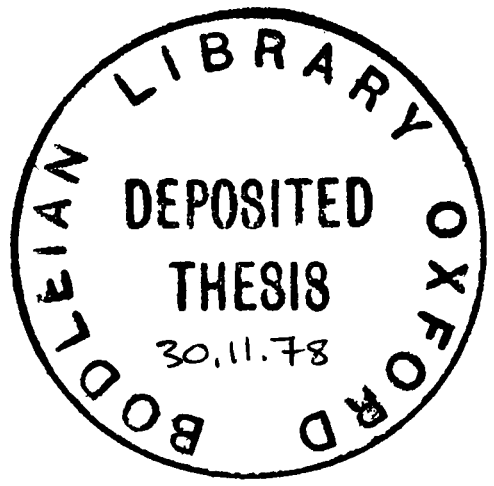
FACTOR MARKET DISEQUILIBRIUM
IN NEOCLASSICAL AND NEO-KEYNESIAN MODELS

By

J. Peter Neary



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ABSTRACT

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By: J. Peter Neary, Nuffield College, Oxford.

Submitted for the degree of Doctor of Philosophy in Economics, Trinity Term, 1978.

This thesis explores two different approaches to the study of simple general equilibrium models in situations where "full" or "long-run" equilibrium does not prevail.

The first part of the thesis examines the consequences of dynamizing the two-sector model of competitive equilibrium, in the sense of making explicit the process whereby momentary equilibrium (i.e., full equilibrium with a given factor endowment) is attained. A number of plausible adjustment mechanisms are proposed, of which the "short-run capital specificity" hypothesis is an interesting special case. The implications of these adjustment mechanisms for international trade theory, for the theory of proportional factor market distortions in both open and closed economies, for the behaviour of the Harris-Todaro model when capital is intersectorally mobile, and for the dynamic response of the trade balance to a devaluation in a small open economy are then examined.

The second part of the thesis studies the properties of a neo-Keynesian temporary equilibrium, by which is meant a short-period equilibrium where agents base their behaviour on their expectations about the future and where prices and wages do not move to clear markets in the short run. It is shown that the closed economy model of Malinvaud and the open economy model of Dixit are both special cases of a more general model which incorporates a non-traded good whose price is sticky in the short run, and a traded good, whose price is determined on world markets. While the long-run properties of this model are shown to be fully consistent with the monetary approach to the balance of payments (so, for example, a devaluation has no real long-run effects), its short-run comparative statics properties are shown to provide, in some circumstances, considerable support for discretionary policy.

'I mentioned Dr. Adam Smith's book on the Wealth of Nations, which was just published, and that Sir John Pringle had observed to me, that Dr. Smith, who had never been in trade, could not be expected to write well on that subject any more than a lawyer upon physick. JOHNSON. "He is mistaken, Sir: a man who has never been engaged in trade himself may undoubtedly write well upon trade, and there is nothing which requires more to be illustrated by philosophy than trade does. As to mere wealth, that is to say, money, it is clear that one nation or one individual cannot increase its store but by making another poorer: but trade procures what is more valuable, the reciprocation of the peculiar advantages of different countries. A merchant seldom thinks but of his own particular trade. To write a good book upon it, a man must have extensive views. It is not necessary to have practiced, to write well upon a subject."'

- Boswell's Life of Johnson , Oxford Standard Authors edition, London: Oxford University Press, 1953, pp.682-3.

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CHAPTER 1

INTRODUCTION

> '[Jean-Luc] Godard was once asked by an exasperated old-line film-maker whether he would at least admit that films should have a beginning, middle and end. "Yes", he replied, "but not necessarily in that order."'
>
> - James Monaco: The New Wave, New York: Oxford University Press, 1976, p.109.

1.1 Themes and Terminology

As the opening quotation suggests, this thesis examines a number of different issues, and the separate chapters can to a considerable extent be read independently of one another. Nevertheless this does not mean that the thesis is a collection of unrelated "essays in economic theory": on the contrary, all the chapters share at least two common themes, which it is the purpose of this introductory section to outline.

The principal theme of the thesis is the consequences for various branches of economic theory of abandoning the assumption that the economy is always in a state of "full" or "long-run" equilibrium. Since we focus particularly on factor markets, two types of departure from full equilibrium are given special attention: firstly, situations where the same factor temporarily receives a different return in different sectors or uses (we emphasise that these factor return differentials are temporary to distinguish them from factor market "distortions" of a permanent type); and, secondly, situations where some factor (usually labour) is less than fully employed. For convenience, we refer to both of these situations as cases of disequilibrium, although we shall some-

times call them instead states of temporary or short-run equilibrium. This looseness of terminology reflects an elasticity in the concept of equilibrium itself,[1] which may be defined either so narrowly that it rarely prevails or so broadly that it threatens to swallow up the concept of disequilibrium altogether. In the words of Hicks (1939, p.viii, emphasis in original): 'The economic system is always in temporary equilibrium, always more or less out of equilibrium over time.' Hopefully it will be clear from the context what is implied by any particular concept of equilibrium. For example, we have already noted that we are concerned with deviations from "long-run" equilibrium. In this context, the term "long run", as used in Chapters 2 to 5, is to be understood in the Marshallian sense,[2] as a period long enough for each sector to have adopted a scale of operations which is (privately) optimal in the light of its external environment. (A corollary of this is that each factor has been allocated such that it earns the same return in all sectors). But since throughout this thesis we assume that total factor supplies are fixed, this concept is identical with that of "momentary equilibrium" as used by growth theorists. Hence this "long run" may be relatively short

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1. It also reflects the diversity of the conventions followed by different writers. For example, the term "temporary equilibrium" was used by Marshall (1920, Book V, Chap. II) to indicate the very short or "market" period within which supply cannot be varied, whereas it is used by many recent writers (and in Chapter 6 below) in the sense of Hicks (1939) to indicate an equilibrium at a point in time where complete information about the future is unavailable, and where (usually) complete futures markets do not exist. Or again, the models of Barro and Grossman (1971) and Malinvaud (1977) are identical in basic structure, but the former refer to their model as one of "general disequilibrium" whereas the latter prefers the term "fixed-price equilibrium". These semantic differences should not be allowed to obscure a broad agreement in practice, if not in terminology, between a great many authors (including Keynes, as argued persuasively by Patinkin, 1976, pp.115-8).
2. The reason why the appelation "Marshallian" is appropriate should become clear in Section 3.6 below.

in comparison with the time periods usually considered in the theory of economic growth.

Turning next to different types of disequilibrium or temporary equilibrium, we distinguish in the thesis between "neoclassical and "neo-Keynesian" disequilibria. By the former we mean situations where short-run equilibrium is brought about instantaneously (so that no trading takes place out of equilibrium) by means of price adjustment (although we interpret neoclassical broadly, in the sense of "neoclassical synthesis", to include cases where the wage rate is rigid, whether in real or nominal terms). Each such short-run equilibrium is contingent on the values of certain state variables which are given in the short run, but which change endogenously over time according to dynamic adjustment mechanisms which are themselves of a broadly neoclassical kind (e.g., they assume that capital moves towards the sector where it earns the higher return, or that factor prices fall in response to excess supply in the relevant factor market). In this type of analysis, the main focus of interest lies in the consequences of the dynamic adjustment mechanisms, and especially in the light they throw on the comparative static properties of the underlying long-run model. In addition, the features of the adjustment paths, such as whether or not they imply monotonic movements in factor allocations or prices, are of some interest in themselves.

By contrast, in a neo-Keynesian short-run equilibrium, prices do not move to clear markets. Instead, quantities have to adjust, which leads to some agents being rationed with consequences for their behaviour on other markets. These inter-market "spillovers" have important implications, which are as yet only imperfectly understood. Hence, Chapter 6, which examines this kind of model, is primarily concerned with comparisons between different short-run equilibria, and an explicitly dynamic analysis, though highly

desirable, is not attempted.

While the analysis of disequilibrium is the major theme of the thesis, a second theme is the flexibility of the two-sector framework as a vehicle for the study of a wide variety of problems in economic theory. Admittedly, in some circles the term "two-sector" has become a dirty word, partly because such models are associated with a mechanical analysis of systems having little intrinsic economic interest, and partly because they are seen as adding complications without any significant increase in realism. In the words of Hahn (quoted in Jones, 1977, p.1): '...it is well known that an economy with only two goods has a number of important properties which do not carry over to the general case.' But, while admitting the force of these criticisms, and while conceding that an excessive research effort has been devoted to the study of certain properties of two-sector models, it is nonetheless the case that some problems (such as intersectoral factor re-allocation), cannot be studied in a one-sector framework, while considerations of analytical tractability militate against the study of larger models. In any case, we hope to show that it is still possible to say new and interesting things about two-sector models, and also that the fruitfulness of this approach is reflected in the range of interpretations which may be given to the distinction between sectors: in this thesis alone, the sectoral dividing line is interpreted at various times as: export versus import-competing (Chapters 2 and 3), corporate versus non-corporate (Chapter 3), urban versus rural (Chapter 4), traded versus non-traded (Chapters 5 and 6) and consumption-good versus investment-good (Section 6.7.A).

Finally, as the last paragraph has made clear, much of the thesis is concerned with problems in international economics (both the "pure" and monetary theories), but it also considers issues

pertaining to theoretical aspects of tax incidence, development economics, and short-run macroeconomics. Hopefully, as in Neary (1976), the use of a common notation and approach will demonstrate that there are considerable gains to be had from a uniform treatment of a number of areas which have to date been analysed independently. However, in all these areas, the focus of the thesis is on questions of positive economics. This is not to say that the methods and models adopted in the thesis do not have potential applications in normative economics, but, except for some remarks in the concluding chapter, these applications are not pursued.

1.2 Plan of the Thesis

As already indicated, Chapters 2 to 5 examine neoclassical adjustment mechanisms, and their main objective is to establish the implications of these adjustment mechanisms for the comparative static properties of the two-sector neoclassical model of competitive equilibrium. Chapter 2 considers a particularly simple adjustment mechanism, the "short-run capital specificity" hypothesis, and applies it to some traditional problems in international trade theory. Some general remarks are also made on the significance and appropriateness of assuming that capital is intersectorally mobile. Chapter 3 continues the same line of inquiry as Chapter 2, but using mathematical rather than geometric tools. As a result, it is able to consider more general disequilibrium adjustment mechanisms, and to examine their implications for closed as well as open economies. Chapter 4 then applies the same approach to elucidate the properties of the Harris-Todaro model of rural-to-urban migration in developing countries, when it is assumed that capital as well as labour can move between sectors.

Chapter 5 serves as a bridge between the preceding and succeeding chapters, taking its analytical techniques from the former, but sharing a common subject matter - the effects of devaluation in a small open economy - with the latter. Some recent contributions to this area are criticised and extended in the light of the dynamic adjustment mechanisms already introduced. Chapter 6 considers a similar set of issues to Chapter 5, but adopts the very different framework of neo-Keynesian temporary equilibrium models. It is shown that the closed economy model of Malinvaud (1977) and the open economy model of Dixit (1978) are both special cases of a more general model which incorporates a non-traded good, whose price is sticky in the short run, and a traded good, whose price is determined on world markets. While the long-run properties of this model are shown to be fully consistent with the "monetary approach to the balance of payments" (so, for example, a devaluation has no long-run real effects), its short-run comparative static properties are shown to provide, in some circumstances, considerable support for discretionary policy.

Finally, Chapter 7 comments on the relevance of the methodology and results of the thesis, and makes some suggestions for further research. The thesis concludes with a list of works cited.

CHAPTER 2

SHORT-RUN CAPITAL SPECIFICITY AND THE PURE THEORY OF INTERNATIONAL TRADE

'The symptom that a particular branch of science or art is ripe for a change is a feeling of frustration and malaise, not necessarily caused by any acute crisis in that specific branch - which might be doing quite well in its traditional terms of reference - but by a feeling that the whole tradition is somehow out of step, cut off from the mainstream, that the traditional criteria have become meaningless, divorced from living reality, isolated from the integral whole.'

- Arthur Koestler: The Sleepwalkers, Penguin , p.530.

2.1 Introduction

Among its many abstractions from reality, the pure theory of international trade, associated with the names of Heckscher, Ohlin and Samuelson, assumes that both capital and labour are costlessly and instantaneously transferable between sectors. More recently, however, beginning with articles by Jones (1971b) and Sameulson (1971a and b), a number of writers have returned to an older tradition, traceable in the works of Marshall, Ohlin himself, and Harrod, which assumes that, in the short run at least, capital goods are sector-specific. In the light of this tradition, the Heckscher-Ohlin-Samuelson model is seen as describing positions of long-run equilibrium only. In the short run any disturbance will lead to a reallocation of the labour force between sectors. But

capital in each sector is a fixed factor, and so differences emerge between the rentals in the two sectors. Over a longer time horizon capital will flow between sectors in response to these rental differentials, tending eventually (unless another disturbance intervenes) to a new long-run equilibrium with all capital goods earning the same rental.

This view of the adjustment process, which I propose to call the "short-run capital specificity" hypothesis, is hardly novel; apart from the earlier writers already cited it is implicit, for example, in Harberger (1962) and Kemp and Jones (1962). However, as formalised in recent work, especially by Mayer (1974b) and Mussa (1974), it provides a plausible hypothesis about an economy's response to exogenous disturbances. Moreover these writers have shown that it may be used to explain why there is no necessary contradiction between the somewhat counter-intuitive predictions of traditional international trade theory, and the more "common-sensical" views of politicians, businessmen and trade union leaders.

The aim of this chapter is threefold. Firstly, it presents a new diagrammatic technique to illustrate the short-run capital specificity adjustment process in a small open economy. This technique is used in Sections 2.2 to 2.4 to demonstrate the process of adjustment towards long-run equilibrium, following changes in commodity prices, population, and the level of factor market distortions. Sections 2.2 and 2.3 expound the findings of Mussa and Mayer on the effects of changes in the terms of trade and in total factor supplies, noting some extensions of these writers' analyses. Section 2.4 then applies the technique to the consideration of changes in the level of factor market distortions. It is shown that conflicts between long-run and short-run interests may arise in this case: for example, workers in a labour-intensive sector

may have an incentive to press for higher wages, despite the fact that in the long run their action will lower wages in both sectors.

Secondly, the implications of the short-run capital specificity adjustment process are examined in the context of an open economy with pre-existing factor market distortions. Much of the recent literature in this area (see especially Jones, 1971a, and Magee, 1976), has been concerned with the elucidation of a number of paradoxes which can arise in the presence of such factor market distortions, of which two of the more notable are a perverse price-output response and a perverse distortion-output response. Section 2.5 begins by giving a new diagrammatic exposition of these paradoxes, and then shows that, if the economy is assumed to adjust according to the short-run capital specificity hypothesis, then <u>these paradoxes will never be observed</u>, because they correspond to <u>dynamically unstable</u> long-run equilibria. For devotees of the Heckscher-Ohlin-Samuelson model, this is an encouraging conclusion, since it implies that the long-run predictions of that model in the presence of factor market distortions are much more consistent with simple economic intuition than has been thought. The analysis of this section is extended in Chapter 3 below, where the same conclusions are shown to hold under a wider class of disequilibrium adjustment mechanisms.

The third aim of the chapter is to point out the central role of the assumption of intersectoral capital mobility in traditional international trade theory. Section 2.6 surveys a number of cases, additional to those in Sections 2.2 to 2.4, where this assumption is responsible for "paradoxical" or counter-intuitive conclusions. It is argued in Section 2.7 that both commonsense and the implications of observed self-interested behaviour on the part of market participants make this assumption inappropriate in the short run;

and that the peculiar nature of the primary factor capital which it assumes - a fixed stock of homogeneous, infinitely long-lived, and perfectly mobile machines - makes it suspect in the long run.

2.2 Short-Run and Long-Run Response to Changes in the Terms of Trade

We begin by introducing the diagrammatic technique to be used in this chapter. Essentially this combines two diagrams: the Edgeworth-Bowley production box, introduced to international trade theory by Stolper and Samuelson (1941), and the sector-specific capital diagram, familiar in writings on economic development, and used by Jones (1971b) and Mussa (1974). As shown in Figure 2.1, measuring the economy's labour force on the horizontal axis of the Edgeworth-Bowley box enables us to place the two diagrams vertically above one another, and thus to examine simultaneously the short-run and long-run consequences of any exogenous change.

The usual assumptions of the two-sector model of international trade are built into Figure 2.1, where the initial equilibrium is indicated by the points A_0 and B_0 in the upper and lower parts of the figure respectively. The economy produces two goods, X and Y, under perfectly competitive conditions in both commodity and factor markets, using fixed supplies of the two factors, labour and capital, and subject to constant returns to scale. In the long run, both factors are completely mobile between sectors. In the short run, however, there are diminishing returns to labour in each sector, because of the fixity of capital goods. Hence, entrepreneurs in each sector maximise profits by increasing employment until the value marginal product of labour equals the wage. Assuming that the wage rate adjusts to ensure full employment at

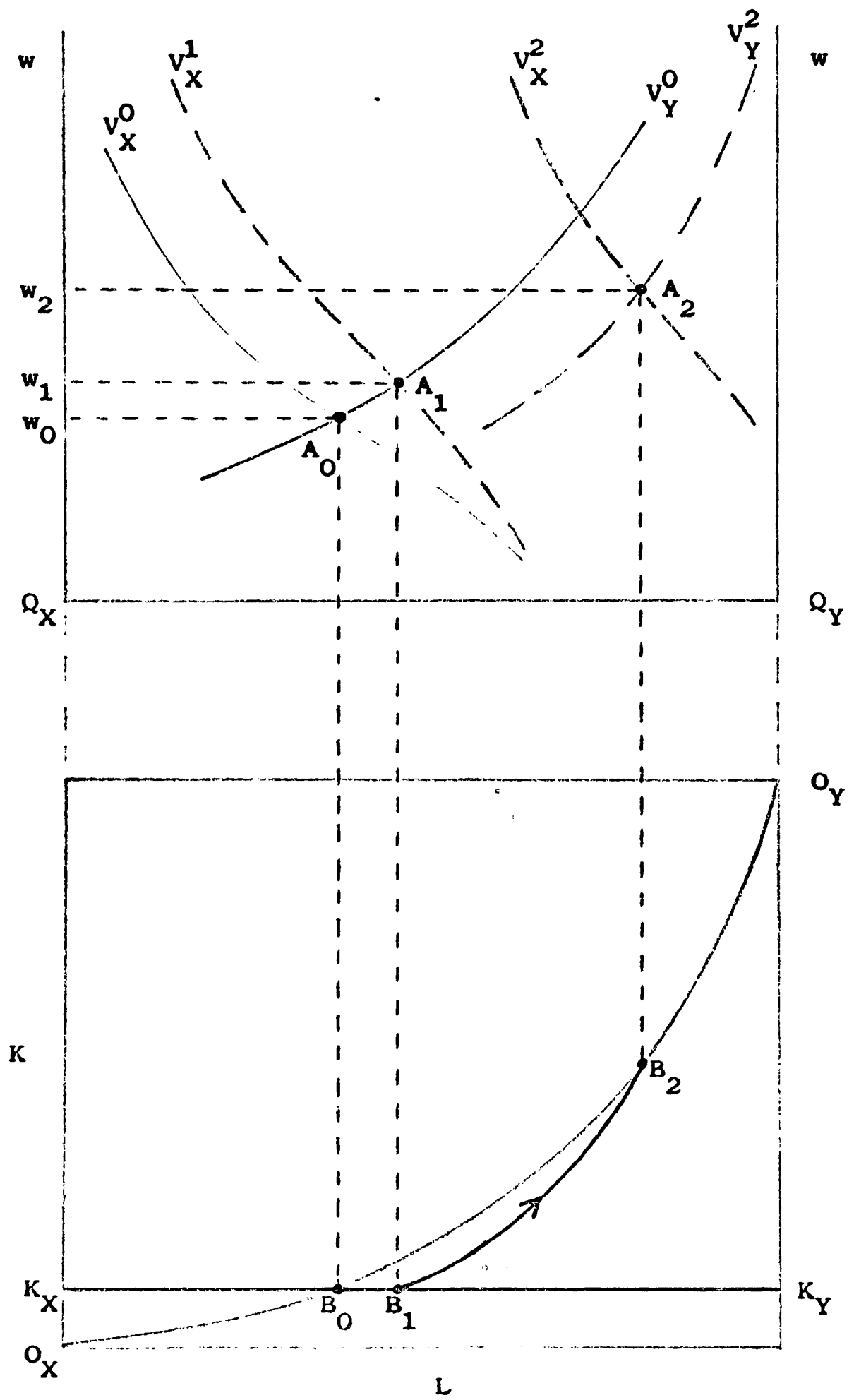


Figure 2.1: Short-run and long-run adjustment to an increase in the relative price of the labour-intensive good X

all times, the initial wage rate and labour force allocation is therefore determined by the intersection of the two value marginal product of labour schedules, V_X^O and V_Y^O, at A_O in the upper part of Figure 2.1. The location of these schedules depends on the initial commodity prices, and on the initial allocation of capital to each sector, with the latter represented by the distances O_XK_X and O_YK_Y in the lower part of the figure. Finally, the fact that the initial position is one of long-run as well as of short-run equilibrium is shown by the fact that B_O, the point in the lower part of the diagram which corresponds to A_O, lies on the contract curve of the Edgeworth-Bowley box. This contract curve lies below the diagonal of the box, reflecting our last assumption, that X is the relatively labour-intensive sector.

Consider now the effect of a displacement of this initial equilibrium by a once-and-for-all change in the terms of trade, involving an increase in the relative price of X. With capital sector-specific in the short run, we may begin by examining the upper part of Figure 2.1. Choosing good Y as numeraire, the value marginal product of labour in Y schedule, V_Y^O, is unaffected, whereas the corresponding schedule for the X sector shifts upwards, from V_X^O to V_X^1, by the same proportional amount as the price increase. Therefore the new short-run equilibrium will be that represented by the points A_1 and B_1. (The latter point satisfies the restrictions that it lies vertically below A_1, and on the same capital allocation line, K_XK_Y, as B_O). Labour has moved out of Y into X, and since the amount of capital in X is unchanged, the output of X has increased: thus even in the short run the economy responds to the rise in the relative price of X by expanding its output, to an extent determined by the slopes of the two value marginal product of labour schedules.

The short-run reactions of factor prices to this change have

been considered in detail by Mussa (1974). The wage rate increases in terms of Y but falls in terms of X (this may be seen from the fact that the capital-labour ratio rises in sector Y but falls in sector X), so that the effect on the real income of wage earners is not independent of their consumption pattern. As for the rentals on capital, that in the X sector increases in terms of both goods, whereas that in the Y sector falls in terms of both. However, while all of these changes are of interest from the point of view of income distribution, the crucial fact from the point of view of resource allocation is that the capital rental in X has increased relative to that in Y. This may also be seen from the lower part of the diagram: since B_1 lies below the efficiency locus, it follows that the rental-wage ratio is relatively higher in X, and since the same wage prevails in each sector this means that the rental must be higher in X than in Y. Given our assumed adjustment process therefore, competitive pressures will lead in the "medium run" to a reallocation of capital from the low- to the high-rental sector.[1] In the lower part of the diagram, this has the effect of causing the capital allocation line to shift upwards; in the upper part, both the V_X^1 and V_Y^0 schedules shift to the right, since an increase (decrease) in the quantity of capital in a sector must lead the marginal product of labour to rise (fall) at all levels of employment.

To establish the effects of this capital reallocation on factor rewards and on factor usage in each sector, we note first that the transfer of a given amount of capital from Y to X leads the former sector to seek to shed labour and the latter to try to acquire labour.[2] Since X is the relatively labour-intensive sector,

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1. The timing and speed of this reallocation will depend on a variety of considerations including reallocation costs and entrepreneurial wage and price expectations. For a study which examines these aspects in greater detail, see Mussa (1975).
2. I am very grateful to Alasdair Smith, whose comments suggested a major simplification of the remainder of this section.

the quantity of labour it wishes to acquire will, at the initial factor prices, exceed that which the Y sector is willing to give up. Excess demand for labour in the economy as a whole therefore develops, and so the wage rate is bid up. With both commodity prices constant, the increase in the wage must reduce the rental in each sector. This follows from the fact that the proportional change in the price of each good is a weighted average of the changes in factor prices in each sector, the weights being the share of each factor in the value of output of that sector:

$$\hat{p}_X = \theta_{LX} \hat{w} + \theta_{KX} \hat{r}_X \qquad (1)$$

$$\hat{p}_Y = \theta_{LY} \hat{w} + \theta_{KY} \hat{r}_Y \qquad (2)$$

(A circumflex over a variable indicates a proportional rate of change: $\hat{x}$ = dlogx). Since the wage-rental ratio rises in each sector as capital reallocates, both capital-labour ratios must also rise. The economy therefore moves away from B_1 in a north-easterly direction, along the path shown by a heavy line, which satisfies the properties that at every point along it the slope of the path is greater than the slope of the ray from O_X to that point, and less than the slope of the ray from O_Y to that point. This path may be called a "labour market equilibrium locus", because although it is characterised throughout by disequilibrium in the capital market, the labour market is in equilibrium at all points along it (in the sense that full employment of labour and a uniform wage rate prevail).

Finally, what happens to the intersectoral rental differential as the economy moves along this locus? The fact that X is the relatively labour-intensive sector means that the distributive share of labour is greater in X than in Y; hence to keep relative

commodity prices constant, it is necessary for the rental in X to fall by more than that in Y. This may be seen by setting the proportional changes in price in equations (1) and (2) equal to zero, and manipulating the equations to obtain:

$$\hat{r}_X - \hat{r}_Y = - \frac{\theta}{\theta_{KX}\,\theta_{KY}} \hat{w} \qquad (3)$$

where θ is the determinant of the matrix of sectoral shares, which is positive in this case, because X is relatively labour-intensive.[1] Equation (3) shows that, as a result of the transfer of capital between sectors and the consequent increase in the wage, the gap between the rentals in the two sectors has been partially closed. This process of capital reallocation continues until the gap is fully closed; at which time a new long-run equilibrium, corresponding to the points A_2 and B_2, is attained. This new equilibrium is exactly that predicted by Stolper and Samuelson (1941), at which, relative to the initial equilibrium at A_0 and B_0, the wage has risen and the rental common to both sectors has fallen in terms of each good. Thus the short-run effect of the price change in increasing the rental on capital in the X sector is eroded, and eventually reversed, in the course of the adjustment process, as capital flows into the X sector in response to the higher return obtainable there.

Having examined the case where X is relatively labour-intensive, the case where it is relatively capital-intensive is straightforward. It is illustrated in Figure 2.2. Perhaps the most important feature is that the initial reaction to the increase in the

---

1. i.e.:
$$\theta = \begin{vmatrix} \theta_{LX} & \theta_{LY} \\ \theta_{KX} & \theta_{KY} \end{vmatrix} = \begin{vmatrix} \theta_{LX} & \theta_{LY} \\ 1-\theta_{LX} & 1-\theta_{LY} \end{vmatrix} = \theta_{LX} - \theta_{LY}$$

relative price of X is qualitatively identical to that in Figure 2.1: as before, the wage rises initially in terms of Y, while the rentals on capital in X and Y rise and fall respectively in terms of both goods. It is only in the course of the adjustment process that relative factor intensities play a role, as the verbal description above will have made clear. In this case, the movement of capital into the relatively capital-intensive sector reduces the demand for labour in the economy; hence the rental in both sectors rises, and the common wage rate falls, throughout the adjustment process. The capital-labour ratio in each sector therefore falls as capital reallocates, and so the path of adjustment from B_1 to B_2 is less steeply sloped at any point than the ray from O_X to that point, and more steeply sloped than the corresponding ray from O_Y. At the new long-run equilibrium (represented by A_2 and B_2) the wage will be lower than its initial value of w_0. But, despite this, it is possible for labour actually to favour the change on completely rational grounds, if its consumption pattern is sufficiently biased towards Y, and if either the speed of capital reallocation is sufficiently slow, or the rate at which labour discounts its future consumption to the present is sufficiently high.

The only additional qualification which must be made to the case where X is initially relatively capital-intensive, is that a sufficiently large price increase could cause the new short-run equilibrium point to lie to the right of C in the Edgeworth-Bowley box, thus reversing the initial factor intensity ranking of the two sectors. This possibility was pointed out by Mussa (1974, p.1200, footnote 10), who claimed that such a factor intensity reversal would only be temporary, and that the factor allocation point in the Edgeworth-Bowley box would eventually recross the diagonal. However this is incorrect: if the new short-run equili-

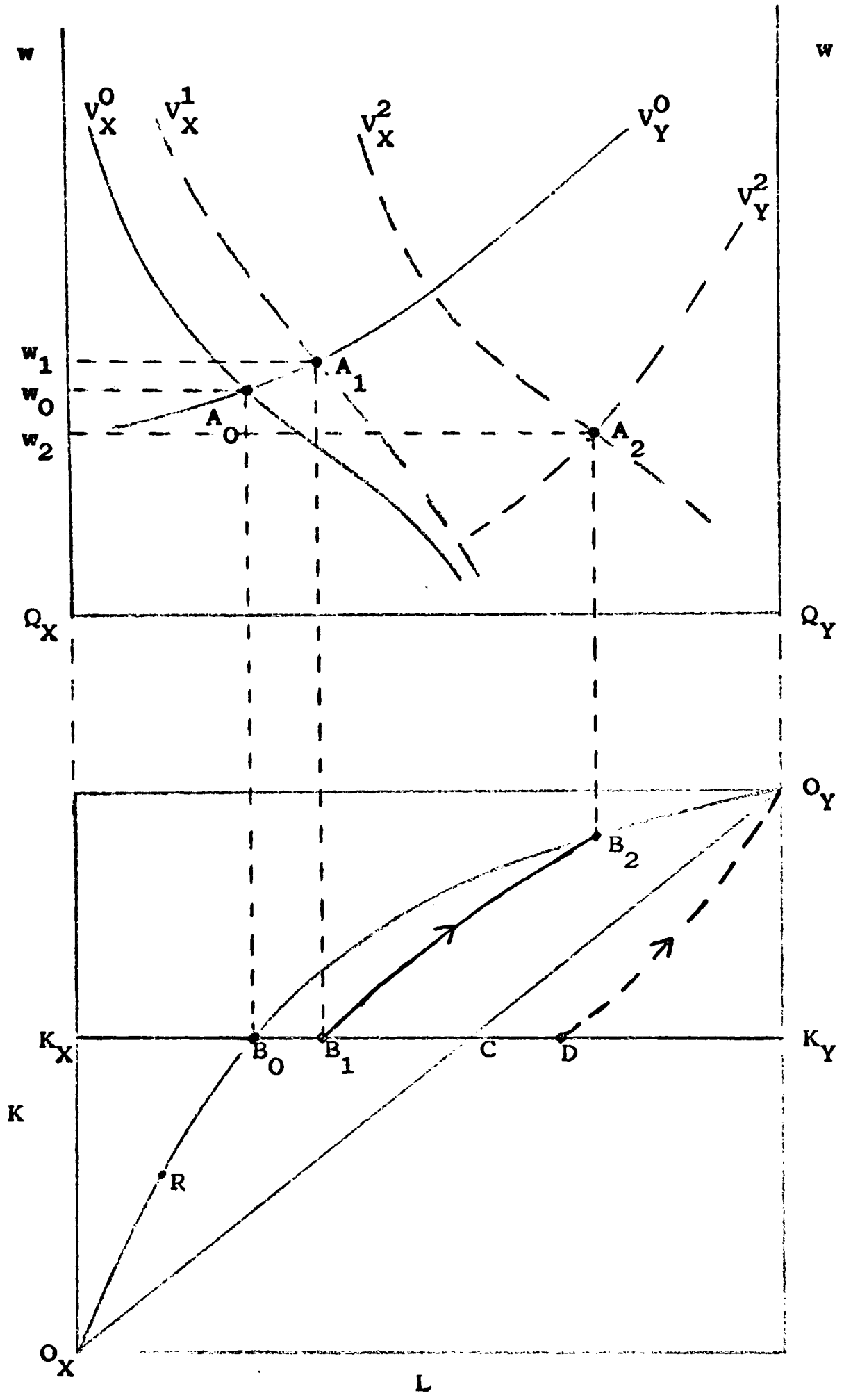


Figure 2.2: Short-run and long-run adjustment to an increase in the relative price of the capital-intensive good X

brium occurs at a point such as D, to the right of C in Figure 2.2, the factor allocation point will not recross the diagonal, but will move instead towards O_Y along the labour market equilibrium locus indicated by the dashed line. The Y industry will eventually be completely eliminated, and the economy will specialise in the production of X. This follows from the fact (already established above) that, as capital reallocates, the expansion of the now labour-intensive sector X increases the wage-rental ratio in both sectors. Hence the capital-labour ratio in sector Y cannot fall during the adjustment process, as it would have to if the labour market equilibrium locus were to cross the diagonal.

In summary, this section has illustrated the conclusions of Mayer and Mussa that an increase in the relative price of X under the short-run capital specificity adjustment process will always imply a conflict between the short-run and long-run interests of at least one group of factor income recipients: when X is relatively labour-intensive, this is true of the owners of sector X capital, and when X is relatively capital-intensive it is true of both wage-earners and owners of sector Y capital. In addition it has been shown that, contrary to the suggestion of Mussa, a change in the terms of trade can never lead to a temporary reversal of the relative factor intensities of the two sectors, since the price change required to induce a short-run factor intensity reversal is more than sufficient to induce complete specialization in the long run.

2.3 Short-Run and Long-Run Response to Changes in Factor Endowments

The next case to be considered is that of a once-and-for-all increase in population, as examined by Mayer (1974b). In Figure 2.3, the initial equilibrium is at A_0 and B_0, with X the

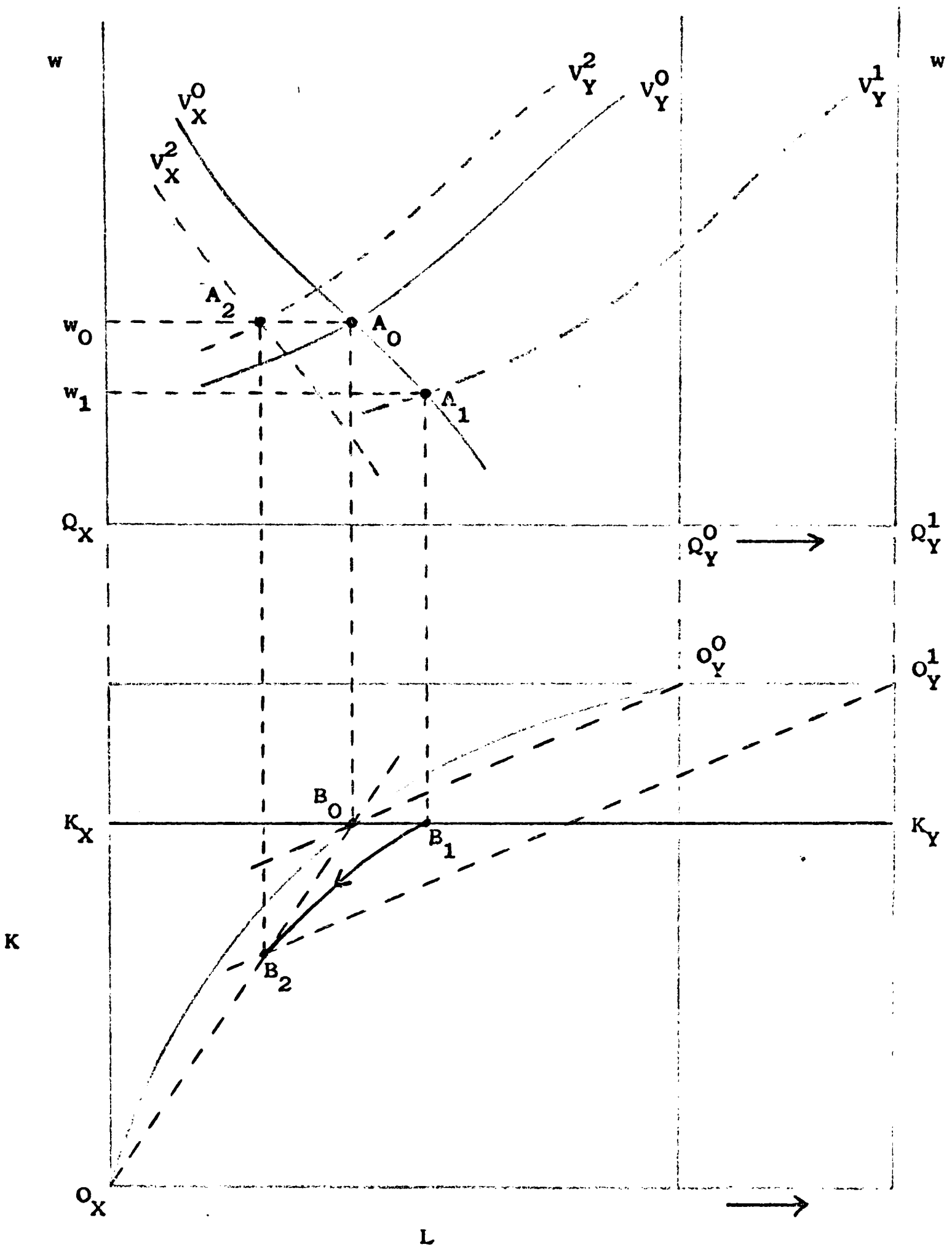


Figure 2.3: Short-run and long-run adjustment to population growth

relatively capital-intensive sector. Suppose now that the labour force (assumed to be identical to the population) increases by an amount equal to the distance $Q_Y^O Q_Y^1$. With unchanged capital allocations, the V_Y^O schedule is shifted to the right by the full extent of the population increase, leading to a new short-run equilibrium at A_1, corresponding to the point B_1 in the production box.[1] It is clear from the diagram that the wage falls, and hence at constant (absolute and relative) commodity prices, the rental in each sector must rise. Moreover, from equatior (3) it follows that the rental must increase by a greater proportional amount in the relatively labour-intensive sector. Hence, in the "medium run", capital moves along the labour market equilibrium locus B_1 B_2 from the capital-intensive sector X into the labour-intensive sector Y, causing the wage rate to increase steadily, and the rental to fall in each sector, with the gap between the two rentals narrowing and finally being eliminated.

