it, so that the various price effects can be distinguished.

In addition, ΔY represents the change in real income occurring from the beginning of the period to the end of the period. The coefficient $(1-\alpha)$ indicates that the induced change in absorption resulting from the income effect must be subtracted from the change in income, so that one can get a measure of the net income effect influence on the trade balance.

The following table gives a list of the effects appearing in the two equations listed above. This list indicates exactly what effects the various subscripts are referring to.

Table 1

1. $(1-\alpha_{11})\ \Delta y_{11}$ is the idle resource effect in real terms in period 1, where α_{11} is the marginal propensity to absorb associated with the idle resource effect in period 1, $(1-\alpha_{11})\Delta Y_{11}$ would indicate this effect in value terms in the first period.

2. $(1-\alpha_{12})\ \Delta y_{12}$ is the reallocation of resource effect in period 1, where α_{12} is the marginal propensity to absorb associated with this effect, $(1-\alpha_{12})\Delta Y_{12}$ would indicate this effect in value terms.

3. $(1-\alpha_{13})\ \Delta y_{13}$ is the terms of trade effect in period 1, where α_{13} is the marginal propensity to absorb associated with this effect, $(1-\alpha_{13})\ \Delta Y_{13}$ would indicate this effect in value terms in period 1.

Note that $(1-\alpha)\ \Delta Y$ corresponds to $\partial Y/\partial y dy - \partial \bar{A}/\partial y dy$ of equation 2; where $\partial A/\partial y$ is α.

4. ΔA_{11} is the real cash balance effect in real terms in period 1, while $\Delta \bar{A}_{11}$ is this effect in value terms in period 1.

5. ΔA_{12} is the money illusion effect in period 1, while $\Delta \bar{A}_{12}$ is this effect in value terms in period 1.

6. ΔA_{13} is the redistribution of income effect in real terms in period 1, while $\Delta \bar{A}_{13}$ is this effect in value terms in period 1.

7. ΔA_{14} is the high cost of investment effect in real terms in period 1, while ΔA_{14} is this effect in value terms in period 1.

8. ΔA_{15} is the dynamic price expectation effect in period 1, while $\Delta \bar{A}_{15}$ is this effect in money terms in period 1.

9. ΔS is the substitution effect in period 1, while $\Delta \bar{S}$ is this effect in value terms in period 1.

10. ΔYP is the change in money income resulting from the price level change in period 1.

Equation system 1 indicates that for each period of time there is a change in the real balance of trade, which is arrived at by adding all of the individual effects of devaluation occurring during that time period. Equation system 2 indicates that the change in the money trade balance within any period of time is calculated by summing up the effects of devaluation occurring during that time period.

In order for equation systems 1 and 2 to be more than a pictorial device, the functional relationship of each of the effects specified in the system must be known. As of yet, no one has worked out what the exact functional relationship of Alexander's effects would be. However, we do have equations for the substitution effect developed in the literature. If there were equations for each of the effects, then it might conceivably be possible to work out a system of difference equations, which would show the pattern of each effect over time. In addition, these equations would show the pattern of the trade balance over time resulting from a devaluation.

In order to get the acceleration of the money trade balance within any time period, all one has to do is subtract the change in the money trade balance for two consecutive periods. Hence, the acceleration of the trade balance is equal to the following:

$$(5) \quad \Delta^2 b_t = \Delta(\Delta b_t) = \Delta(b_{t+1} - b_t)$$

$$(6) \quad \Delta^2 b_t = \Delta b_{t+1} - \Delta b_t$$

The acceleration of the real trade balance could be found in an analogous way.

Therefore, the acceleration of the trade balance in period 1 is equal to the difference between Δb_2 and Δb_1. It will be important later to have a means for figuring out the acceleration in the trade balance.

Since the functional relationship of each of the effects of devaluation cannot be specified, the next best thing would be to specify how they would be expected to behave. The next section of the chapter will specify how each of the ten effects are expected to behave over time. This specification will allow for some a priori specification on how the

acceleration in the trade balance will be behaving.

III. The Effects Over Time

This section discusses what can happen to the individual effects of devaluation over time. The ten effects will be discussed under four headings which are income, income-price, price and substitution effects. The effects associated with the model in money-terms will be analyzed, although the effects of the basic model in real-terms will be mentioned only in passing.

a. The Income Effects

There are three income effects of devaluation. These effects have already been introduced in a previous chapter and need little further introduction.

The idle resource effect will lead to an increase in output when idle resources are shifted to the expanding export sector. Since money income is the money valuation of output, as the output level increases, money income will increase. The idle resource effect can only operate when the devaluing country's economy is at less than full employment. However, the movement of idle resources to productive employment takes time. Therefore, the initial idle resource effect is zero. After a period of time, output will respond, which in turn will increase both money income and expenditure. The increase in expenditure will have a slight lag in regard to the increase in income.

Many economists believe that devaluation will lead to a wage-price spiral when workers try to regain the buying power which they lost as a

result of the devaluation. Michael Michaely[7] and Gottfried Haberler[8] are only two such economists. If a wage-price spiral does occur, this will lead to reversals in the original idle resource effect, because the rising price level will make exports less competitive. If exports become less competitive, then the export sector will contract. Contraction of the export industry will lead to more idle resources and hence less output.

In addition, any changes in the long-run elasticities of the curves can cause additional idle resource effects if the short-run equilibrium is inconsistent with the long-run equilibrium.

The immediate idle resource effect will be zero. The short-run results will at first be favorable, because of the increase in money income induced by the increase in output. This favorable influence will be followed shortly by an expenditure increase. The net short-run effect will be unfavorable, if the marginal propensity to absorb is greater than one. In the long-run, some reversal of the short-run idle resource effect can be expected if the tendency for cost inflation is strong. A better prediction of the long-run idle resource effect can not be ventured without specific information on the economy.

The real-term idle resource effect analysis follows analogously, except now one must look only at the change in output and not at the influence of the change in output on money income.

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7 Michael Michaely, "Devaluation, Cost, Inflation and the Supply of Exports" Economic Internazionale, February 1956, pp. 243-58.

8 Gottfried Haberler, Op. Cit., pp. 208-209.

The time period analysis of the second income effect, which is the reallocation of resources effect, follows closely that of the first. Since resources will reallocate to the expanding export sector because of the favorable profit incentive, there will be an expansion in output.

The initial reallocation of resources effect is probably nil because of the lead time required for resources to relocate. The short-run will be initially characterized by the favorable influence of an increase in output, which in turn will lead to an increase in money income. After a short lag the increase in money income will induce an increase in expenditure which will adversely affect the trade balance. If the marginal propensity to absorb is greater than one, then the net short to middle-run reallocation of resource effect will be negative.

In the long-run, any tendency for cost inflation to develop will make export prices rise. The rise in the export prices will make exports less competitive on the international market. If exports become less competitive, then less will be sold, which will cause resources to leave the industry. Any movement of resources from the export industry back to an industry which uses an older technology will set up a reversal to the initial reallocation resource effect. However, any technological advance made in the long-run would make for an additional positive effect.

The last income effect is the terms-of-trade effect. This effect will begin to operate immediately, as soon as the international price ratio has been changed by the devaluation. Of all the real income effects, the terms-of-trade effect is the most dynamic. Any change in the equilibrium position of the import and export curves will immediately cause a terms-of-trade change and hence a terms-of-trade effect.

Even a prediction about the direction of the terms-of-trade effect cannot be ventured without assumptions being made about the elasticities of the curves involved.

Most writers assume that the initial change in the terms-of-trade is a deterioration. The deterioration of the terms-of-trade will cause an initial worsening of the trade balance, because real income will decline, causing money income to fall. In a short while, absorption will react to the declining money income and decrease. The decrease in absorption will outweigh the decrease in income when the marginal propensity to absorb is greater than one.

The longer-run effects will be anyone's guess. The effect in real-terms will be the same as the money-term effect, except that only real changes are examined.

b. Income-Price Effect

This effect appears only in the basic model which is in money terms. The income-price effect takes into account changes in money income resulting from changes in the price level. Since devaluation leads to an increase in the price level, this will mean that the goods and services of the economy must be valued at a higher money level. This increase in monetary valuation of goods and services of the devaluing country is the income price effect.

The initial influence of the income-price effect will be positive because of the rise in the price level after devaluation. If the devaluing country experiences a degree of cost inflation great enough to offset other influences, then the long-run income-price effect will also be positive.

C. The Price Effects

There are five price effects of devaluation that account for changes in absorption resulting from changes in the price level. The price effects analyzed in this section are those from basic model 2. When analyzing price effects in basic model 2, it is important to realize that an account must be made both for the change in the physical quantity of absorption and the influence of the price level. We will assume in this section that the price level influence does not outweigh the quantity change.

The first price effect which will be discussed is the real cash balance effect. The initial results of the real cash balance is in the direction of a cutback in the physical absorption of goods and services. This occurs so that the citizens of the devaluing country can replenish their real saving balances. With our assumption about the quantity and price influences, the initial cash balance effect will be favorable.

Cost inflation will lead to a further rise in the price level and hence a tendency for further cash balance effects in the middle and long-run. However, anything which changes the short-run equilibrium position of the curves will cause additional effects in the long-run. Therefore, the long-run effects are quite uncertain.

Another price effect of devaluation is the money illusion effect. Initially, the money illusion effect will cause a decrease in the amount of expenditure, because many people will respond to the higher price level after the devaluation and feel poorer. This awareness of the rising price level causes many to economize.

The usual analysis leaves out an important point, which becomes apparent only when the money illusion effect is analyzed over time. Usually, the statement is made that the populace will respond either to the increased price level and feel poorer or else it will respond to the increase in money income and increase expenditure.

First, the price level will be altered by a devaluation, but later the workers will bid up the level of money income in order to replenish their old standard of living. The initial money illusion effect will have people responding to the price level and cutting expenditure. Later, in the short-run, people will respond to the increase in money by increasing expenditure. Hence, any favorable initial effect will be reversed to some extent in the short and middle-runs. The longer-run effects are quite uncertain.

Another price effect is the redistribution of income effect. Of all the price effects, this is the most difficult to predict its direction. In order to be able to predict its direction, the wage good of the society and the marginal propensities of the fixed income recipients, wage recipients and profit recipients must be known.

Although the direction of the redistribution effect is unpredictable, the change of this effect over time can be analyzed. If originally there is a redistribution effect from wage earners to profit recipients, then at a later point in time, wage earners will try to bid up their money income to replenish their standard of living. This will reverse the initial redistribution effect.

Initially, the redistribution effect will change the income shares of the people. The long-run will be characterized by the attempt to

shift the shares in favor of the original losers. If the losers are successful in their attempt, then there will be a reversals of the initial effect.

Another price effect of devaluation is the high cost of investment effect. This effect states that the rising price of imported raw materials might induce investors to stop investing if the higher priced imported raw material makes the cost of investing prohibitively high. If possible, an investor can substitute into a domestic good provided that the isoquants permit substitution. The substitution into domestic raw materials will increase their price and this increase in price may make marginal investment projects unprofitable. If this effect operates, then the decrease in investment expenditure will also mean a decrease in overall expenditure. Any further rise in the price level or in the price of raw materials can cause further decreases in absorption and hence long-run improvements in the real trade balance.

This effect also depends directly on the elasticity of substitution of the isoquants. Anything which would increase the elasticity of substitution to allow the devaluing country's industries to use less imported raw materials, will temporarily help the trade balance both in money and in real terms. The longer the time period allowed, the more elastic will be the production process. Hence, there is reason to believe that this effect can be of a positive magnitude in the long run.

The last price effect to be discussed is the dynamic price expectation effect. This price effect will operate primarily in the very short-run, such as period 1. If the populace of the devaluing country believe that a country will need to devalue again, they will spend a

large amount of money now before their buying power diminishes.

This is the most dynamic of all Alexander's effects and will be discussed separately in a later chapter.

d. Substitution Effect

Like the "price effects", the substitution effect is subject to frequent variation. Any change in the equilibrium position in the import and export markets will change relative prices and set up a new substitution effect.

In real terms, the substitution effect will always improve the trade balance in the short-run because export quantity will increase while import quantity will decrease. In value terms, whether the substitution effect will improve the trade balance in the short-run depends on the elasticities involved. If the elasticities of the import and export demand curves are quite large, while the elasticities of supply are not infinite, then the money trade balance will improve.

The long-run will involve shifts in the respective curves and changes in the respective elasticities. The final results and tendencies are too uncertain, because they depend on numerous things.

Hence, the best that can be said is that the short-run substitution effects will be favorable in real terms and probably favorable in money terms. In the long-run, any tendency for prices of domestic goods to rise because of a wage-price spiral will set off possible reversals.

IV. Time Analysis Revised

The pictorial device introduced in section 2 can now be incorporated with the analysis of the last section, which expressed the probable changes in the effects of devaluation from the initial period to the

short-run and from the short-run to the long-run. The initial period direction of movement of each effect was based on certain assumptions. Whether these assumptions are truly realistic is a moot question. The main purpose of the time analysis of this chapter is to show that certain reversals of initial period's effects can occur. We are interested in showing that the effects of devaluation can be quite different in the short-run as compared to other runs.

If one lets period 1 stand for the initial period after devaluation, period 2 stand for the short-run and period 3 stand for the long-run, then one can get table 2 which incorporates the analysis of the last section with the two equation system presented in section 2. The effects of the real-term model are presented in the top three rows, while the effects of the money-term model are presented in the bottom three rows. The numbers along the vertical side of the table indicate to which period the effects are referring.

The table is based on the assumption that the marginal propensity to absorb is greater than one, that the elasticity of demand for imports and exports is large and the elasticity of supply is such that there will result a favorable substitution effect. Also, it is assumed that the decrease in the quantity of goods absorbed resulting from the price effects will initially outweigh the increase in prices. This assumption will allow the prediction of initially favorable price effects in money terms. However, as the price level rises in the short-run, these price effects will tend to become negative as the price level change starts to outweigh the quantity decrease.

TABLE 2

	Period	Idle Resources	Reallocation of Resources	Terms of Trade	Income-Price	Cash Balance	Money Illusion	Redistribution of Income	High cost of I	Price Expectational	Substitution
Real Terms	1	0	0	?	X	+	+	?	+	-	+
	2	+/-	+/-	?	X	+	-	?	+	0	-
	3	-/+	-/+	?	X	?	?	? (reversal)	?	0	?
Money Terms	1	0	0	?	+	+	+	?	+	-	+
	2	+/-	+/-	?	+	+	-	?	+	0	-
	3	-/+	-/+	?	+	?	?	? (reversal)	?	0	?

In table 2, a zero indicates that no effect is present, while a minus indicates an adverse effect on the trade balance is present. A plus sign indicates that a favorable effect on the trade balance is occurring, while a question mark indicates that an effect is present, but its direction can not be predicted given our assumptions. The boxes with a plus dash minus indicate a positive effect which is followed by an offsetting negative effect. This offset can be partial, complete or more than complete depending on the situation.

Table 2 shows that according to our assumptions almost all of the price effects, both in real terms and money terms, are acting in a favorable manner in the initial period after a devaluation. In addition, at the start of the second period, the idle resources and reallocation of resources effects are also favorable. Initially, the substitution effect will also be a positive influence on the real trade balance.

As the previous analysis showed, the tendency for absorption to catch up with the income increase will start to cause secondary negative income effects in the short-run. Also, the substitution effect and the money illusion effect will probably start to reverse themselves because of the wage-price spiral. Many of the price effects will be favorable both initially and in the short-run, but their degree of favorability will start to decline as people become accustomed to the high price level.

Substitution of the positive and negative signs into equation 2 seems to suggest that the initial effect of devaluation, barring any strong expectational effects, will be favorable given the above assumptions. Later, there seems to be a tendency for this favorability

to decrease somewhat with time, or at least to decrease in the next period as lagged absorption catches up with income.

Hence, there is reason to believe that the acceleration of the trade balance is negative. As will be shown in the next chapter, if the acceleration of the trade balance is negative, this will lead to an adverse capital speculation.

The analysis can be expanded by the addition of more time periods.

V. Implications and Conclusions

The analysis of this chapter illustrates that a devaluation's short-run effects can be quite different from its long-run effects. If this is true, a comparative static approach to devaluation might be of questionable value.

The possibility of having short-run effects of devaluation which are quite different from the long-run effects of devaluation raises important policy implications. If the short-run effects of a devaluation produce a very favorable response of the trade balance, then a country may need very little supporting monetary and fiscal policy in the short-run. If the long-run effects of devaluation produce less favorable changes in the trade balance, then the long-run may require more supporting monetary and fiscal policy. The separation of the effects of devaluation into time periods demonstrates that in many instances the supporting monetary and fiscal policy associated with devaluation policy must be flexible in order to give support only when needed. Constant application of a policy may not be necessary.

This conclusion has an important implication for the model of Dr. Tsiang. The Tsiang model demonstrated the importance that monetary policy can have in allowing a country to achieve a successful devaluation. The analysis of this chapter suggests that this monetary policy must be applied to different degrees within the different periods.

The separation of the effects of devaluation into a number of time periods has important implications for a devaluation when the balance of payments is examined. Examination of the balance of payments means that capital flows are examined along with the balance of trade. The addition of capital flows requires the examination of speculative capital flows as well as other capital flows. If speculative capital flows respond to the change in the balance of trade as many economists hypothesize, then within each period after devaluation speculative capital flows will respond differently. Hence, monetary policy must account not only for the different changes of income and the trade balance, but it must also account for the differential change of capital flows, especially speculative capital flows.

Within a time period analysis, the idle resource effect can now exist, even though there are no idle resources when a devaluation is undertaken. This occurs whenever resources become available soon after a devaluation. Whenever this occurs, the time period analysis gives a different theoretical result than the analysis which the Alexander and the synthesis models gave. The greater degree of flexibility which the time period analysis allows makes it possible to explain in greater detail the processes behind a devaluation adjustment. The period analysis lends itself as a teaching device which can explain conceptually the

complex relationships involved with a devaluation.

There are two other important implications which can be drawn from this chapter. First, since there is an interaction between income, price and substitution effects which arise whenever the assumption of constant costs is dropped, it becomes doubtful whether the effects of devaluation can even be discussed as separate entities. If the effects do not exist as separate entities, then empirical measurement of the effects would be difficult. This raises serious questions about the usefulness of an approach such as Alexander's for policy implementation. In addition, if the marginal propensity to absorb changes within each period when different individuals are affected, then policy implementation is made rather difficult. Policy implementation is also difficult whenever a different marginal propensity to absorb is associated with each of the income effects.

Secondly, since price effects do not die out immediately, policy must account for the presence of price effects beyond the short-run. Previous models such as Alexander's, suggests that the price effects must only be accounted for in the immediate period after devaluation.

The next two chapters revert back to comparative static analysis when capital flows are introduced. However, the results can and should be interpreted under a period analysis as well.

In conclusion, the following main points have been presented in this chapter.

1. The tendency for elasticities to increase with time will set off new substitution, price and income effects in the long-run, when the short-run equilibrium is inconsistent with the long-run equilibrium.

2. Lagged income effects will set off new price and substitution effects.
3. There is an interaction between income, price and substitution effects, which makes a separate analysis of each one quite difficult.
4. Price effects don't die out immediately, but are present many periods after devaluation.
5. Price effects in the basic model in value terms must be analyzed in conjunction with elasticities in order to determine the effect on the money trade balance.
6. Price and substitution effects react more quickly than income effects.
7. The effect of devaluation on the money trade balance might be quite different than the effect on the real trade balance.
8. Given our assumptions, the initial short-run effects of devaluation will be better than the later short-run effects of devaluation. Hence, the acceleration of the trade balance is negative in period 2.

CHAPTER IV

SHORT-TERM CAPITAL FLOWS ADDED

The balance of payments must be examined if the international equilibrium of a country's currency is being studied. The balance of payments is comprised of both the balance of trade (the current account) and the capital account. Traditional devaluation theory has examined only the balance of trade, since investigators felt that the balance of trade would give a good indication of external equilibrium.

This chapter focuses on both the current and the capital account by incorporating the analysis of the previous chapter with models that allow capital to enter the picture. This chapter discusses some potentially important relationships which must be discussed in an analysis of a devaluation. These relationships have to do with the capital account.

The addition of capital flows into the analysis of devaluation yields some important policy implications which have been previously ignored. These policy implications arise from the introduction of both speculative and transactional capital flows into the analysis.

The analysis of this chapter points to the importance of both the interest rate and the trade balance on short-term capital flows. The addition of capital flows demonstrates that monetary policy which supports devaluation must be very careful to account for interest rates and the way in which interest rates affect both the current and capital account.

This chapter examines only short-term capital flows and the trade balance. Basic model 2 which is in money terms is extended to allow for

short-term capital flows. There are three models presented in this chapter. The first two models examine only the short-term speculative capital flow, and both models assume that transactional short-term capital flows are a constant. Although this assumption is unrealistic, it is employed in order to isolate the speculative capital flows for a careful analysis. The third model allows transactional short-term capital flows to vary also.