From the Rybczynski theorem, we know that the final long-run equilibrium must be at B_2 in the production box: with unchanged commodity prices and rentals equalised between sectors, relative factor prices, and hence factor proportions in each sector, must be identical to those which prevailed before the population increase. This may also be seen from the upper part of the diagram: the V_X and V_Y schedules have both shifted to the left to intersect at A_2, restoring the original wage w_0. Despite this long-run independence of the wage from the size of population, however, if workers have any positive discount rate, they will (for example) oppose immigration in a small open economy on perfectly rational grounds. Furthermore, the strong Rybczynski

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1. The point B_1 is above the new contract curve (not drawn) of the enlarged production box, since at B_1 the wage-rental ratio in X exceeds that in Y.

prediction, that at constant relative commodity prices the output of the capital-intensive sector must fall, is shown to be a long-run result only: with sector-specific capital in the short run, the increased employment in X represented by the move from A_0 to A_1 means that the output of X will initially rise as a result of the population growth.

The case where X is relatively labour-intensive may be examined in the same way. As in Section 2.2, this makes no qualitative difference to the new short-run equilibrium; but from equation (3) the intersectoral differential in capital rentals will be the opposite to the case just considered, leading to the familiar Rybczynski result of a fall in the output of Y in the long (though not in the short) run. Finally, the same diagrammatic technique may also be applied to the case of capital accumulation. Assuming the new capital is initially usable in one sector only, say X, it will displace the value marginal product of labour schedule of that sector to the right. Thus in the short run the wage rate will increase and so from equation (3) the rental in the relatively capital-intensive sector will ~~increase~~ fall by ~~more~~ less than that in the other sector. Hence, assuming that both the initial and the new capital goods become mobile in the long run, capital will move into the relatively capital-intensive sector, until a new long-run equilibrium is attained where the original factor prices are restored. If X is the relatively capital-intensive sector, its output will increase both in the short and the long run. But if it is relatively labour-intensive, its output must fall in the long run. Indeed, in the latter case, not only the proportional, but the absolute amount of capital in use in X will be less in the final long-run equilibrium than that quantity which it used before the initial capital accumulation.

2.4 Short-Run and Long-Run Adjustment to Changes in Factor Market Distortions[1]

In this section we apply the same framework of analysis to an examination of the process of adjustment to a change in the level of a factor market distortion, such as a trade-union-imposed wage differential or a sector-specific factor tax. We continue to assume that the economy has no influence over its terms of trade. Moreover, we assume that the factor market distortion is introduced in a situation where factor markets are initially distortion-free. This assumption, of no pre-existing distortions, is a crucial one, and the consequences of relaxing it are examined in Section 2.5.

We consider first the case of a wage differential, where the high-wage sector is relatively labour-intensive. In Figure 2.4, the initial equilibrium is at A_0 and B_0, with the same wage rate prevailing in each sector.[2] Suppose now that workers in Y become unionised, and succeed in obtaining a wage which exceeds that in the X sector by a proportionate amount measured by the distortion parameter α:

$$w_Y = \alpha w_X \quad (\alpha > 1) \tag{4}$$

This change has no immediate effect on the V_X^O and V_Y^O schedules in the top half of Figure 2.4: with an unchanged capital allocation they continue to represent the value marginal product of labour as a function of the employment level in each sector. However the effect of the union action is to drive a wedge between the value marginal products which can prevail in equilibrium in each sector. Faced with the obligation to pay higher wages, entrepreneurs in

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1. Since this section was written, I have found a somewhat similar analysis in Hu (1973).
2. I am very grateful to Dermot McAleese, who pointed out a serious error in an earlier version of this diagram.

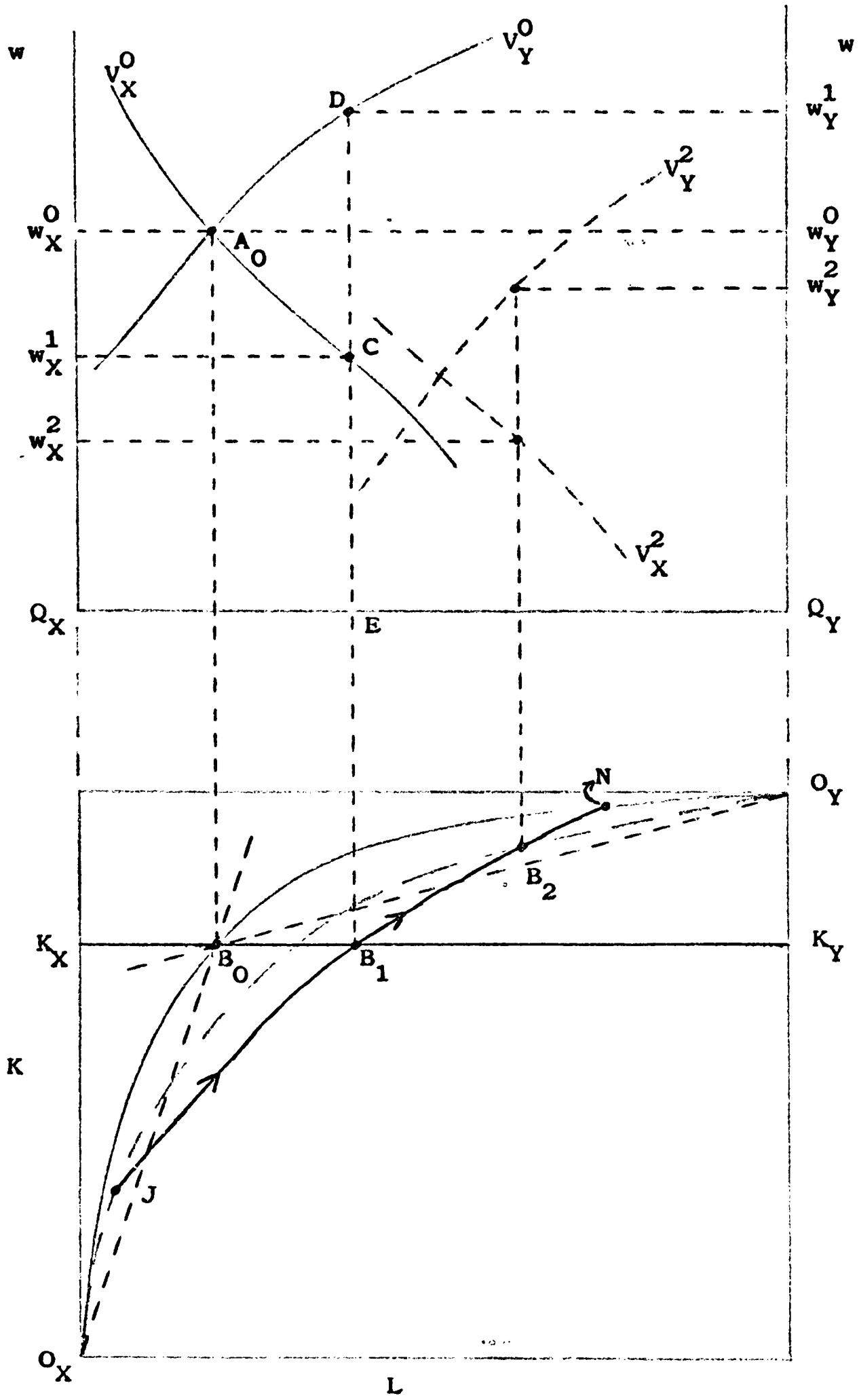


Figure 2.4: Short-run and long-run adjustment to the introduction of a wage differential in favour of the labour-intensive sector Y

the Y sector will shed labour, and so a new short-run equilibrium will be established where the ratio between the value marginal products of labour in the two sectors, that is, the ratio between the distances DE and CE, equals the distortion parameter, α. Clearly, the initial impact of the differential is, in qualitative terms, independent of the relative factor intensities of the two sectors: the wage in the unionised sector rises and that in the X sector falls, and each of these changes is less, proportionately, than the change in the differential.

Turning to the lower part of Figure 2.4, one effect of the introduction of the wage differential is to shift the contract curve downwards as shown, since in long-run equilibrium the X sector now faces a lower effective wage-rental ratio than the Y sector. The new distorted contract curve must therefore cut the initial capital allocation line, $K_X K_Y$, to the right of B_0. However it cannot cut it at or to the right of the new short-run equilibrium point B_1, because the short-run fall in the X sector wage rate combined with the rise in the Y sector wage rate must at constant output prices lead to an intersectoral rental differential in favour of sector X; hence B_1 must lie below the distorted contract curve. From a similar reasoning to that in Section 2.2, it follows that in the medium run capital will reallocate from the unionised sector Y into the X sector, moving the economy upwards and to the right along the labour market equilibrium locus through B_1; and as capital reallocates into the relatively capital-intensive sector the wage rate is reduced in both sectors, and the intersectoral rental differential is narrowed.

Where will the new long-run equilibrium occur? Evidently it must be at B_2, the intersection of the labour market equilibrium locus and the distorted contract curve to the northeast of B_1.

where the intersectoral rental differential is finally eliminated.[1] (The intersection to the southwest, at J, will be considered in the next section). Moreover, as Magee (1971) has shown (and as will be demonstrated in the next section), the capital-labour ratio must fall in both sectors between the old and the new long-run equilibria; hence B_2 must lie above the ray $O_Y B_0$. It follows that the long-run effect of unionization in the labour-intensive sector is to increase the rental and lower the wage in both sectors (implying that non-union wages must fall by more than the proportional wage differential[2]). This of course is the well-known result, derived in various ways by Harberger (1962), Johnson and Mieszkowski (1970), Jones (1971a) and Magee (1971), that an increase in the differential paid to a factor in the sector which uses it intensively may, and, when commodity prices are constant, must, reduce the factor's reward in both sectors. However, we have shown that this result is a long-run one only, for the short-run effect of the union action was to increase the wage in the Y sector. Hence, contrary to the implication of the result just mentioned, it may be perfectly rational for a union in a relatively labour-intensive sector to press for higher wages, if its discount rate is high enough, and the process of capital reallocation sufficiently slow. Similar results may be derived for the case where the unionised sector is relatively capital-intensive: in the long run, labour in both sectors must gain, but once again a conflict between short-run and long-run interests arises, this time in the case of labour in X.

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1. If the initial move from B_0 to B_1 had been caused by an increase in the relative price of X, the new long-run equilibrium would lie on the original efficiency locus at N. Thus, comparing a price change and a wage differential change, each of which has the same short-run effect, the long-run effect of the price change is greater than that of the wage differential change. This is intuitively plausible, since wage costs are a smaller percentage of variable costs in the long run than in the short run.
2. This is another example of what Jones (1965) has called the "magnification effect" in the two-sector model with intersectoral capital mobility, which does not arise when capital is sector-specific.

Finally, what can be said of distortions in the capital market, such as a corporate income tax of the kind studied by Harberger (1962)? The imposition of such a tax has no effect on resource allocation in the short run: since capital in the taxed sector is a fixed factor, its income amounts to a Marshallian quasi-rent, the taxation of which will have no immediate impact on behaviour.[1] However the resulting differential between the net rentals in the two sectors will lead eventually to a reallocation of capital away from the taxed sector. This shows an important difference between the short-run consequences of a capital and a labour tax, which follows from our assumption about the relative adjustment speeds of the two factors: the imposition of a capital market distortion has no immediate effect on resource allocation, whereas that of a labour market distortion leads to a contraction of the sector obliged to pay the higher wage. In the long run, on the other hand, there is a basic symmetry between the two types of distortion, at fixed commodity prices, in the sense that qualitatively the same effects will follow the imposition of a tax (or a trade union differential) on labour in sector Y as will follow the granting of a subsidy to capital in the other sector.

2.5 Pre-Existing Distortions and the Reversal of Value and Physical Factor Intensity Rankings

In the previous section, we explicitly confined attention to the situation where a factor market distortion is introduced to factor markets which are initially undistorted. For "small" pre-existing distortions, the analysis already given continues to hold without modification. However, for a sufficiently large initial

1. As is well known, this statement is crucially dependent on the validity of the assumption of profit maximization.

distortion (precisely how large depends in a complicated manner on various characteristics of the economy), many recent writers have shown that the long-run conclusions of the last section, as well as some other results of the Heckscher-Ohlin-Samuelson model, will no longer hold. (See, for example, Jones, 1971a; Bhagwati and Srinivasan, 1971; Herberg and Kemp, 1971; and Magee, 1976). One writer has gone as far as to say that the introduction of factor market distortions into international trade models opens a "Pandora's Box of paradoxes" (Batra, 1973, p.279). The source of many (though not all) of these departures from orthodoxy is a particular feature which the economy may exhibit in the presence of initial factor market distortions, namely a lack of correspondence between the value and physical factor intensity rankings of the two sectors. The purpose of the present section is to show that, under the short-run capital specificity adjustment process, this feature is necessarily associated with dynamic instability of long-run equilibrium in a small open economy, which implies that the comparative static paradoxes discussed by the authors mentioned are theoretical curiosa which will "almost never" be observed.

We begin by elucidating the meaning and significance of the two senses of factor intensity. Sector X is said to be relatively labour-intensive in the physical sense if its observed capital-labour ratio is lower (in long-run equilibrium) than that of the other sector (which is represented in the diagrams above by the contract curve's lying below the diagonal of the Edgeworth-Bowley box); whereas sector X is said to be labour-intensive in the value sense if the share of payments to labour in the value of its output is higher than that in the other sector (which corresponds to a positive value of the determinant θ in equation (3)). When factor prices are equalised between sectors, that is, when factor

markets are undistorted, the ranking of the sectors by these two concepts of factor intensity must be the same. But with an inter-sectoral divergence between marginal rates of substitution, either or both of these rankings can be reversed from their undistorted levels.[1] If both physical and value factor intensity rankings differ from their undistorted levels, the usual long-run predictions of the Heckscher-Ohlin-Samuelson model are unaffected. But if only one is changed, so that the rankings of the two sectors by physical and value factor intensity differ (i.e., one sector is capital-intensive in physical terms but labour-intensive in value terms), then many of the most familiar comparative static properties of the Heckscher-Ohlin-Samuelson model no longer hold. As Jones (1971a) has emphasised, the reason for this is that it is the physical factor intensities which provide the link between the "real" variables of the model (i.e., factor endowments and output levels), while the value factor intensities link the "financial" variables (i.e. commodity and factor prices). When the rankings of the two sectors by these two factor intensity concepts differ, the link between the "real" and "financial" sides of the economy is broken, and various paradoxes can result.

Two of the most surprising of the paradoxes which appear when the value and physical factor intensity rankings of the sectors differ are: (1) a perverse price-output response: at constant factor market distortion levels, an increase in the relative price of one commodity will lower its output; and, (2) a perverse distortion-output response: at constant commodity prices, an increase in the differential paid on either factor in one sector

---

1. For example, while the undistorted efficiency locus must lie on one side of (or else coincide with) the diagonal in the Edgeworth-Bowley production box, a sufficiently large distortion may shift it to the other side of the diagonal, so changing the relative physical factor intensities of the two sectors.

will increase the output of that sector.[1,2] While other authors have given algebraic proofs of these paradoxes, they may be demonstrated geometrically as follows, making use of the unit cost function diagrams in Figures 2.5 and 2.6.[3] In Figure 2.5, which assumes no initial factor market distortions, c_X and c_Y are the unit cost functions for sectors X and Y respectively, corresponding to the initial relative commodity prices. The slope of each of these curves at any point is the capital-labour ratio which will be adopted in the corresponding sector when costs are minimized subject to the factor prices represented by the co-ordinates of that point; similarly, the elasticity of each of these curves at any point is the ratio of capital's to labour's share in the value of output when the sector faces these factor prices. Therefore, at the initial equilibrium A, where both sectors pay the same factor prices, w^O and r^O, sector X is relatively capital-intensive in both physical and value senses.

---

1. To appreciate the paradoxical nature of (2), note that it implies that, at constant commodity prices, an increase in a subsidy paid to one sector (whether an output or an input subsidy) will reduce the output of that sector and its employment of both factors. See Neary (1978).
2. Another consequence of a difference between value and physical factor intensity rankings is a lack of correspondence between the Rybczynski and Stolper-Samuelson theorems: Each of these theorems continues to hold in isolation, but the former must be expressed in terms of physical factor intensities, and the latter in terms of value factor intensities. Hence, if labour force growth at constant commodity prices increases the output of good X, an increase in the relative price of X assuming a constant labour force will reduce rather than increase the real wage. More surprisingly still, a country may be capital-abundant relative to the rest of the world, and exporting its physically capital-intensive commodity, with all the other conditions for the Heckscher-Ohlin theorem holding, and yet a protection-induced increase in the domestic price of the import-competing good may reduce the real return of the scarce factor (labour).
3. This diagram may be viewed as the "dual" of the Lerner-Pearce diagram. For a recent exposition, which discusses its properties in detail and shows its usefulness in deriving many trade theorems, see Woodland (1977).

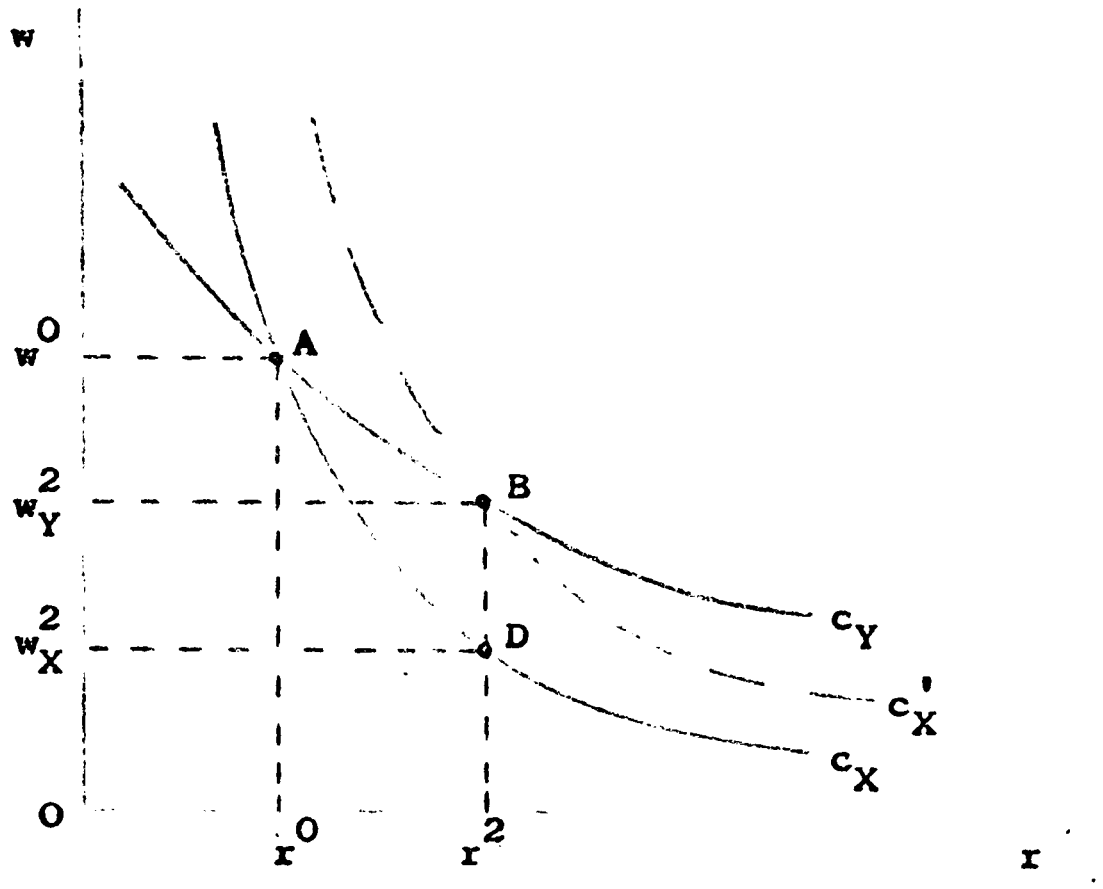


Figure 2.5: Long-run effects of a change in relative prices and of the introduction of a wage differential, when factor markets are initially undistorted

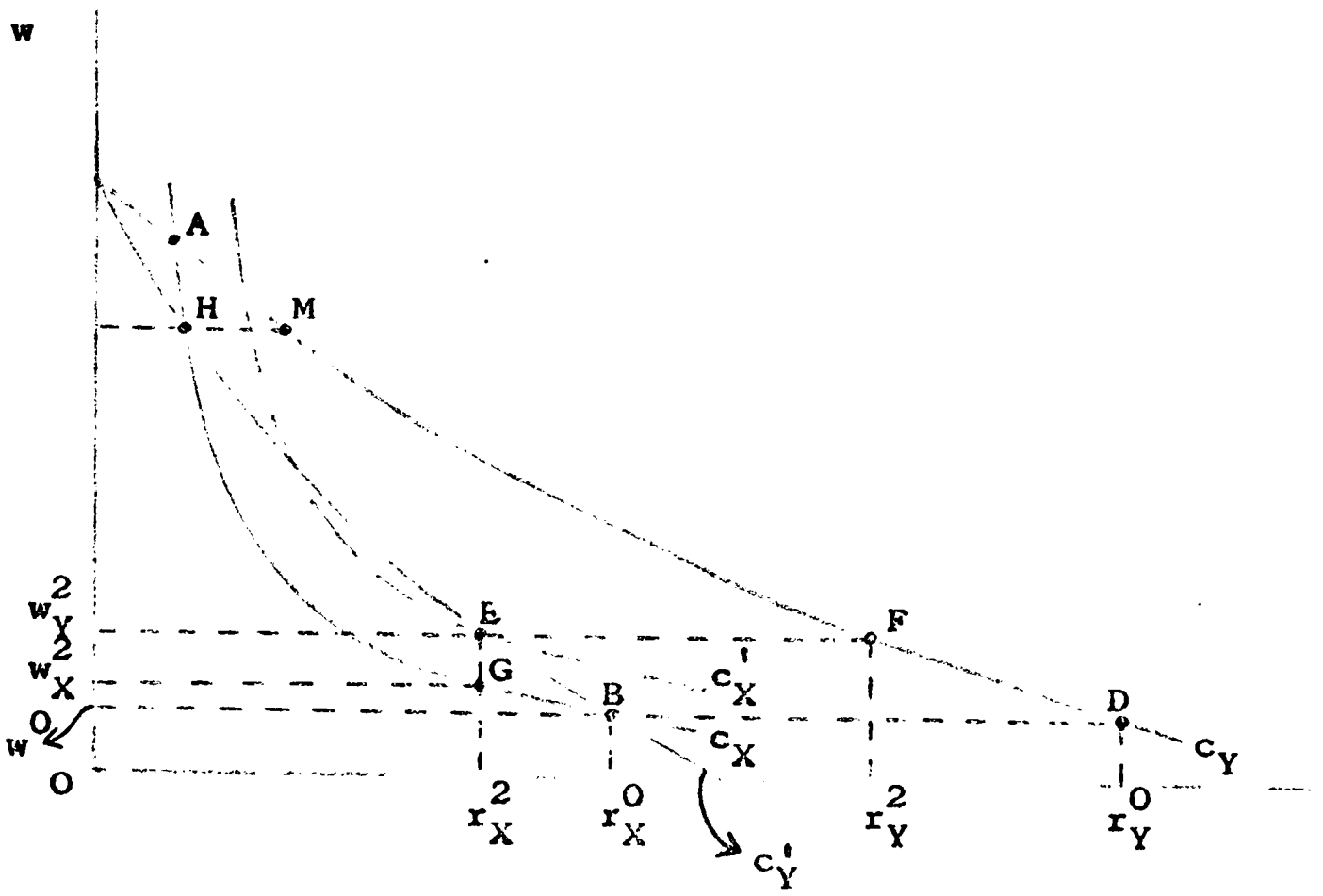


Figure 2.6: Long-run effects of a change in relative prices and of the introduction of a wage differential, when initial factor market distortions are such that the value and physical factor intensity rankings of the two sectors differ

With no initial factor market distortions, the "normal" price-output and distortion-output responses of the economy may be demonstrated by combining Figure 2.5 with the Edgeworth-Bowley boxes of Figures 2.2 and 2.4. Thus, an increase in the price of X shifts c_X radially outwards from the origin, by an amount equal to the proportional magnitude of the price change. At the new long-run equilibrium, B, the usual Stolper-Samuelson conclusions of an increase in the real rental and a fall in the real wage (recalling that X is relatively capital-intensive) may be derived. Moreover, since the common wage-rental ratio (represented by a ray from the origin to B) has fallen, the capital-labour ratio in each sector must also have fallen. Hence, in the lower part of Figure 2.2, the new long-run production point must lie along the contract curve to the right of B_0, implying an increase in the output of X. Similarly, the introduction of a wage differential in favour of sector Y is represented in Figure 2.5 by a movement from A to B (which may be called a Stolper-Samuelson effect) for sector Y and from A to D (i.e., the same Stolper-Samuelson effect plus a pure wage differential effect represented by the move from B to D) for sector X. Once again the "effective" wage-rental ratio (i.e., the ratio of the marginal product of labour to that of capital) has fallen in each sector, and so both capital-labour ratios must also fall. This confirms the assertion in Section 2.4 above, that the new long-run equilibrium in Figure 2.4 following the introduction of the differential must lie above the ray $O_Y B_0$. It is evident that the output of sector Y has fallen, implying a "normal" distortion-output response.

The situation is very different when pre-existing distortions are sufficient to reverse the value and physical factor intensity rankings, however, as Figure 2.6 demonstrates. If each sector were to pay the same factor prices, equilibrium would be at A, but

instead the presence of a substantial capital market distortion with sector Y paying a higher rental leads to an initial equilibrium at B for sector X and D for sector Y.[1] This equilibrium is determined by the intersection of c_X and c'_Y, where c'_Y is a leftwards displacement of c_Y by the same proportionate amount as the initial capital market distortion (i.e., r^O_Y / r^O_X). The slope of c_X at B is greater than that of c_Y at D, implying that (as at the "undistorted" equilibrium A) sector X is relatively capital-intensive in the physical sense. However the elasticity of c_X at B is less than that of c_Y at D, since it is easily checked that the latter is equal to the elasticity of c'_Y at B. Therefore, while X is relatively capital-intensive in the physical sense, it is relatively labour-intensive in the value sense, because the higher rental which sector Y is obliged to pay inflates the share of capital in the value of its output. The paradoxical conclusions are now easily derived. An increase in the price of X shifts c_X outwards to c'_X and implies a new long-run equilibrium with sector X at E and sector Y at F. The "effective" wage-rental ratio, and hence the capital-labour ratio, has therefore increased in both sectors, and this implies that in Figure 2.2, the new long-run equilibrium must lie on the contract curve, but to the left of B_O, at a point such as R. Thus, the increase in the price of the commodity which is relatively labour-intensive (in value terms) increases the real wage, by the usual Stolper-Samuelson mechanism; but for this to be consistent with factor market equilibrium requires an expansion of the sector which is labour-intensive in physical terms, which imples a fall in the output of X, i.e., a perverse price-output response.

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1. Note that the initial equilibrium could alternatively be at H and M, instead of at B and D. It will be shown below that the equilibrium at H and M is stable, whereas that at B and D is not.

Similarly, the introduction of a wage differential in favour of sector Y may be decomposed into a Stolper-Samuelson effect which shifts equilibrium in Figure 2.6 from B and D to E and F; and a pure wage differential effect, which ensures that the equilibrium for sector X takes place not at E but at G, on the initial unit cost function, c_X. Hence, in the new long-run equilibrium, sector Y at F pays a higher wage and a higher rental than sector X at G; the "effective" wage-rental ratio, and so the capital-labour ratio in each sector has risen; and therefore the economy must have moved in Figure 2.4 to a point such as J on the new contract curve, implying a perverse distortion-output response, since sector Y which was obliged to pay a higher wage has in fact expanded.

So far, I have simply provided a new exposition of the effects of a difference between the value and physical factor intensity rankings: Figures 2.5 and 2.6 have been exclusively concerned with comparisons between long-run equilibria, and have given no attention to the passage from one such equilibrium to another. Referring back however to the discussion in Sections 2.2 and 2.4, it is easily seen that, under the short-run capital specificity adjustment process, the economy will never converge towards the new long-run equilibria indicated by the above comparative static reasoning in the paradoxical cases. Consider, for example, the case of an increase in the relative price of X. The discussion in Section 2.2 of the response to such a change in unaffected by a difference between value and physical rankings: when X is physically capital-intensive, the new short-run equilibrium will still occur at B_1 in Figure 2.2, and since this point is below the contract curve of the box, there is an incentive for capital to reallocate from sector Y into sector X. Hence the capital allocation line K_XK_Y in Figure 2.2 will move upwards in the Edgeworth-Bowley box, and the factor

allocation point will move along the labour market equilibrium locus in the opposite direction to the new long-run equilibrium predicted by the comparative static analysis.

This contrast between the dynamic and the comparative static analyses is illustrated in relative-output-relative-price space in Figure 2.7. The initial equilibrium is at C_0, the intersection of the demand curve D_0 (horizontal because of the small country assumption) and the supply curve S, which is downward-sloping reflecting the perverse price-output response. An increase in the relative price of X, represented by an upward shift of the demand curve to D_1, should, according to the comparative static analysis, lead to a new long-run equilibrium at E, involving a fall in the relative output of X. But the dynamic adjustment process just outlined asserts to the contrary: the economy will first move along the short-run supply curve SRS_0 to the point C_1; and then, as capital reallocates into the X sector, that short-run supply curve will gradually move to the right, leading to a sequence of short-run equilibria as indicated by the double-headed arrow. Eventually, as is clear from the production box analysis, a new long-run equilibrium will be attained either at a point (not shown in Figure 2.7) where the long-run supply curve turns up again to intersect the new demand curve (this intersection would correspond to point B_2 in Figure 2.2); or, as shown in Figure 2.7, the supply curve never turns up, in which case the economy will be driven to specialise in the production of X (corresponding to a factor allocation at point O_Y in Figure 2.2). In both cases the paradoxical price-output response will never be observed.

An identical argument applies to the effects of a change in distortion levels. The comparative static analysis predicts that the new long-run equilibrium in Figure 2.4 will be at a point such as J; but, following the first move from B_0 to B_1, capital

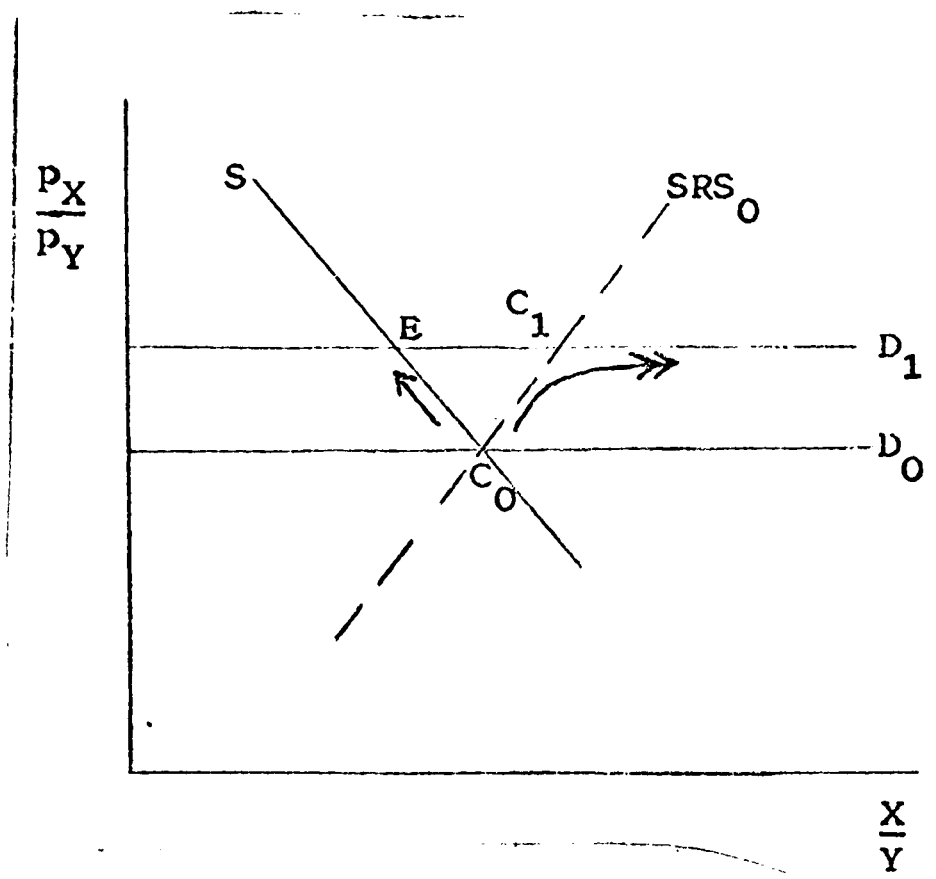


Figure 2.7: Effects of a change in relative prices when the value and physical factor intensity rankings differ

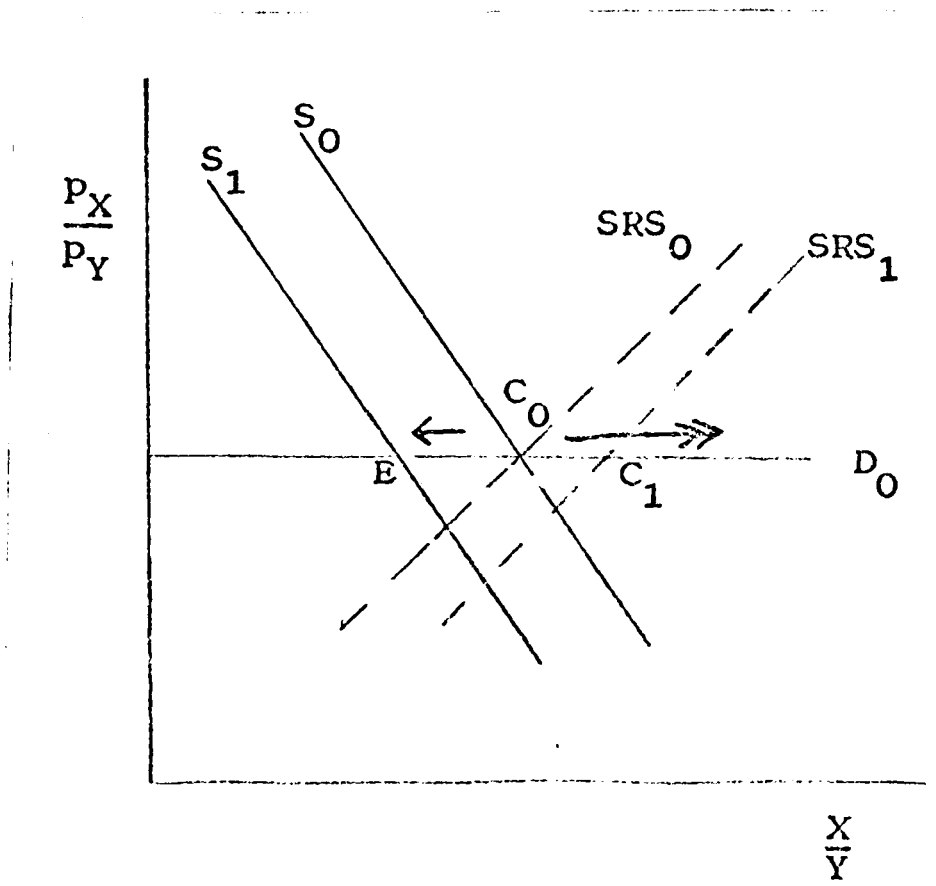


Figure 2.8: Effects of a change in the level of a factor market distortion when the value and physical factor intensity rankings differ

will move out of sector Y, and the factor allocation point will move in a north-easterly direction, towards a new equilibrium either at a point such as B_2 or (if no such point exists) at O_Y. In relative-output-relative-price space, as shown in Figure 2.8, the long-run supply curve shifts to the left, reflecting a perverse distortion-output response. But the dynamic analysis shows that the equilibrium will initially move from C_0 to C_1, as the short-run supply curve shifts from SRS_0 to SRS_1; and following the reallocation of capital into sector X the equilibrium will move to the right along the demand curve, as indicated by the double-headed arrow.

Evidently a similar analysis could be carried out for the effect of any exogenous change in an economy where the value and physical factor intensity rankings differ. The common feature of all these cases is that every long-run equilibrium in the Edgeworth-Bowley box corresponds to an intersection of the contract curve and a labour market equilibrium locus (both of which must be upward-sloping); but from the simple dynamic adjustment mechanism implied by the short-run capital specificity hypothesis, such equilibria are stable only when the labour market equilibrium locus is more steeply sloped than the contract curve. This condition in turn implies that the rankings of the two sectors by value and physical factor intensities must be the same. Hence, we may conclude that the long-run comparative static paradoxes which have received so much attention in recent writings are associated with unstable long-run equilibria only, and will therefore "almost never" be observed in practice.[1]

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1. Although this conclusion has only been demonstrated here for a particular adjustment mechanism, I show in Chapter 3 that it continues to hold under more general mechanisms which allow for non-instantaneous adjustment in the labour market.

2.6 Intersectoral Capital Mobility and "Paradoxes" in International Trade Theory: A Survey

Sections 2.2 to 2.4 above examined three of the more striking predictions of the Heckscher-Ohlin-Samuelson model of a small open economy - that protection has an unambiguous effect on the real wage, population growth leaves wages unchanged and reduces the output of one sector, and unionization in the relatively labour-intensive sector reduces both union and non-union wages - and showed that they do not hold when capital is assumed to be sector-specific. The purpose of the present section is to survey a number of additional cases where the assumption of sector-specific capital (SSC) leads to more intuitively plausible results than the assumption of intersectoral capital mobility (ICM). It will be seen that adopting this perspective serves to synthesise a substantial portion of international trade theory. (Needless to say, the list is not intended to be exhaustive).

(i) Technological progress and income distribution: Findlay and Grubert (1959) and Johnson (1970, pp.46-47) showed that, with ICM, technological progress in the relatively capital-intensive sector must lower the real wage at constant commodity prices. With SSC, however, McCulloch (1976) has shown that technological progress in either sector must benefit labour (except in an extreme case where the technological progress is Hicksian labour-saving, and the potential for factor substitution in the progressing sector is implausibly low.[1])

(ii) Technological progress and the terms of trade: Findlay and Grubert also showed that with ICM technological progress in one sector is not necessarily "ultra-biased" (i.e. the output of

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1. These conditions are derived in Appendix 2.A.

the other sector need not fall), and hence it has an ambiguous impact on the terms of trade, if it "saves" the factor which that sector uses relatively less intensively. (For example, if exportables are capital-intensive, the effect on the terms of trade of labour-saving progress in exportables or of capital-saving progress in importables cannot be predicted without a knowledge of domestic demand patterns). By contrast, with SSC, technological progress in one sector is usually ultra-biased (except in the extreme case mentioned in (i) above), and hence its effect on the terms of trade is in the "expected" direction (i.e., they improve following progress in the import-competing sector and deteriorate following progress in exportables). Thus the assumption of SSC serves to partially rehabilitate the much-maligned claim of Hicks (1953) that import-biased technological progress (i.e., technological progress which occurs predominantly in the import-competing sector) in the U.S. would improve the U.S. terms of trade.

(iii) Income distribution and the offer curve: Johnson (1959) showed that if labour- and capital-income recipients have different consumption patterns, it is possible with ICM for imports to behave as a Giffen good in aggregate consumption, implying complicated shapes for the offer curve, and introducing the possibilities of multiple trade equilibria and reversals of trade direction. From a purely formal point of view, this phenomenon is identical with the redistributive effect which endangers the uniqueness of momentary equilibrium in Uzawa's two-sector model of economic growth (which, of course, assumes ICM); see Hahn (1965). In both cases the paradoxical outcomes are possible when each factor has a higher marginal propensity to consume the commodity in the production of which it is used relatively intensively. Once again, however, these problems do not arise with SSC (at least when full employment is assumed). (See Appendix 2.B for proof).

(iv) Harris-Todaro model: In their analysis of rural-urban migration in response to differences between the actual wage in agriculture and the expected wage in urban areas, Harris and Todaro (1970) assumed SSC. However subsequent work has extended their model to allow ICM, and has discovered the possibility of a number of "paradoxes": an increase in the urban minimum wage can increase manufacturing output and employment (Corden and Findlay, 1975); urban unemployment may increase following capital accumulation and fall following population growth (loc. cit.); and the model is unstable if the urban sector is labour-abundant relative to the rural sector. (See Chapter 4 below). None of these pathological outcomes is possible in the original Harris-Todaro case with SSC.

(v) Devaluation with rigid wages: Jones and Corden (1976) have examined the effect of devaluation on the trade balance of a small open economy in a two-sector model which distinguishes between traded and non-traded goods rather than between export-ables and importables. Assuming continual government interven-tion to maintain full employment and a constant nominal wage, they found that a devaluation always leads to a trade surplus under SSC, but (paradoxically) to a trade deficit under ICM when tradeables are relatively labour intensive. Moreover, under the short-run capital specificity hypothesis, long-run equilibrium is unstable in the paradoxical case. Similar conclusions under ICM have been found by Helpman (1976) in a model which resembles that of Jones and Corden but allows the level of employment to vary. (These models are examined further in Chapter 5).

(vi) Variable factor supplies and specialisation: The introduction into the ICM model of variable factor supplies which respond positively to their real return increases the likelihood that even a relatively small change in the terms of trade will lead

the economy to specialise in one or other commodity. (See Martin, 1976). In the limit, when one factor is in infinitely elastic supply at a given return (i.e., when the economy faces a binding minimum wage or rental constraint) there is only one relative commodity price ratio which is consistent with non-specialisation. (See Brecher, 1974). With SSC, however, specialisation is much less likely: although Caves (1971, p.18) claimed that, if the capital goods specific to each sector were internationally mobile, one country would have to specialise, Amano (1977) has shown that this is not necessarily the case.

(vii) Many-factor, many-commodity generalisations: The elegance of the properties of the 2x2 model with ICM have led to many attempts to generalise them to models with many goods and factors (all of the latter being assumed to be perfectly mobile between all sectors). (See Ethier, 1974, for a recent survey and extension). Without wishing to denigrate the intellectual activity which has been expended on this, it is probably fair to say that the results in this area have been disappointing: the properties of the two-good two-mobile-factor model do not appear to generalise in any simple way to the many-goods many-factors case. By contrast, the extension of the SSC model to many commodities is relatively straightforward (see Mussa, 1974, and Jones, 1975).

The preceding survey provides convincing evidence, if any were needed, that ICM is the source of many of the counter-intuitive results or "paradoxes" to be found in international

trade theory.[1] Another way of expressing the same point is that SSC provides a rigorous general equilibrium foundation for partial equilibrium analysis as far as the supply side of the economy is concerned, whereas with ICM partial equilibrium reasoning will frequently be misleading. (See Samuelson, 1971a). At the very least, these observations provide a convenient unifying principle for much of international trade theory.

Finally, it may be asked whether there is any formal way of characterising the difference between the ICM and SSC models. One approach to doing so is to express each model using the appropriate revenue (or national income) function, which gives the value of output as a function of exogenous variables. For the model with ICM this function is:

$$R\ (p_X, p_Y, K, L) = \text{Max}\ \Big[p_X F(K_X, L_X) + p_Y G(K_Y, L_Y) \ :\ K_X + K_Y = K;\ L_X + L_Y = L;\ p_X F_K = p_Y G_K;\ p_X F_L = p_Y G_L \Big] \qquad (5)$$

while for the model with SSC it is:

$$R\ (p_X, p_Y, K_X, K_Y, L) = \text{Max}\ \Big[p_X F(K_X, L_X) + p_Y G(K_Y, L_Y) \ :\ L_X + L_Y = L;\ p_X F_L = p_Y G_L \Big] \qquad (6)$$

All of the results of this chapter could be derived by making use of some fairly well-known duality properties of these functions.

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1. It may be conjectured that ICM is the source of <u>all</u> the paradoxes which are peculiar to international trade theory, with the exception of those which arise from the failure to adopt first-best policies, and which therefore fall under the head of the theory of the second best. The latter include both those paradoxes which arise from the failure to follow first-best <u>trade</u> policies (such as the Metzler paradox and the Bhagwati (1958) form of immiserizing growth), and those which arise from the failure to follow first-best <u>domestic</u> policies (such as various welfare paradoxes which are possible in the presence of factor market distortions, all of which may be viewed as special cases of the immiserizing growth phenomenon; see Bhagwati, 1973).

(For the derivation of the properties of (5) and (6), see Dixit, 1976, Chap. 2, and Samuelson, 1971b, respectively). In particular, it turns out that a crucial feature of (5) is that all its partial cross-elasticities involving one price variable and one factor endowment variable must lie outside the zero-one interval. This feature, which gives rise to what Jones (1965) called the "magnification effect", is not shared by (6), and it is largely responsible for the propensity of the model with ICM to generate paradoxical behaviour. However, while this approach permits a formal synthesis of the results of this chapter, the additional insights it yields were not thought sufficient to justify a full presentation of the complicated derivations required.[1]

2.7 A Critique of the Assumption of Intersectoral Capital Mobility

The preceding sections have interpreted the assumption of SSC as referring to the short run, and the Heckscher-Ohlin-Samuelson assumption of ICM as referring to the long run. However, it is tempting to go further and to argue that there is no time horizon over which the assumption of ICM is appropriate. For short-run analysis it is clear that SSC is more satisfactory;[2] this is confirmed by the fact that it is more consistent with the apparent perceptions of industry and trade union lobbyists (see Magee, 1977). Of course, for medium- and long-run analysis, SSC is quite unrealistic: changes in exogenous variables which give

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1. One area where this approach may prove very fruitful is the generalisation of these models to include many goods and factors. For the present, this must be left as a suggestion for future research.
2. This is not to say that the assumptions underlying the short-run capital specificity hypothesis are completely satisfactory: for example, though immobile between sectors, capital is assumed to be no less substitutable for labour in the short run than it is in the long run. However since shift lengths are variable even in the very short run, this assumption may not be excessively unrealistic.

rise to intersectoral differences in quasi-rents must lead sooner or later to intersectoral resource reallocation if competitive pressures are allowed to operate. It is here, however, that a major difficulty with the assumption of ICM becomes apparent: in practice medium-run resource reallocation does not for the most part take the form of a diversion of physical capital equipment from one use to another, with the total stock of homogeneous, infinitely long-lived machines remaining constant throughout. Rather it appears frequently to take the form of a slowing down in the rate of replacement of depreciating capital goods in the declining sector, coinciding with a rechannelling of new investment towards the expanding sector. Once it is recognized that investment requires abstinence from consumption, it is clear that, except under very strong assumptions, this process will lead to a change in the total capital stock between the old and the new long-run equilibria. Hence the usual long-run Heckscher-Ohlin-Samuelson predictions will not follow in general.[1] Pending the development of a more satisfactory way of modelling the process of medium-run intersectoral resource allocation, this suggests that the Heckscher-Ohlin-Samuelson model should be treated with more caution and less esteem than is currently the case in international trade theory.

2.8 Summary and Conclusion

This chapter began by introducing a simple geometric technique to illustrate the process of adjustment towards long-run

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1. Even retaining the assumption of reallocation of a fixed stock of homogeneous machines between sectors, the Heckscher-Ohlin-Samuelson predictions will not hold in the long run if the two sectors face different costs of reallocation. See Mussa (1975).

equilibrium in a two-sector economy where capital is sector-specific in the short run. The technique was used to show how such an economy would react to changes in commodity prices, in factor endowments, and in the level of factor market distortions. It was shown that the rational pursuit by market participants of their own self-interest could lead to behaviour very different from that implied by traditional "long-run" international trade theory.

The technique was then applied to analyse the behaviour of the Heckscher-Ohlin-Samuelson model of a small open economy with pre-existing factor market distortions. It was shown that if such an economy is assumed to adjust according to the short-run capital specificity adjustment process, then an equilibrium where the rankings of the two sectors by physical and value factor intensities differ must be dynamically unstable. This means that a number of paradoxes which have attracted much attention in recent writings, such as a perverse price-output response and a perverse distortion-output response, will "almost never" be observed.

Finally, attention was drawn to the pivotal role of the assumption of intersectoral capital mobility in international trade theory: this assumption was shown to be largely responsible for a propensity to generate paradoxes which is seen by many as an unattractive feature of the theory. It was argued that the assumption is inappropriate over any time horizon: in the short run capital goods are not mobile, while in the medium and long runs their total stock is not fixed.

It would perhaps be going too far to suggest, paraphrasing Jevons's remark about Ricardo, that the influence of Heckscher, Ohlin and Samuelson has shunted the car of international trade

theory on to a wrong line.[1] Nevertheless, in a broader historical perspective, the concentration by trade theorists in the post-war period on an especially simple form of intersectoral capital mobility may well be seen as a mistake, not merely because it is unrealistic (since this must be true to some extent of all assumptions) but because it focusses attention on a particular time horizon which bears little or no relation to any economically relevant time period. A more satisfactory way of conceptualizing the effects of exogenous changes on medium-run resource allocation is required.

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1. Such a suggestion would also be unfair to the originators of the theory. The analyses of Heckscher and Ohlin were considerably richer and less formalized than the theory which bears their name, while Ohlin at least can be interpreted as having assumed sector-specificity of capital, as Samuelson recently pointed out in his retraction of his own earlier views on factor price equalization. See Samuelson (1971b).

APPENDIX 2.A

ON THE SHORT-RUN EFFECTS OF TECHNOLOGICAL PROGRESS

This appendix present a simple but apparently new result concerning the short-run impact of technological progress under perfect competition, and uses it to throw light on two classic issues: namely, the effects of technological progress on income distribution and on the terms of trade.

I

We begin by reviewing some basic concepts and notation, and then derive the main result of this appendix: the effect of technological progress on the marginal product of labour, when labour is the only variable factor of production. Following Jones (1965, Sect. IX), technological progress is classified with reference to its effect on unit input requirements at constant relative factor prices.[1] Assuming cost minimization, constant returns to scale, and two inputs, labour (L) and capital (K), each unit input requirement may be written as a function of factor prices, w and r, and of a technology parameter, t:

$$a_i\ (w,\ r,\ t) \qquad i = L,\ K \tag{1}$$

Since these unit input requirements are partial derivatives of the unit cost function, they are homogeneous of degree zero in w and r. Total differentiation yields, after some manipulation (see Jones for details):

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1. The results of this appendix are interpreted in terms of the Hicksian classification of technological progress, but they may easily be re-expressed in terms of the Harrodian or Solovian classifications, or in terms of factor-augmenting coefficients. See Jones (1966) and Chang (1970).

$$\hat{a}_L = -\theta_K \sigma \, (\hat{w} - \hat{r}) - \hat{b}_L \quad . \tag{2a}$$

$$\hat{a}_K = \theta_L \sigma \, (\hat{w} - \hat{r}) - \hat{b}_K \tag{2b}$$

A circumflex over a variable indicates a proportional rate of change; σ is the elasticity of substitution between labour and capital; θ_i is the share of factor i in the value of output (so that $\theta_L + \theta_K = 1$); and $\hat{b}_i$ is the proportionate reduction in a_i due to technological progress at constant factor prices. Equations (2a) and (2b) may be combined to obtain the Hicksian measure of the bias of technological progress, β, which gives the proportionate change in the capital - labour ratio at constant factor prices:

$$\hat{K} - \hat{L} = \hat{a}_K - \hat{a}_L = \sigma(\hat{w} - \hat{r}) + \beta \tag{3}$$

where $\beta = \hat{b}_L - \hat{b}_K$ (4)

Similarly, by noting that, definitionally:

$$\hat{X} = \hat{K} - \hat{a}_K \tag{5}$$

where X is the level of output, equations (2a) and (2b) may be manipulated to yield the Hicksian measure of the extent of technological progress, π, which gives the proportionate change in output when inputs are held constant:

$$\hat{X} = \theta_L \hat{L} + \theta_K \hat{K} + \pi \tag{6}$$

where $\pi = \theta_L \hat{b}_L + \theta_K \hat{b}_K$ (7)

Finally, it is easily shown (again, see Jones for details) that π also measures the decrease in unit cost, and hence in output price p, at constant factor prices:

$$\hat{p} = \theta_L \hat{w} + \theta_K \hat{r} - \pi \tag{8}$$

Following these preliminaries, it is now a simple matter to derive our main result. From (8) and (3) the change in the marginal

product of labour may be written:

$$\hat{w} - \hat{p} = \theta_K (\hat{w} - \hat{r}) + \pi \qquad (9)$$

$$= \frac{\theta_K}{\sigma} (\hat{K} - \hat{L} - \beta) + \pi$$

Hence, for the marginal product of labour to remain constant when the stock of capital is fixed in the short run (so that $\hat{K} = 0$), the relationship between the technological progress parameters and the profit-maximising level of labour input must be:

$$\hat{L} = \frac{\sigma}{\theta_K} \pi - \beta \qquad (10a)$$

$$= (\sigma \frac{\theta_L}{\theta_K} - 1) \hat{b}_L + (\sigma + 1) \hat{b}_K \qquad (10b)$$

In order to interpret the first term on the right-hand side of (10b) we substitute from (2b) and (9) into (5), to obtain the supply function:

$$\hat{X} = \hat{K} + \sigma \frac{\theta_L}{\theta_K} (\hat{p} - \hat{w}) + \sigma \frac{\theta_L}{\theta_K} \pi + \hat{b}_K \qquad (11)$$

Hence the expression $\sigma\theta_L/\theta_K$ is the short-run price elasticity of output supply, and equation (10b) may be expressed in words as follows:

In order for technological progress to reduce in the short run the level of employment corresponding to a given marginal product of labour, it is necessary: (a) that the technological progress be Hicksian labour-saving ($\hat{b}_L > 0$); and (b) that the short-run elasticity of supply be less than unity.[1] It should be emphasised that these conditions are necessary but not sufficient for technological progress to reduce labour demand; for example equation

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1. McCulloch (1976) gives a different formulation of this condition.

(10a) shows that Hicks-neutral technological progress ($\beta = 0$) cannot have this effect, irrespective of the value of the elasticity of supply.

It may be thought paradoxical that an innovation which is defined to be labour-saving (in the Hicksian sense) may or may not 'save' labour depending on the value of the elasticity of supply. There is no paradox however: the Hicksian definition refers to the effects of technological progress holding constant the wage-rental ratio, whereas the above result is valid only when the marginal product of labour is held constant. When technological progress takes place, these two conditions are not in general equivalent.[1]

II

The application of the result of the last section to the two issues discussed in the introduction is immediate. Consider Figure 2.A.1 which illustrates the equilibrium of a two-sector neo-classical economy producing importables X, and exportables Y: the initial allocation of the labour force between the two sectors is determined by the intersection of the two labour demand (i.e., value marginal product of labour) schedules at A. Following technological progress in sector X (but assuming unchanged output prices), that sector's labour demand schedule is affected, to an extent determined by equation (10b). If (10b) is positive, the schedule shifts to the right, to V_X^1, and a new short-run equilibrium at B is attained where a higher wage rate prevails. Conversely,

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1. An alternative approach would be to define as neutral any technological progress which leaves unchanged the marginal product of labour with a given stock of capital. For reasons which will become apparent in Section II, the term 'Ricardo-neutral' would be appropriate for such a change, which is not equivalent in general to either Hicks-, Harrod-, or Solow-neutrality. However it is probably best to avoid further proliferation of terminology in this jargon-prone field.

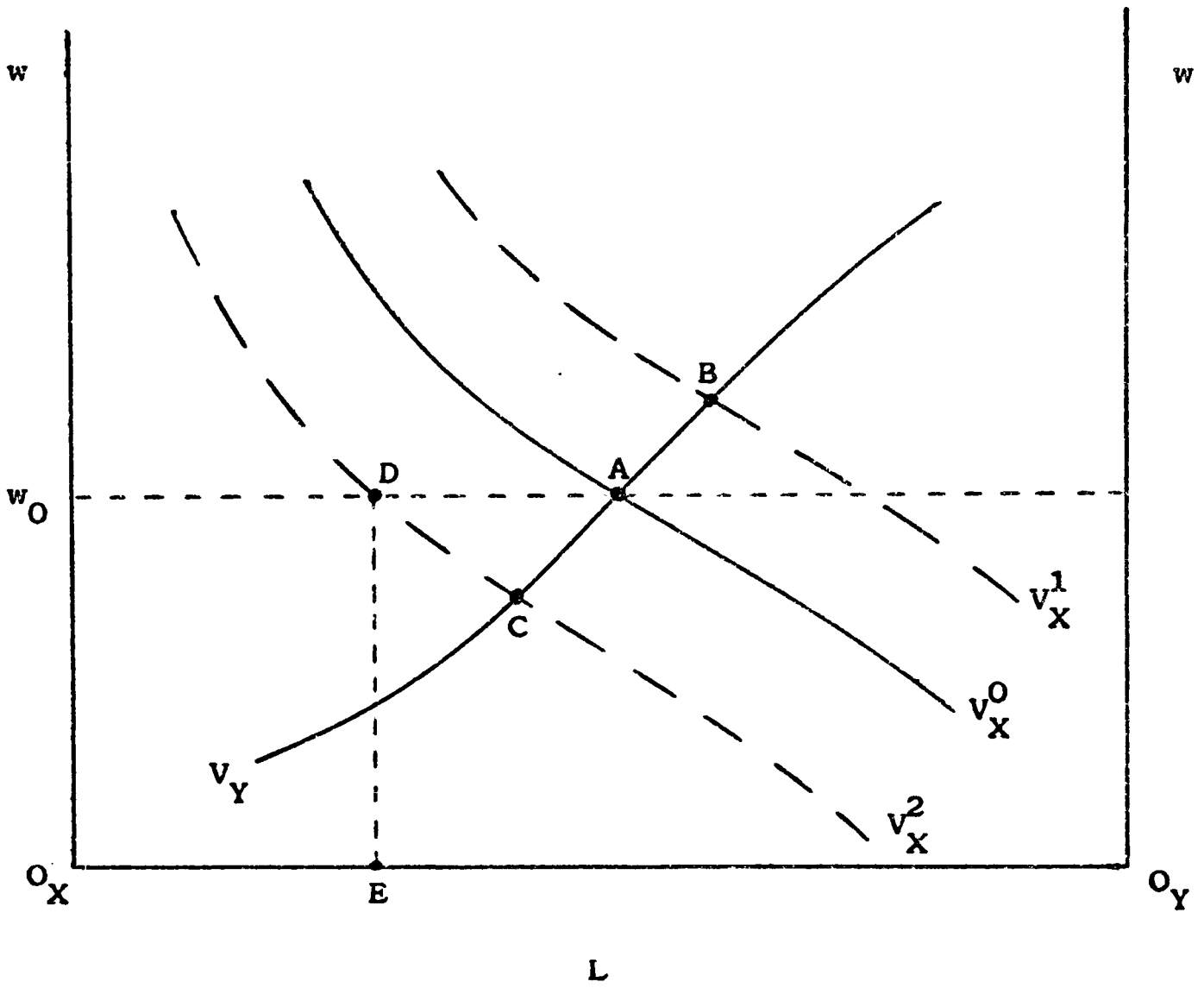


Figure 2.A.1: Short-run effect of technological progress on the labour demand schedule.

if (10b) is negative, the value marginal product of labour in X schedule shifts to the left, and, assuming the wage is flexible, it falls to maintain full employment. Hence equation (10b) gives a necessary and sufficient condition for technological progress to increase the wage rate in the short run. This may be contrasted with the corresponding result in the Heckscher-Ohlin-Samuelson model with intersectoral capital mobility, namely that technological progress raises the wage rate if and only if the progressing sector is relatively labour-intensive.[1]

Equation (10b) may also be used to examine the effect of technological progress on the terms of trade, a question raised in recent years by Hicks (1953) and formalised within the framework of the Heckscher-Ohlin-Samuelson model of international trade by Johnson, Mishan and Corden, culminating in the definitive work of Findlay and Grubert (1959). In this literature the key issue has been taken to be whether or not an unambiguous statement may be made about the effect of technological progress in one sector on the terms of trade, when no assumptions about domestic demand are made, other than the exclusion of inferior goods. This is equivalent to asking whether or not the production effect of the technological progress is ultra-biased, meaning that at the initial terms of trade the output of one sector actually falls. For, only when (e.g.) the output of exportables falls following technological progress in importables, can we be certain, independent of demand conditions, that an excess world supply of importables will develop, thus tending to improve the home country's terms of trade.[2]

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1. This result was derived implicitly by Findlay and Grubert (1959) and explicitly by Johnson (1970, pp.46-47).
2. Of course, the requirement that technological progress be ultra-biased is over-strong. It is easily shown that, whatever assumptions are made about production and factor markets, the terms of trade will improve following technological progress in either (or both) sectors, if and only if the following expression is positive: $\eta_Y \hat{X} - \eta_X \hat{Y}$, where $\hat{X}$ and $\hat{Y}$ are the proportional changes in home import-competing and export sectors, at the initial terms of trade, respectively, and η_i is the home income elasticity of demand for good i.

Although this question could be examined under a variety of assumptions about production and factor markets, it has traditionally been studied, at least formally, only in the context of the Heckscher-Ohlin-Samuelson model, assuming flexible factor prices and intersectoral capital mobility. As shown by Findlay and Grubert (1959), a sufficient condition for technological progress to be ultra-biased under these assumptions is that it "save" (in the Hicksian sense) the factor which is used relatively more intensively in the sector experiencing the technological progress. When this condition is not met, the effect on the terms of trade is ambiguous: for example, if importables are labour-intensive, the effect on the terms of trade of capital-saving progress in importables or of labour-saving progress in exportables cannot be predicted in general without a knowledge of domestic demand patterns.

On the alternative assumption of sector-specific capital, the result of Section I may be immediately applied to determine when technological progress will be ultra-biased. If equation (10b) is positive, the labour demand schedule of sector X shifts to the right. Since employment in sector Y falls, its output must also decline, and so the technological progress is ultra-biased, and induces an improvement in the home country's terms of trade. However, if equation (10b) is negative the labour demand schedule of sector X shifts to the left, to V_X^2. Two outcomes are now possible: (a) if the wage rate is flexible, the new equilibrium is at point C. The output of both sectors now rises, and so the technological progress is not ultra-biased; (b) if the wage rate is downwardly rigid, then employment and output in sector Y are unaffected, employment in sector X falls to O_XE, and unemployment of DA emerges. However, in case (b) the output of sector X cannot fall (this may be seen by setting $\hat{K}$ and $\hat{p} - \hat{w}$ equal to zero in

equation (11)). Hence we may say that the technological progress in this case is weakly ultra-biased, in the sense that the terms of trade cannot deteriorate provided neither good is inferior.

The conditions for the change in the terms of trade to be indeterminate in the short run (when the wage rate is flexible) are not a proper subset of the corresponding long-run conditions, since the former take no account of relative factor intensities. Nevertheless the above discussion should have made clear that the conditions necessary for technological progress not to be ultra-biased are more stringent with sector-specific capital than with intersectoral capital mobility: with the latter, the progressing sector may be either labour- or capital-intensive, and the technological progress may be either labour- or capital-using, or both, or neither; in four of the eight possible combinations of these alternatives, the change in the terms of trade is ambiguous. Whereas, with sector-specific capital, ambiguity requires in addition that the elasticity of supply in the progressing sector be less than unity, which in the light of much empirical evidence requires an implausibly low potential for factor substitution. Hence, as I asserted in Section 2.6, the claims of Hicks concerning the effect of technological progress on the terms of trade are more likely to be true in the short run (i.e., with sector-specific capital) than in the long-run context in which they were originally presented.

Finally, it may be noted that equation (10b) may also be applied to another classical question, namely, the effect of technological progress on employment, a hotly-debated issue ever since Ricardo's change of heart on the question, which led him to include a new chapter 'On Machinery' in the third edition of his Principles (1821). Assuming that the wage rate is rigid in the short run, it is immediately clear that equation (10b) gives a

necessary and sufficient condition for the Ricardian outcome to ensue: only if that equation is negative will "technological unemployment" come about.[1]

Since, as already argued, casual empiricism suggests that equation (10b) is likely to be positive, the Ricardian result would appear to be rather unlikely. However it should be emphasised that this is only true under the neoclassical assumptions adopted here. As will be seen in Chapter 6, the situation is very different when this question is viewed instead in a "neo-Keynesian" framework, meaning by the latter one in the tradition of Clower (1965), Barro and Grossman (1971) and Malinvaud (1977).

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1. Findlay (1974, p.10) has provided an alternative justification for the Ricardian outcome, which, though rather different from that given here, requires the same necessary condition: that the technological change be labour-saving in the sense that the marginal product of labour falls at a given level of employment (i.e., that equation (10b) be negative). In Findlay's account, the wage is flexible, and so the level of employment is not reduced by the change. However profits in the progressing sector fall, and since they are the only source of increases in the wage fund the growth rate of employment must fall. Findlay also assumes that prices are flexible, which may partially or wholly offset the fall in profits induced by the technological progress.

APPENDIX 2.B

INCOME DISTRIBUTION AND THE AGGREGATE DEMAND SCHEDULE IN THE SHORT RUN

This appendix reconsiders the relationship between relative prices and aggregate demand in a two-sector neoclassical model where income recipients differ in their spending propensities. Section I uses an approach similar to that of Dixit (1976, Chap. 6) to derive the familiar result linking perverse demand behaviour to the relationship between relative spending propensities and relative factor intensities. (This result was first derived by Johnson (1959), who studied the implications of perverse demand behaviour for the shape of the offer curve in an open economy; the same result was independently discovered in the literature on the two-sector growth model, initiated by Uzawa (1961) and synthesized by Hahn (1965), where it is of importance in determining whether or not (for given initial conditions) momentary equilibrium is uniquely determined). Section II then shows that, if all the Johnson-Uzawa assumptions are retained, except that capital is assumed to be sector-specific, perverse demand behaviour cannot arise.

I

We assume an economy producing two goods, X and Y, using two factors, capital, K, and labour, L, and obeying all the assumptions of the Heckscher-Ohlin-Samuelson model on the production side, except that we allow for the possibility that the rentals in the two sectors may differ ($r_X \neq r_Y$). On the demand side, we assume that capital- and labour-income recipients have different demand patterns, which are modelled by means of the simple assump-

tion, attributed to Graham, of constant (average and marginal) propensities to consume good X, denoted by m_K and m_L. Under these assumptions, the demand for each good may be written, in obvious notation, as:

$$p\,X = m_L wL + m_K(r_X K_X + r_Y K_Y) \qquad (1)$$

$$Y = (1-m_L)wL + (1-m_K)(r_X K_X + r_Y K_Y) \qquad (2)$$

(Note that for convenience, and by contrast with the mathematical derivations in the remainder of the thesis, we choose commodity Y as numeraire, so that $p_Y = 1$ and $p_X = p$).

We seek to derive an expression for the elasticity of substitution in demand, relating changes in the ratio of X and Y demanded to parametric changes in their relative price, p. To do so, we first totally differentiate (1) and (2) to obtain:

$$\theta_X (\hat{p} + \hat{X}) = m_L \theta_L \hat{w} + m_K (\theta_{KXZ}\hat{r}_X + \theta_{KYZ}\hat{r}_Y) \qquad (3)$$

$$\theta_Y \hat{Y} = (1-m_L) \theta_L \hat{w} + (1-m_K) (\theta_{KXZ}\hat{r}_X + \theta_{KYZ}\hat{r}_Y) \qquad (4)$$

where θ_i is the share of factor i (i = K,L) or of good j (j = X,Y), in the value of national income, Z, and where we write θ_{KXZ} for the share in national income of the capital income which accrues in sector X to avoid confusion with θ_{KX} which represents the share of payments to capital in the value of output of sector X. The relationship between these two shares (and similarly for sector Y) is:

$$\theta_{KXZ} = \frac{r_X K_X}{Z} = \frac{pX}{Z}\frac{r_X K_X}{pX} = \theta_X \; \theta_{KX} \qquad (5)$$

To simplify equations (3) and (4), multiply (3) by θ_Y and (4) by θ_X and subtract, making use of the following expressions for θ_X and θ_Y (which follow from equations (1) and (2)):

$$\theta_X = m_L \theta_L + m_K (\theta_{KXZ} + \theta_{KYZ}) = m_L \theta_L + m_K \theta_K \quad (6)$$

$$\theta_Y = (1-m_L)\theta_L + (1-m_K)(\theta_{KXZ} + \theta_{KYZ})$$

$$= (1-m_L)\theta_L + (1-m_K)\theta_K \quad (7)$$

This procedure yields:

$$\theta_X\theta_Y (\hat{p} + \hat{X} - \hat{Y}) = (m_L-m_K)\theta_L (\theta_K\hat{w} - \theta_{KXZ}\hat{r}_X - \theta_{KYZ}\hat{r}_Y) \quad (8)$$

In order to simplify further it is necessary to know the relationship between goods and factor prices, for which we need to be more explicit about the assumptions of the model. For the remainder of this section therefore, we specialise to the Heckscher-Ohlin-Samuelson case where capital is intersectorally mobile and hence earns the same rental in each sector ($\hat{r}_X = \hat{r}_Y$). This permits us to invoke the Samuelsonian, or factor-price equalisation, relationship between changes in commodity and factor prices:

$$\hat{p} = \theta (\hat{w}-\hat{r}) \quad (9)$$

where $\theta = \theta_{LX} - \theta_{LY}$ as in Section 2.2 above. Using (9), equation (8) may be manipulated to yield:

$$\hat{X} - \hat{Y} = -\sigma_{DLR} \hat{p} \quad (10)$$

where: $$\sigma_{DLR} = 1 + \frac{\theta_K\theta_L}{\theta_X\theta_Y} \frac{(m_K - m_L)}{\theta} \quad (11)$$

Equation (11) is the expression sought for the aggregate elasticity of substitution in demand in the long run (i.e., when capital is intersectorally mobile). It is clear that, while its value is equally likely to be greater or less than unity (the value it takes when spending propensities are equal), it can be negative if (m_K-m_L) and θ are of opposite sign. This is the well-known condition of Johnson and Hahn that perverse aggregate demand behaviour

is possible when each class of factor income recipients has a relatively higher propensity to consume the good in the production of which it is used relatively more intensively.

II

When capital is sector-specific, we must proceed after equation (8) of the last section in a different manner, since the Samuelsonian relationship (9) no longer holds. In order to express changes in factor prices in terms of changes in goods prices, we follow Mussa (1974) (see also Chapter 3 below) and differentiate the full employment constraint, which is expressed by equating the sum of the labour demand schedules of each sector to the fixed labour endowment:

$$L_X \left(\frac{w}{p}, K_X \right) + L_Y \left(w, K_Y \right) = L \qquad (12)$$

Differentiating (12), holding the capital allocation constant, yields:

$$\hat{w} = \eta \hat{p} \qquad (13)$$

where η measures the contribution of sector X to Δ, the elasticity of the economy's aggregate labour demand schedule:

$$\eta = \frac{1}{\Delta} \lambda_{LX} \frac{\sigma_X}{\theta_{KX}} \qquad (14)$$

$$\Delta = \lambda_{LX} \frac{\sigma_X}{\theta_{KX}} + \lambda_{LY} \frac{\sigma_Y}{\theta_{KY}} \qquad (15)$$

(As elsewhere in this thesis, we adopt the notation of Jones (1965), where λ_{ij} represents the proportion of factor i allocated to sector j, and σ_j represents the elasticity of factor substitution in sector j).

Expressions corresponding to (13) for the change in the rental in each sector may also be derived by combining (13) with equations

(1) and (2) of Chapter 2, which express the change in the price of each good as a weighted average of the changes in factor prices in each sector. Hence:

$$\hat{r}_X = \frac{1}{\theta_{KX}} (1 - \eta\theta_{LX}) \hat{p} \quad \text{and} \quad \hat{r}_Y = - \frac{\theta_{LY}}{\theta_{KY}} \eta\hat{p} \qquad (16)$$

Combining these expressions, we obtain:

$$\theta_K \hat{w} - \theta_{KXZ} \hat{r}_X - \theta_{KYZ} \hat{r}_Y = (\eta - \theta_X) \hat{p} \qquad (17)$$

Thus, when capital is sector-specific, equation (10) may be re-written as:

$$\hat{X} - \hat{Y} = - \sigma_{DSR} \hat{p}$$

where: $$\sigma_{DSR} = 1 + \frac{\theta_L}{\theta_X \theta_Y} (m_K - m_L) (\eta - \theta_X) \qquad (18)$$

This resembles (11), but unlike it, it is unambiguously positive, as may be seen by substituting for η:

$$\sigma_{DSR} = 1 + \frac{\theta_L}{\theta_X \theta_Y} \frac{m_K - m_L}{\Delta} \left[\theta_Y \lambda_{LX} \frac{\sigma_X}{\theta_{KX}} - \theta_X \lambda_{LY} \frac{\sigma_Y}{\theta_{KY}} \right] \qquad (19)$$

$$= \frac{1}{\theta_X \theta_Y \Delta} \left[m_K \theta_Y \lambda_{LX} \frac{\sigma_X}{\theta_{KX}} + (1 - m_K) \theta_X \lambda_{LY} \frac{\sigma_Y}{\theta_{KY}} \right] \qquad (20)$$

Since each term in (20) is positive, we have proved that, when all the assumptions made by Johnson are adopted, except that capital is assumed to be sector-specific, then perverse demand behaviour is impossible.

III

Some further light may be thrown on the expression for the short-run elasticity of substitution in demand by noting that (in the absence of factor market distortions):

$$\frac{\theta_L \lambda_{Lj}}{\theta_j} = \theta_{Lj} \quad (j = X,Y) \tag{21}$$

Hence, (19) may be rewritten as:

$$\sigma_{DSR} = 1 + \frac{(m_K - m_L)}{\Delta} \left[\sigma_X \frac{\theta_{LX}}{\theta_{KX}} - \sigma_Y \frac{\theta_{LY}}{\theta_{KY}} \right] \tag{22}$$

The expression in square brackets in (22) is the difference between the short-run price elasticities of supply in each sector. (Recall equation (11) of Appendix 2.A). These supply elasticities therefore play the same role in the model with sector-specific capital as did relative factor intensities in the intersectorally mobile capital case: σ_{DSR} exceeds unity if and only if capital-income recipients have a higher propensity to consume the good which is in more elastic supply.