This chapter assumes that the monetary authorities vary the money supply in order to keep the interest rate constant. This assumption is dropped towards the end of the chapter when extensions are examined. In addition, it is assumed that long-term capital flows are constant. This last assumption is admittedly unrealistic, and it will be dropped in the next chapter when long-term capital flows are analyzed. However, long-term capital flows are assumed to be constant in order that attention can first be focused on the short-term flows.

I. The First Capital Model

This model will be built upon basic model 2, which was presented in Chapter 2. In basic model 2, the balance of trade was shown to be equal to money income minus money absorption. (equation 1)

$$(1) \quad b = Y - \overline{A}$$

As Chapter 2 explained, money income depends upon both output and the price level, whereas money absorption depends upon money income and the exchange rate (e).

Chapter 2 showed that the change in the money trade balance could be expressed either as equation 2 or as equation 3.

$$(2)\quad db = dY - \partial\bar{A}/\partial Y\, dY - \partial\bar{A}/\partial e\, de$$

$$(3)\quad db = \partial Y/\partial p\, dP + \partial Y/\partial y\, dy - \partial\bar{A}/\partial y\, dy - \partial\bar{A}/\partial p\, dP - \partial\bar{A}/\partial e\, de$$

These equations have been fully explained in Chapter 2. The only difference between equation 2 and equation 3 is that equation 3 breaks down the change in money income into both its output component ($\partial Y/\partial Y\, dY$) and its price component ($\partial Y/\partial p\, dP$).

Equation 2, which states that the change in the trade balance in value terms is equal to the change in money income minus the induced change in absorption (as caused by the change in income) and the change in absorption (resulting from the change in the exchange rate), will be the starting point of the present model.

The balance of payments ($\bar{P}$) is equal to the balance of trade plus the net capital inflow (Cn). This can be expressed as equation 4.

$$(4)\quad \bar{P} = b + Cn$$

The net capital inflow is comprised of the net short-term capital inflow (Cs) and the net long-term capital inflow (Cl). In this chapter, the net long-term capital inflow is assumed to be constant and independent of the variables of the model. Hence, equation 4 can be expanded into equation 5.

$$(5)\quad \bar{P} = b + Cs + Cl$$

A word or two to explain the rationale of the mathematical manipulations which follow is in order. In order to examine devaluation in terms of the balance of payments, an expression for the change in the balance of payments must be derived. This expression for the change in

the balance of payments will represent the various readjustments which result when the exchange rate is varied. Therefore, the key to the analysis is to derive an expression for the change in the balance of payments. Taking the change of both sides of equation 5 will give the simplest expression for the change in the balance of payments.

$$(6) \quad d\overline{P} = db + dCs + dCl$$

Equation 6 states that the change in the balance of payments is equal to the change in the balance of trade plus the change in net short-term and long-term capital inflows. In order to really understand equation 6, a close examination of the three terms on the right-hand side is required. The first term (db) has already been fully examined in basic model 2. All that has to be done is to subsitute either equation 2 or equation 3 in for the change in the trade balance to get a more detailed analysis.

The last term of equation 6 is equal to zero because of our assumption that long-term capital flows are constant. Therefore, the remaining term, which represents the change in short-term capital flows, is the term which requires more analysis.

In order to examine the change in the net short-term capital flow, specifications about the functional relationship of the short-term capital flows must be made. In this model, only speculative short-term capital flows will be analyzed, thus transactional short-term capital flows will be assumed constant for the present.

Speculative capital will flow to take advantage of interest rate differentials and to take advantage of expected changes in the exchange rate. If the interest rate is higher abroad than it is at home, then a

rational speculator can borrow money at a lower interest rate at home and invest it abroad at a higher interest rate. Such a transaction would yield a speculative profit, barring any other changes, to the speculator. There tends to be a flow of short-term capital from countries with a low interest rate to countries with a higher interest rate.[1] Usually, there must be a minimum difference between two countries' interest rate before a flow will start. A minimum differential of rates is needed so that anyone engaged in this activity can pay the brokerage fees involved in the transfer of funds from one currency to another.

An increase in the interest rate differential will cause an even greater inflow of capital to the country with the higher interest rate, because the expected profits have increased. As the interest rate differential declines, so will the capital flows used for speculating against the interest rate start to subside.

Speculation also arises as a result of expected changes in the exchange rate.[2] If a country's currency is in danger of devaluation, then a rational individual would exchange his holdings of that country's currency for another nation's currency. If the currency of the country, which is in danger of devaluation, is the peso and the exchange rate is one peso per dollar, then a ten percent devaluation of the peso will mean that 1.1 pesos must be given per dollar. If an individual of the devaluing country exchanges one hundred pesos for one hundred dollars before the devaluation, then after the devaluation he will be given 110 pesos for his hundred dollars. Speculative money will flow away from a

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[1] P. Einzig, A Textbook on Foreign Exchange, New York, St. Martin's Press, 1966, pp. 85-94.

[2] Ibid., pp. 95-104.

country with a large deficit, since this country will be in danger of a devaluation and a profit can be made by buying another currency.

A rational individual would place his money in a strong currency. A strong currency is a currency which is not in danger of a devaluation. In fact, a strong currency may be in danger of an appreciation owing to a continual surplus on the balance of payments. When a currency appreciates, then holders of that currency will gain a profit in terms of all other currencies.

Hence, speculative flows will move from a weak currency to a stronger currency (assuming that the gain or loss which can be reaped from interest payments do not outweigh this tendency). In order for individuals to determine whether a currency is strong, they can look at how the balance of trade is changing. If the balance of trade is deteriorating over time, then this is usually a good indication that the strength of the currency is diminishing. If the trade balance has been improving over time, then this would indicate that the currency is getting stronger. Thus, the change in the trade balance can be a good signaling device for short-term speculative capital flows. Negative changes in the trade balance would cause capital outflows from the country, while positive changes in the trade balance will cause capital inflows.

Many well known economists have argued that short-term speculative capital flows depend on how the trade balance is changing and the interest rate differential. Alexandre Lamfalussy states, "It is probably true that interest rate differentials will have a determining effect on capital flows in the long run, but in the shorter run their impact may well be offset by adverse speculation. Speculators seem to

attach as much importance to changes in the current account..."[3] Paul Einzig mentions that speculation will occur against devaluation-prone currencies and that the behavior and the position of the trade balance is an important determinant of an impending devaluation.[4] In addition, F. Lutz mentions that short-term capital will flow into countries with higher short-run interest rates.[5] Recently E. Canterbery discussed empirical tests on the functional relationship of capital flows. As the paper points out, capital flows are dependent on both the interest rate differential and on the expected change in the exchange rates.[6]

It is assumed from the above analysis that short-term speculative capital flows are a function of the change in the trade balance and the interest rate differential between the devaluing country and the non-devaluing country ($r^D - r^N$).

$$(7) \quad Csp = Csp\ (db,\ r^D - r^N)$$

Equation 7 states that short-term speculative capital flows (Csp) are a function of the change in the trade balance and the interest rate differential. The short-term capital flows are equal to the sum of the short-term speculative capital flow and the short-term transactions capital flow (Ct). For the purpose of this model, the transactional capital flows are assumed constant. Equation 8 expresses the statement

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[3] A. Lamfalussy, "Limitations of Monetary and Fiscal Policy," in Fellner, et al, Maintaining and Restoring Balance in International Payments, Princeton, Princeton University Press, 1966, p. 158.

[4] P. Einzig, Op. Cit., pp. 95-114.

[5] F. Lutz, The Problem of International Equilibrium, Amsterdam, North Holland Publishers, 1966, pp. 33-35.

[6] E. Canterbery, "Exchange Rates, Capital Flows and Monetary Policy," American Economic Review, June 1969, pp. 426-431.

that the short-term capital flows are equal to the sum of transactional and speculative capital flows.

$$(8) \quad Cs = Csp\ (db,\ r^D - r^N) + Ct$$

The last step of the analysis is to find an expression for the change in short-term capital flows. Since transactional capital flows are assumed constant, they will have a zero change over time. Speculative short-term capital flows will be affected by changes in db and changes in the interest-rate differential.

Taking a total differential of equation 8 gives an expression for the change in short-term capital flows.

$$(9) \quad dCs = {}^{\partial Csp}/_{\partial (db)}\ d^2b + {}^{\partial Csp}/_{\partial (r^D - r^N)}\ d(r^D - r^N)$$

Equation 9 shows that a change in short-term capital flows is influenced both by changes in the change in the trade balance and by changes in the interest rate differential.

A change in the change in the trade balance (d^2b) will be henceforth referred to as the acceleration of the trade balance. The acceleration of the trade balance tells whether the trade balance is changing at either an increasing or a decreasing speed. This term will be discussed more fully a little later.

Any change in the interest rate differential will change the profit opportunities on the international capital market and will cause more capital to flow.

The ${}^{\partial Csp}/_{\partial (r^D - r^N)}\ d(r^D - r^N)$ term is equal to zero in the present model, because it is assumed that both countries engage in a monetary policy in which the interest rate is held constant. Therefore, the change in the interest differential is zero and the term drops out. Hence,

equation 9 becomes equation 10.

$$(10)\quad dCs = {}^{\partial Csp}/_{\partial(db)} \cdot d^2b$$

The ${}^{\partial Csp}/_{\partial(db)}$ term will be referred to as the speculative propensity (λ). This term represente the change in the short-term capital inflows resulting from a change in the change in the trade balance. One can think of λ as showing the reaction of speculators to ways in which the change in the trade balance is behaving.

In order to put the above analysis together, equation 10 must be substituted into equation 6 -- this gives equation 11.

$$(11)\quad d\overline{P} = db + {}^{\partial Csp}/_{\partial(db)}\ d^2b + dCl$$

Letting λ equal ${}^{\partial Csp}/_{\partial(db)}$, and remembering that the changes in long-term capital flows are assumed equal to zero, gives equation 12.

$$(12)\quad d\overline{P} = db + \lambda d^2b$$

Equation 12 explains the heart of the first capital model, which we are examining. Once speculation has been added, no longer is the change in the trade balance the only determinant of the change in the balance of payments. In addition to the change in the trade balance, the acceleration in the trade balance is important in determining capital flows. The speculative propensity will tell the exact influence that the acceleration of the trade balance will have on speculative capital flows.

This analysis should seem quite novel, since the acceleration of a variable is usually not discussed. When dealing with speculation, which is built on expectations, speculators will not only be responsive to changes in variables, but they will also be interested in how fast these changes are occurring. This is why it is fitting to have an accelerator in a model which deals with speculation.

The last chapter separated the analysis of devaluation into a finite number of time periods in order to be able to determine the change in the trade balance for each period (ΔB_t). By taking the difference between the change in the trade balance for two consecutive time periods, one will get the acceleration in the trade balance ($\Delta^2 B_t$) which will approximate d^2b.

As chapter 3 showed, the trade balance change will be different in each period, because different effects will be operating within the periods. If the change in the trade balance varies from period to period after the devaluation, then so will the acceleration of the trade balance vary from period to period.

If initially the trade balance improves by a greater and greater amount within the first few months after the devaluation, then the acceleration of the trade balance will be positive. The positive acceleration in the trade balance will induce favorable capital inflows, because speculators see that the trade balance is improving at an increasing rate. This will indicate to speculators that the currency is becoming stronger, since demand for the currency is growing faster than supply. Hence, if the short-run effects of devaluation are quite favorable, then this can also help the stability of the currency in the short-run by inducing capital inflows. The balance of payments can show improvement both on the current account and the capital account.

If, on the other hand, later period effects of devaluation start to show a slowing down of the improvement of the trade balance, then the longer run capital flows will start to reverse. This slowing down of the improvement of the trade balance will be caused by lagged absorption and reversals of some of the favorable price and substitution effects.

Especially, if the trade balance starts to deteriorate at some future date, then capital flows will start to leave the devaluing country.

Chapter 3 indicated that the initial improvements in the trade balance tend to be greater than the short and middle run improvements. This was true, because lagged absorption will start to reverse the positive income effect. In addition, the money illusion effect and the redistribution of income effect will experience reversals in the middle run. If the initial effect of devaluation is truly greater than the longer run effects, then speculation will be favorable at first and will be less favorable later.

The analysis of the first capital model points to an interaction between the current account and the capital account which must be considered. The analysis of devaluation must account for the reactions and interactions of both accounts.

By substituting equation (2) into equation 12, equation 13 is derived.

$$(13)\quad d\overline{P} = dY - {}^{\partial\overline{A}}/_{\partial Y}\, dY - {}^{\partial\overline{A}}/_{\partial e}\, de + \lambda\, d^2b$$

Equation 13 simply expands the change in the money trade balance so as to explicitly show that both changes in income and changes in absorption are still present in the analysis. The only difference between the capital model presented in equation 13 and the basic model 2 is the last term in equation 13 which accounts for the additional speculative capital flow.

If we go one step further and calculate the second differential of the trade balance in terms of income changes and exchange rate changes, then equation 13 will look like equation 14.[7]

[7] Equation 14 is derived within the appendix.

$$(14)\quad d\overline{P} = dY - {}^{\partial\overline{A}}/_{\partial Y}dY - {}^{\partial\overline{A}}/_{\partial e}\,de + \lambda\Big[d^2Y - {}^{\partial^2\overline{A}}/_{\partial Y^2}(dY)^2 - 2\,\frac{\partial^2\overline{A}}{\partial Y\partial e}\,dedY - \frac{\partial^2\overline{A}}{\partial e^2}\,(de)^2\Big]$$

Equation 14 illustrates that the acceleration in the trade balance is comprised of many different things. First the acceleration of money income (d^2Y) is important, since the larger the rate of change of money income, then the greater will be the acceleration of the trade balance. Also, cross partials such as ${}^{\partial^2\overline{A}}/_{\partial Y\partial e}$, which indicate the interaction of money income and the exchange rate on absorption, are now important. The last three terms $({}^{\partial^2\overline{A}}/_{\partial Y^2}\,(dY)^2 + 2{}^{\partial^2\overline{A}}/_{\partial Y\partial e}dedY + {}^{\partial^2\overline{A}}/_{\partial e^2}\,(de)^2)$ indicate the rate of change in absorption and what it is equal to.

The important point of these equations can be succinctly stated by diagram 1.

Diagram 1

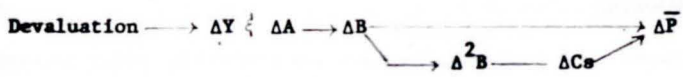

Diagram 1 indicates the causation involved. Devaluation will change money income and absorption through income, price and substitution effects. The change in income and absorption will in turn lead to a change in trade balance. The change in the trade balance sets off two reactions. First, it changes the balance of payments directly. Second, it causes the acceleration of the trade balance to alter, which in turn changes the short-term capital flows. The change in the short-term capital flows also changes the balance of payments. Hence, the change in the trade balance also influences the balance of payments indirectly through the short-term capital flows.

The analysis can be expanded to a time analysis like that of chapter 3, by realizing that diagram 1 indicates what would happen in the first period. After the first period, the causation will start by having secondary lagged effects of devaluation change the trade balance and start the process off.

The capital model examined in this section is very unstable in comparison with the previous models in the literature, because even if the trade balance improves there might still be instability. This instability would arise if the trade balance was improving at a slower rate. No longer can one examine the sum of the demand elasticities and be able to say anything about the stability of the system, because too much else must be accounted for in the analysis.

The problem with the model presented above is that it is too unstable. It is reasonable to believe that some speculative capital will flow into a country even when the trade balance is improving at a decreasing rate. Therefore the next model will try to remedy the situation slightly by allowing for a more realistic assumption.

Before we examine the next model, it may be of interest to introduce equation 15.

$$(15)\quad d\bar{P} = {}^{\partial Y}/_{\partial dy} + {}^{\partial Y}/_{\partial pdP} - {}^{\partial \bar{A}}/_{\partial Y}\left({}^{\partial Y}/_{\partial ydy} + {}^{\partial Y}/_{\partial pdP}\right) - {}^{\partial \bar{A}}/_{\partial ede} + \lambda\left[{}^{\partial^2 Y}/_{\partial y^2}(dy)^2 + 2\,{}^{\partial^2 Y}/_{\partial p\partial ydPdy} + {}^{\partial^2 Y}/_{\partial p^2}(dP)^2 - {}^{\partial^2 \bar{A}}/_{\partial Y^2}\left({}^{\partial Y}/_{\partial ydy} + {}^{\partial Y}/_{\partial pdP}\right) - 2\,{}^{\partial^2 \bar{A}}/_{\partial y^2 ede}\left({}^{\partial Y}/_{\partial ydy} + {}^{\partial Y}/_{\partial pdP}\right) - {}^{\partial^2 \bar{A}}/_{\partial e^2}(de)^2\right]$$

This complex formula is derived in the appendix and is no different

from formula 14, except that now the change in money income and money absorption have been expanded to explicitly show the influence of real income and prices. The interesting thing about equation 15 is that it shows that there are also cross effects between prices and real income on money absorption and money income. Equation 15 starts to give the true flavor of the complex workings behind the scenes of a devaluation.

The analysis shows that looking at simple partial derivatives is not enough, second order partial derivatives, both direct partials and cross partials, must be examined. More complicated functional relationships allow for even more cross effects.

II. The Second Capital Model

This model allows for more stability than the last model. The assumptions of this model are, for the most part, the same as those of the last model. Namely, a two country model is employed in which one of the countries devalue their currency. Long-term capital flows are assumed constant as well as short-term transactional capital flows. The monetary authority varies the money supply to keep the interest rate constant.

The start of the analysis is exactly like the first capital model. The change in the balance of payments is equal to the change in the trade balance plus the change in the short-term capital flows plus the change in long-term capital flows.

$$(16)\quad d\overline{P} = db + dCs + dCl$$

There is no problem with the first-term of equation 16, since this was analyzed in basic model 2 and is equal to: $dY - \partial\overline{A}/\partial Y\,dY - \partial\overline{A}/\partial e\,de$.

The change in the trade balance is composed of income, price and substitution effects.

The last term of equation 16 is equal to zero, since it is assumed that long-term capital flows remain constant. The last term can be dropped from equation 16 leaving equation 17.

$$(17)\quad d\overline{P} = db + dCs$$

The dCs term in equation 17 is the key variable in this model. This term expresses both the change in speculative short-term capital flows (Csp) and the change in transactional capital flows. Hence, the change in short-term capital flows is simply equal to the change in speculative flows plus the change in transactional capital flows (dCt).

$$(18)\quad dCs = dCsp + dCt$$

Since the change in transactional capital flows is assumed constant, the dCt term is equal to zero and drops out from the analysis. The term which must be fully analyzed is the change in speculative short-term capital flows. So far, the analysis is exactly the same as the analysis of the first capital model. The differences arise when one examines the speculative capital flow, because it will depend not only on the change in the trade balance and the interest rate differential, but it will also depend on the value of the trade balance.

As was discussed in the last section, the speculator tries to make profits by predicting exchange rate movements and by taking advantage of interest rate differential.

Currency will move away from countries with weak currencies to countries with stronger currencies. Anything which will alleviate the fear of a devaluation will help reverse capital outflows that deteriorate

the balance of payments. Since the change in the trade balance is a good indicator of the stability of a country's currency, speculative short-term capital flows are made a function of the change in the trade balance.

The change in the trade balance is not the only good proxy for determining whether a currency is strong or weak. The actual value of the trade balance is also an indicator to speculators of the strength of the currency. A large positive trade balance would indicate that the currency would not be in danger of devaluation, while a large negative trade balance would indicate a weak currency.

The combination of speculators looking at both the trade balance and the way it is changing will give a fairly good signal of the stability of the currency. Therefore, speculative capital flows are assumed to be a function of the trade balance and the change in the trade balance, since they will set off capital flows when they change. Also, any change in the interest rate differential will change the profit opportunities and hence will change capital flows.

The functional relationship of speculative capital flows can be expressed by equation 19.

$$(19)\quad Csp = Csp\ (b,\ db,\ r^D - r^N)$$

Taking a total differential of equation 19 gives a statement of the specific influences on speculative short-term capital flows.

$$(20)\quad dCsp = {}^{\partial Csp}/_{\partial b}\ db + {}^{\partial Csp}/_{\partial (db)}\ d^2b + {}^{\partial Csp}/_{\partial (r^D - r^N)}\ d\ (r^D - r^N)$$

Equation 20 shows the three influences which can change speculative capital flows. First, any change in the trade balance will change speculative short-term capital flows, because the proxy for determining

the strength of the currency has changed. Any increase of the trade balance in the positive direction will increase speculative capital inflows, because the demand for the currency has increased relative to supply. Any decrease in the trade balance will cause a capital outflow, because demand is decreasing relative to supply, which indicates that the currency is weakening.

The last two terms of equation (20) are exactly the same as in capital model 1 and need no further exposition. The last term drops out, because the interest rate is assumed to be constant.

Substituting equation 20 into equation 18 and then substituting this term for dCs into equation 17 gives a statement of the change in the balance of payments for this model.

$$(21)\quad d\overline{P} = db + {}^{\partial Csp}/_{\partial b}\, db + {}^{\partial Csp}/_{\partial (db)}\, d^2b$$

The difference between the change in the balance of payments in this model as compared to the last model, centers around the term ${}^{\partial Csp}/_{\partial b}\, db$. The term represents the change in speculative capital flows resulting from changes in the trade balance.

This equation indicates that speculative capital can now flow into a country even if the acceleration in the trade balance is adverse. For speculative capital to have a net additional inflow, speculators would have to be more responsive to the favorable change in the trade balance than they are to the unfavorable acceleration of the trade balance. Hence, even though a trade balance is improving at a decreasing rate, speculators might be more responsive to the fact that the trade balance is improving and therefore hold that country's currency. If the trade balance is decreasing, then some speculators might still purchase that currency if the

rate of deterioration is slowing.

This model points to the important idea that to a speculator both the change and the acceleration in the trade balance will affect his decisions. Whether speculators are more responsive to the change in the trade balance or to the acceleration of the trade balance raises a question.

Equation 21 can be expressed in terms of income and absorption changes, by substituting into equation 21 what the change in the trade balance is equal to in terms of income, absorption and exchange rate changes.

$$(22)\quad d\overline{P} = dY - {}^{\partial \overline{A}}/_{\partial Y}\, dY - {}^{\partial \overline{A}}/_{\partial e}de + {}^{\partial Csp}/_{\partial B}$$

$$(dY - {}^{\partial \overline{A}}/_{\partial Y}\, dY - {}^{\partial \overline{A}}/_{\partial e}\, de) + {}^{\partial Csp}/_{\partial (db)}\ (d^2Y - d^2\overline{A})$$

Equation 22 expresses the balance of payments in terms of income, absorption and exchange rate changes.[8]

Diagram 2 indicates the new causation pattern which would exist in any period of time. Devaluation changes money income and absorption, which in turn changes the trade balance. The change in the trade balance now affects the balance of payments directly through the current account. Secondly, as the upper loop shows, it affects the balance of payments indirectly by causing a change in short-term capital flows. Thirdly, it affects the balance of payments indirectly by causing the acceleration of the trade balance to alter, which influences speculative short-term capital flows.

The interesting point of the causation is the interaction between

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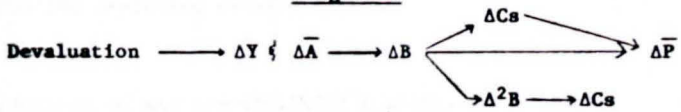
[8] This equation is derived in the appendix.

the current account (the balance of trade) and the capital account. This interaction can cause more instability than indicated in the usual analysis of devaluation. If the balance of trade deteriorates, then this will hurt the balance of payments by adversely affecting the current account. In addition, the deterioration of the trade balance will change speculation unfavorably by lowering confidence in the currency.

Diagram 2



Nevertheless, the model is more stable than the first model presented, since a trade balance which moves favorably will induce an inflow of capital.

As the model stands now, it is still too unstable because it does not allow transactional short-term capital to change. By focusing our attention on speculation alone, we have derived two capital models which can be quite unstable. In order to remedy this situation, our horizons must be expanded to admit changes in transactional short-term capital flows and changes in long-term capital flows. The next section presents a model which allows for changes in transactional short-term capital, while the next chapter will allow for changes in long-term capital flows.

III The Third Capital Model

This capital model will use the last two models as building blocks.

Basically, this model will differ from the other two models by allowing transactional demand for foreign currency to change within both the devaluing country and the non-devaluing country. In order for a country to engage in selling and buying activities within another country, a certain amount of the other country's currency is necessary.

The amount of transactional currency needed by the devaluing country within the economy of the non-devaluing country will depend on how much income the devaluing country generates in the non-devaluing country. The greater the amount of income generated by the devaluing country within the economy of the non-devaluing country, the greater will be its transactional currency needs.

A good indicator of the amount of income generated by the devaluing country within the economy of the non-devaluing country is the amount of goods the devaluing country exports. Exports will be paid in terms of the non-devaluing country's currency to the devaluing country's exporters. Some of the money paid to the devaluing country's exporters will be exchanged for home currency, while a small proportion will be held in terms of the other country's currency for transactional purposes. The part which is held is the devaluing country's transactional demand for foreign currency. This transactional demand for foreign currency will be equal to some proportional constant (v) times the amount of exports. Therefore, the devaluing country has a transactional demand for foreign currency of vX. In order to express this quantity in terms of the currency of the devaluing country, vX must be multiplied by the exchange rate (e).

$$(23)\quad T_o = evX$$

Equation 23 simply expresses the transactional demand for foreign currency by the devaluing country as equal to the exchange rate times the transactional proportional constant times the value of exports in terms of the non-devaluing currency. The symbol (To) represents the transactional demand for foreign currency which is a capital outflow and an adverse influence on the devaluing country's balance of payments.

The non-devaluing country also generates income in the devaluing country through exports. The non-devaluing country's exports are the devaluing country's imports (M). The exports of the non-devaluing country will be termed imports since this model will be from the devaluing country's point of view.

The non-devaluing country will hold a proportion of the currency given for the imports of the devaluing country, which the non-devaluing country sold. If the proportional constant is called v', then v'M will be held in foreign currency by the non-devaluing country. The amount of currency held by foreigners will be a favorable influence on the devaluing country's balance of payments.

$$(24)\quad Ti = v'M$$

Equation 24 indicates that the devaluing country will have a transactional capital demand by the non-devaluing country of the amount v'M. The exchange rate need not enter the analysis here, since the value of imports is in terms of the devaluing country's currency.

In order to determine the net transactional capital inflow, the capital outflow must be subtracted from the capital inflow. Subtracting equation 23 from equation 24 gives the net inflow.

$$(25)\quad Ct = v'M - evX$$

Equation 25 expresses our net transactional capital inflows. In order to complete the analysis, this expression must be substituted into the balance of payments equation for Ct. The balance of payments is equal to the trade balance plus net short-term speculative capital inflows plus net short-term transactional capital inflows plus net long-term capital inflows. This is expressed in equation form in equation 26.

$$(26)\ \overline{P} = b + Csp + Ct + Cl$$

Substituting equation 25 into equation 26 gives equation 27.

$$(27)\ \overline{P} = b + Csp + v'M - evX + Cl$$

By taking the change of both sides of equation 27, an expression for changes in the balance of payments is derived. The change in the balance of payments will indicate the influence a devaluation will have. Equation 28 expresses the total change in the trade balance, assuming that the speculative capital flows are a function of the trade balance, the change in the trade balance and the interest rate differential. In addition, equation 28 assumes that the long-term capital flows are a constant and that the interest rate differential is constant.

$$(28)\ d\overline{P} = db + {}^{\partial Csp}/_{\partial b}\, db + {}^{\partial Csp}/_{\partial (db)}\ {}_d{}^2b + v'dM - evdX - vXde$$

The first three terms were analyzed in the last model and will not be analyzed here again, except to say that db is the change in the trade balance, while the next two terms represent the changes in speculation. The next three terms represent the influence on the balance of payments by the change in the transactional short-term capital flows.

The v'dM term indicates that foreigners will change their transactional demand for the devaluing country's currency according to how

imports change. If imports decrease, then foreigners will generate less income in the devaluing country's economy. If the foreigners generate less income, then this will cause them to hold less of the devaluing country's currency for transactional purposes. If a devaluation decreases imports, this will lead to a smaller amount of short-term capital flowing in for transactional purposes. This means that although an improvement in the trade balance will induce capital inflows through favorable speculative flows, it will induce transactional capital outflows. This is even more apparent when the next two terms are studied.

The (evdX) term indicates that the devaluing country's transactional demand for foreign currency will change as its exports change. An increase in exports will mean that the devaluing country will be generating more income in the economy of the non-devaluing country. If the devaluing country is generating more income in the economy of the non-devaluing country, then the devaluing country will need more of the non-devaluing country's currency for transactional purposes. Any increase in exports will lead to a short-term transactional capital outflow from the devaluing country, which will be an adverse influence on the devaluing country's balance of payments.

The last term of equation 28, namely vXde, indicates another influence on transactional capital outflows of the devaluing country. This term indicates that the amount of transactional currency demanded by the devaluing country (vX) in the economy of the non-devaluing country, must be multiplied by the change in the exchange rate. If the exchange rate is devalued, then more currency of the devaluing country must be given for a unit of the foreign currency. Hence, in order to have trans-

actional balances in the non-devaluing country's economy, the devaluing country must give up more of its devalued currency. This will be an additional adverse influence of transactional capital flows.

Since a devaluation will increase exports and decrease imports, this will lead to an unfavorable change in net transactional short-term capital inflows. The adverse change in transactional short-term capital flows is an influence which has been overlooked in the literature. The change in transactional capital flows tends to be a mitigating effect. Any unfavorable change in the trade balance will lead to a favorable net transactional capital inflow change, since the increased imports over exports will lead to more transactional capital inflows compared to transactional capital outflow. Hence, the transactional capital flows tend to partially offset unfavorable change in the trade balance, while it will also offset favorable changes in the trade balance.

The final magnitude of the effect will depend on the values of the two proportional constants. The strength of the effect will depend both on the value of the constants and on the value of one country's constant as compared to the other country's constant. In addition, the change in the exchange and the changes in import's and export's value are important.

Table 1

v	v'	de	dM	dX	X	net inflow
.1	.1	.1	-100	100	1000	-30
.2	.1	.1	-100	100	1000	-50
.1	.1	.1	-200	100	1000	-40
.1	.2	.1	-100	100	1000	-40
.1	.4	.1	-100	200	1000	-70

Table 1 is derived by assuming that the exchange rate is equal to 1 and that exports are initially equal to 1000 units of the devaluing country's currency. The table shows various net transactional capital inflows for different proportional constants and changes in the imports and exports. All the net inflows are negative indicating that they are net outflows from the devaluing country. All the situations depicted are cases where the trade balance improves with imports decreasing and exports of the devaluing country increasing. The size of v, v', de, dM, dX, and X all determine the size of the net capital inflow.

Diagram 3

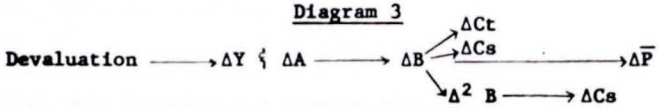


Diagram 3 illustrates the new causation involved in this model. This diagram is quite similar to diagram 2. Devaluation will change money income and absorption, which in turn will change the trade balance. Changes in the trade balance will directly (and indirectly) affect the balance of payments. It will indirectly affect the balance of payments by changing short-term speculative capital flows and short-term transactional capital flows.

IV. Interest Rate Assumption Dropped

This section briefly discusses how the three models presented in this chapter change if the interest rate is allowed to vary. This can be accomplished by assuming that a constant money supply is maintained by the monetary authorities.[9] If the interest rate is allowed to vary,

[9] S. C. Tsiang, Op. Cit., p. 924.

then a new interest-rate differential will exist after a devaluation. This will mean a change in speculative capital flows, because of the change in the interest rate differential.

Since short-term capital flows depend on the interest rate differential, the $\partial Csp/\partial(r^D - r^N)\ d\ (r^D - r^N)$ term will no longer drop out as it did previously.

S. C. Tsiang worked out an elegant model which makes absorption a function of the interest rate.[10] Rather than repeat his model, only his final results will be reiterated. His model differs very slightly from basic model 2. However, his model is quite different from the model used in this chapter, because he does not have capital flows. S. C. Tsiang only examined the balance of trade.

Tsiang reasoned that $\partial\overline{A}/\partial r$ would be negative. In other words, an increase in the interest rate would decrease absorption, because the inducement to save would be greater, while the inducement to invest and consume would be smaller.

In order to develop a model in which the interest rate is allowed to change, the money market must be added in. Hence, one must have a demand for money, which usually includes both a domestic speculative demand and a domestic transactional demand. The transactional demand will be a function of income, while the speculative demand will be a function of the interest rate. In addition, a supply of money function must be specified. Also, the demand for money must be equated with the supply of money in order to derive the equilibrium condition.

S. C. Tsiang's major result was that if the trade balance improves

[10] Ibid., pp. 917-19.

and if money income rises, then there will be additional favorable influence on the balance of trade produced by the money market. The following quote of Dr. Clements sums up the conclusion of Dr. Tsiang the best:

> If, for example, the initial impact of a devaluation improves the trade balance, and hence, raises money income, a greater amount of money is then demanded for transactions purposes. With the supply of money held constant by the monetary authorities, fewer funds are available to meet the speculative demand for money and the interest rate to rise. If the hypothesis of an inverse relationship between absorption and the interest rate is accepted, an increase in the interest rate causes interest induced reduction in absorption and, presumably, an improvement in the trade balance.[11]

The above statement gives a good indication of the causation involved. The question that this chapter will answer concerns the additional effect of introducing capital flows into the analysis.

If it is assumed that the short-term speculative capital flows depend only on the interest rate differential, then, since the interest rate tends to rise in the devaluing country, there is reason to believe that the interest rate differential is widening in favor of the devaluing country. However, when one examines what is happening in the non-devaluing country, it is seen that there is a tendency for the trade balance to deteriorate and for the money income to decrease. The decrease in money income, which results from adverse income effects, releases money from domestic transactional purposes, which in turn makes for idle cash balances, causing a lowering of the interest rate.

If the trade balance did improve, as Dr. Tsiang hypothesized, then there will be an additional effect on the balance of payments through the creation of a larger interest rate differential, which causes a short-

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[11] Clement, Theoretical Issues in International Economics, Princeton, Princeton University Press, 1967, p. 338.

term speculative capital inflow. This short-term speculative inflow will be an additional favorable factor on the balance of payments, which can be added on to the previous favorable factor mentioned by Dr. Tsiang.

Hence, there is reason to believe that the addition of the money market will add to the stability of the exchange rate on two accounts. First, it will cut absorption and second, it will induce speculative capital inflows because of the change in the interest rate differential. Therefore, if the balance of trade improves, this will induce an additional influence on the speculative capital account.

The model can be made more complex by making short-term capital flows a function of the trade balance, the change in the trade balance, and the interest rate differential, as was done in capital model 2.

It should be noted that the addition of the money-market adds cross-effects between the real side and the money side, which were previously absent.

A third possible model would discuss foreign capital flows in terms of a portfolio equilibrium context. Investment in foreign assets would be one of many possible assets which foreigners or residents of the devaluing country could invest in. One would balance the marginal utility yielded per dollar of all the assets of ones portfolio. A model along this line has been developed by John E. Floyd.[12] John Floyd developed a complete two-country model dealing primarily with the capital side of the balance of payments. The whole model deals with the alternative assets available, both on the domestic market and the foreign market,

[12] J. Floyd, "International Capital Movements and Monetary Equilibrium," American Economic Review, September 1969, pp. 472-92.

which people choose to spend their money on. The model is very realistic, however, very complex. There would be room for a model which focused both on the balance of trade and on the capital account with Floyd's investment portfolio function.

V. Implications and Conclusions

This chapter has added both short-term speculative capital flows and short-term transactional capital flows to the balance of trade so that the balance of payments could be examined. Causation diagrams illustrated the new causation flows that developed. The adding of the short-term capital flow onto the analysis of the current account can give a much truer analysis of the effectiveness of a devaluation.

This chapter has shown that the current account and the capital account interact with one another. This interaction of the two accounts raises the question whether an analysis of devaluation can really separate the two accounts and focus attention on only one of the accounts.

Monetary and fiscal policy which supports devaluation theory must account for the current account and the capital account. Whenever monetary policy changes the interest rate, then the interest rate differential existing between the two countries will change. This change in the interest rate differential will alter speculative capital flows. In addition, if absorption is dependent on the interest rate, then a change in the interest will also change absorption, which will in turn alter the trade balance.

A model such as Tsiang's can be of questionable value since it only examines the current account and the relationship of the interest rate. If the change in the interest rate resulting from a devaluation signifi-

cantly changes speculative capital flows, then the devaluation's effect on the stability of the currency may be different than the effect predicted by the Tsiang model.

Any balance of trade model of devaluation can give irrelevant results whenever the capital account is a significant proportion of the balance of payments. Since both the capital and the current account determines the stability of the currency, both accounts must be analyzed.

An empirical analysis of a country's balance of trade which is for the purpose of predicting the effectiveness of a devaluation may be failing to examine an important factor. Many empirical analyses of a country's trade balance only examine the predicted changes in absorption and income. These studies fail to examine the possibility of adverse movements of speculative and transactional short-term capital flows. Hence, a question is raised as to the usefulness of an empirical study which examines only the balance of trade.

The analysis of speculative capital flows showed that both the change in the trade balance and the acceleration of the trade balance determined speculative capital flows. Knowing only the predicted change in the trade balance may tell little about speculative capital flows, if speculative capital flows are more responsive to the acceleration of the trade balance. Hence, adequate policy may have to account both for the acceleration of the trade balance and for a measure of the responsiveness of speculative capital flows with respect to the acceleration in the trade balance.

The analysis of the transactional capital flows indicated another influence which devaluation policy and theory must account for. The

section on transactional capital flows showed that these flows may be a stabilizing influence since they tend to move in an opposing direction to speculative capital flows. If transactional capital flows have a significant influence on a country's balance of payments, then an analysis of devaluation which fails to account for its influence may be deficient. In addition, if speculative capital flows and transactional capital flows tend to move in opposing directions, then policy which tries to correct for adverse speculative capital flows would have to account for the mitigating effects of transactional capital flows.

The dropping of the constant interest-rate assumption suggests that supporting monetary policy can have significant effects on the success of a devaluation. The addition of the capital flows underscores the possible importance of the interest rate within the analysis of a devaluation. Dr. Tsiang was among the first to mention the importance of analyzing the money supply and the interest rate within devaluation theory. Capital flows make it even more imperative to analyze the money markets. Moneyless models or models cast in real terms such as Alexander's are of questionable value, since they fail to deal with the money market.

The next chapter continues the analysis of capital flows by examining long-term capital flows.

APPENDIX - CHAPTER IV

I. Derivation of equation 14

Money income depends both on real income and the price level.

$$(1)\quad Y = Y(y, P)$$

Taking a total differential will give:

$$(2)\quad dY = {}^{\partial Y}/_{\partial y}\, dy \;+\; {}^{\partial Y}/_{\partial p} dP$$

Money absorption will be a function of money income and the exchange rate:

$$(3)\quad \bar{A} = \bar{A}(Y, e)$$

The total differential of equation 3 is

$$(4)\quad d\bar{A} = {}^{\partial \bar{A}}/_{\partial Y} dY \;+\; {}^{\partial \bar{A}}/_{\partial e} de$$

The money trade balance is equal to money income minus money absorption.

$$(5)\quad b = Y - \bar{A}$$

Taking the total differential of equation 5 and substituting equation 4 into 5 gives equation 6.

$$(6)\quad db = dY - {}^{\partial \bar{A}}/_{\partial Y} dY \;+\; {}^{\partial \bar{A}}/_{\partial e} de$$

Short-term speculative capital flows depend on the change in the trade balance and the interest rate differential.

$$(7)\quad Csp = Csp\,(db,\ r^D - r^N)$$

The differential of equation 7 gives the following:

$$dCsp = {}^{\partial Csp}/_{\partial (db)}\, d^2b + {}^{\partial Csp}/_{\partial (r^D - r^N)}\, d\,(r^D - r^N)$$

The $d(r^D - r^N)$ term is zero since the interest rates are assumed constant.

$$(8)\quad dCsp = {}^{\partial Csp}/_{\partial (db)}\, d^2b$$

Call the $\partial Csp/\partial(db)$ term, which is the change in short-term capital flows resulting from a change in the change in the trade balance (λ).

(9) $dCsp = \lambda d^2b$ where d^2b is the second degree differential.

If the balance of payments is defined as

(10) $\overline{P} = b + Cs + Cl$ then the change in the balance of payments is equal to equation 11.

(11) $d\overline{P} = db + dCs$ since dCl is assumed to be zero.