It is of interest to compare the short-run and long-run elasticities of substitution in demand. Subtracting (18) from (11) yields, after substituting for η:

$$\sigma_{DLR} - \sigma_{DSR} = \frac{\theta_L(\sigma_X \lambda_{LX} + \sigma_Y \lambda_{LY})}{\theta_X \theta_Y \Delta} \frac{m_K - m_L}{\theta} \tag{23}$$

Comparing this with (11), it may be seen that σ_{DLR} exceeds σ_{DSR} if and only if σ_{DLR} exceeds unity. This means that σ_{DLR} cannot lie between σ_{DSR} and unity. However it is not true that σ_{DSR} must lie between σ_{DLR} and unity, since, as may be seen from a comparison between (11) and (22), σ_{DSR} and σ_{DLR} lie on the same side of unity if and only if the more labour-intensive sector has the higher supply elasticity. All this shows that there is no sense in general in which demand is necessarily more elastic in the long than in the short run.

In conclusion, it should be stressed that the result of Section II should not be interpreted as implying that perverse demand behaviour is highly unlikely in the short run. On the

contrary, that result appears to be very brittle, in that it does not survive the relaxation of some of the assumptions of Section II other than that of sector-specific capital. For example, if different spending propensities out of the income accruing to capital in each sector are permitted, perverse demand behaviour is possible even with sector-specific capital; the same is true when the whole of capital income is spent according to the same demand function, but this function does not follow the simple Graham form. (See Taylor, 1974, p.92). Hence the significance of the result of Section II lies not in the fact that it guarantees "well-behaved" aggregate demand functions in the short run, but rather that, by contrast with the result of Section I, it provides further evidence of the significance of assuming sector-specific as opposed to intersectorally mobile capital.

CHAPTER 3

MORE GENERAL ADJUSTMENT MECHANISMS IN THE TWO-SECTOR NEOCLASSICAL MODEL OF COMPETITIVE EQUILIBRIUM

'The two-sector ... story is not for the squeamish.'

- A.K. Sen: 'Introduction' to Penguin Growth Economics, p.30.

3.1 Introduction

In Section 2.5 it was shown that the assumption of the short-run capital specificity adjustment mechanism was sufficient to rule out many paradoxical comparative static outcomes in a small open economy of the Heckscher-Ohlin-Samuelson kind. Clearly, it is of interest to inquire into the robustness of this conclusion: does it continue to hold under more general adjustment mechanisms? Also, can these mechanisms be used to throw light on the comparative static properties of a closed economy? These are the issues with which the present chapter is concerned.

Section 3.2 begins by deriving the result of Section 2.5 using algebraic methods. This is not done merely by way of methodological overkill however, but rather to introduce a notation and approach which may easily be generalised to problems for the study of which geometric tools are inadequate. This generalisation is begun in Section 3.3, where a more general class of adjustment mechanisms, permitting both labour and capital to be sector-specific in the short run, is introduced.[1] Section 3.4

1. Since this chapter was written, my attention has been drawn to two interesting papers, by Mayer (1974a) and Kemp, Kimura and Okuguchi (1977), which study adjustment mechanisms similar to those considered here. However both of these papers are exclusively concerned with a small open economy, and do not discuss the question of factor market distortions.

extends the analysis to the case where relative commodity prices are endogenous and derives a general stability condition for this case also. Section 3.5 considers an alternative adjustment mechanism, which resembles a Phillips curve in some respects. This is shown to introduce some interesting new possibilities, including the presence of "frictional" unemployment throughout the adjustment period; however the same stability conditions continue to apply. The implications of these conditions are examined in Section 3.6: it is shown that they permit a considerable simplification of both international trade theory and the general equilibrium theory of tax incidence, and also that they may be interpreted in terms of the relationship between Walrasian and Marshallian stability conditions. Finally the principal conclusions of the chapter are summarised in Section 3.7.

3.2 Short-Run Capital Specificity in a Small Open Economy

In this section, we examine the process of adjustment to an exogenous change in the level of a factor market distortion in a small open economy which obeys all the assumptions of the Heckscher-Ohlin-Samuelson model of international trade (including perfect competition, constant returns to scale and fixed aggregate factor supplies) with two exceptions: firstly, long-run equilibrium is characterised by constant proportional differentials between the value marginal products of capital and labour in the two sectors:

$$(1a) \quad w_Y = \alpha w_X \qquad (1b) \quad r_Y = \beta r_X$$

and secondly, while the labour force is instantaneously reallocated to ensure that (1a) is satisfied at all times, capital goods are sector-specific in the short run, and move between sectors in the

medium run in response to deviations from (1b).[1]

To investigate the short-run effect on the intersectoral differential in capital rentals of a once-and-for-all increase in the labour market distortion parameter α (attributable, for example, to an increase in the rate of labour subsidy to sector X), we recall from Chapter 2 that, because of profit maximisation and constant returns to scale, the proportional change in the price of each good must equal a weighted average of the changes in factor prices in each sector, the weights being the share of each factor in the value of output of that sector:

$$\hat{p}_X \doteq \theta_{LX}\,\hat{w}_X + \theta_{KX}\,\hat{r}_X \qquad (2)$$

$$\hat{p}_Y = \theta_{LY}\,\hat{w}_Y + \theta_{KY}\,\hat{r}_Y \qquad (3)$$

With both commodity prices held constant because of the "small country" assumption, equations (1a), (2) and (3) may be manipulated to express the change in the intersectoral rental differential as a function of changes in the labour market distortion parameter and the wage in the X sector:

$$\theta_{KX}\,\theta_{KY}\,(\hat{r}_X - \hat{r}_Y) = -\theta\,\hat{w}_X + \theta_{LY}\,\theta_{KX}\,\hat{\alpha} \qquad (4)$$

where θ is the determinant of the matrix of sectoral factor shares, and is positive if and only if the X sector is relatively labour-intensive in the value sense. To eliminate the change in w_X from (4), we use the full employment condition, which is expressed by equating the sum of the labour demand schedules of each sector to

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1. Most writers in the enormous literature on factor market distortions deal exclusively with the long-run, two-mobile-factors, case. (See especially Harberger, 1962, and Jones, 1971a). Exceptions include: McLure (1974) who uses a model where labour is sector-specific but capital instantaneously mobile; Magee (1976, pp.85-86) who briefly discusses the adjustment process, citing unpublished work by J. Marquez-Ruarte; and Neary (1978), who examines the consequences of a particular factor market distortion in both mobile and immobile capital models, but without examining the adjustment process.

the fixed labour endowment:

$$L_X \left(\frac{w_X}{p_X}, K_X\right) + L_Y \left(\frac{w_Y}{p_Y}, K_Y\right) = \bar{L} \qquad (5)$$

Differentiating (5), holding commodity prices and capital allocations constant, and using equation (1a), we may express the short-run proportional change in the wage rate in sector X as a function of the change in the labour market distortion parameter:[1]

$$\hat{w}_X = -\frac{1}{\Delta} \lambda_{LY} \frac{\sigma_Y}{\theta_{KY}} \hat{\alpha} \qquad (6)$$

where $$\Delta = \lambda_{LX} \frac{\sigma_X}{\theta_{KX}} + \lambda_{LY} \frac{\sigma_Y}{\theta_{KY}} > 0 \qquad (7)$$

Finally, substituting from (6) into (4):

$$\theta_{KX}\, \theta_{KY} (\hat{r}_X - \hat{r}_Y) = \frac{1}{\Delta}(\sigma_X \lambda_{LX} \theta_{LY} + \sigma_Y \lambda_{LY} \theta_{LX}) \hat{\alpha} \qquad (8)$$

Assuming that the capital market is in long-run equilibrium before the change, this shows that an increase in the wage differential in favour of sector Y will increase the relative rental on capital in the other sector in the short run. Hence, in the medium run, capital will begin to reallocate from sector Y to sector X, irrespective of the relative factor intensities (in either the physical or value sense) of the two sectors.

But this capital reallocation will itself affect the inter-sectoral rental differential. To see this, we again differentiate equation (5), this time holding commodity prices and factor market distortions constant:

$$\hat{w}_X = \frac{1}{\Delta} (\lambda_{LX} \hat{K}_X + \lambda_{LY} \hat{K}_Y) \qquad (9)$$

---

1. The notation used is that of Jones (1965): λ_{ij} is the proportion of the fixed stock of factor i used in sector j; θ_{ij} is the share of gross payments to factor i in the value of output of sector j; and σ_j is the elasticity of substitution between capital and labour in sector j (so defined as to be non-negative).

This gives the effect on the X sector wage rate of any arbitrary changes in the capital stocks in each sector. Of course, when we consider a reallocation of the given stock of capital, the changes in each sector are not arbitrary, but must continue to satisfy the capital endowment constraint:

$$K_X + K_Y = \bar{K}$$

or in differential form:

$$\lambda_{KX} \hat{K}_X + \lambda_{KY} \hat{K}_Y = 0 \qquad (10)$$

Substituting from (10) into (9) gives:

$$\hat{w}_X = \frac{\lambda}{\Delta} \frac{\hat{K}_X}{\lambda_{KY}} \qquad (11)$$

where λ is the determinant of the matrix of factor-to-sector allocations, and is positive if and only if sector X is relatively labour intensive in the <u>physical</u> sense. Finally, substituting from (11) into (4), holding constant the level of the labour market distortion parameter α, we obtain:

$$\hat{r}_X - \hat{r}_Y = -\frac{1}{\Delta} \frac{\lambda.\theta}{\theta_{KX}\ \theta_{KY}} \frac{\hat{K}_X}{\lambda_{KY}} \qquad (12)$$

This shows that a reallocation of capital into sector X will reduce the proportional gap between the rentals in the two sectors, if and only if the product of the two determinants, λ and θ, is positive; in other words, if and only if the rankings of the two sectors by physical and value factor intensities are the same.[1] Hence, if these rankings differ, the initial reallocation of capital in response to an increase in the wage differential will widen the intersectoral rental differential, leading to an increased flow of

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1. Equation (12) was derived by Jones (1975, p.13), who nevertheless claimed that the adjustment process would eventually converge when λ and θ have different signs because, as capital reallocates, the absolute gap between the two rentals is narrowed. However, he did not point out that the adjustment is taking place in the opposite direction to that predicted by the comparative static analysis.

capital from Y to X, moving progressively further away from the new long-run equilibrium predicted by the comparative static analysis. We may conclude, therefore, that under the short-run capital specificity adjustment process, an equilibrium where the physical and value factor intensity rankings differ in a small open economy must be locally unstable.

3.3 Stability in a Small Open Economy when Both Capital and Labour Adjust Sluggishly

In the last section we examined the stability of equilibrium following a particular exogenous change (a change in the level of distortion in the labour market), and assuming a particular adjustment mechanism (the short-run capital specificity process). In this section we generalise to the case where both capital and labour adjust sluggishly, and show that the same stability criterion applies. We continue to adopt the small open economy assumption of fixed relative commodity prices.

The dynamic assumptions of this section are that both capital and labour follow adjustment processes of the same form (though not necessarily of the same speed). Both factors are now sector-specific in the short run, but complete flexibility of the wage and rental rate within each sector ensures that both factors are fully employed throughout the adjustment period.[1] As before, a long-run equilibrium is defined as a state where each factor earns the same return in both sectors, taking into account the distortion parameters α and β in equations (1a) and (1b). Starting from such

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1. One difficulty with this assumption arises if either factor is "inessential" in the production function of either sector (in the sense that the isoquants of the function intersect the axis corresponding to that factor). In such cases the assumption of complete factor price flexibility implies that the return of the relevant factor in the sector concerned may be zero during part of the adjustment period. This situation is logically consistent, provided it is assumed that the inessential factor is maintained above subsistence level by lump-sum transfers where necessary. However, it is not a very appealsituation, and where it is likely to occur a different adjustment mechanism, similar to those considered in Section 3.5 below, may be preferred to that of the present section.

an equilibrium, any exogenous shock will bring about a short-run intersectoral divergence of the distortion-inclusive returns of each factor. These divergences in turn will lead, in the medium run, to a gradual reallocation (or "migration") of each factor out of the sector where it earns a lower return into the sector where it earns a higher return. The rate at which this reallocation takes place will depend, in general, on a variety of considerations, including migration costs, rates of time preference and expectations of future price changes on the part of factor owners. However, since our primary interest lies not in these influences themselves, but rather in their implications for stability, we may subsume them into general migration functions of the following form (where D is the time derivative operator):[1]

$$D\,K_X = \phi\{\beta\,\frac{r_X}{r_Y} - 1\} \qquad \phi' > 0,\ \phi(0) = 0 \qquad (13)$$

$$D\,L_X = \psi\{\alpha\,\frac{w_X}{w_Y} - 1\} \qquad \psi' > 0,\ \psi(0) = 0 \qquad (14)$$

It turns out that these dynamic assumptions may be conveniently analysed by locating the stationary loci of (13) and (14) directly in the Edgeworth-Bowley box.[2] Consider first the capital market equilibrium locus (henceforth, KMEL), equation (1b). On total differentiation (noting that the exogenous, long-run, distortion parameter β remains constant throughout the adjustment period)

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1. Of course, these functions are not completely general, since they are assumed to be continuous and differentiable. We conjecture that the results to be derived would survive the relaxation of these assumptions.
2. The only previous writer to discuss these loci appears to be Magee, who considered only one of the two loci, calling it first a "distortion equilibrium locus" (Magee, 1971, p.630), and later, following J. Marquez-Ruarte, an "iso-price locus" (Magee, 1976, pp.28,86). The latter term is inappropriate in the present context, however, since with both factor markets in disequilibrium, any point in the production box is a feasible short-run equilibrium for a given relative goods price.

this becomes:

$$\hat{r}_X - \hat{r}_Y = 0 \tag{15}$$

In order to transfer this locus into the Edgeworth-Bowley box, we convert (15) to a differential function of relative commodity prices and factor allocations to sector X only. To do this we invoke the relationship between the capital-labour ratio and the marginal product of capital in sector X, in differential form:

$$\hat{K}_X - \hat{L}_X = -\frac{\sigma_X}{\theta_{LX}} (\hat{r}_X - \hat{p}_X) \tag{16}$$

as well as the corresponding equation for sector Y; and also the full employment constraints: (10) for capital, and for labour:

$$\lambda_{LX} \hat{L}_X + \lambda_{LY} \hat{L}_Y = 0 \tag{17}$$

After tedious manipulation, (15) is therefore replaced by:

$$\text{KMEL:} \quad \hat{p}_X - \hat{p}_Y - A_1 \hat{K}_X + B_1 \hat{L}_X = 0 \tag{18}$$

$$\text{where:} \quad A_1 = \frac{\theta_{LX}}{\sigma_X} + \frac{\theta_{LY}}{\sigma_Y} \frac{\lambda_{KX}}{\lambda_{KY}} \quad \text{and} \quad B_1 = \frac{\theta_{LX}}{\sigma_X} + \frac{\theta_{LY}}{\sigma_Y} \frac{\lambda_{LX}}{\lambda_{LY}} \tag{19}$$

As exactly analogous procedure applied to the labour market equilibrium locus (LMEL), $\hat{w}_X - \hat{w}_Y = 0$, yields:

$$\text{LMEL:} \quad \hat{p}_X - \hat{p}_Y + A_2 \hat{K}_X - B_2 \hat{L}_X = 0 \tag{20}$$

$$\text{where:} \quad A_2 = \frac{\theta_{KX}}{\sigma_X} + \frac{\theta_{KY}}{\sigma_Y} \frac{\lambda_{KX}}{\lambda_{KY}} \quad \text{and} \quad B_2 = \frac{\theta_{KX}}{\sigma_X} + \frac{\theta_{KY}}{\sigma_Y} \frac{\lambda_{LX}}{\lambda_{LY}} \tag{21}$$

Finally, the same procedure may be followed with the distorted efficiency locus (DEL) or contract curve of the Edgeworth-Bowley box, whose equation is:

$$\frac{\alpha}{\beta} \frac{w_X}{r_X} = \frac{w_Y}{r_Y} \tag{22}$$

A similar sequence of substitutions yields:

$$\text{DEL:} \qquad A_3 \hat{K}_X - B_3 \hat{L}_X \tag{23}$$

$$\text{where:} \qquad A_3 = \frac{1}{\sigma_X} + \frac{1}{\sigma_Y} \frac{\lambda_{KX}}{\lambda_{KY}} \quad \text{and} \quad B_3 = \frac{1}{\sigma_X} + \frac{1}{\sigma_Y} \frac{\lambda_{LX}}{\lambda_{LY}} \tag{24}$$

We may note that the DEL is unaffected by changes in relative commodity prices, although its location will be altered by changes in the levels of the long-run distortion parameters.

Assuming commodity prices to be fixed, we now have three loci to locate in the Edgeworth-Bowley box, with the elasticity of each given by B_i/A_i $(i = 1,3)$. We may note first that at any point of long-run equilibrium all three must intersect; moreover, at such a point the difference between their slopes has the same sign as the difference between their elasticities. For example, the sign of the difference in slope between KMEL and LMEL is given by:

$$\frac{B_1}{A_1} - \frac{B_2}{A_2} = - \frac{1}{A_1 A_2} \frac{1}{\sigma_X \sigma_Y} \frac{1}{\lambda_{LX} \lambda_{KY}} \lambda . \theta$$

By carrying out similar comparisons between the elasticities of KMEL, LMEL and DEL, the following relationships between the slopes of the three loci, at any point of long-run equilibrium, may be established:

$$\lambda . \theta > 0: \quad 0 < \left.\frac{dK_X}{dL_X}\right|_{KMEL} < \left.\frac{dK_X}{dL_X}\right|_{DEL} < \left.\frac{dK_X}{dL_X}\right|_{LMEL} \tag{25}$$

$$\lambda . \theta < 0: \quad \left.\frac{dK_X}{dL_X}\right|_{KMEL} > \left.\frac{dK_X}{dL_X}\right|_{DEL} > \left.\frac{dK_X}{dL_X}\right|_{LMEL} > 0 \tag{26}$$

Finally, by comparing the elasticities of KMEL and LMEL with the elasticities of rays from the two origins of the Edgeworth-Bowley box (the elasticity of a ray from O_X, expressed in terms of $\hat{K}_X$ and $\hat{L}_X$ is 1, while the corresponding elasticity of a ray from O_Y is $\lambda_{LX} \lambda_{KY}/\lambda_{LY} \lambda_{KX}$), the following additional relationships may be derived for <u>any</u> point G along KMEL and <u>any</u> point H along LMEL (not just long-run equilibrium points):

$$\lambda \gtrless 0 : \left.\frac{dK_X}{dL_X}\right|_{O_XG} \begin{matrix} < \\ > \end{matrix} \left.\frac{dK_X}{dL_X}\right|_{KMEL} \begin{matrix} < \\ > \end{matrix} \left.\frac{dK_X}{dL_X}\right|_{O_YG} \qquad (27)$$

$$\text{and} \qquad \left.\frac{dK_X}{dL_X}\right|_{O_XH} \begin{matrix} < \\ > \end{matrix} \left.\frac{dK_X}{dL_X}\right|_{LMEL} \begin{matrix} < \\ > \end{matrix} \left.\frac{dK_X}{dL_X}\right|_{O_YH}$$

We are now in possession of all the information necessary to construct a phase diagram of the adjustment process in the Edgeworth-Bowley box. Figure 3.1 presents the case where sector X is capital-intensive in the physical sense (λ <0), and where the rankings of the two sectors by physical and value factor intensities correspond ($\lambda.\theta$ >0). For all points other than the long-run equilibrium point, E, the directions of movement are shown by the arrows. These may be verified by reference to equations (18) and (20), and are in any case intuitively plausible. For example, an upward movement away from any point on the KMEL implies an increase in the capital-labour ratio in X and a decrease in that in Y; at constant commodity prices this implies a fall in the rental in X and an increase in that in Y; hence capital is encouraged to move out of the X sector into Y. The direction of labour migration at all points off the LMEL may be established in a similar manner. The final conclusion to be drawn from the figure is that the equilibrium at E is globally, as well as locally, stable.

Precisely the opposite conclusion is drawn from Figure 3.2, however, where the physical and value factor intensity rankings of the two sectors differ. At the equilibrium point F, the KMEL cuts the DEL from below, while the LMEL cuts it from above. As a result, the point F is a saddle-point: there is one knife-edge path, indicated by the dotted line JJ', along which factor allocations converge towards F. But this path is itself unstable: the slightest divergence from it leads to a cumulative movement away

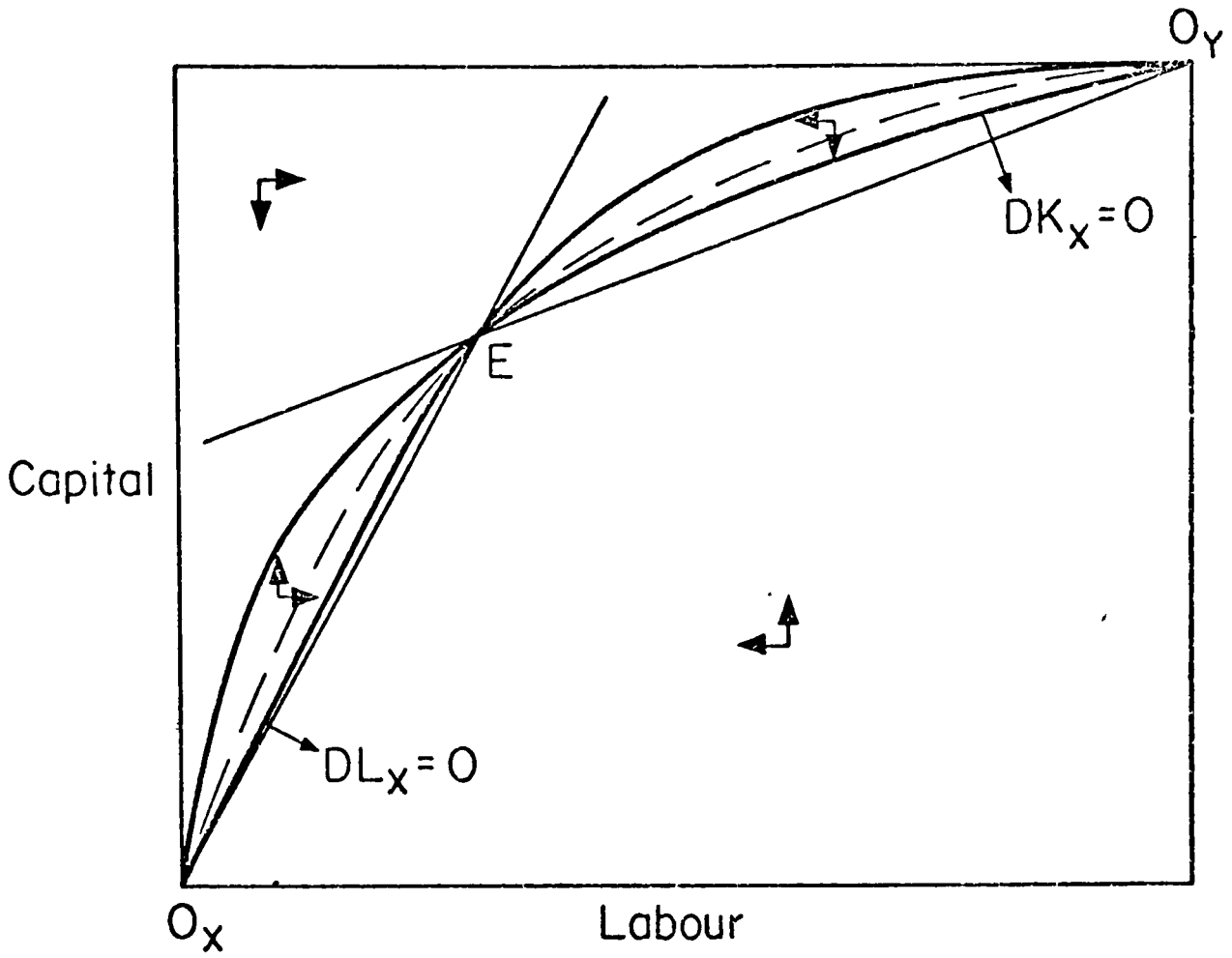


Figure 3.1: Phase diagram when the value and physical factor intensity rankings are the same

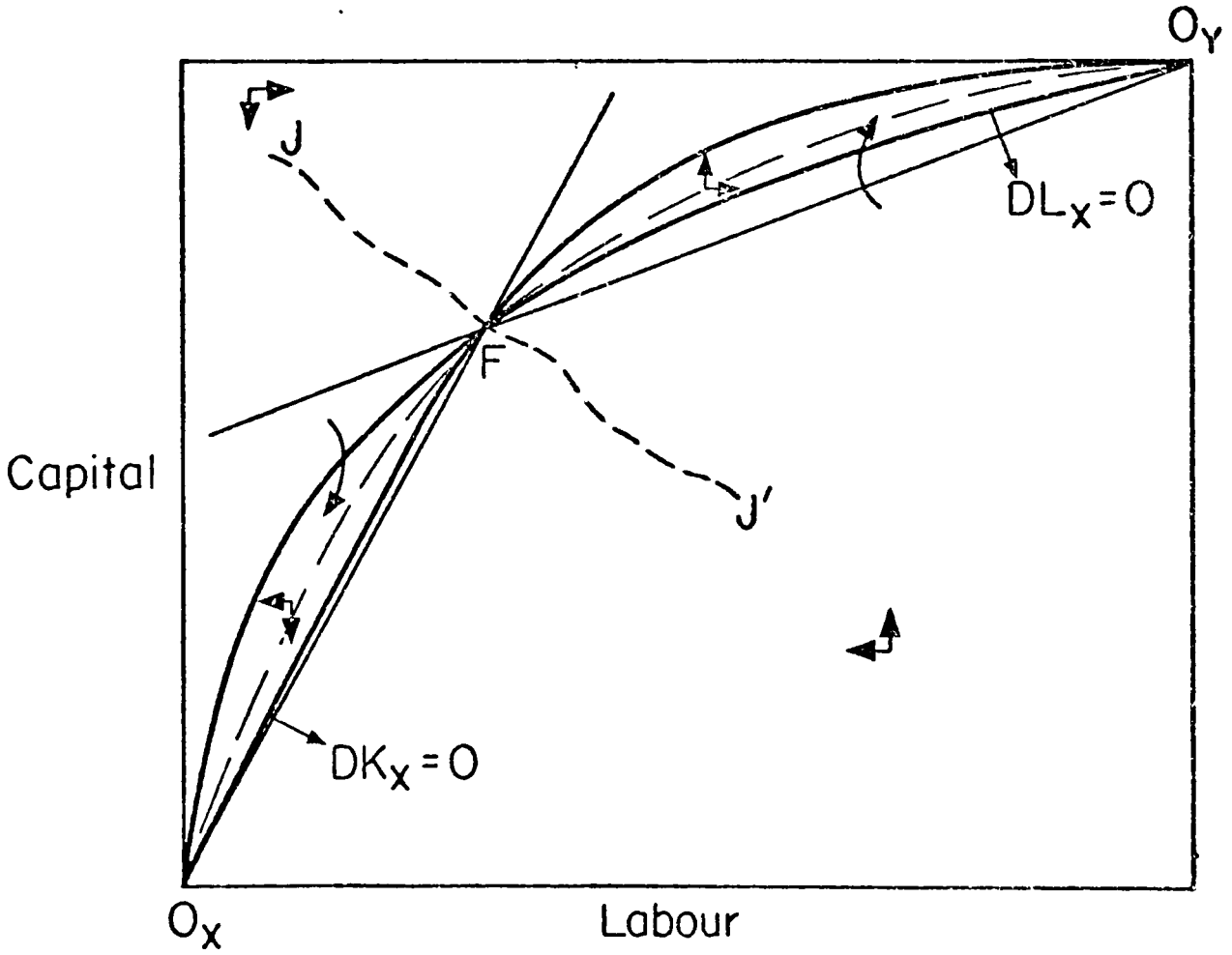


Figure 3.2: Phase diagram when the value and physical factor intensity rankings differ

from F. Hence, while the condition $\lambda.\theta < 0$ does not precisely imply global instability, equilibria where this condition is met are likely in practice to be highly unstable.

Two special cases of the general adjustment mechanism may be mentioned in passing. The first, where the labour force is assumed to be reallocated instantaneously, is simply the short-run capital specificity adjustment process of Chapter 2 and Section 3.2. Only points along the LMEL in Figures 3.1 and 3.2 are now admissible, and it is clear that point E in Figure 3.1 is still globally stable, while point F in Figure 3.2 is now globally unstable, thus reinforcing the conclusions of Section 3.2. The second special case is where capital goods are sector-specific in the long run (or, more plausibly, "capital" in each sector is a different fixed factor, for example, plant and machinery in the manufacturing sector X, and land in agriculture Y, as in Jones, 1971b). In this case, it may be seen that no instability problem arises, even in Figure 3.2. We may conclude therefore, that the comparative static paradoxes, and the associated problem of instability, arise only when <u>both</u> capital and labour are assumed to be intersectorally mobile in the long run.

Having shown that, when the rankings of sectors by physical and value factor intensities differ, the economy will not move towards the new equilibrium predicted by the comparative static analysis, we must now establish where it will tend towards. In brief, the answer is: either towards a <u>specialised</u> equilibrium, or towards a new non-specialised equilibrium where the initial ranking of the sectors by <u>value</u> factor intensity has been reversed, so that the physical and value rankings now coincide. To illustrate this, refer back to Figure 3.2. As the diagram is drawn, all paths other than those starting along the line JJ' converge towards either O_X or O_Y, implying that the economy specialises in good Y or good X

respectively. Nevertheless, it is possible that the process of factor reallocation may reverse the value factor intensity ranking of the sectors, in which case a new, stable, long-run equilibrium may be attained at some point other than F on the DEL. At such a point, both the KMEL and the LMEL would again intersect the DEL, and a local stability analysis similar to that of Figure 3.1 would be appropriate. However, if this reversal does not occur (for example, it cannot occur if both production functions are Cobb-Douglas), then the factor reallocation will continue until the economy specialises in the production of one or other good.

Finally, it may be mentioned in passing that, in addition to their use in stability analysis, the factor market equilibrium loci may also be used to provide simple geometric proofs of a number of results in the theories of international trade and tax incidence. As an illustration, consider the question of the monotonicity of factor adjustments following exogenous changes, as recently studied by Kemp, Kimura and Okuguchi (1977). Figure 3.1 shows that the region bounded by the KMEL and the LMEL is a region of monotonic factor allocation adjustment. For convenience we call this a ROMA.[1] Now, from equations (18),(20) and (23) it may be seen that, following a change in either relative prices or in the level of factor market distortions, one of the three loci is unaffected. (For example, a change in relative prices does not affect the DEL; a change in the level of the labour market distortion parameter does not affect the KMEL; etc.). Hence the initial long-run equilibrium (i.e., that which prevails before the change) lies within or on the boundary of the post-change ROMA. It follows therefore that the path taken by sectoral factor allocations towards the new long-run equilibrium must be monotonic.

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1. The mnemonic is doubly appropriate, since with fixed prices all roads (paths) in the Edgeworth-Bowley box lead to ROMA.

3.4 Pre-Existing Distortions and Stability of Equilibrium when Commodity Prices are Variable

So far we have been exclusively concerned with a small open economy, where prices are parametrically given. However, the adjustment processes just considered may also be applied to examine the stability of equilibrium when commodity prices are variable. To investigate this we follow Jones (1965 and 1971a) and assume that the aggregate demand function, in differential form, is given by:

$$\hat{X} - \hat{Y} = -\sigma_D (\hat{p}_X - \hat{p}_Y) \qquad (28)$$

This may be interpreted as referring to a closed economy where aggregate preferences are homothetic, in which case the parameter σ_D is the elasticity of substitution in demand. Equation (28) could alternatively be interpreted as a composite demand function, representing the combined effects of home and foreign demand in an economy which possesses some monopoly power in international trade. In both cases we assume that σ_D is positive.

In addition to specifying the demand function (28), we assume that relative commodity prices move instantaneously to clear the commodity market at all times. This assumption is partially relaxed in Section 3.6, but it is necessary if the model is to be confined to two differential equations, thus permitting the use of phase diagram analysis. When this assumption is made, equation (28) may be equated with the economy's aggregate supply function, written (in differential form) as a function not of relative commodity prices, but of the allocations of factors to each sector:

$$\hat{X} - \hat{Y} = \theta_{LX}\hat{L}_X + \theta_{KX}\hat{K}_X - \theta_{LY}\hat{L}_Y - \theta_{KY}\hat{K}_Y \qquad (29)$$

Using (17) and (10) to eliminate $\hat{L}_Y$ and $\hat{K}_Y$, this becomes:

$$\hat{X} - \hat{Y} = B_L \hat{L}_X + B_K \hat{K}_X \tag{30}$$

where $B_L = \theta_{LX} + \theta_{LY} \frac{\lambda_{LX}}{\lambda_{LY}}$ and $B_K = \theta_{KX} + \theta_{KY} \frac{\lambda_{KX}}{\lambda_{KY}}$

Combining (28) and (30) with (18) and (20) yields differential expressions for the two factor market equilibrium loci which take into account the endogenous changes in relative commodity prices:

KMEL: $$-A_4 \hat{K}_X + B_4 \hat{L}_X = 0 \tag{31}$$

where: $$A_4 = \frac{B_K}{\sigma_D} + \frac{\theta_{LX}}{\sigma_X} + \frac{\theta_{LY}}{\sigma_Y} \frac{\lambda_{KX}}{\lambda_{KY}}$$

and: $$B_4 = -\frac{B_L}{\sigma_D} + \frac{\theta_{LX}}{\sigma_X} + \frac{\theta_{LY}}{\sigma_Y} \frac{\lambda_{LX}}{\lambda_{LY}}$$

LMEL: $$A_5 \hat{K}_X - B_5 \hat{L}_X = 0 \tag{32}$$

where: $$A_5 = -\frac{B_K}{\sigma_D} + \frac{\theta_{KX}}{\sigma_X} + \frac{\theta_{KY}}{\sigma_Y} \frac{\lambda_{KX}}{\lambda_{KY}}$$

and: $$B_5 = \frac{B_L}{\sigma_D} + \frac{\theta_{KX}}{\sigma_X} + \frac{\theta_{KY}}{\sigma_Y} \frac{\lambda_{LX}}{\lambda_{LY}}$$

Before discussing the phase diagrams implied by these equilibrium loci, we pursue a formal analysis of local stability. Taking a Taylor series approximation to the adjustment functions (13) and (14) in the neighbourhood of a long-run equilibrium point (K_X^o, L_X^o), and substituting from (31) and (32) gives the following matrix equation:[1]

$$\begin{bmatrix} DK_X \\ DL_X \end{bmatrix} = \begin{bmatrix} -A_4 & B_4 \\ A_5 & -B_5 \end{bmatrix} \begin{bmatrix} K_X - K_X^o \\ L_X - L_X^o \end{bmatrix} \tag{33}$$

1. To avoid notational clutter, the elasticities of the adjustment functions are set equal to unity. This does not affect any of the conclusions drawn from (33).

Since the diagonal terms are negative, a necessary and sufficient condition for local stability is that the determinant of the coefficient matrix in (33) be positive. This yields the condition:

$$\text{Det} = A_4B_5 - A_5B_4$$

$$= \frac{1}{\sigma_D\sigma_X\sigma_Y} \frac{1}{\lambda_{LY}\lambda_{KY}} (\sigma_D \lambda.\theta + \sigma_X Q_X + \sigma_Y Q_Y) > 0 \quad (34)$$

where: $Q_X = \lambda_{LX} \theta_{KX} + \lambda_{KX} \theta_{LX}$

and: $Q_Y = \lambda_{LY} \theta_{KY} + \lambda_{KY} \theta_{LY}$

Hence, the stability condition we seek (assuming that σ_D, the elasticity of substitution in demand, is positive) is that the bracketed expression in (34) be positive. This expression, which we denote by σ, has been termed by Jones (1965) the economy's "aggregate elasticity of substitution". Its importance for the comparative static results of the two-sector model is well known, but its crucial role in affecting stability does not appear to have been noted by previous writers. Note that the stability criterion for the fixed prices model of Sections 3.2 and 3.3 is a special case of (34), corresponding to the limiting value as σ_D tends to infinity.

While the local stability criterion, $\sigma > 0$, is just as convenient as that for the small open economy model, $\lambda.\theta > 0$, the analysis of global stability is more complicated when prices are variable, since there is no guarantee that either factor market equilibrium locus will slope upwards (i.e., the off-diagonal terms in the coefficient matrix in (33), A_5 and B_4, are of indeterminate sign). There are now three configurations which the phase diagram may exhibit in the neighbourhood of a long-run equilibrium point: (i) both loci may slope upwards; in this case the analysis of Figures 3.1 and 3.2 is directly applicable: the equilibrium will

be locally stable if and only if the KMEL cuts the DEL from above and the LMEL cuts it from below;

(ii) one locus may be upward-sloping and the other downward-sloping; in this case condition (34) is necessarily fulfilled and the equilibrium is locally stable; or

(iii) both loci may be downward sloping; here (34) requires that the slope of the KMEL be greater (i.e. less negative) than that of the LMEL for local stability. Finally, as in Section 3.3, it is quite possible for multiple equilibria to exist, with the two equilibrium loci crossing and recrossing the DEL, implying a succession of alternately stable and unstable long-run equilibria.

3.5 Stability under Adjustment Mechanisms which allow Transitional Unemployment

The stability criteria which have been derived in the preceding sections clearly have important implications for the comparative static properties of the two-sector model. However, a consideration of these is postponed until Section 3.6. In the present section we examine some other plausible adjustment mechanisms, which, unlike those in previous sections, do not assume that wage rates are perfectly flexible in the short run.