Substitution of equation 6 and 9 into equation 11 gives

(12) $d\overline{P} = dY - \partial\overline{A}/\partial Y\, dY - \partial\overline{A}/\partial e\, de + \lambda d^2b$

Finding the second differential of the trade balance yields

(13) $d^2b = d(db) = d^2Y - d^2\overline{A}$ where $d^2\overline{A}$ is equal to

(14) $d(d\overline{A}) = d^2\overline{A} = \partial/\partial Y(\partial\overline{A}/\partial Y dY + \partial\overline{A}/\partial e\, de)\, dY +$

$$\frac{\partial}{\partial e}\left(\frac{\partial\overline{A}}{\partial Y}\, dY + \frac{\partial\overline{A}}{\partial e}\, de\right) de$$

Simplifying

(15) $d^2\overline{A} = \partial^2\overline{A}/\partial Y^2(dY)^2 + 2\,\partial^2\overline{A}/\partial Y\partial e\, dedY +$

$\partial^2A/\partial e^2(de)^2$

Substitution of equation 15 into equation 13 gives:

(16) $d^2b = d^2Y - \partial^2\overline{A}/\partial Y\,(dY)^2 - 2\,\partial^2\overline{A}/\partial Y\partial\, ededY$

$- \partial^2\overline{A}/\partial e^2(de)^2$

Substitution of equation 16 into equation 12 gives equation 14 of the text

(17) $d\overline{P} = dY - \partial\overline{A}/\partial Y dY - \partial\overline{A}/\partial e de + \lambda\left[d^2Y - \partial^2\overline{A}/\partial^2\right.$

$\left.(dY)^2 - 2\,\partial^2\overline{A}/\partial Y\partial e\;\; dedy - \partial^2A/\partial e^2(de)^2\right]$

II Derivation of Equation 15

Taking the second total differential of money income and using equation 2.

$$(18)\quad d(dY) = d^2Y = {}^{\partial}/_{\partial y}\left({}^{\partial Y}/_{\partial y}\, dy + {}^{\partial Y}/_{\partial p} dP\right)dy + \frac{\partial}{\partial p}\left({}^{\partial Y}/_{\partial y}\, dy + {}^{\partial Y}/_{\partial p} dP\right) dP$$

Simplifying

$$(19)\quad d^2Y = {}^{\partial^2 Y}/_{\partial y^2}\,(dy)^2 + 2\,{}^{\partial^2 Y}/_{\partial y \partial p}\, dP dy + {}^{\partial^2 Y}/_{\partial p^2}\,(dp)^2$$

Substituting equation 19 into equation 17 for d^2Y, and substituting equation 2 for each dY term in equation 17 yields the required equation-

$$(20)\quad d\bar{P} = {}^{\partial Y}/_{\partial y}\, dy + {}^{\partial Y}/_{\partial p}\, d\,P - {}^{\partial \bar{A}}/_{\partial Y}\left({}^{\partial Y}/_{\partial y}\, dy + {}^{\partial Y}/_{\partial p}\, dP\right) - {}^{\partial \bar{A}}/_{\partial e} de +$$
$$\lambda\Big[{}^{\partial^2 Y}/_{\partial y^2}(dy)^2 + 2\,{}^{\partial Y}/_{\partial p \partial y}\, dy\, dP +$$
$${}^{\partial^2 Y}/_{\partial p^2}(dp)^2 - {}^{\partial^2 \bar{A}}/_{\partial y^2}\left({}^{\partial Y}/_{\partial y}\, dy + {}^{\partial Y}/_{\partial pd}\, P\right)^2 -$$
$$2\,{}^{\partial^2 \bar{A}}/_{\partial y \partial e} de\left({}^{\partial Y}/_{\partial y}\, dy + {}^{\partial Y}/_{\partial p}\, dP\right) -$$
$${}^{\partial^2 \bar{A}}/_{\partial e^2}(de)^2\Big]$$

III Derivation of Equation 22

Let $Csp = Csp\,(b, db, r^D - r^N)$ and take a total differential with the assumption that $d\,(r^D - r^N) = 0$

$$(21)\quad dCsp = {}^{\partial Csp}/_{\partial b}\, db + {}^{\partial Csp}/_{\partial (db)}\, d^2b$$

Simplifying

$$(22)\quad dCsp = {}^{\partial Csp}/_{\partial b}\, db + \lambda\, d^2b$$

Substituting equation 6 and 13 into 23 yields the required results.

$$(24)\quad d\overline{P} = dY - \partial\overline{A}/\partial y\, dy - \partial\overline{A}/\partial ede + \partial Csp/\partial b\, (dy - \partial\overline{A}/\partial Y\, dY - \partial\overline{A}/\partial ede) + \lambda\, (d^2Y - d^2\overline{A})$$

CHAPTER V

LONG-TERM CAPITAL FLOWS ADDED

In Chapter 4, the discussion of devaluation was extended to include short-term capital flows. The addition of short-term capital flows pointed to some potentially important effects of a devaluation which have been previously ignored within the balance of trade models of a devaluation. This chapter carries the analysis of devaluation one step further by examining long-term capital flows. The addition of long-term capital flows will also point to potentially important effects of a devaluation which are not evident when only the trade balance is analyzed.

Chapter 4 assumed long-term capital flows constant, and therefore, they dropped out of the analysis when changes in the balance of payments were examined. This chapter differs from the last, because net long-term capital flows are no longer assumed constant.

This chapter builds upon the analysis of the last chapter. The analysis of this chapter uses the same basic equation as that of Chapter 4, namely equation 1 below.

$$(1)\quad \bar{P} = b + Ct + Csp + Cl$$

The basic equation states that the balance of payments is equal to the balance of trade plus net short-term transactional capital inflows plus net short-term speculative capital inflows plus net long-term capital inflows.

The first section of this chapter discusses long-term capital flows. In that section a functional relationship for long-term capital flows is specified. The next section substitutes this functional relationship into

basic Equation 1 and then analyzes devaluation in terms of basic Equation 1. The third section of this chapter summarizes the important points and gives the implications of the analysis of this chapter.

I. Long-term Capital Flows

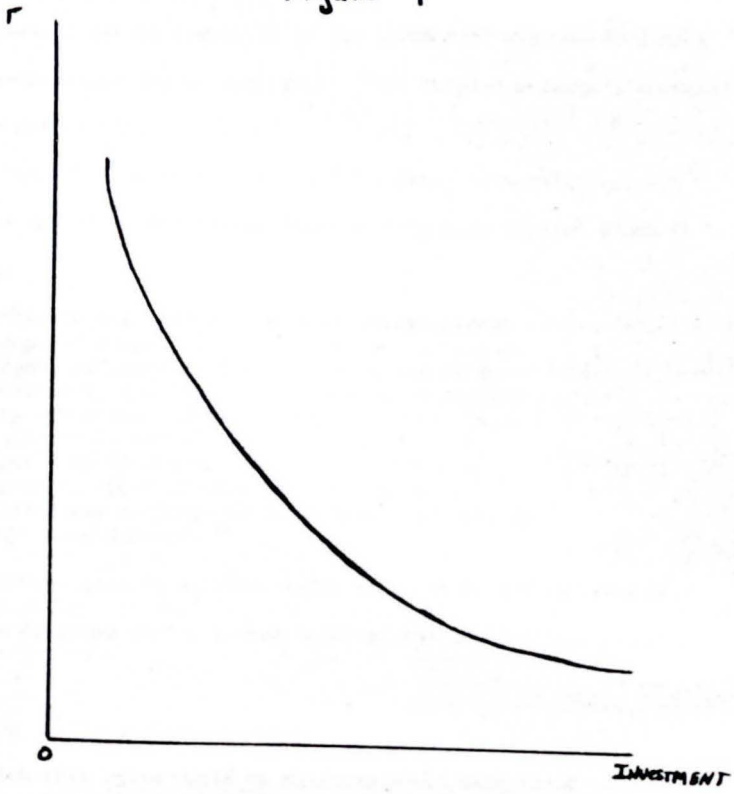
Long-term capital flows from one nation to another in order to take advantage of profit opportunities in the field of investment, since long-term capital flows are usually for the purpose of investment. When determining whether to invest domestically, an investor would want to calculate his expected rates of return on different possible investment opportunities. A rational investor would not stop once he had compared the rates of return on various domestic investment opportunities. Instead, he would also compare the domestic investment opportunities to the foreign investment opportunities. If a foreign investment opportunity had a higher rate of return, then some long-term capital will flow to that country.

Therefore, in order to derive a functional relationship for long-term capital inflows and outflows, one must determine what influences the expected rates of return of investment at home and abroad.

Investment at home and/or abroad is a function of both the interest rate and the income level. Diagram 1 illustrates the investment function. The rate of interest is measured on the vertical axis while the amount of investment is measured on the horizontal axis.

The marginal efficiency of investment curve holds income constant. An increase in income shifts the marginal efficiency of investment curve to the right. This means that at a given interest rate, a greater quan-

Figure 1



tity of investment is undertaken.

The devaluing country's long-term capital outflow is assumed to be a function of the income level of the non-devaluing country, because income determines the position of the marginal efficiency of investment schedule. The higher the income level is, the greater will be the amount of investment which can be supported in the economy of the non-devaluing country (assuming other things constant). This chapter assumes a constant interest rate differential.

Dr. John Patrick sums up both his and Dr. Harry Johnson's feelings concerning the impact of the income level on long-term capital flows in the following:

> "Income may have an effect on international capital flows. Interest rates are an important indicator of the rate of return to investment, but they are not the whole picture by any means. The addition of incomes is an attempt to include the effect of economic activity in the two countries on rates of return. Much of what I shall say on this point was anticipated in an important article by Harry Johnson."[1]

Thus, long-term capital outflows (oCl) from the devaluing country will be made a function of the income level of the non-devaluing country (Y^N).

In addition to the position of the investment curve of Diagram 1, the way in which this curve would be shifting would also be of utmost importance. If the curve would be increasingly moving to the right, then

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1 J. Patrick, "The Optimum Policy Mix: Convergence and Consistency" in Kenan and Lawrence, The Open Economy: Essays on International Trade and Finance, New York, Columbia University Press, 1968, pp. 263-289.

this would indicate ever increasing profit opportunities. An increase of output and/or income would be shifting the investment curve to the right. Therefore, the growth of income would be a factor in determining the change in investment and the profitability of investment. A growing economy will have more profitable investment opportunities than an economy which is more sluggish. Thus, long-term capital outflows from the devaluing country will be made a function of the change of the non-devaluing country's income level (dY^N). The final function relationship of long-term capital outflows is expressed as Equation (2).

$$(2) \quad oCl = oCl\ (dY^N, Y^N)$$

Long-term capital outflows are a function of both the level of income and the change in income of the non-devaluing country. Other things, such as the exchange rate, will also determine the profitability of foreign investment. However, its influence is minor, and long-term capital flows which respond to expected exchange rate changes can be placed with short-term capital flows.

In order to examine the determinants of long-term capital inflows into the devaluing country, one must examine the economy of the devaluing country. In particular, one must determine how profitable investment opportunities are in the devaluing country and what determines these profit opportunities. As in the non-devaluing country, a change in income and the income level magnitude will determine the profitability of investment and hence, they will determine the long-term capital inflow. This is true under our assumption of a constant interest rate differential.

Equation (3) expresses the functional relationship of long-term capital inflows (iCl).

$$(3) \quad iCl = iCl(dY^D, Y^D)$$

By subtracting Equation (2) from Equation (3), the expression for the net inflow of capital is derived.

$$(4) \quad iCl - oCl = iCl(dY^D, Y^D) - oCl(dY^N, Y^N)$$

As Equation (4) indicates, the net long-term inflow of capital is equal to the inflow of long-term capital minus the outflow of long-term capital.

Taking a careful look at Equation (4) will point out an important point about net long-term capital flows. Net long-term capital flows will depend on the relative growth of the two countries and the income level of the devaluing country relative to the income level of the non-devaluing country. If the devaluing country starts to grow at a faster rate than the non-devaluing country, then there will be a long-term inflow of capital induced, barring other difficulties. Also, a country with a higher income level will probably be able to attract a greater amount of long-term capital than a country with a lower income level, ceteris paribus.

If devaluation increases a country's income level through income effects such as the idle resource effect and the redistribution effect, then this might induce an inflow of long-term capital. Any induced inflow of long-term capital will help the balance of payments and hence the stability of the currency.

II. The Model

The first step in the creation of the model is the substitution of Equation (4), which represents the net long-term inflow of capital, into Equation (1).

$$(5)\quad \bar{P} = b + Ct + Csp + iCl(dY^D, Y^D) - oCl(dY^N, Y^N)$$

Equation (5) assumes that the monetary authorities hold the interest rate differential constant in both the devaluing and the non-devaluing country. The balance of trade is equal to money income minus money absorption. Money absorption is a function of money income and the exchange rate. Speculative short-term capital flows depend on changes in the trade balance, the trade balance itself, and the interest rate differential. The net transactions short-term capital flow is assumed to be equal to (v'M - veX), as was shown in the last chapter.

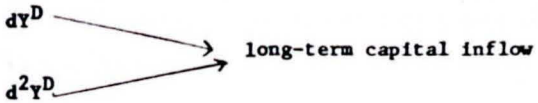
In order to analyze the influence of long-term capital flows, the change in the balance of payments must be examined. Taking a total change of both sides of Equation (5) gives an expression for the change in balance of payments.

$$(6)\quad d\bar{P} = db + dCt + dCsp + \frac{\partial iCl}{\partial Y^D} dY^D + \frac{\partial iCl}{\partial (dY^D)} d^2Y^D - \frac{\partial oCR}{\partial Y^N} dY^N - \frac{\partial oCR}{\partial (dY^N)} d^2Y^N$$

The last four terms of Equation (6) are the important terms for the analysis of this chapter. The first two of these terms namely $\frac{\partial iCl}{\partial Y^D} dY^D$ and $\frac{\partial iCl}{\partial (dY^D)} d^2Y^D$, express the change in long-term capital inflows. The first

term ($\frac{\partial iCl}{\partial Y^D} dY^D$) indicates that long-term capital inflows will change when income changes. The second term indicates that long-term capital inflows will change when the acceleration in income fluctuates.

Diagram 1



As Diagram 1 above illustrates, there are two influences on the changes in long-term capital inflows in the devaluing country. First, changes in the devaluing country's income level and second, the acceleration of the devaluing country's income level will influence long-term capital inflows.

The last two terms of Equation (6) indicate the two influences on the change of long-term capital outflows. The $\frac{\partial oCl}{\partial Y^N} dY^N$ term indicates that long-term capital outflows will change when the income level of the non-devaluing country changes. As the income level of the non-devaluing country increases, then this will mean that the profit opportunities in the non-devaluing country are increasing, which will induce a long-term capital outflow from the devaluing country. A decrease in the non-devaluing country's income level will cause a decrease in the long-term capital outflow.

The $\frac{\partial oCl}{\partial (dY^N)} d^2Y^N$ terms indicate that the acceleration of the income level of country N is also an influence on the change in long-term capital outflows. The influence of the acceleration of the income level is much more difficult to analyze than the influence of the change in the

income level. If the income level is increasing, then an increasing rate of increase will indicate an accelerating economy with a lot of profitable investment opportunities. If the rate of increase is declining, then this would indicate a slowing down of the acceleration of the economy. A slowing down of the acceleration of the economy will mean that profitable investment opportunities will be growing at a slower rate. A look at Figure 3 and 4 can be helpful.

Figure 3 is the investment function in the devaluing country, while Figure 4 is the investment function in the non-devaluing country. In both figures the investment function is shifting to the right. Since

Figure 3 Country D

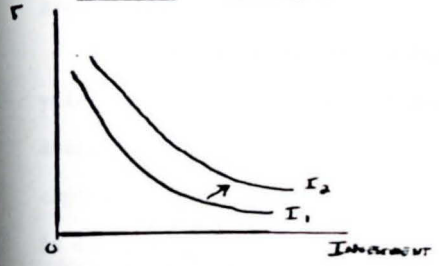
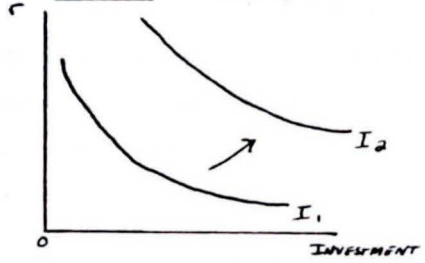


Figure 4 Country N



investment is a function of the interest rate and the income level, changes in the income level will determine how much the investment curve will shift.

The two terms which represent the change in long-term capital inflows state that both the distance which the investment curve shifts to the right and the speed of the shift are important. The greater the speed of the shift in the investment curve to the right, then the greater will be the inflow of capital.

Figure 4 illustrates the shift of the investment function in country N. Like the analysis of the capital inflow, the analysis of capital outflows is analogous, except one now looks at the economy of the non-devaluing country. As the income level increases, the investment curve will shift to the right. Capital outflows from the devaluing country will be greater, the greater the shift of the investment curve to the right and the greater the speed of the shift. Hence, both the change in income in the non-devaluing country and the acceleration of the income level are both important.

The net long-term capital inflow will depend on which country is growing relatively faster and which country has the higher income level.

If the income level was decreasing in either country, then the analysis would be analogous to the increasing income case. The greater the decrease in the income level, the greater will be the decrease in the capital inflow into that country. If the decrease in the income level is decreasing at a slower rate, then this will allow more inflows, than if the income level was decreasing at an increasing rate.

By substituting the expressions we have already derived for the change in the trade balance, the change in net speculative capital inflows and the change in net transactional inflow into Equation (6), one gets a complete expression for the change in the payment balance.

$$(7)\quad d\bar{P} = dY^D - \partial\bar{A}^D/\partial Y^D\, dY^D - \partial\bar{A}^D/\partial e\, de + v'dM - vedX - vXde$$
$$+ \partial Csp/\partial bdb + \partial Csp/\partial(db)\, d^2b + \partial Csp/\partial(r^D - r^N) d(r^D - r^N)$$
$$+ \frac{\partial iCl}{\partial Y^D}\, dY^D + \frac{\partial iCl}{\partial(dY^D)}\, d^2Y^D - \frac{\partial oCl}{\partial Y^N}\, dY^N - \frac{\partial oCl}{\partial(dY^N)}\, d^2Y^N$$

Equation (7) puts together all of the models of Chapters 2, 4, and 5. The important information which Equation (7) gives, is that the balance of payment depends on many things. Both the change in the income level and the change in absorption is important. The influence of the change in the exchange rate and its effect on absorption is important. Changes in import and export values, along with the transactional constants, are important. Also, one must examine changes in the trade balance, the acceleration of the trade balance and changes in the interest rate differential and their influence on speculative capital flows.

III. Implications and Conclusions

If the analysis is expanded to allow for a change in the interest rate, then the effect which changes in the interest rate would have on the long-term capital flow must be accounted for. If an increase in the interest rate means more profitable investment opportunities, as is usually assumed, then a change in the interest rate can change the long-term capital flow. If the Tsiang model is utilized, then it is implied that net long-term capital inflows can be favorably affected by the devaluation. Tsiang showed that with a constant money supply the interest rate would rise in the devaluing country. A rise in the interest rate will mean an upward movement along the investment schedule. This means a higher rate of return in the devaluing country and a favorable change in long-term capital inflows. If the non-devaluing country experiences a lowering of the interest rate, this lowering can induce a long-term capital outflow from the non-devaluing country. This implies that both monetary and fiscal policy must also account for changes in the interest rate and income and their effects on long-term capital flows when trying

to support a devaluation.

This chapter has examined long-term capital flows in both the devaluing country and the non-devaluing country. It has been shown that both the change in income and the income level in the devaluing country determine long-term capital inflows. Long-term capital outflows are determined by income and the change in the income level of the non-devaluing country.

Since devaluation changes the income level of both the devaluing and the non-devaluing country, long-term capital flows will alter. By ignoring long-term capital flows, any analysis of devaluation such as Tsiang's or Alexander's would be overlooking a potentially important factor. Whenever the income effects of devaluation produce a favorable change in income in the devaluing country, this will induce a favorable long-term capital inflow. Hence, when devaluation is examined taking into account the long-term capital flow, the importance of the income effects of devaluation is increased. In addition, the income effects produced within the non-devaluing country are important, since they will affect long-term capital outflows from the devaluing country.

The introduction of long-term capital flows points to the importance of examining both the relative income level of the devaluing and non-devaluing country. In addition, the relative growth rates of the two countries must be examined. Since devaluation is capable of changing both the income level and the growth of income in the two countries, a thorough analysis of devaluation must examine the effect of devaluation on income and the growth of income.

A thorough examination of a devaluation's effect on the stability of a currency, must examine the relative growth positions of the devaluing and non-devaluing countries. This is necessary because changes in the relative growth rates, which can be produced by the income effects of devaluation, can alter the flows of long-term capital.

Hence, one implication of the introduction of long-term capital flows is the potential importance of examining the growth of the economies involved in a devaluation. Previous analysis of devaluation have, for the most part, ignored the question of growth.

Another implication of the analysis of this chapter and the last is to indicate that the capital account and current account are tied together. Examination of only one of the accounts can fail to analyze many important relationships.

Both this chapter and the last points to the necessity of examining the balance of payments rather than the balance of trade when examining the influence of a devaluation on the stability of the currency.

CHAPTER VI

A TWO-COUNTRY INVESTMENT ACCELERATOR MODEL

The previous chapters of this dissertation have analyzed, with the use of comparative static analysis, the effects of devaluation on both the balance of trade and the balance of payments. The present chapter and the next are employing dynamic analysis in their study of a country's income level over time. These two chapters attempt a formulation of some of devaluation theory in dynamic form. A dynamic reformulation of devaluation theory can give a new understanding to an old problem. Previously ignored relationships might prove to be important in determining the effectiveness of devaluation when analyzed from a dynamic approach.

This chapter begins the dynamic analysis by presenting a two-country investment accelerator model. The purpose of this presentation is to show that the stability of the two-country system is different from the stability of either country acting by itself. The chapter presents a model which suggests that business cycles can be transferred from one country to another through international trade, which would mean that effective policy would have to correct for instability by examining and adjusting the economies of all the countries involved. This conclusion suggests that when instability of the trade balance is examined, policy must correct for the instability by causing adjustment within both of the trading countries. This conclusion suggests that devaluation, which entails only unilateral adjustment would miss the

mark. This issue is examined within Chapter 7, where expectational spending is examined.

The solution to the two-country accelerator model determines the stability of the two-country system, not the stability of either country operating by itself. In addition to a discussion of the stability of the two-country system, this chapter demonstrates how the values of the parameters within each country affects the stability of the system.

It is important to realize that the models presented in this chapter and the next do not examine capital flows as was the case in the last two chapters. Instead, these two chapters examine the income stream over time in order to be able to infer important results about the balance of trade and the question of devaluation. The implication, which dynamic analysis can have on the balance of payments, is left for future research.

This chapter has the following format. The first section briefly recapitulates Samuelson's accelerator theory, whereas the second section presents the two-country accelerator model. The third section analyzes the stability results of the two-country system and the influences which the values of the parameters have on the stability. The last section concludes the analysis and mentions the implications derived from the analysis.

I. Samuelson's Accelerator Model

Samuelson's accelerator model examined movements of national income "when there exists a constant continuing level of government

expenditure."[1] Samuelson's model determined whether the injection of a constant continuing level of government expenditure would lead away from equilibrium or whether it would allow the income stream to converge to a new higher equilibrium level. In order to determine this, Samuelson found an expression for the income stream over time.

Samuelson's model assumed no international trade. In addition, it was assumed that national income is equal to government expenditure (g) plus consumption plus investment.[2]

(1) $Y_t = g_t + C_t + I_t$

Within Samuelson's model, government expenditure is assumed to be autonomous, while in the present period consumption is equal to the marginal propensity to consume (α) times the past period's income level. This assumption indicates that it takes a period for people to adjust their consumption patterns to a new income level.[3]

(2) $C_t = \alpha Y_{t-1}$

The heart of the analysis centers around the investment function. Samuelson employed the investment function of Hansen.[4] Hansen assumed that "induced private investment is proportional to the increase in consumption between the previous and the current period."[5]

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[1] P. Samuelson, "Interactions between the Multiplier Analysis and the Principle of Acceleration", Review of Economics and Statistics, May 1939, pp. 76-77.

[2] Ibid, pp. 76-77. Note: The income, consumption and investment variables in this chapter and the next are all in value terms. Also, the subscript t in equation 1 stands for the time period. The t represents the present period while a subscript t-1 represents the past period.

[3] Ibid, p. 76.

[4] Ibid, p. 76-77.

[5] Ibid, p. 76-77.

(3) $I_t = \beta(C_t - C_{t-1})$

This relationship is expressed in equation 3 above, where β is a constant known as the accelerator. The Samuelson-Hansen model made induced investment responsive to changes in aggregate consumption of the economy.

Certain implicit assumptions are included with the investment function. First, investment is assumed to be realized within one period. Second, it is assumed that only induced investment is occurring. In addition, the accelerator is assumed to remain constant. Fourth, it is assumed that there are no limitations on the output capacity in the capital goods industry in the short-run. Fifth, investment decisions are made without a lag.

By substituting equation 2 into equation 4, the investment function can be expressed in terms of income.

(4) $I_t = \beta(\alpha Y_{t-1} - \alpha Y_{t-2}) = \beta\alpha Y_{t-1} - \beta\alpha Y_{t-2}$

Equation 4 expresses the investment function as equal to the accelerator times the marginal propensity to consume times the income level of the previous period minus the accelerator times the marginal propensity to consume times the income level of two periods previous.

Substitution of equations 4 and 2 into equation 1 gives a statement of income in period t.

(5) $Y_t = g_t + \alpha Y_{t-1} + \alpha\beta Y_{t-1} - \alpha\beta Y_{t-2}$

Factoring yields equation 6.

(6) $Y_t = g_t + \alpha(1 + \beta) Y_{t-1} - \alpha\beta Y_{t-2}$

Equation 6 is a second order difference equation whose roots can be found quite easily with the help of the quadratic equation.

Solution of equation 6 yields the following income path.

(7) $y(t) = g_t/(1-\alpha) + A_1 (r_1)^t + A_2 (r_2)^t$

The A's are constants which are determined by the initial conditions. The r's are the two roots of equation 6. These roots determine the stability of the income stream. If either of the roots of equation 6 is greater than 1 in absolute value, then the income stream will exhibit explosive oscillations. If both of the roots are less than 1 in absolute value, then the income stream will exhibit damped oscillations.

In order for the Samuelson accelerator model to yield a stable solution, the marginal propensity to consume times the accelerator must be less than 1, and the marginal propensity to consume must be less than 1.[6] If $\alpha\beta$ is greater than 1, then the system will be unstable. If $\alpha\beta$ is less than 1, then the income stream will be stable. However, if $\alpha\beta$ is exactly equal to 1, then the income stream will exhibit constant oscillations of the same amplitude.

As either the marginal propensity to consume (mpc) or the accelerator increases in value, the instability of the income stream will increase. As the mpc increases, the induced consumption resulting from an increase in government expenditure will increase, which in turn will increase induced investment to a larger extent. In addition, a larger accelerator value makes induced investment respond to a greater extent to a time increase in consumption.

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6 S. Goldberg, Difference Equations, New York, Wiley & Sons, 1967, pp. 171-75. See these pages for a derivation of this boundary of stability.

Basically, the stability condition that $\alpha\beta$ must be less than 1 refers to the reactions of induced investment and consumption to changes in government expenditure and other autonomous changes. When $\alpha\beta$ is greater than 1, the increase in government expenditure sets off changes in induced investment and induced consumption which work in conjunction to make the income stream diverge from equilibrium. When $\alpha\beta$ is less than 1, the increase in government expenditures sets off changes in induced investment and induced consumption which work in conjunction to set off oscillations of the income stream. However, when $\alpha\beta$ is less than 1, the influence of induced investment and induced consumption is not strong enough to work in conjunction to make income diverge from equilibrium. It is important to realize that it is the combination of both induced consumption and induced investment which determines stability. This is seen by realizing that induced investment is dependent on the time change in consumption.

The next section shows that when the model is expanded to a two-country system the stability for the two-country system will be different than the stability of either country examined by itself. Since the Samuelson accelerator model is a way of explaining business cycles, the two-country model suggests an explanation of the propagation of business cycles from one trading country to another.

II. The Two-Country Model

This model assumes that there are investment accelerators in both countries. The imports of one country are equal to the exports of the other country. Rather than solve the equation system involved, this

paper solves only for the roots, since the focus of attention is primarily on the stability of the system.[7]

Equation 8 expresses what income in period t is equal to within country D, while equation 9 expresses what income in country N is equal to within period t. Income in both countries is equal to government expenditure plus consumption plus investment plus exports minus imports.

$$(8)\quad Y_t^D = g_t^D + C_t^D + I_t^D + X_t^D - M_t^D$$

$$(9)\quad Y_t^N = g_t^N + C_t^N + I_t^N + X_t^N - M_t^N$$

In order to derive an interlocking system of two difference equations, equations 8 and 9 must be expressed in terms of the income levels of both countries. This requires certain assumptions in regards to the variables involved. In order to keep the model analogous to Samuelson's model, the same assumptions regarding government expenditure, consumption and investment are employed.

Hence, it is assumed that government expenditure is autonomous within both the economy of country D and in the economy of country N. In addition, consumption in both countries is assumed to equal the mpc of that country times the previous period's income level.

Also, investment in both countries is assumed to equal a constant times the difference between the present period's consumption level and the previous period's consumption level. Note that the constant is most

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7 The mathematical techniques employed will be analyzed within the appendix. Hence, the interested reader is referred to the appendix so as to see the derivation of the equations and results of this section.

likely to be different within the two economies.

In addition, imports in either country are assumed to be equal to the marginal propensity to import (m) times the last period's income level. Since exports in country D are equal to imports in country N, it can be seen that country D's exports are equal to the marginal propensity to import (mpm) of country N times the last period's income level of country N.

In terms of the above assumptions, the following interlocking second order difference equation system is derived.[8]

$$(10)\quad Y_t^D + (m^D - \alpha^D - \alpha^D\beta^D)Y_{t-1}^D + \alpha^D\beta^D Y_{t-2}^D - m^N Y_{t-1}^N = g_t^D$$

$$(11)\quad Y_t^N + (m^N - \alpha^N - \alpha^N\beta^N)Y_{t-1}^N + \alpha^N\beta^N Y_{t-2}^N - m^D Y_{t-1}^D = g_t^N$$

It is important to realize that both equations 10 and 11 are in terms of the income levels of both countries. The addition of imports and exports into the accelerator analysis adds the income level of the other country into the study of the income path over time of country D. Likewise, the income level in country D must be examined when the income path of country N is examined.

The roots associated with the solution of equations 10 and 11 determine the stability of the two economies acting in conjunction. The stability of either country by itself cannot be found, since the two economies are tied together through imports and exports.

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[8] This system is derived in the appendix.

The two country model examines how autonomous changes affect the stability of the two-country system. Induced investment and consumption must be examined within both economies in order to determine the stability of the system.

Severe oscillations within one economy will affect the stability of the other economy. Likewise, a very stable economy can cut down on the instability of the other economy. It is the combined influences that both economies have on the other economy and its own economy, which determine the stability of the two-country system. A situation may arise in which a very stable economy trades with an unstable economy, however, the two-economy system will be stable.

In order to examine the two-country system's stability, the investment accelerator and mpc must be examined in both economies. Induced responses of investment and consumption have to be analyzed within the two economies. In addition, the mpm within both economies must be examined, since both economies determine to a great extent the degree to which oscillations from one economy can be transferred to another through trade.

In order to test for the stability of the two-country equation system, the four roots or eigenvalues of equations 10 and 11 must be solved for. To accomplish this task, it is necessary to express the two second order difference equations as four first order difference equations. A characteristic matrix is derived which is used to solve for the roots. A computer program is also used.[9]

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[9] The appendix goes into the details of the solution. Dr. A. Ziebur solved the equation system and Jerry Kaplan programmed the solution.

There are a few main hypotheses which are tested by placing in various values for the mpc, the accelerator and the mpm within both countries. First, it is hypothesized that the stability solution of the two-country system will yield an answer which is different than the stability of either country considered under autarky. In fact, the stability of the two-country system should be somewhere in between the solution of the two countries' stability derived under autarky.

In addition, predictions are made about the influence which the parameters of the two countries have on the stability of the two-country system.

The larger the value of country D's mpc, then the greater will be the instability of the system. This is true because a change in government expenditure leads to a greater reaction in induced consumption. A larger change in induced consumption makes for a larger change in induced investment, since investment is proportional to the time change in consumption. Also, a larger mpc means a larger multiplier, which makes for larger changes in income. In addition, a larger multiplier makes for a greater interaction between the repercussionary multiplier and the accelerator. Hence, a large mpc will mean more instability for the country examined in isolation and for the two-country system.

The larger the value of country D's accelerator, then the greater will be the response of induced investment to any autonomous change such as government expenditure. Large responses of induced investment within country D make for greater oscillations within the economy of country D and within the two-country system. Large oscillations in income pro-

duced by a large accelerator mean large oscillations in imports. Large oscillations in country D's imports produce income oscillations within the economy of country N. Hence, a large accelerator will make country D, country N and the two countries acting in conjunction more unstable than a smaller accelerator.

The analysis of the mpc and the accelerator in country N is exactly analogous to the analysis of the mpc and the accelerator in country D.

A large mpc in country N will mean that the two-country system will be more unstable. The larger the mpc in country N, then the greater will be induced consumption changes for any income change. The greater induced consumption change will mean larger induced investment changes, because investment is equal to a constant multiplied by the time change in consumption. Hence, a large mpc in country N produces greater oscillations within country N. In addition, these oscillations will affect the stability of country D's income stream. Country D's income stream is affected because oscillations of country N's income level means oscillations in country N's imports. Since a large mpc makes for more instability within both the economy of country N and country D, a large mpc makes for more instability of the two-country system. A large mpc makes for a greater interaction of the repercussionary multiplier and accelerator.

The larger the investment accelerator of country N, then the greater will be the instability of the two-country system. A large investment accelerator will mean large responses of induced investment for any change in either income or consumption. Large responses of investment

to income change will mean greater oscillations within country N. Oscillations of country N's income level will affect country D's income level, because country N's imports will oscillate to a greater extent. Since a large accelerator in country N makes for more instability within both country N's and country D's economy, then a larger accelerator in country N makes for more instability for the two-country system.

The most difficult parameters to examine are the two mpm's and their influence on the stability of the two-country system. The larger the mpm in country D, then the greater will be the amount of imports, ceteris paribus. The larger the amount of imports, then the greater will be the leakage from the economy of country D. However, a large amount of imports will increase the exports from country N. The difficulty which arises is the same difficulty which occurs when explaining the repercussionary multiplier. A change in one country's income level leads to both an income increase through increased exports and to an income decrease through increased imports. The final change can only be determined when all the parameters of the economies of both countries are examined.

The same difficulty arises when examining the influence of the mpm of country N. A large mpm of country N will increase the instability of country D, since exports will fluctuate to a greater extent in country D when country N's income level changes. In addition, a larger mpm will tend to make for more stability in country N, since imports will respond greatly to income changes. Notice that in equations 9 and 10 the sign of imports is different from the sign associated with consumption and

investment, since imports are a deduction from national income. The changes in imports work in an opposite direction to induced changes in consumption and investment. Hence, import changes tend to partially offset changes in consumption and investment.

The final influence of a larger mpm on the stability of the two economies and on the stability of the two-country system is unpredictable without further information, since a large mpm leads to both influences of stability and instability. The mpm determines to a large extent whether the oscillations of one nation's income influence the stability of the other nation.

III. The Test and the Result

In order to test the hypotheses of the last section, certain reasonable values were substituted for the respective countries' mpc, mpm and the accelerators. A Fortran program solved for the characteristic values. The absolute value of each root was determined to test for stability.

Table 1 is used to test for the hypotheses of the last section. The table lists the six parameters which are examined along the top row. The last entry along the top row represents the magnitude of the largest of the four roots of the two-country system. This is the only root which needs to be examined, since it dominates the system and determines whether the system is stable. A magnitude of the largest root of less than one indicates that the two-country system will be stable. A magnitude of greater than one indicates that the two-country system will be unstable. An unstable situation indicates ever increasing oscillations of the income

streams (acting in conjunction) of the two-country system.

The hypothesis that the stability of the two-country system is different than the stability of either country examined under autarky can be proven by examining row 1 of the table. The stability of the two-country system is indicated by the magnitude .95683. If the Samuelson's one-country equation is used to solve for the stability value of both country D and country N considered under autarky, then country D's income stream would have a root magnitude of 1.00 whereas country N's income stream would have a root magnitude of about .91. Notice that the stability of the two-country system is somewhere inbetween the stability of either country's income stream examined under a no trade situation. Hence, the first hypothesis is established.

The influence of country D's mpc can be tested by comparing row 1 with row 2. The only difference between row 1 and row 2 is that the mpc in country D is larger in row 2. In row 1 it is .4, while in row 2 it is .6. The magnitude of the largest root increases from .95683 to 1.19419 as the mpc changes from .4 to .6. Hence, it is proven that a larger mpc in country D means more instability of the two-country system than a smaller mpc. This results from the larger amount of induced consumption and the larger multiplier associated with row 2 as compared to row 1. This can also be tested by comparing row 25 to row 26.

The influence of the mpc of country N can be tested by comparing rows 1 and 4. The only difference between the value of the parameters in row 1 as compared with row 4 is that the mpc of country N is .4 in row 1, whereas it is .5 in row 4. The magnitude of the largest root can be seen to be larger in row 4, indicating that a larger mpc in country N

TABLE 1

	Value of Parameters						Magnitude of largest eigenvalue
	k	B	M	k'	B'	M'	
row 1	.4	2.5	.2	.4	2	.2	.95683
2	.6	2.5	.2	.4	2	.2	1.19419
3	.4	3.0	.2	.4	2	.2	1.03997
4	.4	2.5	.2	.5	2	.2	.99999
5	.4	2.5	.2	.4	3	.2	1.05690
6	.4	2.5	.2	.6	2	.2	1.05962
7	.4	2.5	.2	.4	4	.2	1.21824
8	.4	2.5	.2	.4	2	.4	.99788
9	.4	2.5	.1	.6	0	0	.99999
10	.4	2.5	.4	.4	2	.2	.99792
11	.4	2.5	0	.6	.5	.1	1.00000
12	.4	2.5	0	.6	.5	.2	1.00000
13	.5	2.0	.2	.5	1	.2	.93893
14	.4	2.0	.2	.4	2	.2	.89442
15	.4	2.0	.1	.4	2	.2	.89442
16	.5	1.0	.1	.4	3	.1	1.08197
17	.5	1.0	.1	.5	1	.1	.70711
18	.5	1.1	.1	.5	1	.1	.72469
19	.5	1.0	.1	.5	1.1	.1	.72468
20	.5	1.1	.1	.5	1.1	.1	.74162
21	.5	1.2	.1	.5	1	.1	.74273
22	.6	.5	.2	.6	.5	0	.54772
23	.6	1.0	.2	.6	0	.1	.75220
24	.6	1.0	.3	.6	0	.1	.74540
25	.6	1.0	.3	.6	0	.2	.71382
26	.7	1.0	.3	.6	0	.2	.77202
27	.55	2.0	0	.5	2	0	1.04881
28	.4	2.5	.2	.6	.5	.1	.97707
29	.4	2.5	.1	.6	.5	.1	.96965
30	.4	2.5	0	.6	.7	.3	1.00000
31	.4	2.5	.1	.4	2.5	.1	1.00000
32	.4	2.5	0	.4	2.5	0	1.00000
33	.3	3.0	.1	.4	2.5	.1	.98916
34	.3	3.0	0	.3	2.5	.1	.94868
35	.3	3.0	.1	.3	2.5	0	.94868
36	.3	3.0	1	.3	2.5	.1	.92083
37	.3	3.0	.2	.3	2.5	.1	.91285
38	.6	2.0	.2	.6	1	.1	1.09544
39	.4	2.6	.2	.2	2	.2	.99327
40	.4	2.8	.2	.2	2	.2	1.03316

produces more instability within the two-country system. This is true because the multiplier and induced consumption changes will be greater in country N. The test can also be run by comparing row 33 with row 36.

In order to ascertain the influence of country D's accelerator on the stability of the system, row 1 can be compared to row 3. In row 3, all the parameters are of the same value except for the accelerator of country D, which is 3 in row 3 compared with its value of 2.5 in row 1. The magnitude of the largest root increases in row 3 to 1.03997 compared with .95683 in row 1. Hence, a larger accelerator in country D will mean more instability for the two-country system than a smaller accelerator. A larger accelerator in country D leads to a larger interaction between the multiplier and the accelerator which causes more instability in the economy of both countries. This can also be tested by comparing row 17 with row 18 or by comparing rows 19 and 20.

The influence of country N's accelerator behaves much the same as the accelerator of country D. Comparing rows 1 and 5 shows that a larger accelerator in country N makes for more instability in the two-country system. This can also be tested by comparing rows 7 and 1.

By comparing row 20 with row 17, it can be shown that a larger accelerator in both countries will cause more instability than the case of a larger accelerator within just one of the countries (rows 18 and 19). Hence, the accelerators of the two countries act in conjunction with each other when setting up fluctuations within the two-country system.

Lastly, the mpm of the two countries are now analyzed. By comparing rows 1 and 8 with that of rows 24 and 25, the difficulty involved in predicting the influence of the mpm on the stability of the system without

prior knowledge of both countries' parameters can be seen.

The only difference between row 1 and row 8 arises from the mpm in country N having a value of .4 in row 8 compared with its lower value of .2 in row 1. Notice that in this situation the larger mpm in country N makes for more instability in the system. This can be explained since the larger mpm of country N stimulates country D's economy through exports to a greater extent than a smaller mpm. However, country D was on the borderline of instability to begin with. The larger mpm makes country N's economy more stable. In this situation the increase in instability resulting from a larger mpm outweighs the increase in stability gained, and the net result is a gain in the instability within the two-country system. In rows 24 and 25, the end result is just the opposite since the economies of both countries are very stable. The small increase in the mpm of country N (in row 25) adds instability to country D's economy through greater exports, but it also adds stability to country N's economy through greater imports. This time the gain in stability outweighs the loss in stability which means a net gain in stability from .74540 to .71382.

The same analysis and results hold for the mpm of country D. By comparing row 29 with row 28, one can see that in this case a larger mpm in country D makes for more instability for the two-country system. Comparing row 36 with row 37 indicates just the opposite situation in which a larger mpm in country D makes for more stability.

Hence, one must know whether the instability added by a larger mpm in either country outweighs the stability added in order to determine the exact influence of the mpm.

IV. Implications & Conclusions

This chapter has set up a two-country accelerator model in which the stability of the two countries acting in conjunction can be examined.

The model presented suggests a novel way of examining the propagation of a business cycle from one economy to another. In determining whether an economy will be severely affected by the instability of a nation with which it trades, the model suggests many potentially important factors to examine.