Probably the least attractive feature of the adjustment function (14) is its implication that, although no migration between sectors is possible in the short run, the wage in each sector adjusts instantaneously to ensure full employment at all times. This feature is illustrated in Figure 3.3, where, for expositional convenience only, we assume that capital is permanently sector-specific. Starting at an initial long-run equilibrium point A, suppose that the relative price of Y falls. With good X chosen as numeraire (for the purposes of diagrammatic exposition only), the

value marginal product of labour schedule for the Y sector shifts downwards by an amount equal to the proportional fall in price, as shown, implying a new long-run equilibrium at C. The adjustment mechanism assumed in the preceding two sections, equation (14), implies that no movement of labour takes place between sectors in the short run. Instead the wage rate in the X sector remains unchanged, while that in the Y sector falls to w_Y^1, leaving that sector in short-run equilibrium at D, with its employment at the same level as at A.

Clearly this adjustment mechanism implies a high degree of wage flexibility in each sector. For a short-run analysis, especially, it might be more appropriate to assume that some of the burden of adjustment falls on employment rather than on wages. By contrast with (14), therefore, we examine the implications of assuming that labour is perfectly free to move between sectors in the short run, but that the economy-wide wage rate is downwardly sticky (not rigid).[1] On these assumptions, the fall in the relative price of Y would lead in the short run to "frictional" unemployment equal to AE in Figure 3.3. Over time, however, the resulting excess supply of labour causes the wage rate to fall gradually, until long-run equilibrium at C is finally attained.

It is clear from the diagram that this adjustment process is necessarily stable when capital remains sector-specific throughout;

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1. A more general adjustment mechanism, combining elements from both of those discussed in the text, would assume that labour cannot move between sectors in the short run, and that the wage rate is downwardly sticky in each sector. When combined with the assumption that capital is sector-specific in the short run, this leads to a system of four differential equations which, though tedious to solve, implies exactly the same stability criteria as those found in the text. Another adjustment mechanism of this type, assuming that labour cannot move between sectors in the short run, and that the same wage rate prevails in both sectors at all times, has recently been studied by Lapan (1976) in the context of optimal policy intervention over time. However Lapan assumed capital to be sector-specific in the long run.

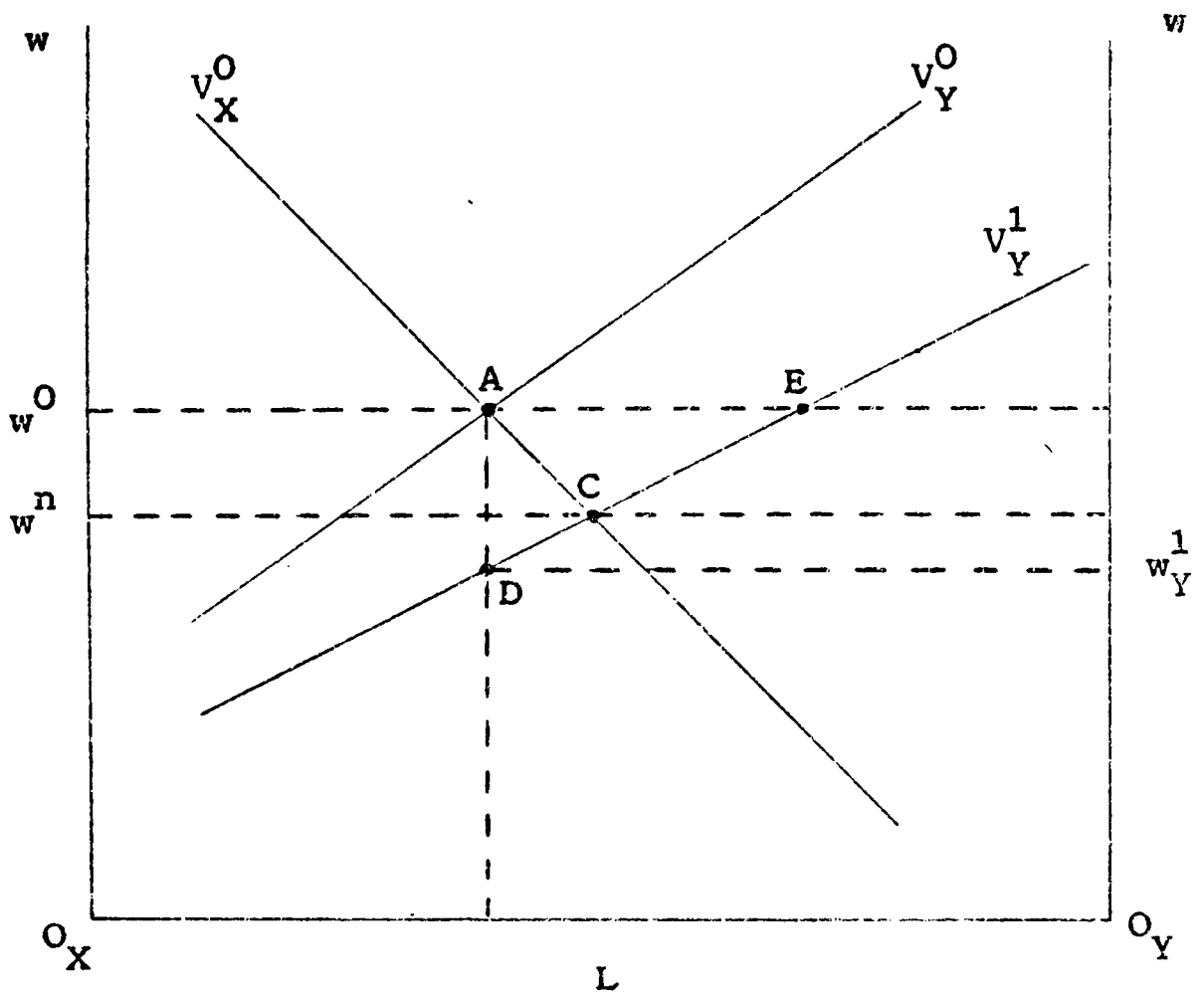


Figure 3.3: Alternative assumptions about labour market adjustment

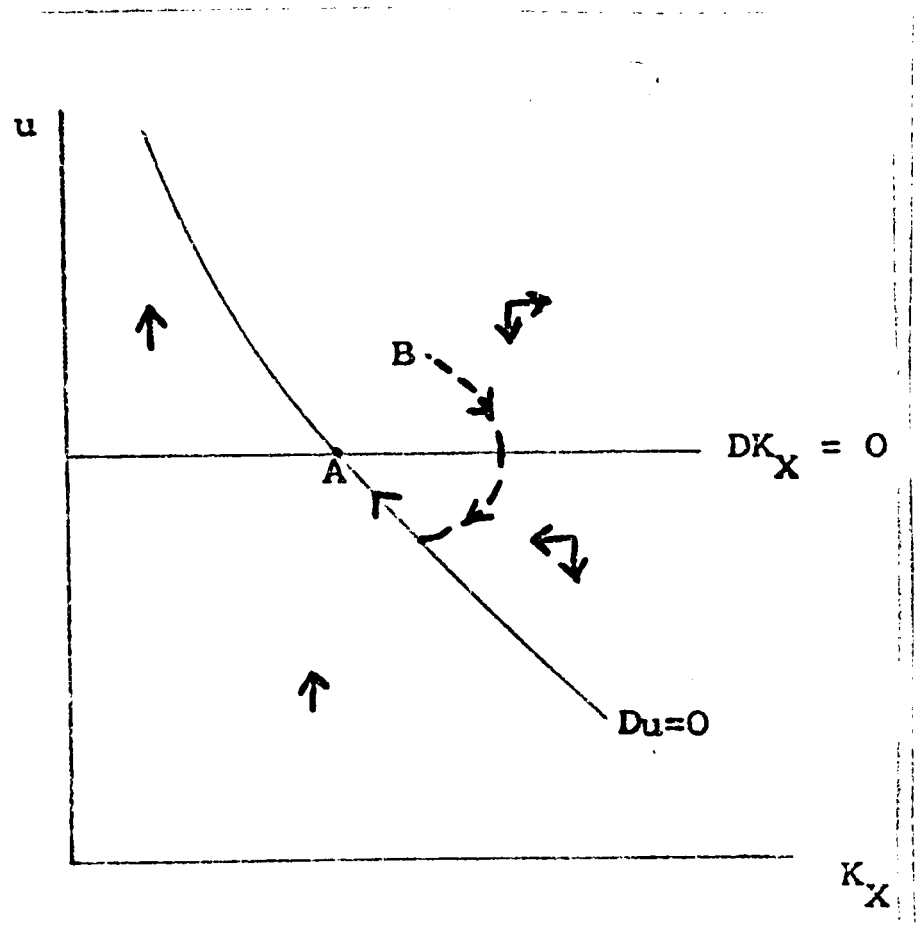


Figure 3.4: Sector X capital-intensive in physical and value terms: $\lambda < 0$, $\theta < 0$.

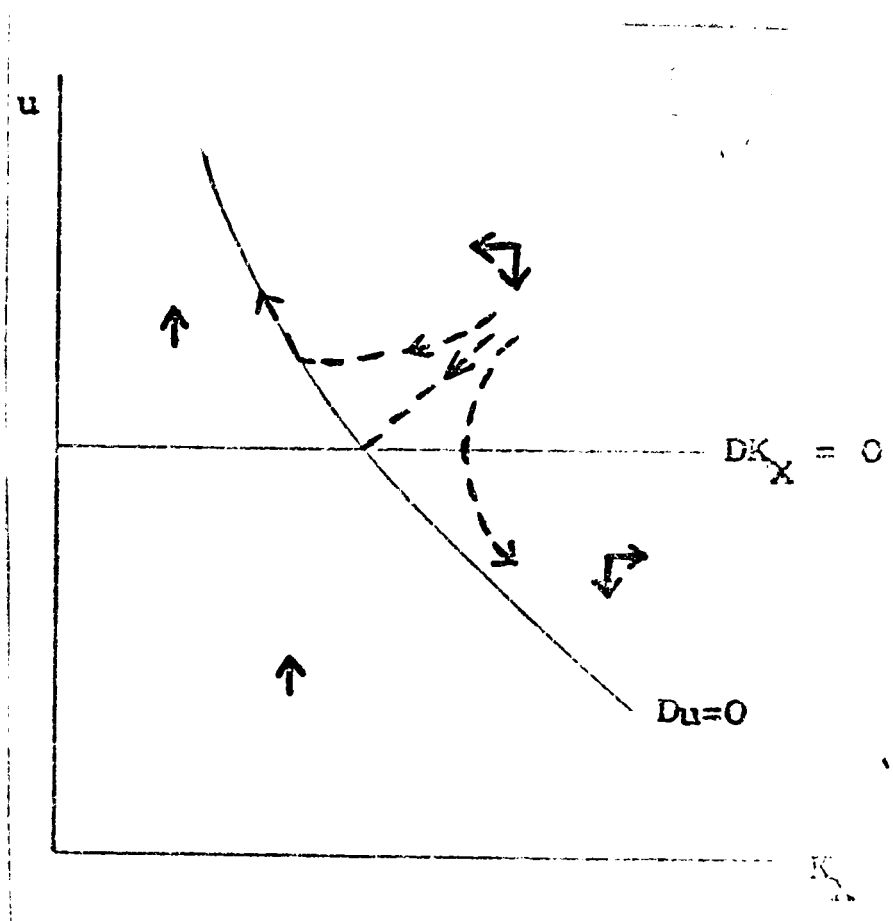


Figure 3.5: Sector X capital-intensive in physical terms, labour-intensive in value terms: $\lambda < 0$, $\theta > 0$.

while if capital begins to adjust only after labour market equilibrium is restored, the analysis of Section 3.2 is directly applicable. However, when both markets adjust simultaneously a new stability analysis is required. To do this, we combine the capital market adjustment mechanism of Section 3.3, equation (13), with the labour market adjustment mechanism just described. Note that this implies the absence of "rental stickiness": Capital remains fully employed at all times, an assumption which seems plausible for all but very large departures from long-run equilibrium.

One minor difficulty which must be faced in formalising the labour market adjustment process is the need to specify a numeraire in terms of which the market wage is assumed to be downwardly rigid in the short run. This problem is most easily overcome by assuming that the representative worker has no non-labour income; this means that the nominal wage equals the representative worker's expenditure which may be written as a function of commodity prices and the utility he attains:

$$w = E(p_X, p_Y, u) \tag{35}$$

Totally differentiating:

$$\hat{w} = \pi \hat{p}_X + (1-\pi) \hat{p}_Y + \frac{E_u u}{E} \hat{u}$$

where π is the budget share of good X. For convenience, we arbitrarily set the utility elasticity of the expenditure function equal to unity, whence we obtain:

$$\hat{w} = \pi \hat{p}_X + (1-\pi) \hat{p}_Y + \hat{u} \tag{36}$$

The level of utility, u, may be identified with the "true" real wages, which is assumed to be downwardly rigid in the short run; and different values of π correspond to different choices of numeraire, ranging from $\pi = 0$ (real wage fixed in terms of Y) to $\pi = 1$

(real wage fixed in terms of X). The dynamic assumption about labour market adjustment may now be written as:

$$Du = \psi \left\{ \frac{L^D}{L} - 1 \right\}, \quad \begin{array}{l} \psi(x) = \infty \text{ when } x > 0 \\ \psi'(x) > 0 \text{ when } x < 0 \\ \psi(o) = 0 \end{array} \qquad (37)$$

where L^D is the aggregate demand for labour by the two sectors, and L is the fixed aggregate labour endowment. Equation (37) may be viewed as a type of "Phillips curve", though since money has no role in this model, the dependent variable is the rate of change of <u>real</u> wages. Note that (37) embodies an asymmetry in adjustment: the real wage rises instantaneously to choke off any incipient excess demand for labour.

As in previous sections, we proceed by expressing the stationary loci of the adjustment mechanisms (13) and (37), as differential functions of the state variables, K_X and u. Beginning with the KMEL, manipulation of equations (5) and (6) show that it may be expressed as:

$$0 = \hat{r}_X - \hat{r}_Y = \frac{1}{\theta_{KX}} \hat{p}_X - \frac{1}{\theta_{KY}} \hat{p}_Y - \frac{\theta}{\theta_{KX}\theta_{KY}} \hat{w} \qquad (38)$$

Substituting for $\hat{w}$ from (36):

$$\text{KMEL:} \quad \theta' (\hat{p}_X - \hat{p}_Y) - \theta \hat{u} = 0 \qquad (39)$$

where $\theta' = \pi\theta_{KX} + (1-\pi)\theta_{KY} > 0$

The elasticities of the LMEL may be derived by differentiating equation (5), holding only the long-run labour market distortion parameter, α, constant:

$$0 = \lambda_{LX} \hat{L}_X + \lambda_{LY} \hat{L}_Y = \lambda_{LX} \frac{\sigma_X}{\theta_{KX}} \hat{p}_X + \lambda_{LY} \frac{\sigma_Y}{\theta_{KY}} \hat{p}_Y - \Delta\hat{w} + \frac{\lambda}{\lambda_{KY}} \hat{K}_X \qquad (40)$$

whence, substituting for $\hat{w}$ from (36):

$$\text{LMEL:} \quad \Delta'(\hat{p}_X - \hat{p}_Y) - \Delta\,\hat{u} + \frac{\lambda}{\lambda_{KY}}\,\hat{K}_X = 0 \qquad (41)$$

$$\text{where} \quad \Delta' = (1-\pi)\,\lambda_{LX}\,\frac{\sigma_X}{\theta_{KX}} - \pi\lambda_{LY}\,\frac{\sigma_Y}{\theta_{KY}} \gtrless 0$$

We are now in a position to examine the stability of these adjustment mechanisms in a small open economy. Considering first local stability, necessary and sufficient conditions for this are that the trace and determinant of the coefficient matrix formed from equations (39) and (41) be respectively negative and positive:

$$\begin{bmatrix} DK_X \\ Du \end{bmatrix} = \begin{bmatrix} 0 & -\theta \\ \frac{\lambda}{\lambda_{KY}} & \Delta \end{bmatrix} \begin{bmatrix} K_X - K_X^{o} \\ u - u^{o} \end{bmatrix}$$

The trace condition is clearly met,[1] while the determinant condition becomes:

$$\text{Det} = \frac{\lambda.\theta}{\lambda_{KY}} > 0$$

This shows that the condition for local stability is identical to that under the full employment labour market adjustment mechanism of Section 3.3.

Turning to global stability, Figure 3.4 illustrates the case where sector X is capital-intensive in both physical and value senses. It can be seen that the path towards long-run equilibrium may exhibit a cycle in both the real wage and the sectoral capital allocation. (By transforming to (u, L^D) space, this may be shown to imply a clockwise lock around a vertical "pseudo-Phillips" curve).

---

1. Note however that the upper left-hand element in the matrix is zero, implying that capital reallocation does not of itself tend to restore the capital market to equilibrium. This reflects the fact that output is indeterminate in a small open economy where the wage rate is downwardly rigid in the long run. See Brecher (1974).

More than one cycle is ruled out, however, by the assumption that in the region of aggregate excess demand for labour (below the LMEL), the real wage adjusts instantaneously; in other words, the real wage is sticky only for downward movements. Figure 3.5 illustrates the case where sector X is relatively capital-intensive in the physical sense, but relatively labour-intensive in the value sense. The locations of the stationary loci are unchanged from Figure 3.4, but the equilibrium is now a saddle point, as in Figure 3.2. Similar diagrams may be drawn for the case where X is relatively labour-intensive in the physical sense: this leads to a positively sloped LMEL, and to an anti-clockwise rather than a clockwise cycle in the stable case, but the stability conclusions are unchanged.

The final issue to be considered in this section is that of stability under the sticky wage adjustment mechanism when commodity prices are variable. The steps in the derivation are identical to those in Section 3.4, and so the details are omitted. First, the aggregate supply schedule (30) is re-expressed as a function of $\hat{K}_X$ and $\hat{u}$ (using (16), (2) and (36)):

$$\hat{X} - \hat{Y} = (B_L + B_K)\,\hat{K}_X + B_L\,\frac{\sigma_X}{\theta_{KX}}\left[(1-\pi)(\hat{p}_X - \hat{p}_Y) - \hat{u}\right] \qquad (42)$$

Next, this supply schedule is equated to the demand schedule (28) to solve for the endogenous change in relative prices:

$$\hat{p}_X - \hat{p}_Y = -\frac{1}{\mu}(B_L + B_K)\,\hat{K}_X + \frac{1}{\mu}B_L\,\frac{\sigma_X}{\theta_{KX}}\,\hat{u} \qquad (43)$$

where: $\mu = \sigma_D + (1-\pi)\,B_L\,\frac{\sigma_X}{\theta_{KX}} > 0$

Finally, (43) is substituted into the two factor market equilibrium loci (39) and (41) to give the final matrix equation:

$$\begin{bmatrix} DK_X \\ Du \end{bmatrix} = \begin{bmatrix} -A_6 & B_6 \\ A_7 & -B_7 \end{bmatrix} \begin{bmatrix} K_X - K_X^o \\ u - u^o \end{bmatrix} \tag{44}$$

where:
$$A_6 = \Delta - \Delta' \frac{B_L}{\mu} \frac{\sigma_X}{\theta_{KX}}$$

$$B_6 = \frac{\lambda}{\lambda_{KY}} - \Delta' \frac{B_L+B_K}{\mu}$$

$$A_7 = -\theta + \theta' \frac{B_L}{\mu} \frac{\sigma_X}{\theta_{KX}}$$

$$B_7 = \theta' \frac{B_L + B_K}{\mu}$$

The trace of the coefficient matrix is necessarily negative since the lower right-hand term is negative by inspection, while the upper left-hand term may be shown to equal a negative expression:

$$-A_6 = -\frac{1}{\mu}\left[\sigma_D \Delta + \frac{\sigma_X}{\theta_{KX}} \frac{\sigma_Y}{\theta_{KY}} B_L \lambda_{LY}\right] < 0 \tag{45}$$

Hence a necessary and sufficient condition for stability is that the determinant of the coefficient matrix be positive. After tedious manipulations, this may be shown to equal:

$$Det = \frac{1}{\mu\lambda_{KY}} \sigma$$

This is exactly the same stability condition as that found in Section 3.4. We have shown therefore that, when combined with short-run capital specificity, the downwardly-sticky wage rate adjustment process has very different implications for the properties of the model while it is out of long-run equilibrium from those of the short-run labour specificity adjustment mechanism of Sections 3.3 and 3.4. Nevertheless, it yields exactly the same local stability criteria both when relative commodity prices are fixed and when they are variable. Hence we may conclude that these

stability conditions: $\lambda.\theta > 0$ when prices are fixed, and $\sigma > 0$ when prices are variable, appear to be relatively robust with respect to alternative specifications of the disequilibrium adjustment mechanism.

3.6 Implications of the Stability Criteria

Evidently, the importance of obtaining stability conditions derives from the fact that we may combine them with Samuelson's Correspondence Principle (Samuelson, 1947, Chap. 9), to assert that, since all empirically interesting equilibria must be stable, long-run equilibria where the stability conditions do not hold will "almost never" be observed.

The implications of the stability condition $\lambda.\theta > 0$ for the theory of factor market distortions in an open economy have already been discussed: the comparative static paradoxes mentioned in Section 2.5 become inconsistent with stable unspecialised equilibrium. This is an encouraging finding, since it eliminates from consideration such blatantly counterintuitive results as perverse price-output and distortion-output responses. However, it is important not to claim too much for this stability condition. For example, as Bhagwati and Srinivasan (1971) and others have shown, there is no necessary relationship between the reversal of physical and value factor intensities and the curvature of the distortion-constrained production possibilities curve. Hence, the stability condition $\lambda.\theta > 0$ does not imply that the transformation curve must be concave to the origin in the neighbourhood of an equilibrium point. Nor does it rule out the possibility that international factor price equalisation may be prevented by the existence of factor market distortions. Furthermore, there are a number of "paradoxes" which are attributable to factor market distortions

but which can occur even when the physical and value factor intensity rankings are the same.[1] Clearly, nothing in the present chapter rules out the possibility of any of these paradoxes.

Turning to the stability criterion for a closed economy, $\sigma > 0$, it is of considerable importance, for the aggregate elasticity of substitution is the key parameter in most of the comparative static derivations for the two-sector model. For example, as shown by Jones (1965, equation (15)), an increase in the aggregate capital-labour ratio will raise the wage-rental ratio if and only if σ is positive: our stability condition therefore rules out "capital-intensity perversities" in the two-sector model with homogeneous capital. It can also be shown (see Neary, 1976) that provided σ is positive the conclusions of Harberger (1962) concerning factor tax incidence in a closed economy and those of Johnson and Mieszkowski (1970) concerning the income distribution effect of unionization continue to hold in a wide variety of circumstances.[2] Finally, this condition may be related to the two-

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1. For example; if a differential is paid by the import-competing sector, free trade may be inferior to no trade (Batra, 1973, p.264); if it is paid by the export sector, an increase in the terms of trade may reduce welfare (op.cit., pp.268-270); and growth may be immiserizing even when the terms of trade are constant and there are no impediments to trade (op. cit., pp.272-273). As noted in Chapter 2, Bhagwati (1973) has shown that all of these paradoxes may be viewed as special cases of the general phenomenon of immiserizing growth.
2. In dicussing their principal equation, Johnson and Mieszkowski (p.550) invoked stability considerations in order to establish the sign of their denominator (which may be shown to be a simple multiple of σ). This is ironic on two counts: firstly, because, contrary to their own claims, Johnson and Mieszkowski implicitly assume zero distortions initially (this was pointed out by Ballentine and Thirsk, 1977), which permits the denominator to be unambiguously signed irrespective of stability; and, secondly, because their appeal to stability involved, not the specification of an explicit dynamic adjustment process, but merely the assertion that if a perverse distortion-output response were observed the original equilibrium must be unstable! Regrettably, this brilliant piece of intuition was not followed up. Most recent writers on tax incidence in the Harberger tradition have simply assumed that σ is positive, despite the fact that this is not guaranteed when initial taxes are non-zero (e.g., Ballentine and Eris, 1975, p.638, Vandendorpe and Friedlaender, 1976, p.219; and Ballentine and

(Cont. page 88).

sector neoclassical growth model of Uzawa (1961): a necessary and sufficient condition for uniqueness of momentary equilibrium in this model is that σ be positive, as Dixit (1975) and others, following Hahn (1965), have shown. The approach adopted here therefore draws attention to the unity of the two-sector framework, whether applied to the theories of public finance, international trade, or economic growth.[1]

A rather different application of this stability condition is the light it throws on the relationship between the so-called Marshallian and Walrasian stability criteria. For example, in examining closed economy equilibria where the aggregate supply schedule slopes downwards, Jones (1971a) assumed that its intersection with the aggregate demand schedule should exhibit Walrasian stability. Such an intersection is shown at C_o in Figure 3.6: the downward-sloping long-run supply schedule S_o cuts the demand schedule D from above, implying that excess demand is positive for prices just below and negative for prices just above the equilibrium price p_o.

Is the stability criterion $\sigma > 0$ satisfied at C_o in Figure 3.6? It is easily seen that it is not. For at that point, the algebraic value of the elasticity of the aggregate demand schedule is less than that of the long run aggregate supply schedule, or in symbols: $-\sigma_D < \sigma_{LRS}$. Invoking the expression for the long-run

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Footnote 2 continued from previous page:
Thirsk, 1977, p.145). The only exception is Homma (1977), who argues, by analogy with the two-sector growth model, that for "causality" (i.e., uniqueness of momentary equilibrium) σ must have the same sign throughout, and opts for a positive sign as the more plausible.

1. The parallel with growth theory is not exact however, since we are comparing a static model exhibiting short-run factor specificity with a dynamic model where capital is instantaneoulsy transferable between sectors. For studies of two-sector growth models with capital specificity, see Inada (1966) and Bosch, Mas-Colell and Razin (1973).

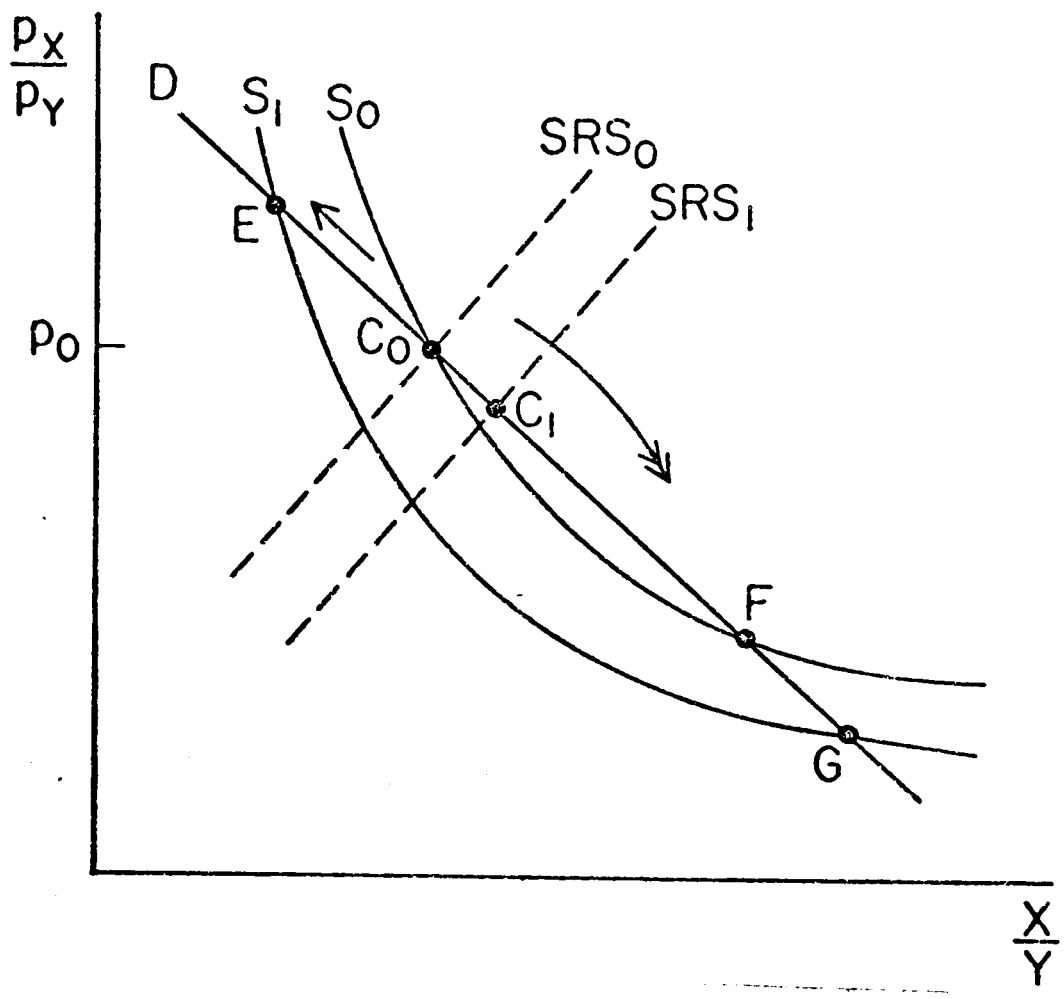


Figure 3.6: Dynamic versus comparative static analyses of the effect of a change in the level of a factor market distortion.

supply elasticity derived by Jones (1965), this may be rewritten as:

$$\sigma_D + \frac{\sigma_X Q_X + \sigma_Y Q_Y}{\lambda.\theta} > 0 \qquad (46)$$

But, since the aggregate supply curve is downward sloping, the term $\lambda.\theta$ is negative. Hence, multiplying (46) by $\lambda.\theta$ reverses the sign of the inequality:

$$\sigma_D \lambda.\theta + \sigma_X Q_X + \sigma_Y Q_Y < 0$$

This shows that the equilibrium at C_o is indeed unstable in the long-run sense. For example, the granting of a subsidy to sector X shifts the long-run supply curve from S_o to S_1, implying that the new long-run equilibrium should be at E (note that the variability of commodity prices does not affect the comparative static prediction of a perverse distortion-output response in the long run). But the adjustment path which the economy actually follows involves a sequence of short-run equilibria, moving down the demand curve in the direction of the double-headed arrow, and converging towards a new stable long-run equilibrium at G. At this point the long-run supply curve cuts the demand curve from below, implying that the stability condition $\sigma > 0$ is indeed fulfilled there. Hence, contrary to Jones, the correct criterion for the stability of long-run equilibrium in this model is that the aggregate supply and demand schedules exhibit Marshallian, not Walrasian, stability.[1]

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1. The implicit assumption made by Jones is that the commodity market is cleared by a tâtonnement price adjustment mechanism, but that factor markets adjust fully to each suggested price announced by the hypothetical auctioneer. But in this bizarre situation, the model would be unstable whenever the aggregate supply schedule were downward-sloping, since factor markets would be adjusting in the face of fixed commodity prices (even though no trading was actually taking place) and so the stability analysis of Section 3.3. would be appropriate.

Does this mean that there is no role for the Walrasian stability criterion? The answer to this is no, for the model must also exhibit Walrasian stability, but this refers to the intersection of the demand curve with the short-run supply curve. A different short-run supply curve is implied by each of the adjustment mechanisms considered. For example, if, as in Sections 3.3 and 3.4, both capital and labour are sector-specific in the short run but remain fully employed, the short-run supply curve is vertical. Alternatively, under the adjustment mechanisms assumed in Sections 3.2 and 3.5, the short-run supply curve is upward-sloping, as shown in Figure 3.6. In the latter case, the effect of increasing the rate of subsidy in the X sector is to shift the short-run supply curve to the right, leading to a new equilibrium at C_1. But, irrespective of the adjustment mechanism assumed, as factor markets move towards long-run equilibrium, the short-run supply curve shifts progressively to the right, tracing out a sequence of short-run equilibria where each short-run supply curve intersects the demand curve. At each of these intersections Walrasian stability must prevail. It should be noted that this analysis is perfectly consistent with the usual explanation for the difference between Marshallian and Walrasian stability (see Blaug, 1968, pp.411-14): that the former assumes it is quantities which adjust out of equilibrium whereas the latter assigns that role to prices. The present section confirms this analysis, and supplements it by showing that under the adjustment mechanisms considered above, the two stability criteria are complementary; since in full long-run equilibrium both must hold, though the Marshallian criterion must be interpreted with respect to the long-run supply curve, whereas the Walrasian criterion is applicable to the short-run supply curve.

Finally, we may ask whether anything may be said about the case where commodity prices do not adjust instantaneously. The

answer is that a full analysis of this case would have to allow for trading at disequilibrium prices, with rationing of agents on the long side of each market. This would therefore introduce dual decision considerations of the kind to be discussed in Chapter 6, and the dynamic analysis of such processes is as yet in its infancy. However the question of local stability may be easily examined using the tools already developed. All that is required is the specification of an additional adjustment equation which states that the commodity price ratio adjusts positively to excess demand in the commodity market:

$$Dp = \xi \left[\left(\frac{X}{Y}\right)^{D} / \left(\frac{X}{Y}\right)^{S} - 1 \right] \qquad \xi' > 0,\ \xi(0) = 0 \qquad (47)$$

where $p = p_X/p_Y$

In order to combine this with (19) and (20), the equilibrium loci of equations (13) and (14), the equilibrium locus of (47) is obtained by equating the aggregate demand and supply schedules (28) and (30). Hence, in the neighbourhood of long-run equilibrium the three adjustment equations may be written as the following matrix equation:

$$\begin{bmatrix} Dp \\ DK_X \\ DL_X \end{bmatrix} = \begin{bmatrix} -\sigma_D & B_K & B_L \\ 1 & -A_1 & B_1 \\ 1 & A_2 & -B_2 \end{bmatrix} \cdot \begin{bmatrix} p - p^o \\ K_X - K_X^o \\ L_X - L_X^o \end{bmatrix}$$

The requirement that the determinant of the coefficient matrix be negative reduces to:

$$-\frac{\sigma}{\sigma_X\ \sigma_Y\ \lambda_{LY}\ \lambda_{KY}} < 0$$

So yet another very different adjustment mechanism yields the same condition for local stability of long-run equilibrium: that the aggregate elasticity of substitution be positive. Exactly the same may be shown when (47) is combined with the sticky wage assumption of Section 3.5. This provides further evidence of the robustness of this stability criterion.

3.7 Summary and Conclusion

This chapter has examined the implications for the theory of proportional factor market distortions of a number of adjustment mechanisms, of which the short-run capital specificity assumption is an interesting special case. It was shown that, whichever of a wide class of adjustment mechanisms is assumed to apply, the existing literature requires modification in a number of respects:

(1) A small open economy (i.e., an economy for whom prices are parametrically given) can never be in a stable unspecialised equilibrium where one sector is relatively labour-intensive in physical terms, but relatively capital-intensive in value terms. This conclusion rules out a number of paradoxical outcomes (such as a "perverse" price-output response) which have received a great deal of attention in the literature on factor market distortions.

(2) A closed economy, or an open economy which has influence over its terms of trade, can be in a stable unspecialised equilibrium where the rankings of the two sectors by physical and value factor intensities do not correspond. The condition for such an equilibrium to be stable is that Jones's "aggregate elasticity of substitution" be positive. This stability condition is important since it permits us to sign unambiguously a great many comparative static results of the two-sector model; and in this case

too, most of the results turn out to be more consistent with simple economic intuition than has been thought.

(3) Finally, contrary to Jones (1971a), when the rankings of the two sectors by physical and value factor intensities differ, the condition for the economy to be in stable equilibrium implies that the intersection of the demand schedule and the long-run supply schedule in relative-price-relative-output space must exhibit Walrasian instability. This is not really a paradox, however, since the supply curve which is downward-sloping in these cases is a long-run supply curve; the situation is thus analogous to that of a long-run equilibrium in a perfectly competitive industry with external economies of scale: there also, the fact that the long-run supply curve is downward-sloping and cuts the demand curve from below, does not in any way imply that the equilibrium is unstable.

One final qualification to the conclusions of this chapter must be noted. It involves what might be called the Ambiguity of the Correspondence Principle: while the assumption of stability is a powerful tool in deducing comparative static results, it may yield different results depending on which particular adjustment mechanism is assumed. Thus all of the conclusions given above are conditional on the particular classes of adjustment mechanism which have been examined. Nevertheless, the apparent robustness of the stability criteria which have been obtained should be noted. It may reasonably be claimed that the various adjustment mechanisms considered above are all "natural" dynamic extensions of the neo-

classical two-sector model.[1] This is supported, for example, by the popularity of the short-run capital specificity adjustment process, which though a special case of those examined in this chapter has been widely used in empirical studies, as well as in the theoretical work of Harberger (1962), Kemp and Jones (1962), Mayer (1974b) and Mussa (1974). Clearly, it would be desirable to develop still more complicated adjustment mechanisms, insofar as the objective is to model the actual process of adjustment towards long-run equilibrium in real-world economies.[2] But for the present it seems reasonable to accept the conclusions derived from the adjustment mechanisms studied in this chapter, with their attractive implication that the long-run predictions of the theory of factor market distortions are much more consistent with simple economic intuition than has been thought.

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1. It is not difficult to devise adjustment mechanisms which reverse the stability implications of those examined in this chapter. Consider, for example, equations (13) and (14) as in the text, except with ϕ' negative instead of positive. This is equivalent to assuming that adjustment in the capital market depends on the degree of disequilibrium in the labour market (i.e., capital flows into the sector where the lower rental and hence the higher wage is being earned), and it is therefore a simple application of the argument with which Patinkin (1965, Appendix to Chap. XII) attacked the generality of the Correspondence Principle. But it is clearly a highly implausible assumption, and the fact that it gives rise to paradoxical comparative static predictions reflects not the Correspondence Principle but the Principle of the Conservation of (Waste) Matter (also known as "Garbage in, garbage out").
2. Among the least satisfactory assumptions of the present model may be mentioned: the absence of any explicit costs to factor reallocation, the assumption that elasticities of substitution in production are no greater in the long run than in the short run, and the lack of consideration given to monetary factors. Moreover, as was noted in Section 2.7, it may be questioned whether the process of capital reallocation can be distinguished even conceptually from that of capital accumulation.