First, the size of the two countries' mpm will determine to a large extent the interdependence of the two nations. Secondly, the importance of trade, as determined by the proportion of GNP which trade comprises, is also a determining factor of the degree of interdependence. If a nation has a very tiny proportion of its GNP composed of trade, then even severe oscillations in a trading country will have little effect on its stability.

In addition, the model may suggest that the old hypothesis that large nations will have strong effects on small nations whereas small nations may have little effect on larger nations is valid.

The importance of the two-country accelerator model is its illustration on a dynamic level of the interdependence of two countries. This has been shown numerous times on a static level, but far fewer times on a dynamic level.

The model suggests a few important policy implications. First, it suggests that in combating a business cycle, a country must account for the parameters' values both in the country instituting the policy

and in nations with which the country trades. The model also points to the novel conclusion that to correct for some business cycles, policy must be instituted in both countries.

In addition, the model points to the importance of the parameters in determining the stability of the system. Since the values of the parameters, such as the mpc and the accelerator, are of key importance policy might, in some instances, be better directed at changing the sizes of the parameters than in manipulating the variables and autonomous factors.

The model points to the need for coordinated fiscal and monetary policy to be undertaken within more than one country in order to solve the stability problems which face some nations.

The institution of policy from a dynamic level can be much more effective than the institution of policy derived from comparative static analysis. This is true because dynamic analysis examines the path encounter over time of the variables whereas static analysis examines only final positions.

Another favorable factor of this model is that it can someday be expanded to allow for growth of income. Hence, policy can be determined which would try to achieve large growth with small oscillations.

Regarding devaluation theory, the model presented in this chapter suggests a consumption accelerator model which can be used to illustrate speculative buying associated with the fear of a devaluation. This model is presented in the next chapter.

In addition, the analysis of this chapter suggests that devaluation which changes income and absorption might operate much differently when

analyzed under a comparative static approach vs. a dynamic approach. If a country had both a large mpc and investment accelerator, then induced absorption might outweigh income increases even though the marginal propensity to absorb is less than 1. Hence, with the addition of an investment accelerator the analysis of the Alexander absorption model, the elasticity model, and the synthesis did not allow for the possibility of an investment accelerator. If a strong accelerator relationship operates within a country, then it is necessary to account for it when discussing absorption changes.

In conclusion, the importance of this chapter was the development of a two-country investment accelerator model. In the course of the chapter, the stability conditions were examined along with the various influences of the parameters on the stability. Although this chapter has been more or less a digression from the other chapters, it has been instrumental in allowing a better understanding of the interlocking nature of two trading countries. This interlocking property must be thoroughly understood when analyzing devaluation. The degree of dependence of two trading countries depends on the mpm, the size of the repercussionary multipliers, the proportion of income which trade comprises and the number of trading countries. One is cautioned in drawing too strong conclusions from the model. There are many situations in which one trading country is almost completely unaffected by the other.

APPENDIX - CHAPTER VI

Equation (1) represents the income flow in period t in country D, while equation (2) indicates the income flow in country N.

$$(1)\quad Y_t^D = g_t^D + C_t^D + I_t^D + X_t^D - M_t^D$$

$$(2)\quad Y_t^N = g_t^N + C_t^N + I_t^N + X_t^N - M_t^N$$

The g stands for government expenditure while M stands for imports and X stands for exports.

Both government expenditure in country D and N will be assumed autonomous and equal to a constant level of one.

$$(3)\quad g_t^D = 1 \quad \text{and} \quad g_t^N = 1$$

The value of government expenditure is unimportant for the dynamic analysis which follows. The important thing is the assumption that it remains constant when income changes.

Consumption in either country will be assumed equal to the marginal propensity to consume times the previous period's income level of the respective country.

$$(4)\quad C_t^D = \alpha^D Y_{t-1}^D$$

$$(5)\quad C_t^N = \alpha^N Y_{t-1}^N$$

Equation (4) represents the consumption in country D, where α^D is the marginal propensity to consume in country D, while equation (5) is the consumption function in country N.

Investment in country D will be equal to the accelerator in country D (β^D) times the difference between the present period consumption level in country D and the previous period consumption function. This is expressed in equation (6), whereas equation (7) expresses the investment function in country N.

$$(6)\quad I_t^D = \beta^D \left[C_t^D - C_{t-1}^D\right]$$

$$(7)\quad I_t^N = \beta^N \left[C_t^N - C_{t-1}^N\right]$$

where β^N is the investment accelerator in country N.

Substituting equation (4) into equation (6) will yield an expression for investment in country D in terms of country D's income level. Also substituting equation (5) into equation (7) will yield an expression for investment in country N in terms of country N's income level.

$$(8)\quad I_t^D = \beta^D \left[\alpha^D Y_{t-1}^D - \alpha^D Y_{t-2}^D\right] = \beta^D \alpha^D Y_{t-1}^D - \beta^D \alpha^D Y_{t-2}^D$$

$$(9)\quad I_t^N = \beta^N \left[\alpha^N Y_{t-1}^N \quad \alpha^N Y_{t-2}^N\right] \quad \beta^N \alpha^N Y_{t-1}^N - \beta^N \alpha^N Y_{t-2}^N$$

Imports in the respective countries will be assumed to be equal to the respective country's marginal propensity to import times the previous period income.

$$(10)\quad M_t^D = m^D Y_{t-1}^D$$

$$(11)\quad M_t^N = m^N Y_{t-1}^N$$

where M is the marginal propensity to import.

Since one country's imports are the other country's exports one can express exports in the respective country in terms of the other country's

marginal propensity to import and the previous period income level.

$$(12)\quad X_t^D = M_t^N = m^N Y_{t-1}^N$$

$$(13)\quad X_t^N = M_t^D = m^D Y_{t-1}^D$$

Substituting equations 3, 4, 8, 10 and 12 into equation (1) will yield an expression for the present period income level of country D in terms of the past period income levels of both countries and the marginal propensities to import and consume and the accelerators. Equation (14) is the final equation derived after factoring and simplification.

$$(14)\quad Y_t^D + (m^D - \alpha^D - \alpha^D\beta^D)Y_{t-1}^D + \alpha^D\beta^D Y_{t-2}^D - m^N Y_{t-1}^N = 1$$

Equation (15) is derived for country N by substituting equations 3, 5, 9, 11 and 13 into equation (2).

$$(15)\quad Y_t^N + (m^N - \alpha^N - \alpha^N\beta^N)Y_{t-1}^N + \alpha^N\beta^N Y_{t-2}^N - m^D Y_{t-1}^D = 1$$

Equation (14) and (15) form an interlocking system of difference equations. This is a second order system of difference equations in two variables.

This system can be solved so as to determine the income paths in both country D and country N.

The solution technique for the roots of the equation system 14-15 will be to express the system of two second order difference equations in terms of four first order difference equations. In order to do this we let $U_t^D = Y_t^D$, $U_t^N = Y_t^N$, $v_t^D = Y_{t-1}^D$ and $v_t^N = Y_{t-1}^N$.

Using the above identities for the v and U variables one can derive equations 16 and 17.

$$(16) \quad v_t^D = U_{t-1}^D$$

$$(17) \quad v_t^N = U_{t-1}^N$$

Substituting the expressions of U and v into equation 14 and 15 yield equations 18 and 19.

$$(18) \quad U_t^D = (\alpha^D\beta^D + \alpha^D - m^D)U_{t-1}^D - \alpha^D\beta^D v_{t-1}^D + m^N U_{t-1}^N + 1$$

$$(19) \quad U_t^N = (\alpha^N\beta^N + \alpha^N - m^N)U_{t-1}^N - \alpha^N\beta^N v_{t-1}^N + m^D U_{t-1}^D + 1$$

Equation 16–19 can be written in matrix form as equation 20.

$$(20) \quad \begin{pmatrix} U_t^D \\ U_t^N \\ v_t^D \\ v_t^N \end{pmatrix} = \begin{bmatrix} \alpha^D\beta^D+\alpha^D-m^D & m^N & m^D-\alpha^D\beta^D & 0 \\ m^D & \alpha^N\beta^N+\alpha^N-m^N & 0 & -\alpha^N\beta^N \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix} \begin{pmatrix} U_t^D \\ U_{t-1}^N \\ v_{t-1}^D \\ v_{t-1}^N \end{pmatrix} + \begin{pmatrix} 1 \\ 1 \\ 0 \\ 0 \end{pmatrix}$$

The square term represents the characteristic matrix whereas the terms in parenthesis are vectors. The matrix is a four by four matrix.

Let the matrix be represented by A, whereas I_2 represents the two by two identity matrix.

Using the theory of characteristic value, the roots of equation system 20 is given by the solution of the determinant of $(\lambda I - A)$.

Where $\det(\lambda I - A) =$

$$\begin{vmatrix} \lambda - (\alpha^D\beta^D + \alpha^D\bar{M}^D) & -\bar{M}^N & \alpha^D\beta^D & 0 \\ -\bar{M}^D & \lambda - (\alpha^N\beta^N + \alpha^N\bar{M}^N) & 0 & \alpha^N\beta^N \\ -1 & 0 & \lambda & 0 \\ 0 & -1 & 0 & \lambda \end{vmatrix}$$

Setting the determinant above equal to zero and solving will yield the four characteristic values (or eigenvalues) for the solution of the second order difference equation system.

The method followed was to use a computer program which expressed the determinant as a fourth degree polynomial in λ. Then another program found the zeros of this polynomial, the characteristic values of our matrix A.

The magnitude of the largest roots will determine the stability condition.

CHAPTER VII

A TWO-COUNTRY SPECULATIVE SPENDING ACCELERATOR

The analysis employed in this chapter is dynamic, as was the analysis of the last chapter. A dynamic reformulation of devaluation theory can indicate important relationships which have been previously uninvestigated. The dynamic analysis of this chapter points to the importance of examining the parameters of both the devaluing and the non-devaluing country. It is shown that in some cases unilateral adjustment in only the devaluing country might be ineffectual in curing the inherent instability of a system. This indicates that devaluation policy might require certain adjustments in the non-devaluing country as well.

This chapter is devoted to the examination of one of Alexander's price effects. The dynamic price expectation effect is the most dynamic of all of Alexander's effects--very little has been written on this effect. This effect can occur before a devaluation as well as after a devaluation. The effect is based upon confidence in the stability of the currency. Before a devaluation, if the people of a country feel that a devaluation is imminent, then many people will start to spend money on goods before the price level rises. Devaluation raises the price level because it makes domestic currency worth less in terms of foreign currency. This means that the price of imports will cost more in terms of domestic currency. People will shift their purchases into import substitutes, which will raise the price of import substitutes. Prices of domestic goods which employ imported raw materials will also rise. In addition, the increased

foreign demand for exports will raise the price of exports. Also, the bidding up of wages by unions will also raise prices at times of a devaluation. Thus, devaluation will lead to a higher price level which in turn lowers the real purchasing power of domestic currency.

The speculative buying, which occurs because of the price expectation effect, makes the situation worse by raising the price level even further. This speculative buying is considered as speculative consumption buying. Nevertheless, this buying does not only include the buying of consumption goods, but it also includes the buying of raw materials and intermediate goods by firms before their price is expected to rise. Past wealth and savings will be used in order to finance this speculative spending. Eventually the price level and spending on both domestic goods and imports will reach such a high level that a devaluation will be necessary. Therefore, the price expectation effect can by itself determine whether a devaluation would be necessary. This is by no means always the case. However, there are times when expectations become pessimistic and this sets adverse influences into motion.

If a country has already devalued its currency, then there can still be a price expectation effect. The price expectation effect would operate when people of the country felt that the original devaluation was too small. If the people expected another devaluation to occur in the future, then they would buy goods whose prices will rise even higher when a second devaluation would be undertaken. The process would only stop when the majority of a country's populace had confidence in the stability of the currency.

This chapter formulates a model which allows the price expectations

effect to operate. Solution of the model will determine the stability of the two countries acting in conjunction. As will be shown in the body of the chapter, an unstable situation will probably mean that a devaluation will be necessary.

I. The Model

The speculative buying accelerator model is very similar in operation and analysis to the investment accelerator model of the last chapter. A two-country model is employed in which one country is the devaluing country, whereas the other country is the rest of the world (country N). Two second-order difference equations are derived, as was the case in the investment accelerator model. These two second-order difference equations are inter-locking because of exports and imports. The stability conditions, as determined by the roots of the two equations system, indicate the stability of both countries acting together.

The income level of country D during period t will be equal to consumption plus investment plus government expenditure plus exports minus imports. The same relationship holds in country N.

$$(1)\quad Y_t^D = C_t^D + I_t^D + g_t^D + X_t^D - M_t^D$$

$$(2)\quad Y_t^N = C_t^N + I_t^N + g_t^N + X_t^N - M_t^N$$

Government expenditure is assumed to be constant and independent of income within both countries.

Consumption in country N is assumed equal to the marginal propensity to consume of country N (c^N) multiplied by the previous period's income level of that country. Hence, a lagged consumption relationship is

assumed.

$$(3)\quad C_t^N = c^N Y_{t-1}^N$$

Consumption in country D is comprised of two components. First, it is comprised of a usual consumption component (C_{ct}^D), which is equal to the mpc of country D times the previous period's income level.

$$(4)\quad C_{ct}^D = c^D Y_{t-1}^D$$

Equation 5 expresses the assumption that consumption in period t in country D is equal to the usual consumption spending component, which is based on the income level and a speculative buying component (C_{st}^D) based on the deficit.

$$(5)\quad C_t^D = C_{ct}^D + C_{st}^D$$

The speculative buying component of consumption is the key factor in the analysis of this model. Speculative consumption depends directly on the likelihood of a devaluation. It is assumed that the greater the likelihood of a devaluation, then the greater is the speculative buying component of consumption. The deficit of the trade balance ($M^D - X^D$)is a good indicator of the stability of the currency. As the deficit grows larger, the danger of devaluation becomes more imminent. Speculative buying is made equal to a constant (x) times the deficit of the previous period.

$$(6)\quad C_{st}^D = x\,(M_{t-1}^D - X_{t-1}^D)$$

Speculative buying is dependent on the deficit of the previous period, because there usually is a statistical lag before the size of the trade balance is made known. Therefore, consumers basing their spending on the size of the deficit would probably have to use the previous

period's tabulated deficit. The model would change somewhat if speculative spending was assumed based on this period's deficit. The interested reader can change the model and calculate the slightly different result which indicates less stability.

The constant is the speculative buying accelerator. It is shown later that the size of this constant is very important in determining whether the system is stable. A larger spending accelerator means a greater induced change in speculative buying resulting from the deficit.

Both equations 6 and 4 can be substituted into equation 5 in order to give a statement of country D's consumption level in terms of country D's income level, import and export level.

$$(7)\quad C_t^D = c^D Y_{t-1}^D + x(M_{t-1}^D - X_{t-1}^D)$$

In order to complete the analysis, equation 7 must be expressed in terms of the previous period's income level of country D and country N. To accomplish this purpose, an expression must be found for imports and exports in terms of the past period's income levels.

Imports of country D in any period are assumed equal to the marginal propensity to import multiplied by the income level of the previous period. The same relationship is assumed to hold in country N in terms of its income level. The desired expressions are derived by realizing that one country's exports are the other country's imports.

$$(8)\quad X_t^D = M_t^N = m^N Y_{t-1}^N$$

$$(9)\quad X_t^N = M_t^D = m^D Y_{t-1}^D$$

Investment in country D in period t is assumed to equal the marginal propensity to invest (i) multiplied by the previous period's income level. Country N's investment function in period t is also assumed equal to the mpi (marginal propensity to invest) of that country times its previous period's income level.

$$(10)\quad I_t^D = i^D Y_{t-1}^D$$

$$(11)\quad I_t^N = i^N Y_{t-1}^N$$

The assumptions above are sufficient to allow for an expression of country D's income level during period t as equal to past period's income levels of country D and country N. Likewise, the same thing can be accomplished for country N's income level. This is accomplished by a series of substitutions into equations 1 and 2 from the above assumptions of the model.[1]

$$(12)\quad Y_t^D + (m^D - c^D - i^D)Y_{t-1}^D - xm^D Y_{t-2}^D - m^N Y_{t-1}^N + xm^N Y_{t-2}^N = g_t^D$$

$$(13)\quad Y_t^N + (m^N - c^N - i^N)Y_{t-1}^N - m^D Y_{t-1}^D = g_t^N$$

Equations 12 and 13 behave like the two equations system of the last chapter. These two second-order difference equations form a two-country interlocking system.

Notice that no speculative spending accelerator is assumed in country N, since country N is nowhere in danger of a devaluation. Some may argue that country N would experience non-buying activities in order to take advantage of the anticipated fall in the price level. However, if country

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[1] Details are in the appendix.

N represents the rest of the world, then the effect which a devaluation in country D will have on the general price level of the rest of the world will be small. Hence, the possibility of gain from speculative non-buying would be small. For this reason there is no speculative non-buying in the model presented in this chapter.

There might be some non-buying activity in country N in regards to country D's exports. This arises because after devaluation the price of country D's exports would be cheaper to foreigners. The extent to which people in country N engage in this type of non-buying activity, depends directly on the size of the deficit of the devaluing country. If this activity is felt to be significant, then a non-buying activity can be introduced into equation 13.

$$(14) \quad C^N_{st} = -x^N(M^D_{t-1} - X^D_{t-1})$$

Equation 14 shows one possible representation of this non-buying activity based on country D's deficit. In all likelihood, the constant x^N will be considerably less than country D's constant x, since non-buying in country N primarily affects the buying of country D's exports and not all goods in general, as was the case in the devaluing country. The addition of speculative non-buying in country N makes the model more stable since country N's income stream will be more stable. It is this writer's belief that the stability gained will be slight because speculative non-buying activity is believed to be fairly insignificant. The models presented henceforth only include speculative buying activity.

Returning our attention to country D, it is noted that country D

experiences speculative buying only after the balance of trade has reached a sufficiently large deficit to warrant a lack of confidence in its currency. Therefore the deficit must reach a certain limit before the speculative spending component of consumption starts to operate. One can think of this model as a trigger mechanism. Once the deficit reaches a certain limit, the trigger releases and speculative spending is undertaken. The limit which must be reached before the trigger release depends on many factors.

First, it depends on the proportion of GNP which trade comprises. A country such as England depends heavily on international trade. A devaluation of the pound would mean a greater overall rise in the price level than it would in a country which has only a small proportion of trade. This follows because if only a small proportion of GNP is comprised of trade, then devaluation's influence on the price of imports, import substitutes, exports, and domestic goods using imported raw materials will be relatively unimportant to the general price level. Hence, a country heavily dependent on trade will experience a smaller threshold value for the trigger release than a country less dependent on trade. Also, a country which is more dependent on trade will probably have a larger speculative buying accelerator than a country less dependent on trade simply because the inhabitants have more to lose in the country with the greater amount of trade.

A speculative buying accelerator would probably require larger limits in a key currency country such as the United States simply because a key currency country would be more reluctant to devalue. This is because devaluation would influence the wealth position of the other countries which

have held the key currency in their reserves.

Thirdly, the limit depends upon the skill of the trade authorities in concealing their intentions to devalue. After a devaluation the limit depends on how convincing the authorities are in making people believe that the right policy measure has been taken.

In addition, the limit which the deficit must reach before speculative spending ensues depends on the attitude of the people in regards to speculative behavior. If the people of a nation are very conservative, then little or no speculative spending might be expected.

If there is no speculative spending, then two terms of equation 12 become zero. These two terms are $-xm^{D}Y^{D}_{t-2}$ and $xm^{N}Y^{N}_{t-2}$, which represent the speculative accelerator times the deficit in terms of the past period's income level of the two countries.

The rest of the chapter assumes that country D is a country with a speculative spending situation. In addition, it is assumed that the required limit of the deficit has been reached, meaning that the speculative spending accelerator is in full operation.

If the spending accelerator is operating, then any increase in income will lead to more imports since imports depend on the income level. Any increase in imports relative to exports will cause an additional amount of speculative spending. The change in income will also cause induced changes in consumption and investment. The induced changes in imports, consumption investment and speculative spending will lead to another change in income, which in turn leads to more induced changes in the variables. Decreases would work analogously in the opposite direction.

If the change in income sets off ever increasing induced changes in consumption, speculative spending and investment, then the system will become unstable. A devaluation could solve the problem if it restores confidence to the currency, because then speculative spending would drop down to zero. The results of the next section show that the size of the speculative spending accelerator is an important determinant of the stability of the system.

Since this is a two-country system, the influence of changes induced in the other country is important because of its influence on exports and imports. A change in country D's income level will lead to a change in imports which in turn will change country N's income level by changing country N's exports. A change in country N's income level changes country D's exports. In addition, a change in country D's exports will influence speculative spending. Hence, the income level of both countries must be examined in order to determine the influence of speculative spending.

Severe speculative spending in country D can cause some instability in the economy of country N through the increased exports of country N. The roots of equations 12 and 13 will determine the stability of the two-country system.

The next section gives the results of the solution of the two-equation system. Particular attention is paid to the influence of the accelerator, the marginal propensities to consume, invest and import on the stability of the system.

II. The Stability Results

This section tests the influence of the various parameters on the stability of the two-country system. In order to do this, the roots of the two second-order difference equations system must be found. The method of approach is the same as the one which was utilized in Chapter 6.[2]

Table 1 represents the magnitude of the largest root for nine different sets of parameters. In each of the nine rows of table 1, only one of the parameters is varied, while all the others have the same value of those of row 1. In order to see the influence of a parameter on the stability of the system, one needs only compare the magnitude of the root associated with the row where that parameter is varied to the magnitude of the root in row 1.

Table 1 lists the magnitude of the roots in the far right column, while the row numbers are in the far left column. The various parameters' columns are designated along the top row of the table.

In row 2 the value of country D's mpc is .8, as compared with the value of .7 in row 1. The other parameters are held constant. As can be seen, the magnitude of the largest root is .86334 in row 1, whereas the magnitude is 1.00001 in row 2. This indicates that row 1 is a stable situation while row 2 is an unstable situation. Hence, the larger the mpc in country D, the more unstable will be the two-country system. A larger mpc indicates a larger change in induced consumption for a given change in income. The larger the induced consumption change, then the larger are the secondary income changes. In addition, a larger secondary income change means a greater induced change in imports, induced invest-

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[2] The reader is referred to the appendix for greater detail.

TABLE 1

Row	Parameter Values							Value of Largest Root
	m^D	c^D	i^D	x	m^N	c^N	i^N	
1	.2	.7	.1	2	.2	.7	.1	.86334
2	.2	.8	.1	2	.2	.7	.1	1.00001
3	.2	.7	.3	2	.2	.7	.1	1.09829
4	.2	.7	.1	3	.2	.7	.1	1.00000
5	.2	.7	.1	2	.2	.7	.1	.86334
6	.2	.7	.1	4	.2	.7	.1	1.11652
7	.2	.7	.1	2	.2	.9	.1	.93880
8	.4	.7	.1	2	.2	.7	.1	1.00000
9	.2	.7	.1	2	.2	.7	.3	.93880

ment and speculative spending. A large mpc in country D will also influence the stability of country N. Secondary income changes will change imports of country D, which are the exports of country N. Hence, a larger mpc in country D will slightly affect the stability of country N. Therefore, a larger mpc in country D makes the two countries acting in conjunction less stable.

The situation in row 2 is unstable because the larger mpc is just enough to make induced responses ever increasing. In addition, a larger mpc means both a larger multiplier and a larger repercussionary multiplier. Also there is a greater interaction between the multiplier and the speculative accelerator.

In row 3 the marginal propensity to invest (mpi) is equal to .3 as compared with its value of .1 in row 1. The size of the largest root is equal to 1.09829 in row 3, as compared with its value of .86334 in row 1. A larger mpi will mean more instability for the two-country system. The analysis of the mpi is analogous to the analysis of the mpc. A larger mpi in country D will mean a greater induced response of investment to any change in income. A greater response in induced investment will make for a greater secondary response in income, which will mean a greater change in imports and hence, speculative spending. Also a larger mpi will make for a larger repercussionary multiplier and thus a greater response in country N's economy which will in turn affect country D's economy.

In rows 4 and 6, the speculative accelerator is increased to a value of 3 and 4 respectively. The magnitude of the largest root indicates that as the speculative accelerator increases in value, the greater will be the instability of the system. As the speculative accelerator increases, the

greater will be the responsiveness of speculative spending to a given change in the deficit, which will make for a greater change in income and imports. A greater change in imports will make for an even greater change in speculative spending in the next period.

The values of the seven parameters in row 4 yield a root magnitude of exactly 1.00000, which is exactly on the stability boundary, as is the value of row 8. These two sets of parameters indicate just two points on the boundary. Unfortunately, a simple rule for stability can not be derived as Samuelson did in his one country accelerator model. This follows because of the greater mathematical complexity of this model, as compared to Samuelson's model. The best that can be done is to find certain points on the boundary, as was done in table 1, in order to get some idea of where it is. However, it has been shown that a larger mpc, mpi and speculative spending accelerator in country D make for more instability within the two-country system.

In row 7 the mpc of country N increases to .9 as compared with its value of .7 in row 1. Notice that a larger value of the mpc of country N makes for more instability within the two-country system. A larger mpc in country N will make for larger changes in induced consumption for a given income change. A greater induced response in country N's consumption will make for a greater change in country N's income in the next period, which in turn will increase country N's imports and hence, country D's exports will change by more. There are really two opposing influences at work here. First, a larger mpc makes for more instability in country N, because induced consumption will respond more fully to an income change. Secondly, since a higher mpc in country N makes for

greater secondary income changes in country N, this in turn will change country N's imports and hence country D's exports will change to a greater extent. A greater change in country D's exports will make country D both more stable and unstable. It makes country D more stable because an increase in exports relative to imports will cut down on speculative spending. A greater change in country D's exports will make country D more unstable, because a change in exports makes for a change in income. To get the net influence which the greater mpc of country N has on stability, the stability gain must be added to the stability loss. As row 7 indicates, the loss in stability will usually outweigh the gain in stability so that a higher mpc in country N will mean less stability for the two-country system.

Notice that a change in country N's mpc by .2 in row 7 does not affect stability as much as a .1 change in the mpc of country D. This is because a greater mpc in country D only adds to instability, while a greater mpc in country N adds both to stability and instability making the net effect on instability smaller. It is important to realize that although the model of the last chapter behaved symmetrically, this model does not behave symmetrically with respect to mpc and mpi within the two countries.

Row 9 indicates that a larger mpi in country N will result in more instability within the two-country system. A larger mpi of country N produces a gain in stability and a gain in instability. A larger mpi in country N makes for greater responses of investment to income changes. Greater responses of induced investment for income changes will mean a larger multiplier and more instability in country N as well as the two-country system.

In addition, since a large mpi makes for greater secondary changes in income, this in turn will make for greater changes in country N's imports, which are country D's exports. A greater change in exports of country D can increase stability if exports increase relative to imports, since this will mean less speculative spending. The explanation of the influence of country N's mpi is analogous to the explanation of country N's mpc influence on stability.

The last parameter which will be analyzed is country D's mpm. Unlike the investment accelerator model, mpm plays a very important role in this model. Row 8 has a mpm in country D of .4 in contrast to the value of .2 in row 1. The magnitude of the largest root is equal to 1.00000 in row 8 indicating the border of stability in contrast to the stable root of .86334 in row 1. A larger mpm will indicate a greater amount of instability. This is true because a greater mpm will indicate that a change in income will make for a greater response in imports. A greater import response will make for a greater response of the deficit, which in turn will greatly influence speculative spending activities. The $xm^{D}Y^{D}_{t-2}$ term of equation 12 indicates that the mpm of country D and the speculative spending accelerator work in conjunction with each other. Hence, any increase in mpm of country D will have a significant effect on stability through its effect on speculative spending (assuming a speculative spending accelerator greater than 1). There is also a small gain in stability since more imports will tend to stabilize income in country D, but this stabilizing effect is more than offset by the decrease in stability resulting from speculative spending.

The main result of this analysis is that the interaction of the re-

percussionary multiplier and the speculative spending accelerator will determine whether the two-country system is stable.

The mpm of country N will have an effect on the stability of the system through its changing of country D's exports. The analysis follows that of country D's mpm, except that a larger mpm in country N will increase the stability of the system while a larger mpm in country D decreased the stability of the system.

III. Extensions--An investment-speculative spending accelerator model

The model of this chapter can be extended by combining the speculative spending accelerator and the investment accelerator in one model. This model is much more complex and is not solved here. However, some of the possible results are mentioned. The only change in the assumptions from the assumptions previously employed in this chapter concerns the investment function. In the previous model, investment was assumed equal to the mpi times the previous period's income level within the respective country. This section assumes that investment is equal to a constant (the investment accelerator) multiplied by the time change in consumption. Equation 15 below expresses the new investment function in country D, whereas equation 16 expresses the investment function in country N.

$$(15) \quad I_t^D = \beta^D(C_t^D - C_{t-1}^D)$$

$$(16) \quad I_t^N = \beta^N(C_t^N - C_{t-1}^N)$$

The analysis of equation 16 in terms of the income level of the two countries follows the same procedure that was used in Chapter 6. The dif-

ference arises when country D's investment is expressed in terms of the income level of the two countries. This difference concerns the new expression for consumption in country D within period t and period t-1. As was shown in section 1, consumption in period t is composed of a usual consumption component and a speculative spending component.

$$(17)\quad C_t^D = c^{D}Y^{D}_{t-1} + x(m^{D}Y^{D}_{t-2} - m^{N}Y^{N}_{t-2})$$

Equation 17 above shows what consumption in country D is equal to in period t. The first term on the right-hand side represents the usual consumption component while the compound term represents the speculative spending component. By substituting equation 17 into equation 15, an expression for investment in country D in terms of the income level of the two countries is derived. In order to get an expression for C^D_{t-2}, the subscripts were changed in equation 17.

$$(18)\quad I_t^D = \beta(c^{D}Y^{D}_{t-1} + x(m^{D}Y^{D}_{t-2} - m^{N}Y^{N}_{t-2}))-(c^{D}Y^{D}_{t-2} + x(m^{D}Y^{D}_{t-3} - m^{N}Y^{N}_{t-3}))$$

Equation 18 is the key equation of this model. The terms of this equation indicate that there is an interaction between both the investment accelerator and the speculative spending accelerator. In addition, the multiplier will interact with both of these accelerators creating a high degree of instability. Terms such as $\beta x m^{D}Y^{D}_{t-2}$ and $\beta x m^{D}Y^{D}_{t-3}$ indicate that the two accelerators β and x works in a multiplicative way. This means that only very low values of the accelerators are needed for instability (assuming that the accelerators are greater than 1). This indicates that when both accelerators are operating, induced changes create large changes in income quite quickly causing a greater likelihood

for the system to diverge. This indicates the almost certain need of a devaluation to try to restore confidence in the currency by lowering the deficit to a limit where the speculative spending accelerator would no longer operate. The conclusion is different if either of the accelerators is less than one.

This system is especially unstable because speculative spending not only directly influences induced consumption, but it also influences investment expenditure and in an accelerated relationship.

Since the accelerators' relationships are multiplicative, the two accelerators reinforce each other when they are greater than one, while they mitigate each other when they are less than one.

The larger the mpc in either country, then the greater will be the instability, because both induced consumption and induced investment responds greatly to income changes. In addition, the larger the accelerators in either country, then the greater will be the instability. Also a large mpm in country D makes for more instability because of its influence on speculative spending.

Equation 19 expresses the income level of country D in period t in terms of the past period's income levels of the two countries, while equation 20 expresses country N's income level in period t in terms of past period's income levels. These two equations are derived by a series of substitutions into the usual income equations.[3]

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[3] These substitutions need not be repeated here since they follow analogously from the previous derivation of the expression of a country's income level during period t.

$$(19)\quad Y^D_t - \beta(c^D Y^D_{t-1} + xm^D Y^D_{t-2} - xm^N Y^N_{t-2} - c^D Y^D_{t-2} - xm^D Y^D_{t-3} + xm^N Y^N_{t-3})$$

$$- xm^D Y^D_{t-2} + xm^N Y^N_{t-2} + (m^D - c^D)\, Y^D_{t-1} - m^N Y^N_{t-1} = g^D_t$$

$$(20)\quad Y^N_t - (\beta^N c^N - c^N - m^N)\, Y^N_{t-1} + \beta^N c^N Y^N_{t-2} - m^D Y^D_{t-1} = g^N_t$$

This two equation system can be solved by the usual techniques, except one is now dealing with a third-order difference equation because of the Y_{t-3} terms. The solution would yield six roots. A six by six characteristic matrix would be needed to solve for the roots. The two equations would have to be reduced to six first-order equations. The solution will not be derived in this paper since we already know from our experience with the other systems what the parameters' influence would be.

IV. Three other extensions

This section discusses briefly three other variations on the speculative spending model presented in this chapter. The solutions to these models are not found. The only thing which is discussed is the changed assumptions and some of their possible implications.

Instead of using the assumption that speculative spending is equal to a constant times the previous period's trade deficit, one can assume that it is equal to a constant times the difference in this period's deficit and the previous period's deficit.

$$(21)\quad C^D_{st} = x((M^D_t - X^D_t) - (M^D_{t-1} - X^D_{t-1}))$$

Equation 21 represents a speculative spending function which is

equal to a constant times the difference between period t's deficit and the deficit from the previous period. If speculative spending depended on the above relation, then the change in the deficit over time would determine speculative spending. This model is quite similar in form to the speculative capital model.

In this model, a limit is not needed since it is no longer the size of the deficit which determines speculative spending. Any action by the authorities which improves the trade balance helps the balance of trade in two ways. First, it helps the trade balance directly by helping the current account, and secondly it helps indirectly by cutting down on speculative buying. The influence of the parameters should still hold in this model.

A second possible variation concerns the speculative spending accelerator itself. So far it has been assumed that the speculative spending accelerator is a constant. Another possibility is to make it a function of the deficit.[4] When the trade balance is very adverse, then one can assume that the speculative accelerator would increase in size. When the trade balance is less adverse, then the speculative accelerator would be smaller. With this assumption no explicit limit needs to be set on the trade deficit. The accelerator determines for itself whether it operates.

In this type of model the mpc, mpm of both countries would still have the same influence on stability. However, the accelerator has a greater influence, since a large deficit is multiplied by a larger accelerator. This model can become unstable faster than the model examined in sections 1 and 2 of this chapter.

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[4] One problem involved with this assumption is that the model will no longer be linear and a solution might be impossible.

A third variation concerns making the speculative spending component depend on a number of accelerators times a number of past period's deficits.

$$(22) \quad C^D_{st} = x_1 (M^D_t - X^D_t) + x_2 (M^D_{t-1} - X^D_{t-1}) + x_3 (M^D_{t-2} - X^D_{t-2})$$

Equation 22 expresses the situation in which the speculative spending component is equal to a series of accelerators times past period's deficits. The accelerator of the most recent period is larger than each of the accelerators of the past periods. Hence, x_1 which is the accelerator associated with period t, is greater than x_2 (the accelerator associated with period t-1). Also, x_2 is larger than x_3.

This assumption allows for the influence of past periods' deficits on speculative spending. There is a weighting system in which the most recent deficit has the most influence. The size of the accelerator is the weighting system. With this assumption both the size of the trade deficit and the way in which it is changing influence speculative spending.

The influence of all the parameters will be the same except for the accelerator. Now there are three accelerators which influence the stability of the system. The accelerator associated with the most recent period will be the one with the greatest influence because it is the largest.

Other extensions are also possible, but will not be presented here.

V. Implications and Conclusions

The dynamic analysis of this chapter has some important implications for the theory of devaluation. These implications concern both theoretical points and policy implications.

The main implication of the speculative spending accelerator is that the parameters in both countries are important in determining the stability of the two-country system. This follows because international trade intertwines two nations in dynamic analysis as well as comparative static analysis. In order to cure the inherent instability of the system, policy may have to be instituted in both nations. This is especially true when the non-devaluing country has a great effect on the economy of the devaluing country. Unilateral policies such as devaluation may not be the appropriate policy in some instances, unless additional policy is undertaken in the non-devaluing country as well.

An empirical article by H. Robert Heller indicated that both the devaluing and the non-devaluing countries adjusted to a devaluation. This adjustment was shown by calculating empirically expenditure switching and expenditure reducing policy.[5]

The analysis of the speculative spending model indicates that both expenditure switching and expenditure reducing policy might not be enough unless policy actually changes the values of the parameters such as the mpc and mpm. Dynamic analysis points to the importance of these parameters. In addition, it points to the importance of not only the marginal propensity to absorb but also the accelerators and mpm as well.

Dynamic analysis points to the fact that the size of the parameters must be changed if lasting stability is to be achieved. This last conclusion increases the importance of the effects of devaluation such as the

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5 H. Robert Heller, "Some Evidence on the Burden of Balance of Payments Adjustment", Western Economic Journal, Dec. 1967, pp. 78-81.

redistribution of income effect, which changes the mpc and mpi of the devaluing country. Very little work has been done on this effect. Monetary and fiscal policy in support of a devaluation may be better directed by trying to achieve to a fuller extent a redistribution of income which would lower these parameters. Needless to say, the obstacles which must be overcome to achieve this objective may be formidable.

The analysis of the speculative spending accelerator underscores the importance of confidence in a currency. It is shown within this chapter that the size of the speculative spending accelerator is an important determinant of the stability of the two-country system. Hence, any policy which could effectively decrease the speculative spending accelerator (or eliminate it) would significantly help the stability of the currency. If devaluation can sufficiently restore confidence in the currency, then speculative spending would be eliminated. From an expectational point of view, devaluation may initially be quite effective. Devaluation would fail from an expectational point of view if the deficit returned to a significant value after a period of time. Also devaluation would fail to cure speculative spending whenever it failed to do anything about the trade balance deficit.

The speculative spending accelerator indicates that devaluation must both cure the trade deficit and restore confidence if it is to have a lasting effect. This indicates that an analysis of devaluation must deal explicitly with expectational buying, since it can have such a strong influence on the operation of the system. The effect of speculative spending seems to be a self-generating process. This indicates that the root of the problem must be dealt with immediately by the authorities. Any

analysis of devaluation which completely ignores this effect (or only mentions the effect in passing) may be overlooking the potentially strongest effect of a devaluation.

The analysis of the investment-speculative spending accelerator model indicates to an even greater extent the possible destabilizing influence which the speculative spending accelerator may have. Since the two accelerators act in a multiplicative manner, the two accelerators reinforce each other whenever they are both greater than one in value. The investment-speculative spending accelerator model indicates that the investment accelerator may possibly act in conjunction with the speculative-spending accelerator. This analysis indicates once again that devaluation theory which ignores an investment accelerator model by examining only the marginal propensity to absorb may be deficient. This raises the important doubt whether Alexander's rule, that a marginal propensity to absorb of greater than one would mean a negative idle resource influence on the trade balance, is actually valid. If additional factors, such as an investment accelerator and a speculative spending accelerator are present, then Alexander's rule may hide the underlying dynamism.

The analysis of this chapter has made a beginning at analyzing the problem of devaluation under a dynamic system. Further research must expand the analysis in order to directly analyze the balance of payments. This entails the addition of more equations and variables to the analysis. This is a complexity which is necessary for a better understanding of devaluation theory.

APPENDIX - CHAPTER VII

It will be assumed that the consumer accelerator only operates in country D, which is in danger of devaluation because of a constant large deficit (M - X). In addition, it will be assumed that the deficit in country D has reached the necessary limits so that the consumption expectational accelerator is operating.

Equations 1 and 2 express what the income level in period t is equal to in country D and country N respectively.

$$(1)\quad Y_t^D = C_t^D + I_t^D + X_t^D - M_t^D + g_t^D$$

$$(2)\quad Y_t^D = C_t^N + I_t^N + X_t^N - M_t^D + g_t^N$$

Government expenditure will be assumed independent of income and is constant in each country.

$$(3)\quad g_t^D$$

$$(4)\quad g_t^N$$

Investment will be assumed to be equal to the marginal propensity to invest (i) times the income level of the previous period. This investment function will be assumed to exist in both economies as indicated by equations 5 and 6.

$$(5)\quad I_t^D = i^{DY}{}_{t-1}^D$$

$$(6)\quad I_t^N = i^N Y_{t-1}^N$$

Imports will be assumed equal to the marginal propensity to import times the previous level of income within the respective countries.

$$(7)\quad M_t^D = m^D Y_{t-1}^D$$

$$(8)\quad M_t^N = m^N Y_{t-1}^N$$

In addition since we are dealing with a two country model the imports of country D will be the exports of country N, while the imports of country N will be the exports of country D. Hence, one can derive equations 9 and 10.

$$(9)\quad X^N = M^D = m^D Y_{t-1}^D$$

$$(10)\quad X^D = M^N = m^N Y_{t-1}^N$$

The consumption during period t in country N will be assumed to be equal to the marginal propensity to consume times the previous period income level of that country.

$$(11)\quad C_t^N = c^N Y_{t-1}^N$$

Substitution of equations 4, 6, 8, 9 and 11 into equation 2 will yield an equation of the income level of country N in period t in terms of the past period income levels in country N and country D. Simplification of this equation will give equation 12 which will be one of the two equations in our two country consumer accelerator model.

$$(12)\quad Y_t^N + (m^N - c^N - i^N) Y_{t-1}^N - m^D Y_{t-1}^D = g_t^N$$

The consumption during period t in country D will be assumed to be comprised of two parts. First, consumption will be equal to a usual lagged consumption function (C_{ct}) and second, it will be equal to a speculative consumption part because of the fear of devaluation (C_{st}). The speculative part will consist of consumption expenditure being under-

taken so as to buy as many goods as possible with past savings before devaluation lowers the real purchasing power of the currency by raising the price level.

$$(13)\quad C_t = C_{ct} + C_{st}$$

Equation 13 expresses that consumption in period t will be comprised of both a usual consumption function and a speculative part.