CHAPTER 4

ON THE HARRIS-TODARO MODEL WITH INTERSECTORAL CAPITAL MOBILITY

'Turn again, Dick Whittington'

- traditional

4.1 Introduction

In a pioneering article, Harris and Todaro (1970) presented a simple general equilibrium model consisting of an urban and a rural sector, in which equilibrium is characterised by persistent unemployment in the urban sector. The source of this phenomenon is the equalisation of the expected wage in the urban sector and the actual wage in the rural sector, on the assumption that the urban unemployment rate measures the perceived probability of a rural migrant's finding a job in the urban sector.

Both the positive predictions and the normative implications of the Harris-Todaro (henceforth HT) model differ in important respects from conventional wisdom in development economics and in the theory of international trade. Not surprisingly, therefore, considerable attention has been devoted to the model in each of these fields. While development economists have concentrated on testing and relaxing the underlying labour market assumptions of the model (see, for example, Todaro, 1976, and Fields, 1975), international trade theorists have been concerned with relating its analysis and results to the existing literature on factor market distortions in open economies. Thus, on the welfare side, Bhagwati and Srinivasan (1973, 1974, 1975) have re-examined the welfare implications of the Harris-Todaro model in the light of

the theory of distortions and welfare. While, on the positive side, Corden and Findlay (1975) have extended the model to allow for intersectoral capital mobility, thus bringing it more closely into line with the Heckscher-Ohlin-Samuelson model of international trade theory.

The purpose of the present chapter is to consider further the positive properties of the HT model with intersectoral capital mobility, extending the analysis of Corden and Findlay and examining a number of issues not considered by them. One of these is the question of dynamic stability of equilibrium: HT showed that with sector-specific capital the model is always stable, but when capital is intersectorally mobile this is no longer the case. Another question examined below is the sign of the economy's aggregate supply response; this is relevant to the implications for trade patterns of labour market distortions of the HT kind, a question first analysed by Kreuger (1977). Various other comparative static properties of the model are also explored. In particular, a necessary and sufficient condition is derived for a paradox whose possibility was noted by Corden and Findlay: namely, that an increase in the minimum wage in manufacturing may <u>increase</u> manufacturing output.

The plan of the chapter is as follows: Section 4.2 restates the HT model for a small open economy where capital is sector-specific. Section 4.3 proceeds to the case where capital is intersectorally mobile, and examines the question of dynamic stability of equilibrium. Sections 4.4 and 4.5 then consider the comparative static properties of the model, the former looking at the effects of a change in the level of the minimum wage in manufacturing, and the latter at the effects of a change in prices. Next, the consequences for dynamic stability of assuming that relative prices are endogenous and that land is used in agriculture are examined in

Sections 4.5 and 4.6 respectively. Finally, Section 4.7 summarises the main findings of the chapter, and concludes with a comparison between the HT and other types of factor market distortion, and a general discussion of the significance of assuming that capital is intersectorally mobile. The Mathematical Appendix sketches the derivation of the principal results.

4.2 The Harris-Todaro Model with Sector-Specific Capital

The basic equilibrium condition of the HT model is that the actual wage in the agricultural sector, w_a, equals the expected wage in the urban sector. The latter in turn is assumed to equal the institutionally given minimum wage in industry, w_m, times the urban unemployment rate, which measures the probability of an urban job-seeker's obtaining a job in industry. In obvious notation, this may be expressed as:

$$w_a = \frac{L_m}{L_m + U} \, w_m \qquad (1)$$

The wage in agriculture, w_a, is assumed to be perfectly flexible, and to adjust instantaneously to equate demand and supply in the agricultural labour market. With no unemployment in agriculture, therefore, the numbers employed in each sector, and the numbers of urban unemployed, U, must sum to the given aggregate labour endowment L:

$$L_a + L_m + U = L \qquad (2)$$

These equations may be totally differentiated to give equations (3) and (4), which may then be combined to eliminate the change in the level of urban unemployment, dU. This gives equation (5), which expresses the difference between the proportional changes in the two wage rates as a function of changes in employment in each sector and in the overall labour endowment:

$$\hat{w}_a - \hat{w}_m = u\hat{L}_m - \frac{dU}{L_m + U} \qquad (3)$$

where $u = U/(L_m + U)$ is the urban unemployment rate.

$$\lambda_{La}\,\hat{L}_a + \lambda_{Lm}\,\hat{L}_m + \frac{dU}{L} = \hat{L} \qquad (4)$$

$$\hat{w}_a - \hat{w}_m = \frac{\lambda_{La}}{\lambda_{Lu}}\,\hat{L}_a + \hat{L}_m - \frac{1}{\lambda_{Lu}}\,\hat{L} \qquad (5)$$

As in previous chapters the notation used follows that of Jones (1965), the only additional feature being that it is necessary to distinguish between urban unemployment L_m and urban labour force L_u: the ratio between each of these and the total population is given by λ_{Lm} and λ_{Lu} respectively. These two variables and the urban unemployment rate, u, are related by the identity:

$$\lambda_{Lm} \equiv (1 - u)\;\lambda_{Lu} \qquad (6)$$

Equation (5) is not very useful in its present form, since with enterprises maximising profits in both sectors, employment levels will be set to equalise the value marginal product of labour in each sector to the appropriate money wage. Hence the changes in employment in each sector are not independent of changes in wages. To take account of this, we substitute into (5) from equations (7) and (8), which relate the change in employment in each sector to changes in the sectoral value marginal product of labour and to changes in sectoral capital allocations (assuming constant returns to scale to capital and labour in each sector):

$$\hat{L}_a = -\frac{\sigma_a}{\theta_{Ka}}\;(\hat{w}_a - \hat{p}_a) + \hat{K}_a \qquad (7)$$

$$\hat{L}_m = -\frac{\sigma_m}{\theta_{Km}}\;(\hat{w}_m - \hat{p}_m) + \hat{K}_m \qquad (8)$$

(In this section we are assuming that capital is sector-specific, so that the changes in sectoral capital allocations, $\hat{K}_a$ and $\hat{K}_m$, are purely parametric, and are not related in any way).

Substituting into (5), and invoking the "small open economy" assumption in order to set both commodity price changes equal to zero, we obtain:

$$\Delta \hat{w}_a = \lambda_{Lu} \{1 - \frac{\sigma_m}{\theta_{Km}}\} \hat{w}_m - \hat{V} \qquad (9)$$

where:

$$\Delta = \lambda_{La} \frac{\sigma_a}{\theta_{Ka}} + \lambda_{Lu} \qquad (10)$$

$$\hat{V} = \hat{L} - \lambda_{La} \hat{K}_a - \lambda_{Lm} \hat{K}_m \qquad (11)$$

The basic determinant of the sector-specific capital model, Δ, is necessarily positive. Hence equation (9) states that in a small open economy with fixed factor endowments (i.e., $\hat{V} = 0$), an increase in the minimum wage in the urban sector will raise the wage in agriculture if and only if what Corden and Findlay call the manufacturing elasticity (i.e., the absolute value of the wage elasticity of demand for labour in manufacturing), σ_m/θ_{Km}, is less than one.[1] Where this is the case, it follows from equations (7) and (8) that an increase in the urban minimum wage will reduce employment (and hence, output) in both sectors. When the manufacturing elasticity is greater than one, however, an increase in the urban minimum wage will so depress the demand for labour in manufacturing as to encourage migration into the rural sector, increasing employment and output there.

The second term on the right hand side of equation (9), $\hat{V}$, is a composite charge in resource endowments term.[2] It shows that, for a given urban minimum wage, the agricultural wage will increase, and hence agricultural employment will fall, in response to a fall in the total labour force, or an increase in the capital in use in

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1. HT (1970), p.130, claim that this condition is empirically plausible.
2. This term is also found in the sector-specific capital model with no factor market distortions. See Jones (1971b).

the urban sector. However an increase in capital in use in agriculture, while still raising the wage there, will also increase employment, as may be seen by substituting into (7).

The final comparative statics propositions to be derived from this model are the effects of changes in the urban minimum wage and in factor endowments on urban unemployment:

$$\Delta \frac{dU}{L_u} = \left[\lambda_{La} \frac{\sigma_a}{\theta_{Ka}} + \lambda_{Lm} \frac{\sigma_m}{\theta_{Km}} - u \lambda_{La} \frac{\sigma_a}{\theta_{Ka}} \frac{\sigma_m}{\theta_{Km}} \right] \hat{w}_m + \hat{V} \qquad (12)$$

This shows that an increase in the urban minimum wage will normally raise unemployment, although it may lower it if the unemployment rate is already high. A necessary condition for unemployment to fall is that the product of the unemployment rate and the manufacturing elasticity exceed unity:

$$u \frac{\sigma_m}{\theta_{Km}} > 1$$

Clearly, this condition is unlikely to be met. Finally, the last term in equation (12) shows that population growth will increase and capital accumulation (in either sector) will reduce the numbers of urban unemployed.

4.3 Intersectoral Capital Mobility and the Stability of Equilibrium

We now proceed, following Corden and Findlay, to allow for the reallocation of capital between the two sectors. Our main objective is to establish how this affects the comparative statics predictions of the model. However, it turns out that it is necessary, especially in the open economy case, to give careful consideration to the question of stability of equilibrium. This issue is therefore examined in the present section.[1] We continue to assume

1. Stability of the sector-specific capital model of the last section was demonstrated by HT (1970, Appendix 1). See also Section 4.5 below.

that output prices are fixed, which makes it possible to rely exclusively on diagrammatic arguments. The case where output prices are variable requires a more formal stability analysis, and is considered in Section 4.5 below.

Figure 4.1 illustrates the long-run equilibrium allocation of factors between the two sectors, in a situation where industry is capital-intensive relative to agriculture, and where the urban minimum wage is above the competitive level. With fixed output prices and a given urban wage, the capital-labour ratio in industry is determined (this is clear from equation (8), and is implied by the assumption of constant returns to scale). We assume that this capital-labour ratio is that represented by the ray O_mR. Capital market equilibrium requires that the same rental obtain in both sectors; the capital-labour ratio in manufacturing represented by O_mR fixes the rental there, and we assume that for the same rental to be paid in agriculture, the capital-labour ratio there must be that corresponding to the ray O_aS. Fixing the capital-labour ratio in agriculture fixes in turn the wage there, which must be lower than the given minimum wage in manufacturing (since otherwise the latter would not be a strictly binding constraint, and a full employment equilibrium would be possible at point F, which would lie on the undistorted contract curve). Hence, a full equilibrium prevails when manufacturing and agriculture make use of the factor allocations represented by the points C and D respectively, such that the equilibrium level of urban unemployment, CD, equals one minus the ratio of w_a to w_m.

We now inquire into the stability of the process of convergence towards the equilibrium corresponding to the points C and D. Note first, that if the initial allocation of capital and the initial level of the urban labour force correspond to a point to the left of the ray O_mR, the urban wage will be bid up to a higher level

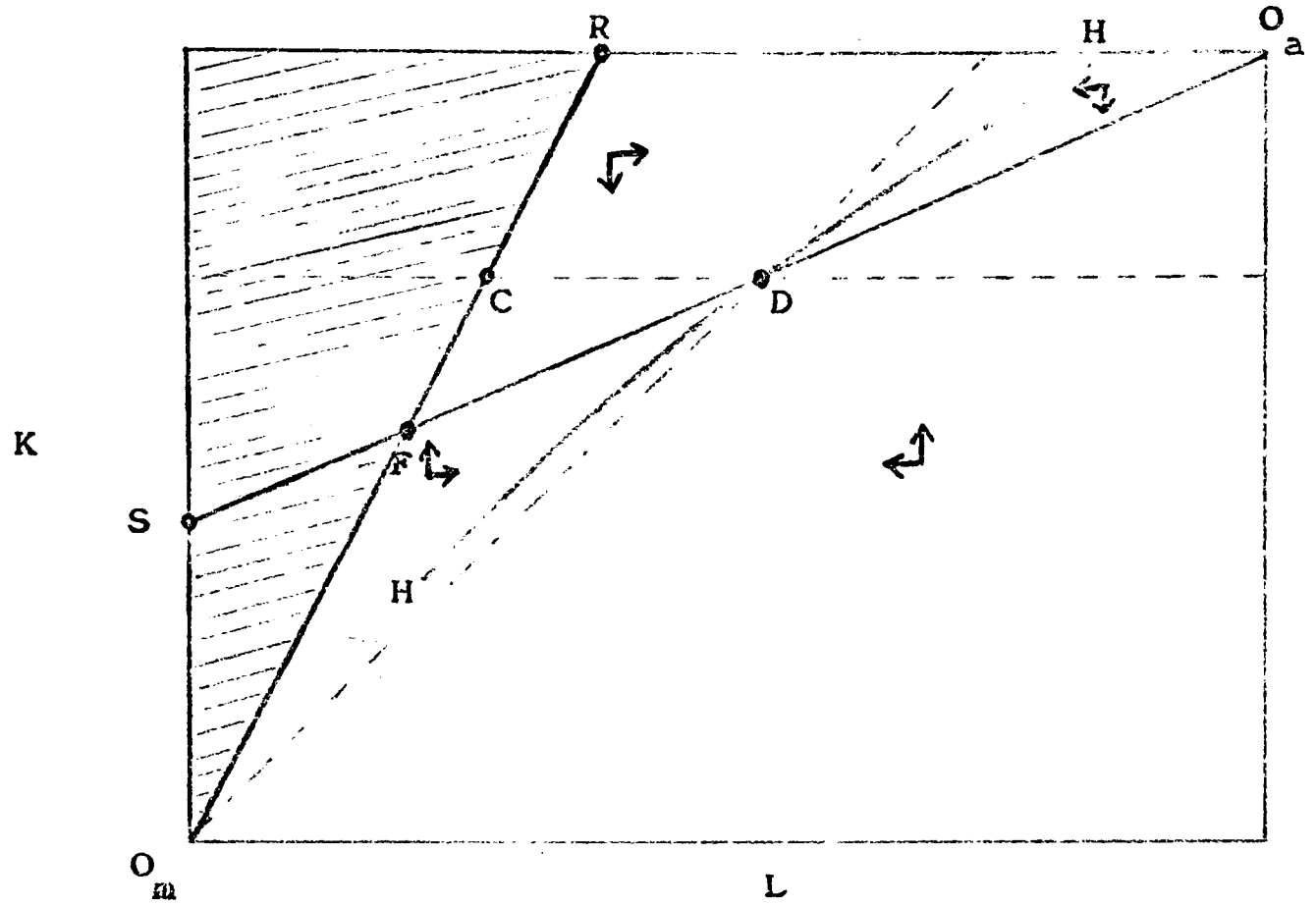


Figure 4.1: Dynamic stability when the urban sector is capital-abundant

than that implied by the capital-labour ratio corresponding to O_mR. It seems most in the spirit of the Harris-Todaro analysis to assume that the urban wage is subject to a ratchet effect; i.e., that once having reached a higher level, it will be prevented by political or trade union pressures from falling below that level. This assumption ensures that if the initial allocation is to the left of O_mR, that ray will itself swing to the left, representing an increase in the urban minimum wage, with a consequent adjustment in the location of the equilibrium point D. In examining the dynamics of the model, therefore, we may assume that any required initial increase in the urban minimum wage has already taken place, and hence confine attention to starting points which are either on or to the right of O_mR (i.e., we ignore the shaded area to the left of O_mR).

Coming next to the explicit adjustment mechanisms, we assume as in Chapters 2 and 3 that capital is always fully employed, and moves between sectors in response to intersectoral differences in rentals:

$$DK_m = \phi\{\frac{r_m}{r_a} - 1\} \quad \phi' > 0, \ \phi(0) = 0 \qquad (13)$$

By construction, the locus of stationary points of this adjustment mechanism, i.e., the locus of factor allocations consistent with capital market equilibrium, is the ray O_aDS, since along this ray the rental in agriculture is equal to the fixed rental in manufacturing. Hence, at all points below this ray, capital is encouraged to move into manufacturing, while at all points above it. it is encouraged to move out of manufacturing and into agriculture; these tendencies are indicated by the vertical arrows in the diagram.

We have already noted that, throughout the adjustment period, the level of employment in manufacturing will lie along the ray

O_mCR, at the point corresponding to the current allocation of capital to that sector. The total labour force in the urban sector, however, will change in response to the differential between the actual wage in agriculture and the expected wage in manufacturing: i.e. in response to deviations from the Harris-Todaro labour market equilibrium condition (1) above:

$$DL_u = \psi\left[\frac{w_m L_m}{w_a L_u} - 1\right] \quad \psi' > 0, \psi(0) = 0 \qquad (14)$$

We may note that (14) is formally identical to the labour market adjustment mechanism (14) in Chapter 3, except that the intersectoral wage differential α is now an endogenous variable. To locate the locus of stationary points of (14) in Figure 4.1, we note first that it must pass through the full equilibrium point D. Now, consider a small movement downwards from D, such that the capital-labour ratio in agriculture rises. This increases the wage in agriculture, so in order to maintain labour market equilibrium with a fixed wage in manufacturing the urban employment ratio L_m/L_u must rise. Below D, therefore, the labour market equilibrium locus must lie above O_mD, which represents a constant urban employment ratio equal to that at D. At the same time, the locus must lie below O_aDS, for otherwise the wage in agriculture is not falling, while the urban employment ratio is. Hence the locus must pass between O_mD and O_aD as shown. By the same argument (which is similar to that used in Section 2.2 above) it may be shown that at any point the locus must be less steeply sloped than the ray from O_m to that point, and more steeply sloped than the corresponding ray from O_a. This establishes that the Harris-Todaro locus must be a line such as HH in Figure 4.1. Points to the right of it represent either a higher agricultural wage or a lower urban employment ratio, or both, and hence lead to migration

out of the urban sector; and conversely for points to the left of it. Once again, these tendencies are represented by the horizontal arrows.

From the two sets of arrows in Figure 4.1, it is clear that the equilibrium at D is both locally and globally stable. However, the situation is very different when the rural sector is relatively capital-abundant, as shown in Figure 4.2. Exactly the same arguments now show that the labour market equilibrium locus is less steep than O_aD, and hence that the equilibrium point D is a saddle point. This means that there is only one locus of initial capital and labour force allocations from which the model will converge towards the equilibrium point D; this knife-edge locus is marked EE in the diagram. From all other starting points the model is unstable; starting at points above EE, that is, initial situations characterised by a relatively large urban labour force or a relatively high proportion of the capital stock in use in manufacturing or both, the model will tend towards specialisation in manufacturing (i.e., the agricultural sector will be eliminated); while from starting points below EE the opposite will take place, i.e., the economy will specialise in agriculture.

Lest it be thought that unstable situations are highly improbable in this model, it should be emphasised that the stability condition refers not to a comparison between the techniques in use in the two sectors in equilibrium, but to a comparison between the relative amounts of the two factors present in the two sectors. In other words, the crucial stability condition is not that manufacturing be capital-intensive relative to agriculture, but that the urban sector be capital-abundant relative to the rural sector. It is quite possible, therefore, for the model to be unstable when manufacturing is capital-intensive relative both to agriculture and to the economy's aggregate factor endowment. Such a case is

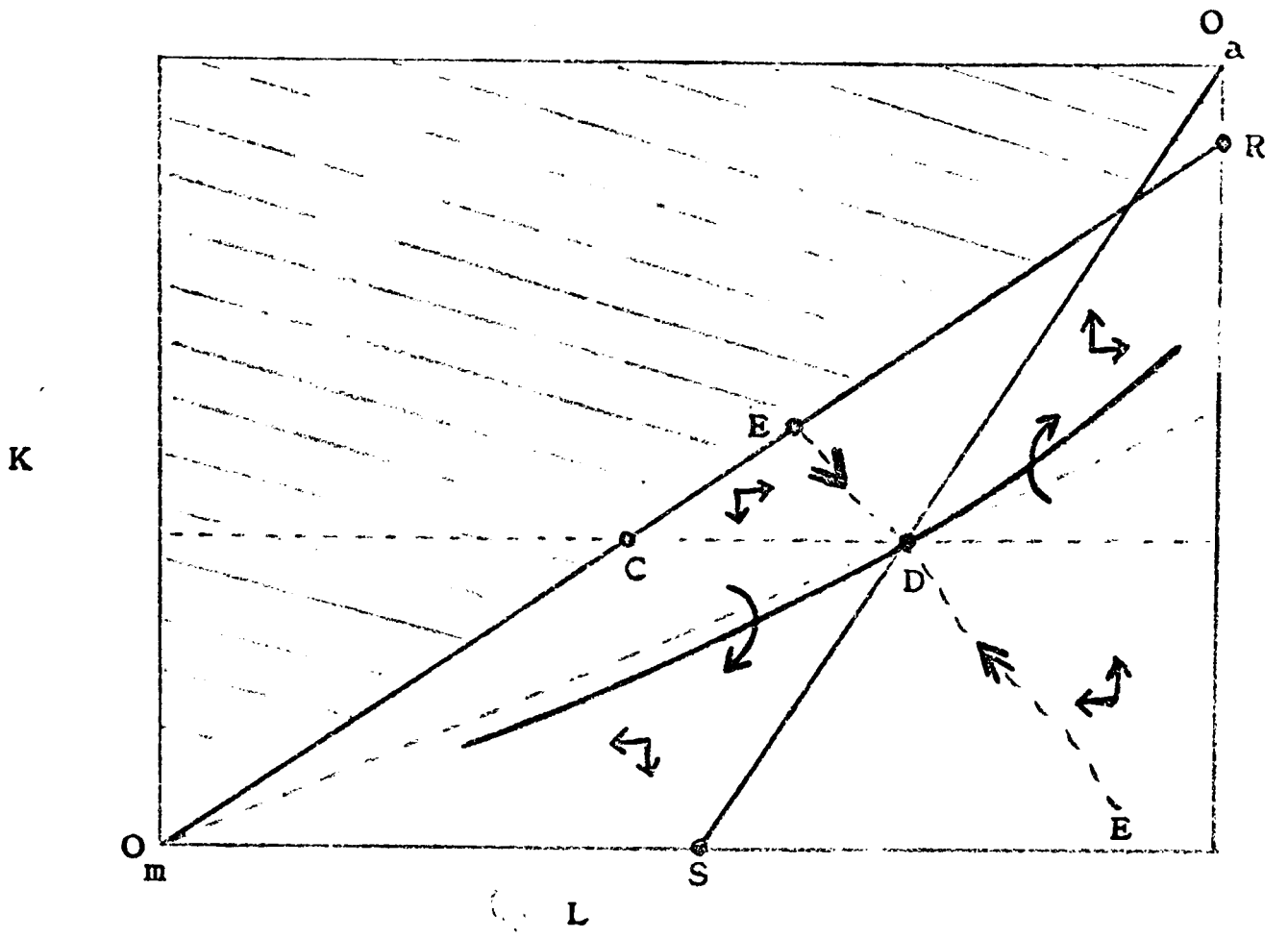


Figure 4.2: Dynamic instability when the urban sector is labour-abundant

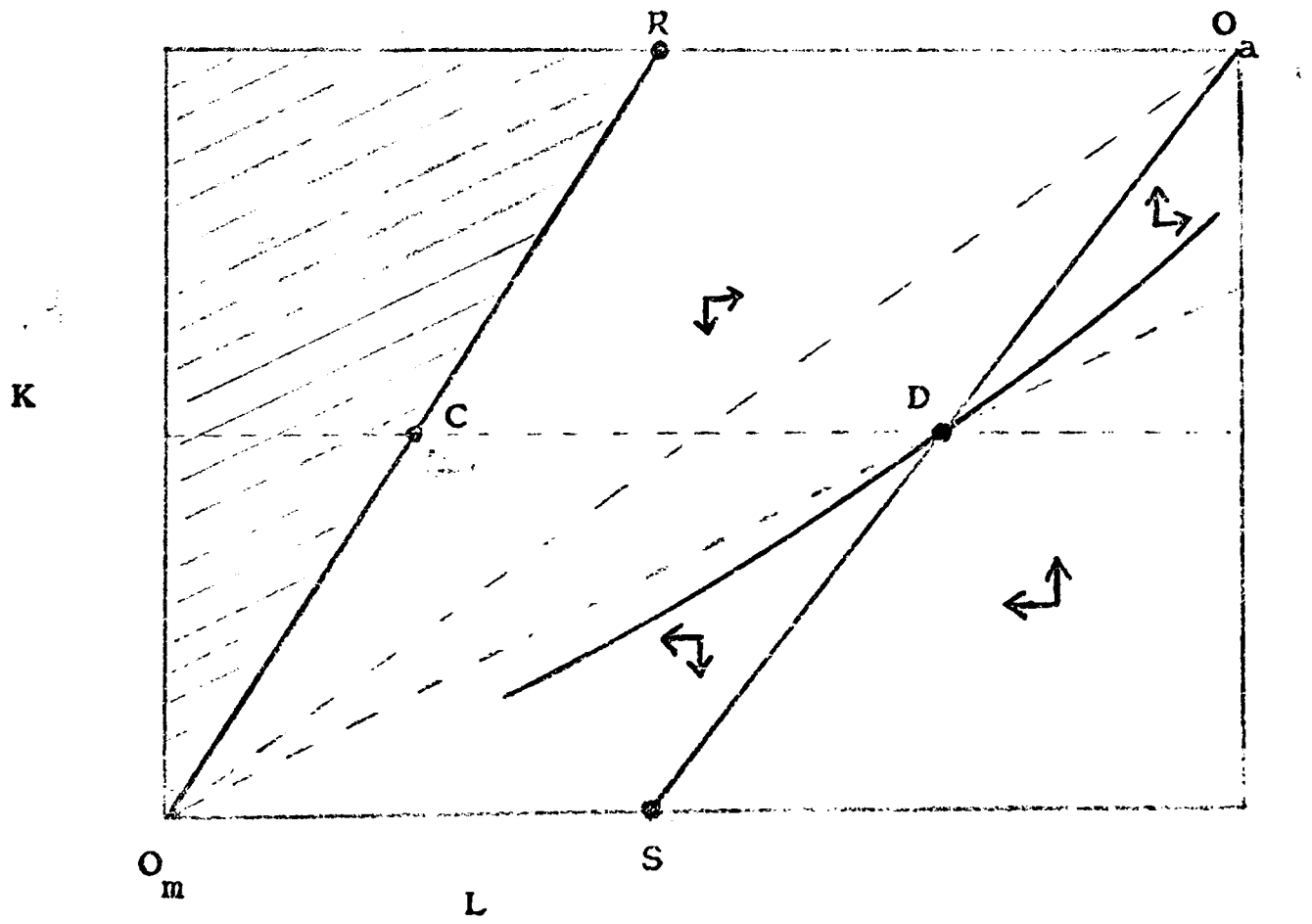


Figure 4.3: Dynamic instability when the urban sector is labour-abundant, even though manufacturing is capital-intensive relative to agriculture

illustrated in Figure 4.3. Here the ray O_mR is steeper than O_aD, indicating that in equilibrium manufacturing is relatively capital-intensive. However instability still arises because point D is below the diagonal of the production box: i.e., the equilibrium ratio of manufacturing sector capital to the urban labour force is less than the equilibrium capital-labour ratio in agriculture. Moreover it is quite possible that, in Figure 4.3, manufacturing is the "naturally" capital-intensive sector, in the sense that with a perfect labour market the "undistorted" contract curve lies above the diagonal of the production box. Conditions necessary for this situation to be consistent with instability will be noted in the next section.

4.4 Comparative Statics: Effects of Changes in the Urban Minimum Wage

Corden and Findlay (op.cit., Sect. ii) showed that when capital is intersectorally mobile, an increase in the urban minimum wage may raise manufacturing output, a paradox which is impossible in the original HT case with sector-specific capital. One purpose of the present section is to supplement their analysis by deriving a necessary and sufficient condition for this paradox. We assume throughout that the urban sector is relatively capital-abundant, since as shown above, this assumption is necessary and sufficient for equilibrium to be stable when relative output prices are fixed.

Figure 4.4 repeats the essential features of Figure 4.1, the initial equilibrium at D being determined by the intersection of the capital market equilibrium locus, O_aS, and the Harris-Todaro, or labour market equilibrium locus, HH. The initial level of urban unemployment is CD. Consider now the effects of an exogenous increase in the urban minimum wage. At constant relative output

prices, this will raise the capital-labour ratio in manufacturing, to an extent dependent on the elasticity of substitution in manufacturing, thus shifting the ray O_mR in a counter-clockwise direction. This means that the rental on capital in manufacturing has fallen, and so to restore capital market equilibrium the rental in agriculture must also fall. Hence the capital market equilibrium locus shifts counter-clockwise from O_aS to O_aS' as shown, the magnitude of its shift depending on the potential for factor substitution (i.e., on the elasticity of substitution) in agriculture. This result may be confirmed by inspecting equation (A.7) in the Appendix.

Next we must consider the effects of an increase in the urban minimum wage on the Harris-Todaro locus, HH. We have already seen in Section 4.2 that when capital is sector-specific, which in Figure 4.4 corresponds to the requirement that all equilibria lie along GG', the change in allocation of the labour force between the rural and urban sectors following an increase in the urban minimum wage depends on the value of the manufacturing elasticity: agricultural employment will rise, as represented by a movement to a point such as T, if this elasticity exceeds unity, whereas it will fall, corresponding to a movement to a point such as W, if the manufacturing elasticity is less than unity. However, the derivations in Section 4.2 which yielded this result (i.e., those preceding equation (9)) made no reference whatsoever to the allocation of the capital stock between the two sectors. It follows therefore, that for any arbitrary allocation of capital between the two sectors, agricultural employment will rise following an increase in the urban minimum wage if and only if the manufacturing elasticity exceeds unity. Hence we may conclude that an increase in the urban minimum wage will shift the labour market equilibrium locus to the right, i.e. to H'H', if the manufacturing elasticity

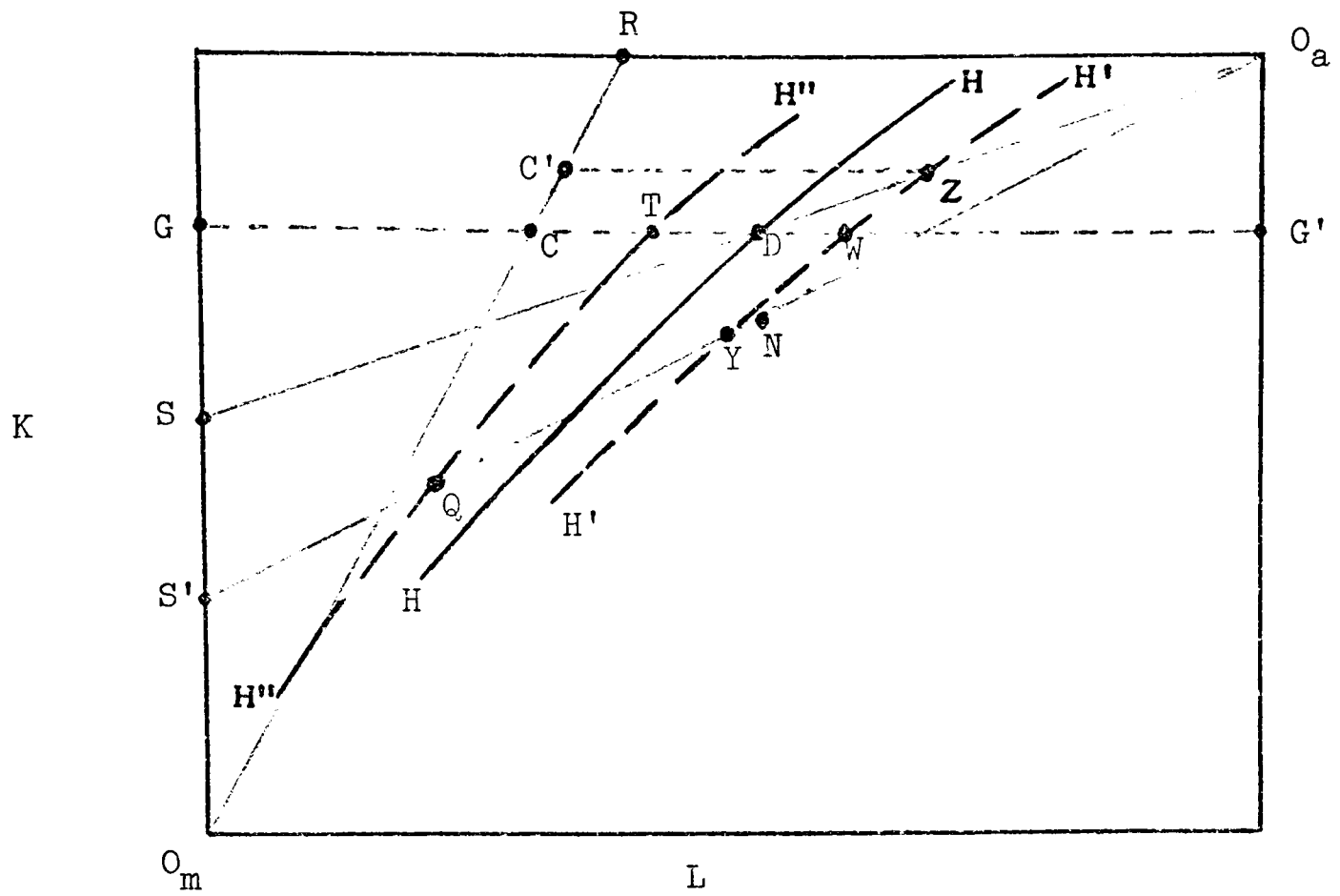


Figure 4.4: Effects of an increase in the urban minimum wage

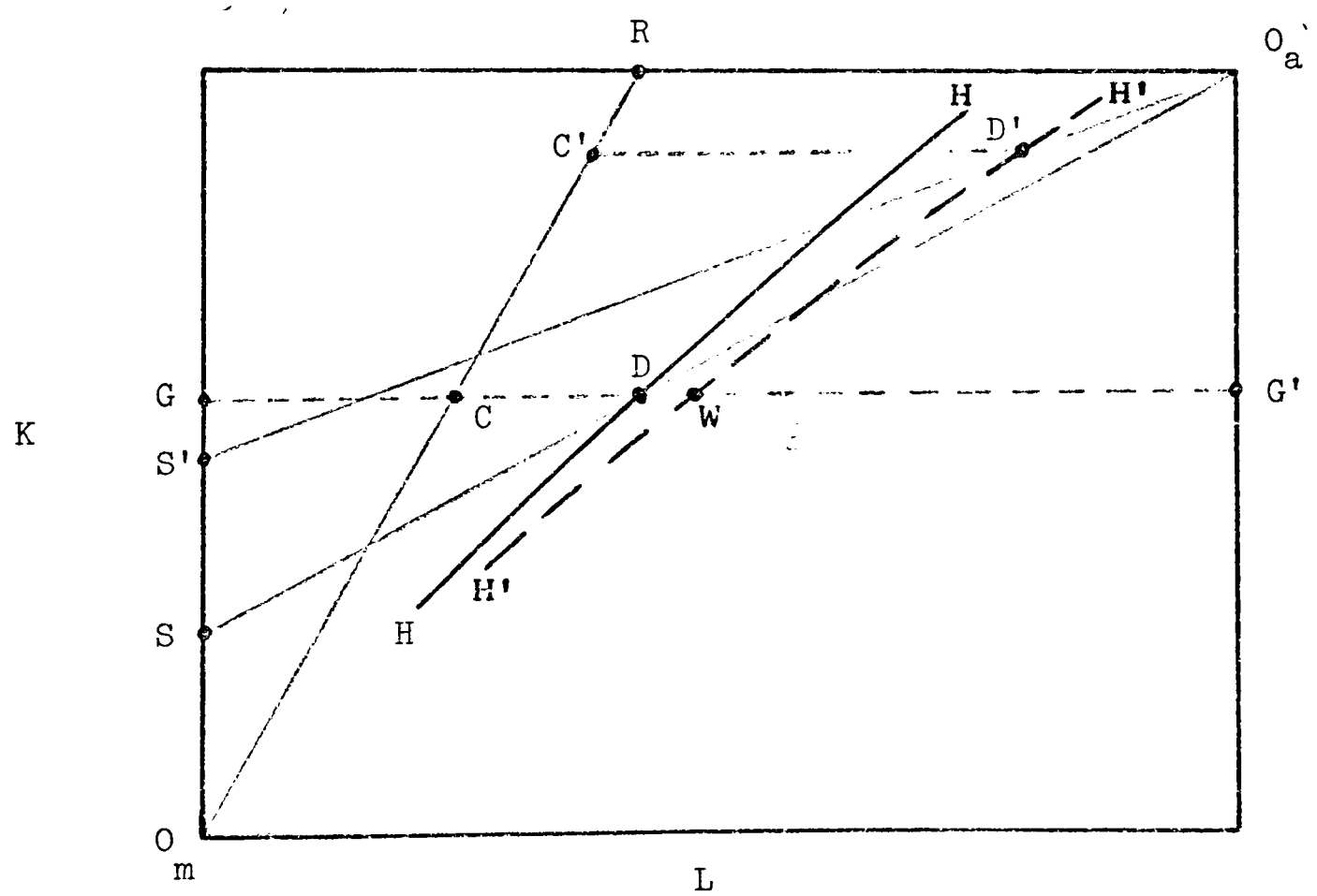


Figure 4.5: Effects of an increase in the relative price of manufactures

is less than unity, and will shift it to the left, i.e., to H''H'', if the manufacturing elasticity exceeds unity. (This, admittedly unrigorous, argument may be confirmed by inspecting equation (A.9) in the Appendix).

Combining the shifts in the two equilibrium loci enables us to locate on the diagram the new equilibrium allocation of factors between urban and rural sectors. Clearly, if the manufacturing elasticity exceeds unity, the new equilibrium must lie in the region O_mSD, implying a movement of both capital and labour into agriculture, as well as a fall in manufacturing output. For any assumed combination of relative adjustment speeds, it is possible to trace out explicitly the path which the economy will follow. Assuming, for example, that labour migrates rapidly and capital relatively slowly, and that the new labour market equilibrium locus is H''H'', the short-run effect of an increase in the urban minimum wage is to move the equilibrium point along GG' from D to T. At the latter point capital is earning a higher rental in agriculture than in manufacturing, and so over time capital will be reallocated into agriculture, implying continued migration out of the urban sector, and causing the equilibrium point to move along H''H'' from T to Q. Note that in this case both the short-run and long-run changes in employment and output levels in each sector are in the same direction.[1]

The same is not necessarily true, however, when the manufacturing elasticity is less than unity, so that the labour market equilibrium locus shifts rightwards to H'H'. In the short run, if

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1. This conclusion is independent of the assumption made about relative adjustment speeds. For example, on the opposite assumption that capital is reallocated instantaneously but labour migrates relatively slowly, the equilibrium will move in the short run from D to N (vertically below D), and as labour migrates the equilibrium will move down O_aS' towards Q. Intermediate assumptions about relative adjustment speeds imply other paths inside the quadrilateral DTQN, along each of which the direction of change in employment and output levels is monotonic.

capital remains sector-specific, the equilibrium moves from D to W: labour migrates into the urban sector, thus lowering agricultural output, and the new migrants swell the ranks of the urban unemployed, since production in manufacturing will be at or to the left of C along GG'. It is conceivable that no subsequent reallocation of capital might be required, i.e., that O_aS' might pass through W. However if O_aS' lies below W as shown, then in the medium run capital will reallocate from manufacturing to agriculture, inducing some return migration from the urban to the rural sector, and moving the equilibrium from W towards Y. In this case, the short-run and medium-run changes in agricultural employment and output are in opposite directions, rendering the net or long-run changes in each indeterminate; however manufacturing employment and output fall (or, at least, do not rise) both in the short run and throughout the adjustment period.[1] Alternatively, if the elasticity of substitution in agriculture is low, the new capital market equilibrium locus will pass above W. In the extreme case where the elasticity of substitution in agriculture is zero, O_aS remains the capital market equilibrium locus, and the new long-run equilibrium point is at Z. Hence in the medium run capital moves out of agriculture, causing the equilibrium point to move along H'H' from W to Z, and inducing continued rural-urban migration. In this case employment and output in agriculture fall in both short and medium runs; however in manufacturing the initial declines in employment and output (implying a move along GG to a point left of C) may be partially or wholly offset by the influx of additional capital from agriculture, which necessitates the

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1. As in the previous footnote, alternative assumptions about relative adjustment speeds imply a range of possible paths between D and Y, all lying within or on the boundary of the quadrilateral DWNY. Recalling the discussion in Section 3.3, it is clear that the non-monotonicity of the adjustment paths arises from the fact that the pre-change equilibrium, D, does not lie within the post-change ROMA, which is the region between the loci O_aS' and H'H'.

hiring of additional workers. If we also assume that the elasticity of substitution in manufacturing is zero, then there is no short-run reduction in employment there, and the manufacturing output point moves along O_mR from C to C'. This is the special case of fixed coefficients in both sectors, when, as Corden and Findlay note, an increase in the manufacturing wage actually raises manufacturing output. However, as they point out, these conditions are excessively stringent, being only sufficient for the paradoxical outcome of a "perverse manufacturing wage-output response". To derive a condition which is both necessary and sufficient, recourse must be had to an explicit algebraic analysis. The approach adopted is indicated in the Appendix, and a derivation similar to that preceding equation (A.15) yields equation (15):

$$\theta_{La}\,\theta_{Km}\,\lambda\,\hat{X}_m = -\left[(\sigma_a\,\lambda_{Ka} + \sigma_m\,\lambda_{Km})\,\lambda_{La}\,\theta_{Lm} - \lambda_{Lu}\lambda_{Ka}\theta\right]\hat{w}_m \qquad (15)$$

The term λ on the left hand side is the determinant of the matrix of factor-to-sector allocations, and is positive if and only if the urban sector is capital-abundant relative to the rural sector:

$$\lambda = \lambda_{La}\,\lambda_{Km} - \lambda_{Lu}\,\lambda_{Ka} = \lambda_{Km} - \lambda_{Lu}$$

It follows from the arguments in Section 4.3 above that this determinant must be positive if the initial equilibrium point is locally stable. The other determinant in (15), θ, is, as in previous chapters, the determinant of the matrix of factor shares, and is positive if and only if the share of capital in manufacturing is higher than that in agriculture:

$$\theta = \theta_{La}\,\theta_{Km} - \theta_{Lm}\,\theta_{Ka} = \theta_{Km} - \theta_{Ka}$$

It is easily checked that λ and θ must have the same sign at a point of long-run equilibrium (provided the same rental on capital is paid in each sector). Hence, equation (15) confirms the finding

of Corden and Findlay (op.cit., p.67) that low (but not necessarily zero) elasticities of substitution work in favour of a perverse manufacturing wage-output response. In addition, the equation shows that this paradox is more likely the greater is θ, i.e. the greater is the difference in factor proportions between the two sectors.

Two other effects of an increase in the manufacturing wage will be briefly considered. The first is its impact on urban unemployment: by substituting from equations (A.6), (A.11) and (8) into equation (4), this is found to be given by:

$$\theta_{La}\,\theta_{Km}\,\lambda\,\frac{dU}{L_u} = \left[\theta\,(\lambda + u\,\lambda_{Lu}\lambda_{Ka}) - u\,\lambda_{La}(\sigma_a\,\lambda_{Ka}\,\theta_{Lm} + \sigma_m\,\lambda_{Km}\,\theta_{La})\right]\hat{w}_m \qquad (16)$$

Comparing (16) with equation (12), it is apparent that, when capital is intersectorally mobile, an increase in the manufacturing wage is more likely to reduce urban unemployment than when capital is sector-specific. In particular, this is more likely the greater the potential for factor substitution in both sectors, and it may occur even when the product of the unemployment rate and the manufacturing elasticity does not exceed unity. Finally, we may note that, starting from an initial equilibrium such as D, which is above the diagonal of the production box, and hence dynamically stable, it is possible for an increase in the manufacturing wage to move the long-run equilibrium to an unstable point below the diagonal. Necessary conditions for this occurrence are: that the manufacturing elasticity be less than unity, and that the elasticity of substitution in the agricultural sector be relatively high.[1]

1. This combination of relatively high substitutability in agriculture and low substitutability in manufacturing was considered empirally plausible by Eckaus (1955), although the source of unemployment in his model is very different from that in the HT model.

This confirms the claim made at the end of the last section that, even when manufacturing is the "naturally" capital-intensive sector, it is possible for a sufficiently high level of the minimum wage to lead to so much urban unemployment that the urban sector as a whole becomes relatively labour-abundant, and so a stable unspecialised long-run equilibrium is ruled out.

4.5 The Effects of Variable Prices

So far, we have followed Corden and Findlay in assuming that relative prices are fixed. In this section we examine two issues which arise when this assumption is relaxed: firstly, the effect of a parametric change in prices; and secondly, the consequences for the stability of the model of assuming (as in the original HT model with sector-specific capital) that prices are endogenously determined by the interaction of supply and demand. We assume throughout that the minimum wage in manufacturing is fixed in terms of manufacturing output; this greatly simplifies the analysis, but, as indicated in the Appendix, the cases where it is fixed either in terms of agricultural goods or in terms of a fixed weight combination of both goods can easily be handled within the same framework.

As in the last section, we begin by examining the effect of a parametric change in relative prices on the location of the two factor market equilibrium loci in the Edgeworth-Bowley box. In Figure 4.5, point D is the initial equilibrium allocation of factors between the urban and rural sectors, manufacturing production takes place at C, and CD is the initial level of urban unemployment. With the manufacturing wage fixed in terms of manufacturing output, a change in relative commodity prices does not affect the relative factor prices faced by the manufacturing

sector; hence that sector's production point will continue to lie along the ray O_mCR. However an increase in the relative price of manufactures will raise the real rental in terms of its own output which must be earned in the agricultural sector to maintain capital market equilibrium, thus lowering the equilibrium capital-labour ratio in agriculture. Hence such a price change causes the capital market equilibrium locus to shift in a clockwise manner, as indicated in Figure 4.5 by the shift from O_aS to O_aS', the extent of the shift being determined by the elasticity of substitution in agriculture. As for the labour market equilibrium locus, the shift in it occasioned by an increase in the relative price of manufactures may be ascertained by inspecting equation (1). This shows that to maintain labour market equilibrium, an increase in the price of manufactures, implying an equal increase in the manufacturing wage, must be offset by either a fall in the urban employment ratio, or by an increase in the agricultural wage (implying the use of more capital-intensive techniques in agriculture). Each of these conditions implies a rightward shift in the locus from HH to H'H'.

Combining these shifts in the two factor market equilibrium loci, it is apparent that the new equilibrium in Figure 4.5 must be at a point such as D', with manufacturing production taking place at C'. Employment and output have increased in manufacturing and fallen in agriculture, and urban unemployment has also risen. As in Section 4.4, the path towards the new equilibrium can be traced out in the diagram, on alternative assumptions about relative adjustment speeds in the two factor markets; and since the initial equilibrium, D, lies within the post-change ROMA (region of monotonic factor adjustment), this path must be monotonic for all relative adjustment speeds. For example, if capital reallocates slowly relative to labour, the price change will give

rise to a short-run migration into the urban sector of DW: all of these new migrants remain unemployed in the short run, and so the only effects of the price rise are a fall in the output of agriculture and a rise in urban unemployment. Over time, however, capital begins to reallocate into the manufacturing sector, thus raising manufacturing output, though also inducing further rural-urban migration.

An explicit expression for the economy's aggregate supply response is derived in the Appendix, and, in the case where the manufacturing wage is fixed in terms of manufacturing output, it is given by:

$$\theta_{La}\ \theta_{Km}\ \lambda(\hat{X}_m - \hat{X}_a) = \left[\sigma_a\ (\lambda_{La}\ \theta_{Ka} + \lambda_{Ka}\ \theta_{La}) + \lambda_{Lu}\ \theta_{Km}\right] \hat{p} \qquad (17)$$

where p is the relative price of manufactures in terms of agricultural output. Two comments may be made on this expression: firstly the economy's aggregate supply response is positive if and only if the urban sector is relatively labour abundant ($\lambda > 0$), i.e., if and only if the stability condition of Section 4.3 is fulfilled. In this respect (and by contrast with the case of a distortion-output response examined in the last section) the present model resembles the Heckscher-Ohlin-Samuelson model with proportional factor price differentials between sectors, in that the hypothesis of dynamic stability of equilibrium is necessary and sufficient to rule out a paradoxical price-output response. (See Chapters 2 and 3 above). Secondly, equation (17) shows that the aggregate supply response is strictly positive even when the elasticity of substitution in each sector is zero. This contrasts with the Heckscher-Ohlin-Samuelson model with or without factor market distortions of the proportional factor price differential kind. (Compare the expression for the aggregate supply elasticity of the latter model in equation (46) of Chapter 3). The reason for this

difference is that in the HT model a change in relative prices changes the equilibrium level of unemployment, and the accompanying intersectoral reallocation of factors permits some "flexibility" in aggregate supply response even when factor proportions used in production in each sector cannot be altered. However, the aggregate supply response is only positive if both factors are intersectorally mobile: in the original HT case with sector-specific capital and the minimum wage pegged in terms of manufactures, a rise in p has no effect on manufacturing output (i.e. production remains at C in Figure 4.5), and merely induces rural-urban migration, thus raising urban unemployment and lowering agricultural output.[1]

The second question to be examined in this section is whether the stability conclusions of Section 4.3 above are affected when (as in the original HT model) the small open economy assumption is dropped, and prices are assumed to be determined endogenously by the interaction of supply and demand. Geometric arguments can be used to suggest that stability will now be more likely: for example, in Figure 4.2, a path starting at point C converges towards O_m, reducing the output of manufactured goods. If relative commodity prices are endogenously determined, the resulting scarcity of manufactures will tend to raise their relative price; from Figure 4.5 above, this will cause the ray O_aS to swing in a clockwise direction, thus making it possible for the path from C to converge towards a stable unspecialised equilibrium. To investigate the question of stability more formally, we must specify a

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1. Thus, with sector-specific capital, the locus of competitive outputs, or the market transformation curve, is a straight line parallel to the agricultural output axis. See the diagrams in Bhagwati and Srinivasan (1973) and Kreuger (1977), and see Eckaus (1955, p.373), and Magee (1976, Chap. 3), for the distinction between "technical" and "market" transformation curves.

demand function and, following HT and Section 3.4 above, we assume for simplicity that aggregate demands depend only on relative prices. Hence:

$$\hat{X}_m - \hat{X}_a = - \sigma_D \hat{p} \qquad (18)$$

where σ_D is the elasticity of intercommodity substitution in demand, assumed to be positive.[1] By equating aggregate demands and supplies and substituting into the two factor market equilibrium loci (see the Appendix for details) the condition for an equilibrium to be locally stable is found to be:

$$\frac{1}{\sigma_D \sigma_a} \left[\sigma_D \lambda \theta_{La} + \sigma_a Q_a + \lambda_{Lu}\right] > 0 \qquad (19)$$

where: $Q_a = \lambda_{La} \theta_{Ka} + \lambda_{Ka} \theta_{La}$

Condition (19) yields a number of alternative sufficient conditions.[2] Firstly, since the only term in (19) which can be negative is the determinant λ, it is clear that, as in Section 4.3, the condition that the urban sector be relatively capital abundant is sufficient for stability. However it is no longer necessary; alternative sufficient conditions which may be derived from (19) by simple manipulation are: (2) $\sigma_D < \sigma_a$; and (3) $\sigma_D < 1/\theta_{La}$. These conditions confirm the heuristic geometric argument already given that a sufficiently high degree of price responsiveness on

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1. The assumptions that demand is independent of the level of income and of its distribution between workers, rentiers and urban unemployed are clearly unrealistic; however relaxing them would complicate the analysis without seriously affecting the conclusions. (For an indication of how these two extensions might be carried out, see Neary, 1976, Chap. 2 and Appendix 2.B above respectively). Equation (18) differs from HT's equation (3) only in notation: their demand parameter ρ' equals (in the notation of the present chapter): $X_a/p X_m \sigma_D$.
2. The bracketed expression in (19) is analogous to the aggregate elasticity of substitution in the two-sector Heckscher-Ohlin-Samuelson model with endogenous prices and factor market distortions of a constant proportional differential kind. It resembles the latter both in that it must be positive for dynamic stability of equilibrium, and in that it equals unity if the elasticities of substitution in both demand and production equal unity. See Jones (1965) and Chapter 3 above.

the demand side (i.e., a sufficiently low value of σ_D) will guarantee stability of the model even when the urban sector is relatively labour-abundant.[1]

4.6 Land in Agriculture

The previous sections have relaxed the assumption (made explicitly by HT) that capital is used in both sectors but is unable to move between them. However, in addition, these sections have assumed away the existence of any fixed factor in agriculture. This is a serious omission, but unfortunately one which is extremely cumbersome to correct. Rather than carrying out a complete analysis of the case where intersectoral mobility of capital is combined with the existence of land in agriculture, the present section outlines the consequences for the stability issue of Section 4.3 of the more general model. The details of the analysis are extremely tedious, and so they are relegated to the Appendix. The purpose of the section is not to give a full analysis of this case, but merely to indicate that the general thrust of the analysis in previous sections is not blunted by the relaxation of this assumption.

As shown in the Appendix, allowing for the presence of land in agriculture necessitates a complete revision of the stability analysis of Section 4.3. Even with the simplifying assumption that relative output prices are fixed, the stability condition

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1. We may note in passing that, when capital is sector-specific, the analysis of stability is considerably more straightforward. Only the labour market equilibrium locus, the second equation in (A.17) in the Appendix, is now relevant, and it no longer contains a term in $K_m - K_m^o$. Hence the stability condition becomes simply that the expression H in (A.17) be negative, and on the assumptions made above this is always satisfied. This stability condition is in fact identical to that derived by HT (op.cit., Appendix 1, equation 1.1).

of that section, $\lambda > 0$, must be replaced by the following expression:

$$\theta_{La}\left[\lambda\ (S_{TL} - S_{TT}) + \lambda_{La}\,\lambda_{Km}\,(S_{TL} - S_{LL}) + \lambda_{Lu}\,\lambda_{Km}\,(S_{KL} - S_{TK})\right] + \lambda_{Lu}\,\lambda_{Km} > 0 \qquad (20)$$

The terms S_{ij} in (20) are the Allen partial elasticities of substitution between factors i and j in agriculture. The sign convention followed here requires that S_{ii} be negative for all i (assuming the production function in agriculture is strictly quasi-concave); but this restriction alone does not permit any unambiguous conclusions to be drawn from (20). In particular, the former stability condition, that the urban sector be relatively capital-abundant, is no longer either necessary or sufficient for stability; although a positive value of λ is at least conducive to stability, provided that $S_{TL} - S_{TT} > 0$, i.e. provided that land is a better substitute for labour than it is for itself. Nor is the question much more clearcut if, following Corden and Findlay, we assume that capital and labour are separable from land in the agricultural production function. This restriction implies:[1]

$$S_{TK} = S_{TL} = S_T > 0$$

Substituting into (20) the stability condition becomes:

$$\theta_{La}\left[\lambda\ (2S_T - S_{TT}) - \lambda_{La}\,\lambda_{Km}\,S_{LL} + \lambda_{Lu}\,\lambda_{Ka}\,S_{KL}\right] + \lambda_{Lu}\,\lambda_{Km} > 0 \qquad (21)$$

In this case a positive value for λ is definitely conducive to stability, but it is still not in general necessary, and it is only

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1. The equivalence between weak separability of the production function and certain equality restrictions on the Allen partial elasticities of substitution is established by Blackorby and Russell (1976). With three factors of production, only one of the three off-diagonal partial elasticities can be negative, whence it follows that if S_{TL} and S_{TK} are equal, their common value cannot be negative.

sufficient for stability if S_{KL} is positive, i.e., if capital and labour are substitutes in agriculture.

Enough has been said to show that the addition of land in agriculture greatly complicates the model, in a manner which does not lend itself to easy summary. The only general conclusion to be drawn is that the possibility of instability is no less likely in this more general case; under plausible conditions, stability is more likely the greater the capital-labour ratio in the urban sector relative to the rural sector, but the simple necessary and sufficient condition of Section 4.3, that the urban sector be relatively capital-abundant, must be abandoned.

4.7 Summary and Conclusion

This chapter has concentrated on the positive aspects of the Harris-Todaro model when capital is assumed to be intersectorally mobile. The main conclusions may be summarised as follows:

(a) When relative commodity prices are fixed (because, for example, the economy is fully open to international trade) and capital and labour are subject to constant returns to scale in agriculture, an unspecialised equilibrium is dynamically stable if and only if the urban sector (i.e., manufacturing plus the urban unemployed) is capital-abundant relative to the rural sector.

(b) Dynamic instability may arise, for a sufficiently high level of the minimum wage in manufacturing, even if the manufacturing sector is at all times capital-intensive relative to agriculture. This outcome is more likely when the potential for factor substitution is relatively low in manufacturing and relatively high in agriculture.

(c) As pointed out by Corden and Findlay, when capital is intersectorally mobile, a higher minimum wage in manufacturing may in-

crease (both absolutely and relatively) the output of manufacturing. This paradox is more likely the smaller the potential for factor substitution in both sectors and the greater the difference between the factor proportions present in the urban and rural sectors.

(d) Provided the initial equilibrium is stable, the economy's price-output response is strictly positive, even when factor substitution is ruled out in both sectors.

(e) The assumption that relative commodity prices are determined endogenously by the interaction of demand and supply (rather than being given parametrically by world markets) reduces the likelihood of dynamic instability of equilibrium, provided demand is assumed to respond negatively to price.

(f) The introduction of a third factor, land, in agriculture greatly complicates the analysis, and makes it impossible to derive simple and clearcut results. However the character of the model is not substantially altered, and, in particular, dynamic stability continues to be less likely, the less capital-abundant is the urban sector relative to the rural sector.

It may be noted that nothing has been said about the welfare and policy implications of assuming that capital is intersectorally mobile. It would be possible to work out detailed comparisons of alternative policies along the lines of the analysis of the sector-specific capital model by Bhagwati and Srinivasan (1973 and 1975). However it seems unlikely that any new insights would be gained by this exercise. The general principles of the theory of distortions and welfare, as applied to the present model by Corden and Findlay (op.cit., Sect. iii), provide an adequate guide to the considerations which should guide policy, if it is thought that the model of the present chapter is empirically relevant.

A different issue which has not yet been considered is the relationship between the Harris-Todaro labour market assumption and the alternative assumption examined in Chapters 2 and 3 of a constant proportional differential between wage rates in different sectors. It might be thought that the key distinguishing feature of the Harris-Todaro model is the assumption that the actual wage in agriculture is equated to the expected wage in the urban sector, since it is clearly this assumption which gives rise to the model's novel prediction of a positive rate of urban unemployment even in long-run equilibrium. However this is not in fact the case: as Bhagwati and Srinivasan have also noted, the key feature of the Harris-Todaro model from many other points of view is not its expectations mechanism, but its assumption of a fixed minimum wage in one sector, and this is especially true in the context of dynamic stability. Thus it is possible to rework the model of the present chapter, replacing the institutionally given minimum wage in manufacturing, w_m, in equation (1) by a constant parameter times the wage in agriculture; this "expectations-augmented" wage differential model may be shown to resemble closely, and to imply the same stability condition as, the usual full employment wage differential model of Chapters 2 and 3. Similarly, the presence of a minimum wage in the labour-intensive sector of a fully employed small open economy necessarily implies dynamic instability, even without the HT expectations mechanism. (See McCulloch, 1974, and see Section 5.3 below for an exposition of this result in a different context). This shows that, especially from a stability point of view, it is essential to distinguish between two different forms of labour market distortion - a parametrically given <u>minimum wage</u> in one sector, and a parametrically given intersectoral <u>wage differential</u> - whereas the presence or absence of unemployment is irrelevant to the issue of stability.

Finally, it must be asked what significance should be attached to one of the main findings of the present chapter: that the Harris-Todaro model with fixed relative commodity prices and inter-sectoral capital mobility is dynamically stable if and only if the urban sector is capital-abundant relative to the rural sector? As already noted, it is not sufficient to claim that this stability condition is empirically plausible, since capital abundance in this context is not solely a technical concept, and instability can arise even when manufacturing is the "naturally" capital-intensive sector. An alternative reaction is to echo Solow's (1961) comment on Uzawa's two-sector growth model: that it is unsatisfactory for stability to hinge on such a "casual property" of the model as a relative capital abundance condition. In the present context this would suggest that it may simply be inappropriate to combine a "short-run" assumption of a fixed minimum wage in manufacturing with a "long-run" assumption of complete intersectoral mobility of capital. As was noted in Section 2.6, it seems to be the case that such a combination of assumptions appropriate to different time horizons tends to lead to curious behaviour. However, irrespective of whether or not this instability result is taken as prima facie evidence against the plausibility of the model, it is clear that it must be kept in mind by international trade theorists working with models which assume sector-specific minimum wages.

MATHEMATICAL APPENDIX TO CHAPTER 4

'Oxford never pretended to be strong in mathematics'.

- Max Beerbohm: Zuleika Dobson, Penguin, p.57.

This appendix sketches the derivation of some of the results quoted in the text.

1. Choice of Numeraire for Manufacturing Real Wage

When prices are changing, it is necessary to specify a numeraire in terms of which the manufacturing wage is fixed. As in Section 3.5, we work with the general case where changes in the real wage (i.e., the utility level of employees) in manufacturing, v_m, are related to changes in the money wage and in the prices of the two goods:

$$\hat{v}_m = \hat{w}_m - \pi \hat{p}_a - (1 - \pi) \hat{p}_m \qquad (A.1)$$

π is the expenditure share of the agricultural good, and hence different values of π correspond to different choices of numeraire, ranging from $\pi = 0$ (real wage fixed in terms of manufactures) to $\pi = 1$ (real wage fixed in terms of agricultural goods).

2. Capital Market Equilibrium Locus

When totally differentiated, this locus may be written as:

$$\hat{r}_m - \hat{r}_a = 0 \qquad (A.2)$$

We wish to write this equation as a function of changes in the exogenous variables: v_m, p_m and p_a; and the endogenous variables which represent the co-ordinates of any point in the Edgeworth-Bowley box: K_m and L_u. The procedure we adopt is very similar to that followed in Section 3.3. We invoke: firstly, the equations

equating the change in each goods price to a weighted average of changes in the returns to factors in the corresponding sector:

$$\hat{p}_a = \theta_{La}\,\hat{w}_a + \theta_{Ka}\,\hat{r}_a \qquad (A.3)$$

$$\hat{p}_m = \theta_{Lm}\,\hat{w}_m + \theta_{Km}\,\hat{r}_m \qquad (A.4)$$

secondly, the relationships between the capital-labour ratio and the marginal product of labour in each sector: equations (7) and (8) in the text; and thirdly, the aggregate factor availability constraints, requiring that at all times capital must be fully employed and labour must be either employed in agriculture or present in the urban sector:

$$\lambda_{Ka}\,\hat{K}_a + \lambda_{Km}\,\hat{K}_m = 0 \qquad (A.5)$$

$$\lambda_{La}\,\hat{L}_a + \lambda_{Lu}\,\hat{L}_u = 0 \qquad (A.6)$$

Substituting these equations into (A.2) and invoking also (A.1) yields the desired expression for the capital market equilibrium locus:

$$-\frac{\theta_{La}}{\sigma_a}\left[\frac{\lambda_{Km}}{\lambda_{Ka}}\,\hat{K}_m - \frac{\lambda_{Lu}}{\lambda_{La}}\,\hat{L}_u\right] = \frac{\theta_{Lm}}{\theta_{Km}}\,\hat{v}_m - \frac{\theta_{Km} + \pi\theta_{Lm}}{\theta_{Km}}\,\hat{p} \qquad (A.7)$$

where $\hat{p} = \hat{p}_m - \hat{p}_a$

3. Labour Market Equilibrium Locus

Totally differentiating this locus, equation (1) in the text, yields:

$$\hat{w}_m + \hat{L}_m - \hat{L}_u - \hat{w}_a = 0 \qquad (A.8)$$

Following a similar series of substitutions, this may be written as:

$$\left[1 + \frac{\lambda_{Km}}{\lambda_{Ka}} \frac{\theta_{Ka}}{\sigma_a}\right] \hat{K}_m - \left[1 + \frac{\lambda_{Lu}}{\lambda_{La}} \frac{\theta_{Ka}}{\sigma_a}\right] \hat{L}_u = - \left[1 - \frac{\sigma_m}{\theta_{Km}}\right] \hat{v}_m$$
$$- \left[1 - \pi + \pi \frac{\sigma_m}{\theta_{Km}}\right] \hat{p} \qquad (A.9)$$

The coefficient of $\hat{v}_m$ confirms the claim in Section 4.4 above that, at constant output prices, an increase in the manufacturing real wage will shift the labour market equilibrium locus upwards (downwards) in the Edgeworth-Bowley box if and only if the manufacturing elasticity is greater than (less than) unity.

4. Comparative Statics with Parametric Prices

Equations (A.7) and (A.9) can now be solved jointly to yield the effects of changes in the urban minimum wage and in relative prices on K_m and L_u:

$$\theta_{La}\ \theta_{Km}\ \lambda \hat{K}_m = \lambda_{Ka} \left[\sigma_a\ \lambda_{La}\ A + \lambda_{Lu}\ B\right]\ \hat{p}$$
$$-\lambda_{Ka}\left[\sigma_a\ \lambda_{La}\ \theta_{Lm} + \sigma_m\ \lambda_{Lu}\ \theta_{La} - \lambda_{Lu}\ \theta\right]\ \hat{v}_m \qquad (A.10)$$

$$\theta_{La}\ \theta_{Km}\ \lambda\ \hat{L}_u = \lambda_{La} \left[\sigma_a\ \lambda_{Ka}\ A + \lambda_{Km}\ B\right]\ \hat{p}$$
$$-\lambda_{La}\left[\sigma_a\ \lambda_{Ka}\ \theta_{Lm} + \sigma_m\ \lambda_{Km}\ \theta_{La} - \lambda_{Km}\ \theta\right]\ \hat{v}_m \qquad (A.11)$$

where: $A = \theta_{Km} + \pi\theta_{Lm}$

$B = \pi\sigma_m\theta_{La} + \pi\theta_{Ka} + (1 - \pi)\ \theta_{Km}$

Next, to derive the economy's aggregate supply response, the change in relative outputs is expressed in terms of changes in the factors employed in each sector:

$$\hat{X}_m - \hat{X}_a = \theta_{Lm}\ \hat{L}_m + \theta_{Km}\ \hat{K}_m - \theta_{La}\ \hat{L}_a - \theta_{Ka}\ \hat{K}_a \qquad (A.12)$$

Using equations (8), (A.5) and (A.6) to eliminate $\hat{L}_m$, $\hat{K}_a$ and $\hat{L}_a$ respectively, (A.12) becomes:

$$\hat{X}_m - \hat{X}_a = \left[1 + \theta_{Ka} \frac{\lambda_{Km}}{\lambda_{Ka}}\right] \hat{K}_m + \theta_{La} \frac{\lambda_{Lu}}{\lambda_{La}} \hat{L}_u - \sigma_m \frac{\theta_{Lm}}{\theta_{Km}} (\hat{v}_m - \pi \hat{p}) \quad (A.13)$$

Substituting from (A.10) and (A.11), we obtain, first, the economy's aggregate supply response:

$$\theta_{La}\, \theta_{Km}\, \lambda\, (\hat{X}_m - \hat{X}_a) = \left[\sigma_a\, Q_a\, A + \pi\sigma_m\, Q_m\, \theta_{La} + \lambda_{Lu} \{\pi\theta_{Ka} + (1 - \pi)\, \theta_{Km}\}\right] \hat{p} \quad (A.14)$$

where: $Q_a = \lambda_{La}\, \theta_{Ka} + \lambda_{Ka}\, \theta_{La}$

$Q_m = \lambda_{Lu}\, \theta_{Km} + \lambda_{Km}\, \theta_{Lm}$

and secondly, the effect on relative outputs of changes in the urban minimum wage:

$$\theta_{La}\, \theta_{Km}\, \lambda\, (\hat{X}_m - \hat{X}_a) = -\left[\sigma_a\, Q_a\, \theta_{Lm} + \sigma_m\, Q_m\, \theta_{La} - \lambda_{Lu}\, \theta\right] \hat{v}_m \quad (A.15)$$

5. Dynamic Stability when Prices are Endogenous

When prices are endogenous, it is necessary to eliminate $\hat{p}$ from the two factor market equilibrium loci, (A.7) and (A.9). To do this, the aggregate supply function (A.13) is equated to the aggregate demand function (18). This yields an expression for the endogenous change in prices as a function of changes in K_m and L_u. (Henceforth we assume for convenience that the urban wage is pegged in terms of manufacturing output, i.e. that $\hat{v}_m = \pi = 0$):

$$-\sigma_D\, \hat{p} = \left[1 + \theta_{Ka}\, \frac{\lambda_{Km}}{\lambda_{Ka}}\right] \hat{K}_m + \theta_{La}\, \frac{\lambda_{Lu}}{\lambda_{La}}\, \hat{L}_u \quad (A.16)$$

Substituting from (A.16) into (A.7) and (A.9), and carrying out a Taylor's expansion of the dynamic adjustment mechanisms (13) and (14), yields the following matrix equation for the behaviour of the model in the neighbourhood of a long-run equilibrium point (K_m^o, L_u^o):

$$\begin{bmatrix} DK_m \\ DL_u \end{bmatrix} = \begin{bmatrix} E & F \\ G & H \end{bmatrix} \begin{bmatrix} K_m - K_m^o \\ L_u - L_u^o \end{bmatrix} \qquad (A.17)$$

where:
$$E = -\frac{\theta_{La}}{\sigma_a}\frac{\lambda_{Km}}{\lambda_{Ka}} - \frac{1}{\sigma_D}\left[1 + \theta_{Ka}\frac{\lambda_{Km}}{\lambda_{Ka}}\right]$$

$$F = \left[\frac{1}{\sigma_a} - \frac{1}{\sigma_D}\right]\theta_{La}\frac{\lambda_{Lu}}{\lambda_{La}}$$

$$G = 1 + \frac{\theta_{Ka}}{\sigma_a}\frac{\lambda_{Km}}{\lambda_{Ka}} - \frac{1}{\sigma_D}\left[1 + \theta_{Ka}\frac{\lambda_{Km}}{\lambda_{Ka}}\right]$$

$$H = -\left[1 + \frac{\theta_{Ka}}{\sigma_a}\frac{\lambda_{Lu}}{\lambda_{La}}\right] - \frac{1}{\sigma_D}\theta_{La}\frac{\lambda_{Lu}}{\lambda_{La}}$$

Both diagonal terms, E and H, are negative, and so the trace of the coefficient matrix in (A.17) is also negative. Hence a necessary and sufficient condition for local stability of the system is that the determinant of this matrix be positive. This condition simplifies to:

$$\frac{\theta_{La}}{\sigma_a}\frac{\lambda}{\lambda_{La}\lambda_{Ka}} + \frac{1}{\sigma_D}\frac{1}{\lambda_{La}\lambda_{Ka}}\left[Q_a + \frac{\lambda_{Lu}}{\sigma_a}\right] > 0 \qquad (A.18)$$

which gives equation (19) in the text.

6. Dynamic Stability with Land in Agriculture

We now assume that prices are fixed, and that the production function in agriculture exhibits constant returns to scale in

three factors: capital, labour, and land, T:

$$X_a = F\ (K_a,\ L_a,\ T) \tag{A.19}$$

Totally differentiating:

$$\hat{X}_a = \theta_{Ka}\ \hat{K}_a + \theta_{La}\ \hat{L}_a + \theta_{Ta}\ \hat{T} \tag{A.20}$$

The first objective is to derive equations analogous to (7), relating changes in the wage and rental rates to changes in factor employment. Consider first the unit cost function:

$$p_a = C^a\ (r_a,\ w_a,\ t)$$

where t is the return to land. Totally differentiating, we obtain the equation which replaces (A.3) in this section:

$$0 = \theta_{Ka}\ \hat{r}_a + \theta_{La}\ \hat{w}_a + \theta_{Ta}\ \hat{t} \tag{A.21}$$

A well-known property of unit cost functions is Shephard's Lemma: the partial derivatives of the unit cost function are the unit input requirements functions. Thus, for capital:

$$K_a/X_a = C^a_r\ (r_a,\ w_a,\ t)$$

Totally differentiating, and substituting from (A.20):

$$(1 - \theta_{Ka})\ \hat{K}_a - \theta_{La}\ \hat{L}_a - \theta_{Ta}\ \hat{T} = \theta_{Ka}\ S_{KK}\ \hat{r}_a + \theta_{La}\ S_{KL}\ \hat{w}_a + \theta_{Ta}\ S_{KT}\ \hat{t} \tag{A.22}$$

where S_{ij} is the Allen partial elasticity of substitution between factors i and j, defined in terms of derivatives of the unit cost function as follows:

$$S_{ij} = \frac{C^a C^a_{ij}}{C^a_i\ C^a_j}$$

Since the unit cost function is linear homogeneous in factor prices, the partial elasticities of substitution must satisfy the

following restrictions:

$$\theta_{Ka}\, S_{iK} + \theta_{La}\, S_{iL} + \theta_{Ta}\, S_{iT} = 0 \qquad i = K,L,T \qquad (A.23)$$

A second equation, similar to (A.22), may be derived by totally differentiating the unit labour requirements function. Combining these two equations, using (A.21) to eliminate $\hat{t}$, and setting $\hat{T} = 0$, yields:

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} \hat{r}_a \\ \hat{w}_a \end{bmatrix} = \begin{bmatrix} 1 - \theta_{Ka} \\ -\theta_{Ka} \end{bmatrix} \hat{K}_a + \begin{bmatrix} -\theta_{La} \\ 1 - \theta_{La} \end{bmatrix} \hat{L}_a \qquad (A.24)$$

Where: $A = \theta_{Ka}\,(S_{KK} - S_{TK})$ $\qquad B = \theta_{La}\,(S_{KL} - S_{TK})$

$C = \theta_{Ka}\,(S_{KL} - S_{TL})$ $\qquad D = \theta_{La}\,(S_{LL} - S_{TL})$

Solving (A.24) by Cramer's Rule gives the required equations:

$$\Sigma\ \hat{r}_a = E\,\hat{K}_a + F\,\hat{L}_a \qquad (A.25)$$

$$\Sigma\ \hat{w}_a = G\,\hat{K}_a + H\,\hat{L}_a \qquad (A.26)$$

Where: $\Sigma = AD - BC$

$$= \frac{\theta_{Ka}\theta_{La}}{\theta_{Ta}}\,(S_{KK}\,S_{LL} - S_{KL}^{\,2}) \qquad \text{From (A.23)}$$

$E = (1-\theta_{Ka})\,D + \theta_{Ka}\,B$ $\qquad F = -\theta_{La}\,D - (1 - \theta_{La})\,B$

$G = -\theta_{Ka}\,A - (1-\theta_{Ka})\,C$ $\qquad H = (1 - \theta_{La})\,A + \theta_{La}\,C$

Note that Σ is necessarily positive, assuming that the production function is strictly quasi-concave. The other terms cannot be signed, in general.