The usual consumption function will be assumed equal to the mpc of country D times the previous period income level of country D (Equation (14).

$$(14)\quad C_{ct} = c^D Y_{t-1}^D$$

Speculative consumption will depend on the trade balance deficit of the previous period since this will indicate to the people how weak the position of the currency is at anytime. Equation 15 expresses the assumption that the amount of speculative consumption will be equal to a constant of proportionality (x, which is the consumer accelerator) times the trade deficit of the previous period (Equation 15).

$$(15)\quad C_{st} = x\,(M_{t-1}^D - X_{t-1}^D)$$

Substituting equations 14 and 15 into equation 13 will give a complete statement of country D's total consumption during period t.

$$(16)\quad C_t = c^D Y_{t-1}^D + x\,(M_{t-1}^D - X_{t-1}^D)$$

Substituting equation 7 and 10 into equation 16 will express consumption in period t in terms of the past income levels of country D and country N.

$$(17)\quad C_t = c^D Y_{t-1}^D + x\,(m^D Y_{t-2}^D - m^N Y_{t-2}^N)$$

Substituting equation 3, 5, 7, 10 and 17 into equation 1 will give

an equation for the income level of country D's at time t in terms of the past period income levels of country D and country N. Simplifying and factoring will give equation 18 which is the other equation in our two equation system.

$$(18)\quad Y_t^D + (m^D - c^D - i^D)\, Y_{t-1}^D - x\, m^D\, Y_{t-2} - m^N\, Y_{t-1} + x\, m^N\, Y_{t-2} = g_t^D$$

Equations 12 and 18 below express a two equation system which must be solved by matrix algebra so that one can determine the four roots.

$$(18)\quad Y_t^D + (m^D - c^D - i^D)\, Y_{t-1}^D - x\, m^D\, Y_{t-2} - m^N\, Y_{t-1} + x\, m^N\, Y_{t-2} = g_t^D$$

$$(12)\quad Y_t^N + (m^N - c^N - i^N)\, Y_{t-1}^N - m^D\, Y_{t-1}^D = g_t^N$$

Using the exact same technique as was employed in the last chapter one can determine the characteristic determinant $(\lambda I - A')$ where A' is the characteristic matrix.

$$A' = \left[\begin{array}{cc:cc} c^D + i^D - m^D & m^N & -x\,m^D & x\,m^N \\ m^D & c^N + i^N - m^N & 0 & 0 \\ \hdashline 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{array}\right]$$

and

$$\text{def}\,(\lambda I - A') = \left|\begin{array}{cc:cc} \lambda + (m^D - c^D - i^D) & -m^N & -x\,m^D & +x\,m^N \\ -m^D & \lambda + (m^N - c^N - i^N) & 0 & 0 \\ \hdashline -1 & 0 & \lambda & 0 \\ 0 & -1 & 0 & \lambda \end{array}\right|$$

Substituting in various values for the parameters, m^D, m^N, c^D, c^N, i^D, i^N and x will prove certain things about the stability of the model. A computer program was used to solve the system.

CHAPTER VIII

CONCLUSION

This chapter sums up the arguments and implications of the dissertation, and presents an over-all picture of the models presented within the body of the dissertation. The first section of this chapter discusses the objective of the dissertation, while a short description of each of the models presented in the dissertation is given in the second section. The findings of the dissertation are stated in the third section. The fourth section is concerned with the over-all significance and the policy implications of the findings. The final section briefly deals with the possibilities for future research.

I. The Objective

The dissertation has three primary objectives. The first objective is to expand the trade balance analysis of devaluation into a balance of payments analysis. The analysis of devaluation has traditionally been dealt with under a balance of trade approach. This was true of the elasticity, absorption and the synthesis approaches. Economists have felt that the balance of trade would be an excellent proxy for determining the effectiveness of a devaluation. Although previous analysts were aware of the potential importance of the capital account, they failed to incorporate it in devaluation models.

Even though a devaluation improves the trade balance, this alone does not insure that the balance of payments will improve as well.

Improvements in the trade balance can be offset by adverse capital flows. Since the international position of a country's currency is determined by the balance of payments, a thorough analysis of devaluation must examine both the trade balance and the capital account. In addition, if the trade balance and the capital account interact with one another, as most economists have hypothesized, then a separate analysis of only one account is certainly of questionable value.

In order to make the analysis of capital flows less general, capital flows were divided into short and long-term flows. Short-term capital flows were further divided into speculative capital flows and transactional capital flows. This division made possible a more careful analysis of the interrelationship of each of the three capital flows with themselves and the interrelationship of each of the flows with the current account.

The addition of capital flows led to some important implications regarding monetary and fiscal policy. In order to be better able to see the monetary policy implications, the interest-rate was allowed to vary by assuming that the authorities held the money supply constant.

The second objective is to expand the study of devaluation into a dynamic analysis in which expectational buying entered. There have been many comparative static analyses illustrating the interdependence of two countries; any analysis employing the repercussionary multiplier is a prime example of such a study. There have been far fewer analyses which illustrate the interdependence of two countries on a dynamic level.

The dynamic analysis presented in the dissertation is applicable to devaluation theory, since a dynamic two-country model which illustrated the dynamic price expectation effect of S.S. Alexander was presented.

Hence, an objective of the dynamic analysis was to attempt to derive a model which explicitly accounted for expectations and speculative spending that occur at times of a devaluation fear. In addition, the dynamic analysis allows for a more flexible study of devaluation, since the marginal propensity to absorb (mpa) is made variable.

The dynamic analysis focused on the stability of the income stream of the two countries acting in conjunction. In particular, the dissertation was interested in discovering whether the stability of the two countries acting as a system would differ significantly from the stability of either country's income stream under the circumstance of autarky. The influence of the parameters on the stability of the two-country system was also examined.

The most important objective of the dynamic analysis was to derive policy implications which might differ from the ones derived from the analysis of the three approaches. Unfortunately, the dynamic model did not analyze capital flows as was the case in the previous models; this would have been too complex an endeavor at this point.

The third primary objective of the dissertation was to examine long and short-run effects of a devaluation in order to determine how they differ from one another. Previous analyses of devaluation have been "time-less", since little was said about the behavior of the effects over time. The primary purpose of the period analysis was to give the reader a better conceptual understanding of a devaluation by explaining the interaction of the effects.

In addition to the three primary objectives, the dissertation has two lesser objectives. First, the dissertation has the objective of

of giving a survey of the literature written on devaluation theory. This survey examined separately the elasticity, absorption and the synthesis approaches so that the similarities and differences could be more readily recognized. Possible shortcomings in the literature were also indicated whenever they appeared. Second, the synthesis model is examined in real and money terms in order to analyze the differences which would arise.

II. The Models

The dissertation presented many models. This section will briefly sketch the most important.

In Chapter 2, both a real-term and a money-term model of devaluation were presented. The real-term model examined the change in the trade balance resulting from a devaluation by examining the change in real income and the change in real absorption. The difference between the change in real income and the change in real absorption yields the change in the real trade balance. Real absorption was made a function of real income, the price level and the exchange rate. This functional relationship of real absorption allowed for income, price and substitution effects. Since all three types of effects were present, the real-term model was a synthesis model.

The money-term model was also a synthesis model having the same basic structure as the real-term model. In contrast to the real-term model, however, the money-term model examined the change in the money trade balance by analyzing changes in money income and money absorption. Money absorption was made a function of money income and the exchange rate. Both real income and price level influences are now incorporated

in the effect of money income on money absorption.

Chapter 3 presented a period analysis of devaluation which was based upon the money-term model. This period analysis allowed for each effect of devaluation to operate within a number of time periods following a devaluation . The time period analysis was conducted by examining the probable changes of the effects of devaluation over time. Quantitative results could not be derived because of the lack of information. The best that could be done was to derive some qualitative results, basing the analysis on some fairly restrictive assumptions. The analysis amounted to deriving a typical pattern of effects rather than presenting all possible patterns of effects.

By introducing capital flows, Chapters 4 and 5 transformed the analysis of devaluation from a balance of trade model into a balance of payments model. Both Chapters 4 and 5 are based on the money-term balance of trade model which was presented in Chapter 2.

The fourth chapter added short-term capital flows into the analysis by assuming long-term flows constant. Both net short-term speculative capital inflows and net transactional capital inflows were analyzed. Net speculative capital inflows were made a function of the trade balance, the change in the trade balance and the interest rate differentials. A change in either of these three independent variables will change net speculative capital inflows and hence the balance of payments, since the balance of payments equals the sum of the trade balance and net short and long-term capital inflows. Improvements in the trade balance and the interest rate differential induce speculative capital inflows.

The net transactional capital inflows were analyzed by examining

both inflows and outflows. The transactional demand for foreign currency arose because people need to buy foreign goods. The size of the transactional demand depends upon the amount of income generated abroad. Since exports determine the amount of income generated abroad, transactional capital outflows depend upon exports, while transactional capital inflows depend upon imports. Essentially, the balance of trade determines net transactional capital inflows so that any change in the balance of trade would change net transactional capital inflows.

Net long-term capital inflows were allowed to vary within Chapter 5. Net long-term capital flows depend upon the profit opportunity for investment. The net long-term capital inflows were made a function of the relative income positions of the two countries and the relative growth rates of the two countries. If the devaluing country's income position improved relative to the non-devaluing country's income position, then a favorable change in long-term capital flows will occur. Likewise, if the growth of the devaluing country increases relative to the non-devaluing country, then this will also induce a favorable change in long-term capital flows.

Chapter 6 presented a two-country Samuelson accelerator model with an investment accelerator operating in both countries. The investment function took Samuelson's form of a constant times the time change in consumption. Government expenditure in both countries was assumed autonomous. Consumption in period t was assumed equal to the marginal propensity to consume (mpc) times the income level of period t-1. Imports in period t were assumed equal to the marginal propensity to import times the income level in period t-1, within the respective countries. Since

the model was a two-country model, imports of one country were equal to the exports of the other country.

The above assumptions allowed for a difference equation representation of the income level over a number of periods of both countries. Two difference equations, which were derived in this manner, were interlocking because of exports and imports. The characteristic values of the system were found. In addition, various values of the parameters were tested in order to determine their influences.

The seventh chapter presented a speculative spending accelerator model which was quite similar to the investment accelerator model of Chapter 6. This model allowed for the existence of speculative buying which would result because of the fear of devaluation. Since a devaluation raises the price level of the devaluing country, people will accelerate spending before a devaluation in order to take advantage of their money's real buying power before it falls.

The speculative spending accelerator model was a two-country model. The non-devaluing country's consumption in period t was equal to the mpc times the income level of the previous period. Investment in period t was assumed equal to the marginal propensity to invest times the income of the previous period within the respective countries. Also, imports in period t were assumed equal to the marginal propensity to import times the income level of the previous period within the respective countries. Government expenditures were assumed autonomous in both countries.

Within the devaluing country, consumption in period t was assumed to be composed of two parts. First, it was composed of a normal consumption component which is equal to the mpc times the income level of the previous

period. Second, it was composed of a speculative spending component which was set equal to a constant times the deficit of the trade balance of the previous period. The speculative spending relation was made dependent on the trade balance deficit, because the deficit would be a good indicator of the need for a devaluation. The speculative spending accelerator relationship only operated when the trade balance deficit had reached a critical limit. This limit was determined by the attitude of the people and by the economic structure of the devaluing country. Speculative non-buying in the non-devaluing country was assumed not to exist.

The structure of the model yielded two-coupled second-order difference equations which were solved in order to determine the stability of the income stream within the two-country system.

Before the findings of the dissertation are presented in the next section, a few words on the methodology are in order. The dissertation is completely theoretical, no data were explicitly used to make any of the conclusions. Any references to empirical results were implicit whenever articles based on empirical observation were cited to support an assumption.

III. The Findings

This section lists the major findings of the dissertation.

1. The real-term and the money-term synthesis models can give different answers to the question of the effectiveness of a devaluation.

2. The price effects and income effects in the money-term model require an analysis of the elasticities of the supply and demand curves for imports and exports, since these effects indicate the change in the

value of absorption and income.

3. The money-term models introduce a money income-price effect which is not present in the real-term model. The money income-price effect indicates the influence which changes in the price level have on money income.

4. The addition of capital flows indicates that the current account and the capital account are interrelated. This is true because changes in the current account will affect both speculative and transactional capital flows. In addition, changes in income will affect long-term capital flows.

5. When examining short-term speculative capital flows, both the change in income, absorption and the acceleration of these variables must be examined.

6. The addition of the transactional demand for foreign currency to the speculative capital flow model will tend to make the model more stable, since transactional capital flows will usually move in an opposing direction to speculative capital flows.

7. If the interest rate is allowed to vary, then the stability of the speculative capital flow model will increase. If the money supply is constant, then devaluation will probably increase the interest rate in the devaluing country, which in turn will increase the interest rate differential. An increase in the interest rate differential will induce speculative capital inflows.

8. If the interest rate is allowed to vary, then the long-term capital flows will be favorably affected.

9. Positive income effects of devaluation can help stimulate long-

term capital inflows.

10. There is an interaction between price, income and substitution effects, which makes a separate analysis of each effect quite difficult.

11. Short and long-run effects of devaluation are quite different regarding changes in the balance of trade.

12. The differential changes in the trade balance over time will make for differential effects on capital flows over time.

13. Price effects do not die out immediately, but are present many periods after a devaluation.

14. Price and substitution effects react more quickly and more often than income effects.

15. Two countries are tied together by trade into a dynamic system.

16. The stability of the two-country system will differ from the stability of either country examined under autarky.

17. The parameters determine the stability of the system. In the investment accelerator model:

    a. A larger accelerator in either country will increase the instability of the system.

    b. A larger mpc in either country will increase the instability of the system.

    c. The mpm's will be one indicator of the interdependence of the two countries.

18. Instability in one country can affect the stability of a trading country.

19. The mpa might not remain stable because of acceleration relationships.

20. In the speculative spending accelerator model, the parameters have the following influence:

a. A larger mpc and/or mpi in the devaluing country will make for a less stable system.

b. A larger speculative spending accelerator makes the two-country system less stable.

c. A larger mpc and/or mpi in the non-devaluing country makes the two-country system less stable, however, the influence of these two parameters will be smaller than the destabilizing influence of the devaluing country's mpc and mpi.

21. The speculative spending model allows the mpa to vary.

22. Confidence in the currency is an important determinant of whether a devaluation will be successful.

23. The addition of the investment accelerator onto the speculative spending accelerator model makes for a multiplicative interaction between the two accelerators.

This concludes the list of the major findings of the dissertation. The next section will present the implications of these findings.

IV. The Significance and Implications

The findings of the analysis of capital flows indicate the interdependence of the capital account and the trade balance. This finding indicates that any monetary or fiscal policy which supports a devaluation must not only account for the effect policy may have on the trade balance, but it must also adjust for the effect policy may have on the capital account. Monetary policy, which can directly affect the interest rate,

must adjust not only for the trade balance but for the capital flow as well. Because both monetary and fiscal policy affect the income level and the growth rate, they must account for their influence on long-term capital flows as well as short-term capital flows.

Since capital flows must be examined in order to determine the stability of a currency, approaches such as the elasticity approach may be of questionable value. In particular, very little can be determined about the effectiveness of a devaluation by examining the sum of the demand elasticities. In addition, both the absorption approach and synthesis approach may indicate a favorable change in the trade balance, although the final change in the balance of payments may be unfavorable. The synthesis and absorption models can lose validity whenever the capital flow can be severely changed by a devaluation. Also, the analysis of capital flows raises doubts about the usefulness of any empirical study which examines only the balance of trade in order to predict the effectiveness of a devaluation.

The dynamic analysis indicated that using only the mpa as a determinant of induced expenditure changes can hide some potentially important relationships. In particular, the mpa does not allow explicitly for any investment accelerator relationship. In addition, an assumption of a constant mpa may be an oversimplification which can greatly distort reality. The speculative spending accelerator is a means for allowing the mpa to vary without losing the linearity of the model. The speculative spending accelerator indicated that a devaluation could restore stability to a two-country system if it can restore confidence to the currency, since speculative spending will stop.

The synthesis model can be considered deficient since it does not allow for a speculative spending accelerator. If speculative spending is a strong influence in a nation, then the synthesis model will fail to account for a potentially important absorption component.

Since the stability of the two-country system was primarily determined by the parameters, the dynamic analysis once again indicated the importance of these parameters. Unlike the Alexander absorption model, the dynamic model stressed the importance of the parameters in both countries. The importance of the parameters on the stability of the two-country system suggests that a more careful analysis of the redistribution of income effect is needed.

Another implication of the dynamic analysis was to point out that in some instances policy must be instituted in both the devaluing and the non-devaluing country. It is possible that the non-devaluing country adds so greatly to the instability of the two-country system that the system will still be unstable even after a devaluation. The importance of the parameters indicates that in some instances supporting monetary and fiscal policy is needed in one or both countries to help to lower the value of some of the parameters. Also, the parameters indicate that if a devaluation does not restore the system to stability, then it is not necessarily true that an appreciation of the currency would have the desired effect. If neither a devaluation nor an appreciation alter the values of the parameters, then the inherent instability of the system will remain.

In addition to the analysis of capital flows and the dynamic analysis, the time period analysis yields some important implications. The first implication is that supporting monetary and fiscal policy must be applied

at different periods since the short and long-run effects of devaluations are different. Since both the balance of trade and the capital flows are changing from period to period, the supporting policy must adjust for both.

If the immediate effects of devaluation are indeed more favorable than the later effects, then little supporting monetary and fiscal policy is needed. This implication suggests that both France and Great Britain might have been pursuing the wrong policy with their last devaluation, since they instituted immediate supporting monetary and fiscal policy.

If the time period analysis is correct in allowing for different marginal propensities to absorb for each effect and time period since different people are being affected, then a model such as Alexander's, which assumes mpa to be constant, may be of questionable value.

The analysis of the real and money-term model also has some important implications. The comparison of the real-term and money term model raises a real doubt about the usefulness of Alexander's absorption approach, which is in real terms, for policy implementation. The change in the money trade balance is the thing which an analysis of the effectiveness of devaluation must be interested in. Since the change in the money trade balance behaves quite differently from the change in the real trade balance, then any analysis which studies only the real trade balance may be deficient. This conclusion is not novel since Fritz Machlup had already discussed it in 1955. In fact, when Alexander reformulated his model he expressed everything in his synthesis model in money terms.

The analysis of the money-term synthesis model also indicates that the elasticities of the demand and supply curves for imports and exports

are still important in the analysis of devaluation. Hence, policy must examine not only changes in income and absorption, but it must also examine the elasticities.

The next section concludes the chapter with a discussion of future research possibilities.

V. Future Research

There are three major areas in which the dissertation indicates the prospect for future research. First, the dissertation indicates the need for some complete balance of payment models of devaluation which would thoroughly analyze both the balance of trade and the capital flows. The analysis of the capital flow and the balance of trade should carefully indicate the interdependence of the two accounts. The model must be built upon a synthesis model of the balance of trade or otherwise important income or substitution effects will be lost. The model must carefully examine the three capital flows. Actually, further refinements of the capital flows into more categories may produce an even better understanding of the interaction of the two accounts. Any balance of payment model must include the money markets of both countries in the analysis.

More detailed analysis on the empirical level of both the reaction of the trade balance and capital flows will further the understanding of the effectiveness of a devaluation. In addition, an empirical investigation of both accounts will test to some extent the validity of the analysis of the devaluation.

More complex analysis of capital flows and the current account must

also explicitly analyze the effects of supporting monetary and fiscal policy which can increase the effectiveness of a devaluation when used properly.

The dynamic analysis of the dissertation should be expanded to explicitly include the balance of trade. This means the addition of another variable and equation. The addition of the balance of trade will allow a direct calculation of the trade balance stream over time. The stability of the trade balance could then be seen directly.

In addition, the analysis can be expanded to study the balance of payments directly by adding in capital flows to the analysis. This addition will be of great complexity, since not only will a capital variable have to be added, but the interest rate must also be added, as well as the supply and demand for money. If the dynamic analysis is expanded to include the balance of payments, then the balance of payment stream can be directly analyzed in order to determine the stability of the balance of payments.

The time period analysis also suggests some possible extensions. The effects of a devaluation must be empirically analyzed over time so that a better understanding and theory of the effects over time can be developed. Also, capital flows must be examined over time and incorporated with the analysis of the trade balance.

Future research must try to develop a complete time period analysis in which the effects of devaluations can be predicted over time. Such a model would allow for a more effective institution of supporting monetary and fiscal policy.

Additional work must also be done in trying to develop a better

synthesis model than the ones existing today.

All in all, there is still a vast amount of theoretical and empirical work which must be accomplished so that a country can time and institute a devaluation properly without the risk of failure. This dissertation has attempted to achieve an analysis of some of the important issues and problems which must be solved before the final goal is reached. All the articles written on devaluation, including this dissertation, have only let in a slight crack of light from a window which still remains closed and dark.

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