The next step involves substituting from (A.25) and (A.26) into the capital and labour market equilibrium loci, (A.2) and

(A.8). This yields the dynamic matrix equation:

$$\begin{bmatrix} DK_m \\ DL_u \end{bmatrix} = \begin{bmatrix} \frac{E}{\Sigma} & \frac{\lambda_{Km}}{\lambda_{Ka}} & \frac{F}{\Sigma} & \frac{\lambda_{Lu}}{\lambda_{La}} \\ 1 + \frac{G}{\Sigma}\frac{\lambda_{Km}}{\lambda_{Ka}} & & 1 + \frac{H}{\Sigma} & \frac{\lambda_{Lu}}{\lambda_{La}} \end{bmatrix} \begin{bmatrix} K_m - K_m^{o} \\ L_u - L_u^{o} \end{bmatrix}$$

The trace of the coefficient matrix is not necessarily negative. Hence a positive value for the determinant is a necessary but not a sufficient condition for local stability. After some simplifications this condition reduces to:

$$\frac{1}{\Sigma}\frac{\theta_{Ta}}{\lambda_{La}\,\lambda_{Ka}}\Big[\theta_{La}\{\lambda\ (S_{TL} - S_{TT}) + \lambda_{La}\,\lambda_{Km}\,(S_{TL} - S_{LL}) + \lambda_{Lu}\,\lambda_{Km}\,(S_{KL} - S_{TK})\} + \lambda_{Lu}\,\lambda_{Km}\Big] > 0$$

CHAPTER 5

DEVALUATION AND FACTOR MARKET DISEQUILIBRIUM IN NEOCLASSICAL MODELS OF A SMALL OPEN ECONOMY

'The theory is that depression in the export industries, which are admittedly hit first [by a revaluation], coupled if necessary with dear money and credit restriction, diffuse themselves evenly and fairly rapidly throughout the whole community. But the professors of this theory do not tell us in plain language how the diffusion takes place.
... The export industries will not be able to reduce their prices sufficiently, until wages have fallen in the sheltered industries... [but] ... wages will not fall in the sheltered industries, merely because there is unemployment in the unsheltered industries'.

- J.M. Keynes (1925), pp.214-5. (emphasis in original).

5.1 Introduction

This chapter applies the tools of neoclassical dynamic analysis developed in previous chapters to study the effects of devaluation in a small open economy, and in particular its effects on resource allocation.

The recent surge of interest in the "monetary theory of the balance of payments" has publicised the claims that "devaluation is always and everywhere a monetary phenomenon", and that the major channel of its influence is through a real balance effect operating on the domestic money supply. (See Frenkel and Johnson, 1976, passim). In the light of previous neglect, this shift in emphasis was clearly welcome, and it has certainly been successful, at least insofar as few would now deny that a satisfactory analysis of devaluation must take account of portfolio effects. Nevertheless the new monetary consensus has tended to distract attention from the real resource reallocation aspect of exchange rate changes.

The view that devaluation works (if at all) by engineering a transfer of resources from non-tradeable to tradeable sectors underlies much current discussion of the efficacy or otherwise of this policy instrument in the U.K., and can be traced back at least as far as Keynes's 'Economic Consequences of Mr. Churchill' (1925)[1] (quoted above). A convenient starting point for examining this view is the so-called "Australian" model of a small open economy, which distinguishes two sectors, producing tradeables and non-tradeables respectively (the former aggregating both exportables and importables into a composite commodity, which aggregation is justified by the assumption of fixed terms of trade). Though this model was originally formulated (by Salter, 1959, and Pearce, 1961) without explicit consideration to the underlying production conditions, attempts have recently been made to "go behind" the supply curves and to specify the interrelationships between product and factor markets.[2] The principal object of the present chapter is to survey and synthesise some of these recent studies of the real effects of devaluation.

We begin, in Section 5.2, by noting some general issues which arise in any attempt to specify the underlying structure of the "Australian" model with traded and non-traded goods, paying particular attention to the relationship between the "real" and "nominal" exchange rates, and to the circumstances in which the former uniquely determines the trade balance. Section 5.3 then examines a specific set of factor market assumptions which have been considered by Jones and Corden (1976), and shows that their

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1. Keynes showed considerably greater awareness of the importance of non-traded goods in this work than he did in his 1929 controvery with Ohlin concerning the transfer problem. See Oppenheimer (1974).
2. The need for greater integration of the real and monetary theories of international economics has been recognised for some time: see for example the remarks of Corden (1965, p.67).

consequences may be studied using the geometric tools of Chapter 2. In the next section, 5.4, we turn to two papers of Helpman (1976 and 1977) where the government is assumed (by contrast with Jones and Corden) to pursue a "neutral" demand management policy in conjunction with a devaluation. It turns out that this model has interesting dynamic properties. Finally, in Section 5.5, the findings of the chapter are summarised, and some general implications for the study of devaluation policy in a small open economy are noted.

5.2 The "Australian" Model of a Small Open Economy

The main outlines of the "Australian" model of a small open economy producing traded and non-traded goods are well known and will not be presented here. (For a recent exposition, see Corden, 1977, Chap. 1). Its principal advantage for balance-of-payments analysis is that, by explicitly specifying a non-tradeables sector, it avoids the objection often made against models which assume traded goods only (such as the simple elasticities model, and most open-economy extensions of the IS-LM model), that they fail to explain where the additional resources required to increase the output of tradeables come from, and hence that these models are applicable (if at all) only to situations of less than full employment. A further advantage of the model is that it emphasises the distinction between the terms of trade (the relative price of exports and imports) and the real exchange rate (the relative price of tradeables and non-tradeables). Many earlier models confused these two price ratios, whereas the Salter model, by assuming that the terms of trade remain constant throughout, emphasises that devaluation may have some policy role even in a

small open economy.[1]

One preliminary question which must be faced before any attempt to work with the Salter model is whether it can even in principle be operationalised.[2] A major difficulty in this regard is that it is illegitimate to assume that the distinction between traded and non-traded goods is exogenous to the model, since a change in the nominal exchange rate will make it profitable to import or export previously non-traded commodities. This difficulty has been recognised for some time; for example, it is implicit in the definition given by Keynes (1931, vol. 1, p.321) of traded goods, which he called "foreign trade goods" (or, in the quotation at the beginning of this chapter, "unsheltered industries"): those goods 'which are capable of entering into foreign trade within the contemplated range of foreign-exchange rate changes, whether as imports or as exports, ... including in this category goods which do not actually enter into foreign trade but are used at home, if they are the same in kind as foreign-trade goods in the above sense'. (emphasis added). A second and related

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1. The assumption of constant terms of trade implies that, according to the elasticities criterion, a devaluation must improve the trade balance; i.e., the special case of the general Bickerdike-Robinson-Metzler condition (see Dornbusch, 1975, equation 20') appropriate when the terms of trade are constant is necessarily positive (unlike the Marshall-Lerner condition, which is the special case appropriate when both exports and imports are in infinitely elastic supply). However, as will be shown in both this and the next chapter, the elasticities approach is at best only a partial analysis, and in some circumstances a devaluation can worsen the trade balance of a small open economy.
2. There is little doubt that the model is a difficult one to operationalise in practice. For example, following their unsuccessful attempt to estimate a model incorporating the tradeables - non-tradeables distinction for the U.K., Cross and Laidler (1976) called it: "... a piece of analytic fiction that enables certain theoretical notions to be expressed with simplicity rather than ... a serious operational classification of the goods and services that enter into national income". On the other hand, O Casaide (1977) obtained successful results from estimating such a model for the Republic of Ireland.

difficulty is that the dividing line between traded and non-traded goods is likely to vary with the time period under consideration. For example, a major shift in the relative price of hitherto non-traded goods is likely to lead after some time to changes in patterns of tourism and residential choice, which will tend to offset the initial price differential. (For example, it seems likely that some explanation along these lines rather than Her Majesty's Jubilee was responsible for the enormous influx of tourists into Britain in 1977).

These issues clearly pose problems for empirical work which attempts to estimate models such as those examined in the present chapter. Nevertheless it seems unreasonable to claim that this imprecision of the dividing line between traded and non-traded goods should render the distinction wholly meaningless. At a theoretical level, a start has been made at studying the first problem mentioned above by Dornbusch, Fischer and Samuelson (1977), who showed how the division of commodities into exportables, importables and non-tradeables would be endogenously determined in a Ricardian production model with a continuum of commodities. While a devaluation in their model changes the allocation of commodities to categories, it also has effects analogous to those postulated in the simple Salter model which distinguishes only between tradeables and non-tradeables. Hence it appears that the theoretical insights to be derived from the latter survive this extension of the model in the direction of greater realism. In any case, the extreme view of the "Global Monetarists",[1] that in some ultimate sense all commodities are tradeable, is unacceptable except perhaps for the very long run, if for no other reason than

1. For a critical review of the Global Monetarist position, see von Neumann Whitman (1975).

that it is incapable of explaining the systematic and persistent departures from purchasing power parity noted by Balassa (1964).

The next general issue which requires discussion is the relationship between the real and the nominal exchange rate in the Salter model.[1] By the former is meant the relative price of traded goods in terms of non-traded goods, to be designated p_2/p_1. Under certain assumptions (to be examined below) this relative price ratio unambiguously determines the trade balance, and many early writers (including Swan, 1955, Salter himself, and Berglas and Razin, 1973) assumed that it was directly under the control of the government. More recently however, it has been realised that any direct control which the government can exercise is over, not the real exchange rate, but the nominal exchange rate, e, where the latter (adopting the U.S. rather than the U.K. convention) is simply the ratio between the home and the foreign prices of tradeables: $p_2 = ep^*_2$. This realisation has shifted interest towards the link between the nominal and real exchange rates, and it is essentially with this issue that the present chapter is concerned. (By contrast, Chapter 6 examines a model where the price of non-tradeables is sticky, and so the government's control of the nominal exchange rate does give it control over the real exchange rate, but where private holdings of money are permitted, and so the real exchange rate is not monotonically related to the

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1. When exchange rates between different foreign currencies change, it is necessary in addition to distinguish between the nominal and the effective exchange rate: the former is the price in home currency of a particular foreign currency, whereas the latter is the price in home currency of some appropriately weighted basket of all foreign currencies. Even in a small open economy, the problem of choosing these weights is a non-trivial one. (See Black, 1975). However in what follows we ignore this distinction, and use the term "nominal" exchange rate to refer to the "true" or "ideal" effective exchange rate.

trade balance).

The problem of the relationship between the real and nominal exchange rates is of course avoided if it is assumed that the government intervenes continually to ensure a constant market-clearing price of the non-traded good. However many writers have thought it more plausible to assume that the wage rate is constant, and it is in trying to incorporate this assumption into the Salter model that the need to specify its factor-market underpinnings has arisen. One approach which has been taken to doing this, which is superficially attractive because of its convenient properties and long lineage in international trade theory, is the Heckscher-Ohlin-Samuelson assumption of intersectoral capital mobility. However, as was briefly mentioned in Section 2.6 above, this assumption gives rise to very curious results. To see how these arise, we may note that, with a pegged wage rate and intersectoral capital mobility the effects of a devaluation may be inferred solely from the relationships between proportional changes in goods and factor prices:

$$\hat{p}_1 = \theta_{L1}\hat{w} + \theta_{K1}\hat{r}_1 \qquad (1)$$

$$\hat{p}_2 = \theta_{L2}\hat{w} + \theta_{K2}\hat{r}_2 \qquad (2)$$

We assume, following Helpman (1976), that the wage rate is subject to a"wage restriction", whereby it is fixed in terms of an arbitrary price index which is homogeneous of degree less than unity.[1]

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1. The term $(1-\pi-\rho)$ measures the extent of money illusion embodied in the wage restriction, where $\pi + \rho$ is the degree of homogeneity of the wage restriction function. Clearly, if there is no money illusion, so that the wage rate is fixed in real terms, a devaluation can have no real effects.

This may be written in differential form as:

$$\hat{w} = \pi\hat{p}_1 + \rho\hat{p}_2 \qquad (3)$$

With rentals in the two sectors equalised by intersectoral capital mobility ($\hat{r}_1 = \hat{r}_2$), equations (1), (2) and (3) may be manipulated to yield the following relationship between the real and nominal exchange rates:

$$\hat{p}_2 - \hat{p}_1 = \frac{1-\pi-\rho}{\pi\theta_{K1} + (1-\pi)\theta_{K2}}\ \theta\ \hat{p}_2 \qquad (4)$$

Equation (4) is remarkable on two counts. In the first place, it has been derived without any mention of the labour market or of the demand for non-tradeables and hence it holds whether or not full employment prevails and whether or not the market for non-tradeables clears. Secondly, it shows that a devaluation (an increase in p_2) increases the real exchange rate and therefore may be expected to improve the trade balance if and only if tradeables are relatively capital-intensive (i.e., if and only if θ is positive). While this condition is empirically plausible,[1] we are back to the familiar situation of everything's depending on (in Solow's phrase) 'a casual property of the technology'. Of course, by analogy with previous chapters, we should expect the appeal to dynamic stability to throw additional light on the plausibility of the paradoxical cases, and it is with this issue that most of the remainder of this chapter is concerned.

Before turning to the stability question, however, another implausible aspect of the assumption of intersectoral capital

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1. Though Edgren et al. (1969) calculated the relative factor intensities of traded and non-traded sectors in Sweden for two years, and found tradeables to be capital-intensive in one year and labour-intensive in the other. So there is no presumption that tradeables are likely to be capital-intensive in practice.

mobility in the context of the Salter model must be faced. This is the propensity of the model to predict "specialisation" in the production of one or other commodity. While this outcome is conceivable, albeit implausible, in a model with exportables and importables, it is nonsensical in a model with traded and non-traded goods. We may illustrate the difficulties which arise by examining one of the remarkable results of Helpman (1976), namely that an expansionary fiscal policy which takes the form of increased government purchases of non-traded goods will increase employment if and only if the tradeables sector is relatively capital-intensive. Helpman proved this by algebraic methods, but the result is more transparent when it is realised that it is a corollary of the Rybczynski theorem. To see this, note that since the fiscal policy does not change the nominal exchange rate, the real exchange rate is also unchanged, from equation (4). Hence relative factor prices, and so profit-maximising techniques, are constant, and the Rybczynski-type diagrams in Figures 5.1 and 5.2 may be applied. The only novel feature is that the Rybczynski mechanism is reversed: instead of asking what will be the output effect of a given exogenous change in total employment, we ask what will be the employment effect of a given exogenous increase in the demand for non-traded goods. As Figure 5.1 shows, in order for the output of non-tradeables to increase from O_1A to O_1B, employment must rise from O_1D to O_1E, since the contraction of the capital-intensive tradeables sector releases a higher ratio of capital to labour than can be absorbed in non-tradeables production with unchanged techniques and the same level of employment. By contrast, when tradeables are labour-intensive as in Figure 5.2, their contraction releases more labour relative to capital than can be absorbed by the expanding non-tradeables

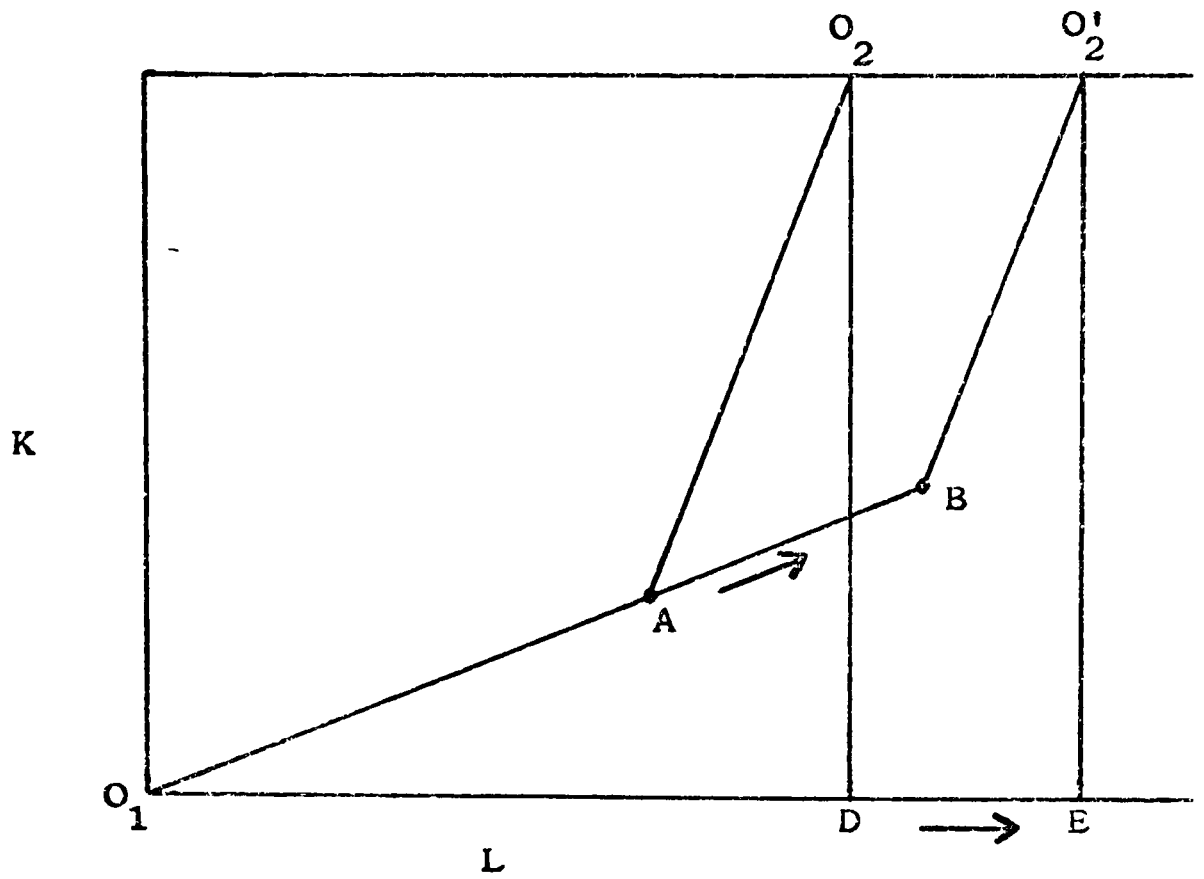


Figure 5.1: Fiscal expansion increases employment when tradeables are relatively capital-intensive

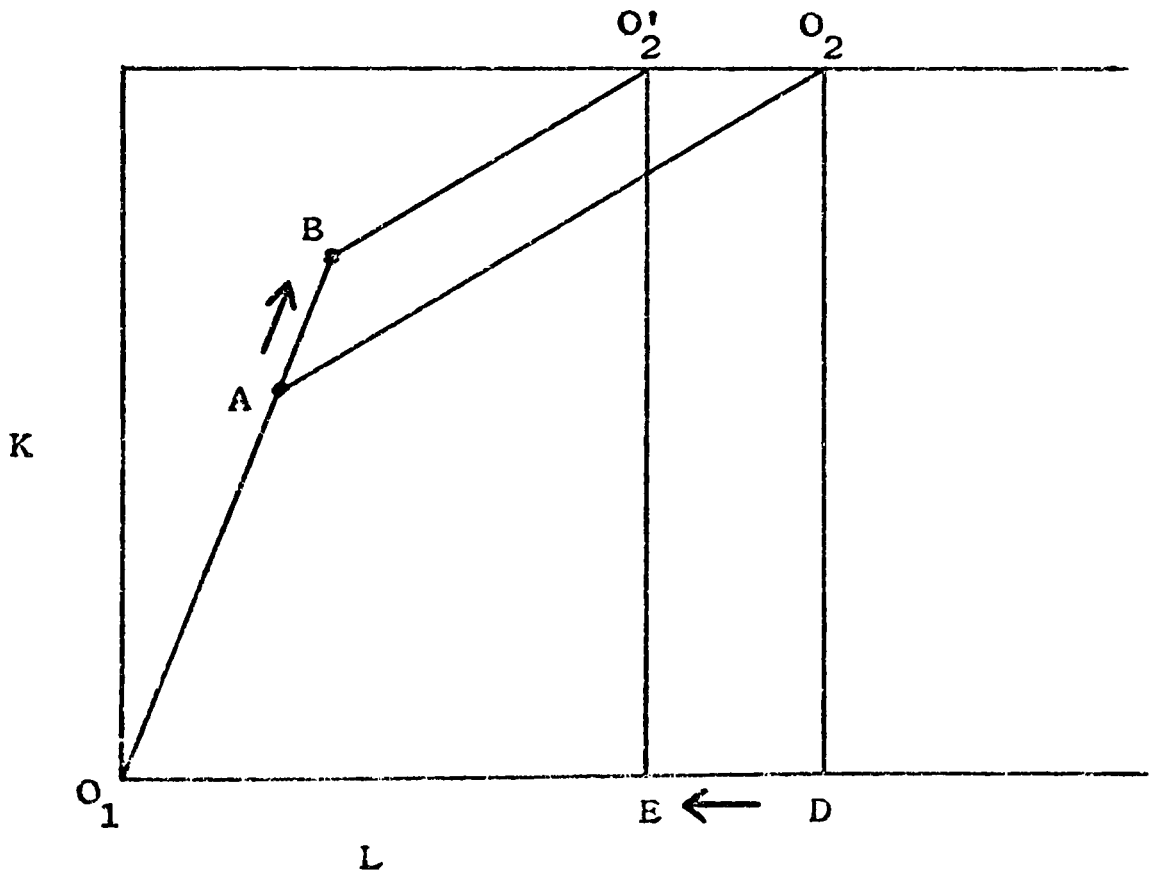


Figure 5.2: Fiscal expansion lowers employment when tradeables are relatively labour-intensive.

sector, and so the total level of employment must fall.[1]

The danger of specialisation can now be seen from the diagrams, for it is clear that, following a sufficiently large increase in government demand for non-tradeables, the projection of O_1A will hit the upper labour axis (i.e., the upper horizontal boundary of the production box) and so the production of tradeables will be squeezed out altogether. A particularly implausible aspect of this outcome is that, even if the government demand is increased in stages, there will be no signal of the impending scarcity of domestically-produced tradeables, because both commodity and factor prices are fixed by world markets. How seriously this aspect of the model should be viewed is a question which must await a consideration of the other properties which are implied by the assumption of intersectorally mobile capital.

A final general issue to be considered in this overview of the Salter model is in what circumstances does the real exchange rate uniquely determine the trade balance. In diagrammatic analyses of the model this is often assumed to be inevitable, but such a

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1. It should be clear that Figures 5.1 and 5.2 give only the impact effects of the government action, since they assume that the government demand for non-tradeables of AB is simply added to an unchanged private sector demand of O_1A. However it may be shown that the multiplier repercussions of the initial injection do not offset the impact effect. For example, in Figure 5.1, the increase in employment of DE raises private sector income and therefore private demand for non-tradeables. The final outcome of this multiplier chain is an even greater expansion of employment than that indicated in Figure 5.1. By contrast, when non-tradeables are relatively capital-intensive, the multiplier is less than one, but it is nonetheless positive; in Figure 5.2 the fall in employment of ED reduces private demand for non-tradeables below O_1A, and this leads to some increase in employment which gives rise to a further multiplier chain. While the net outcome of these opposing first- and second-round effects cannot be predicted from the diagram, it cannot involve a net increase in employment as long as relative prices remain constant. For, this would require that private demand for non-tradeables fall by more than the initial government injection, which is inconsistent with an increase in employment and hence in private income (assuming that non-tradeables are a normal good in private consumption).

deduction invariably assumes that the authorities simultaneously pursue some "background" fiscal or monetary policies, and it turns out that the answer sought depends on the precise nature of these policies. To see this, note that when the non-traded good market clears, and when (as is assumed throughout this chapter) the income and expenditure of the private sector are equal, the value of the trade surplus, s, must be equal to the value of the government's budget surplus:

$$p_2 s = T - p_1 G_1 - p_2 G_2 \qquad (5)$$

(This result, a simple application of Walras's Law, appears to have been first noted by Berglas and Razin, 1973). If government purchases of non-tradeables and tradeables are assumed to be fixed in real terms, equation (5) may be manipulated to express the effects of a devaluation on the trade balance in terms of three components:

$$p_2 \frac{ds}{dp_2} = -\frac{T}{p_2} + \frac{p_1 G_1}{p} \frac{dp}{dp_2} + \frac{dT}{dp_2} \qquad (6)$$

where $p = p_2/p_1$, the real exchange rate. Equation (6) shows that a devaluation alters the government's budget surplus, and hence the trade surplus in terms of foreign exchange, in three separate ways: by reducing the real value of tax receipts it unambiguously worsens it; by changing the real exchange rate it alters the foreign exchange value of government ~~revenue~~ expenditure, tending to reduce it (and so improve the trade surplus) if and only if the domestic price of non-tradeables rises by less than the extent of the deval-uation (i.e., if and only if the real exchange rate is increased); and finally, to the extent that it induces or is accompanied by any increase in the level of tax receipts, a devaluation tends to improve the trade balance.

Equation (6) provides a framework within which the models to

be examined in the remainder of this chapter may be compared. In the next section, the model of Jones and Corden (1976) is examined, which assumes that the government intervenes continually to ensure that the clearing of the non-traded good market is consistent with the maintenance of full employment. This means that the approach to the analysis of devaluation embodied in equation (6), of examining its effects on the government's budget deficit or surplus, is not very helpful, since taxes are continually being changed to offset the employment effects of the devaluation. Hence the effects of the devaluation come primarily through the third term in (6), whose sign cannot be determined without a separate consideration of the goods and factor markets. Fortunately, the assumption of continual full employment ensures that the geometric tools of Chapter 2 combined with the production possibilities curve diagram of Salter (1959) may be employed to examine the effects of a devaluation on the trade balance in this model.

By contrast, in the models of Helpman (1976 and 1977), to be considered in Section 5.4, government policies are assumed to be unchanged by the devaluation, and so the level of employment must adjust to ensure that the non-traded good market clears. Thus the third term in (6) disappears, and since the first term is eliminated by Helpman's assumption that tax revenue is initially zero (this is justified on the grounds that the first term has the same effect as a tax reduction, and so does not require independent analysis), all that is left is the second term in (6). Hence the effect of devaluation on the trade balance depends solely on its effect on the real exchange rate, p.

Helpman's approach has the attraction, by contrast with that of Jones and Corden, that it concentrates on the "pure" effects of a devaluation, without entangling them with the effects of an

accompanying employment-stabilisation policy. On the other hand, the somewhat artifical nature of his assumptions should be noted: a devaluation cannot change the sign of the trade balance, since this is given by the sign of the government's budget surplus (which is negative on the assumption that taxes are zero). The only effect of a devaluation is therefore to change the nominal value of the government's deficit, and this it does solely by affecting to different extents the domestic prices of traded and non-traded goods.[1] Whether this deficiency should be seen as depriving Helpman's model of any interest is an issue which will be postponed until Section 5.5.

5.3 Short-Run and Long-Run Effects of Devaluation when the Government Intervenes to Maintain Full Employment

In this section we begin our analytical survey of models which examine the factor-market underpinnings of the Salter model by considering an approach proposed by Jones and Corden (1976), whose distinguishing feature is the assumption that the government intervenes continually to maintain full employment. In addition to this policy assumption, Jones and Corden examined the effects of a devaluation under two alternative assumptions about factor markets, namely, sector-specific capital (SSC) and intersectoral capital mobility (ICM). They also made some comments on the short run to long run transition, though they did not examine the proper-

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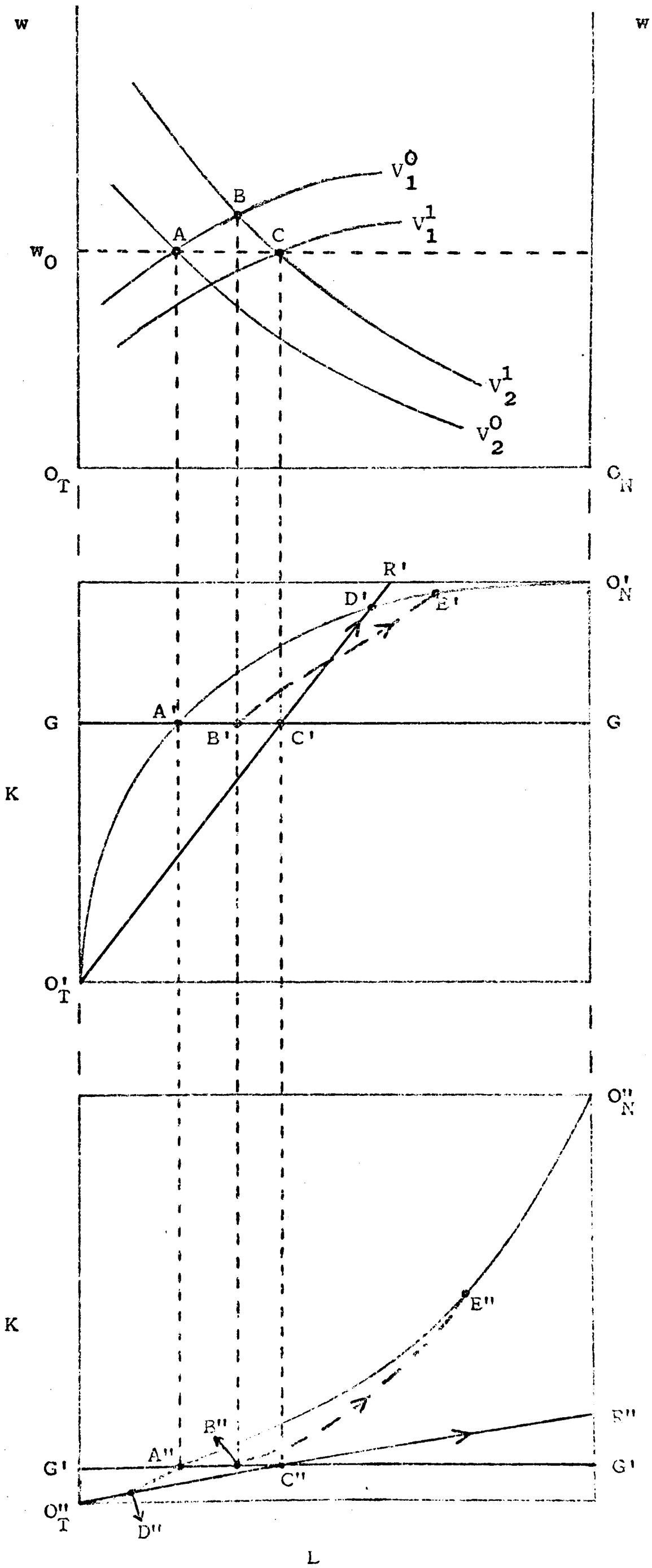
1. It may also be noted that, with tax revenue equal to zero, an increase in the real exchange rate will lower the government's deficit (and so the trade deficit) in terms of the home price of tradeables, but it will raise it in terms of the home price of non-tradeables. Under Helpman's assumptions therefore, the deficit will always improve in terms of one good but worsen in terms of the other. I am grateful to Chris Riley for bringing this point to my attention.

ties of the adjustment path in detail. In this section we first show that all their conclusions may be derived by a simple application of the geometric tools developed in Chapter 2, and we then show that, if their assumption of a fixed nominal wage is replaced by one of a general wage restriction, both their short-run and their long-run conclusions must be somewhat modified.

Figure 5.3 presents the principal diagram, in which X_1 is the non-traded good and X_2 the composite tradeable. This diagram is identical to that used in Chapter 2, so a detailed exposition of its properties will not be repeated. We assume for simplicity that the initial equilibrium is one of balanced trade, though of course the same analysis may easily be applied to the more plausible case where a devaluation is carried out to cure an initial trade imbalance. In the upper panel, (i), the initial equilibrium is represented by point A, at the intersection of the value marginal product of labour schedules for the two sectors, V_2^0 and V_1^0. Each of the Edgeworth-Bowley boxes in the lower panels (ii) and (iii) represents one of two alternative long-run equilibria, corresponding to the equilibrium at A in panel (i): panel (ii) shows the case where the traded goods sector is relatively capital-intensive (since the contract curve lies above the diagonal of the box), and panel (iii) shows the case where the traded goods sector is relatively labour-intensive. Initial equilibrium in each box is at the points A' and A" respectively.

Consider now the effects of devaluation. In the short run the capital stocks in each sector are fixed, so, by raising the home price of traded goods, the immediate effect of the devaluation in panel (i) is to shift the value marginal product of labour schedule for the traded goods sector outwards from V_2^0 to V_2^1. The location of the new short-run equilibrium depends on the assu-

Figure 5.3


(i)
w
w
V_1^0
V_1^1
B
A
C
w_0
V_2^1
V_2^0
O_T
O_N
R'
O'_N
D'
E'
A'
G
G
B'
C'
(ii)
K
O'_T
O''_N
(iii)
K
E''
F''
B''
A''
G'
G'
C''
O''_T
D''
L

mption made about the fiscal policy which accompanies the devaluation, and we follow Jones and Corden in considering two alternative assumptions: (a) stabilisation of the price of non-traded goods; and (b) stabilisation of the nominal wage rate; with full employment assumed to be maintained in each case. In case (a), the value marginal product of labour schedule in the non-traded goods sector does not shift, and so the new short-run equilibrium is established at B: the nominal wage rises, though by less than the extent of the devaluation. Alternatively, under assumption (b), the new equilibrium must be at point C if the nominal wage is to be stabilised, which means that the government must engineer a <u>fall</u> in the nominal price of non-tradeables, such that the new value marginal product of labour schedule in the non-tradeable sector, V_1^1, passes through C as shown. In this case also, the real wage falls in terms of tradeables and rises in terms of non-tradeables.

What is the effect of the devaluation on the trade balance in each of these cases? It is clear that the real exchange rate has risen in both cases, since the price of non-tradeables has either remained constant (under policy (a)) or fallen (under policy (b)). But from the discussion at the end of the previous section, we know that this is not sufficient to establish the sign of the change in the trade balance, since we must consider in addition the sign of the accompanying change in taxation. It is clear however that in both cases taxation must increase: Figure 5.3(i) shows that the output of non-tradeables has been reduced by the devaluation, and at the initial price of non-tradeables the demand for them has increased (these two effects represent the usual expenditure-switching effects of a devaluation). Hence to stabilise or reduce the price of non-tradeables, the government must

intervene to reduce private disposable income. This requires an increase in taxation which leads to a government budgetary surplus exactly equal to the induced trade surplus. Thus, in both cases the balance of trade has unambiguously improved following the devaluation in the short run.

Neither of these short-run equilibria can persist indefinitely, however, for by changing relative output prices the devaluation has disturbed the initial capital market equilibrium. The quasi-rents earned by the fixed or specific capital in each sector now differ, and in the "medium run" this difference will give rise to intersectoral capital reallocation. There are now four different cases to be considered, each combining one of the policy assumptions (a) and (b) with one of the alternative assumptions about relative factor intensities (i.e., panel (ii) or (iii)).

We begin by examining assumption (a), where the government intervenes to maintain a constant price of non-tradeables. Since the capital allocation is fixed in the short run, the new short-run equilibrium when tradeables are capital-intensive must be at point B' in panel (ii) (this point being horizontally across from A' and vertically below B). Since B' is <u>below</u> the contract curve, the rental-wage ratio in the tradeable sector must be greater than that in the non-tradeable sector; and since the same nominal wage prevails in each sector throughout, it follows that at B' the nominal rental (i.e., the quasi-rent) on capital must be higher in the tradeable than in the non-tradeable sector. Hence, in the medium run, capital will begin to move into the tradeable sector, causing the capital allocation line, GG, in panel (ii) to move upwards. The path towards the new long-run equilibrium which the economy will follow in the Edgeworth-Bowley box is a constant price labour market equilibrium locus, since relative commodity prices

stay constant throughout, and the labour market is always in equilibrium (in the sense that full employment prevails and the same wage is paid by each sector). As was shown in Chapter 2 above, when the traded goods sector is capital-intensive (as in panel (ii)), this locus will be less steep at each point than a ray from O_T' to that point; furthermore, as will be shown below, it must intersect the contract curve at or to the right of the point D'. Hence during the adjustment period the economy will follow a path similar to that shown by the dashed line through B', towards a new long-run equilibrium such as E'. Since this path lies at all times below the contract curve, the rental in tradeables exceeds that in non-tradeables throughout, and so there is no problem of failure to converge towards the new equilibrium E'.

While it is of interest to locate this path in the Edgeworth-Bowley box, it is more illuminating in a devaluation context to look at the corresponding path in output space. Figure 5.4, adapted from Mayer (1974b), shows both the initial short-run transformation curve, T'T', constructed on the assumption that capital is sector-specific, and the long-run transformation curve TT, with the former lying everywhere inside the latter.[1] Starting from an initial equilibrium at A, a devaluation combined with government policy to stabilise the price of non-tradeables and maintain full employment leads in the short run to production at B and consumption at M. (This analysis parallels that of Jones and Corden's Figure 1; following them I assume for diagrammatic convenience that home demands are homothetic, so that the Engel curve ONM is linear).

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1. Salter (1959, Sect. V) briefly considered the extreme case where all factors are immobile in the short run, so that the short-run transformation curve is a right angle at the initial production point.

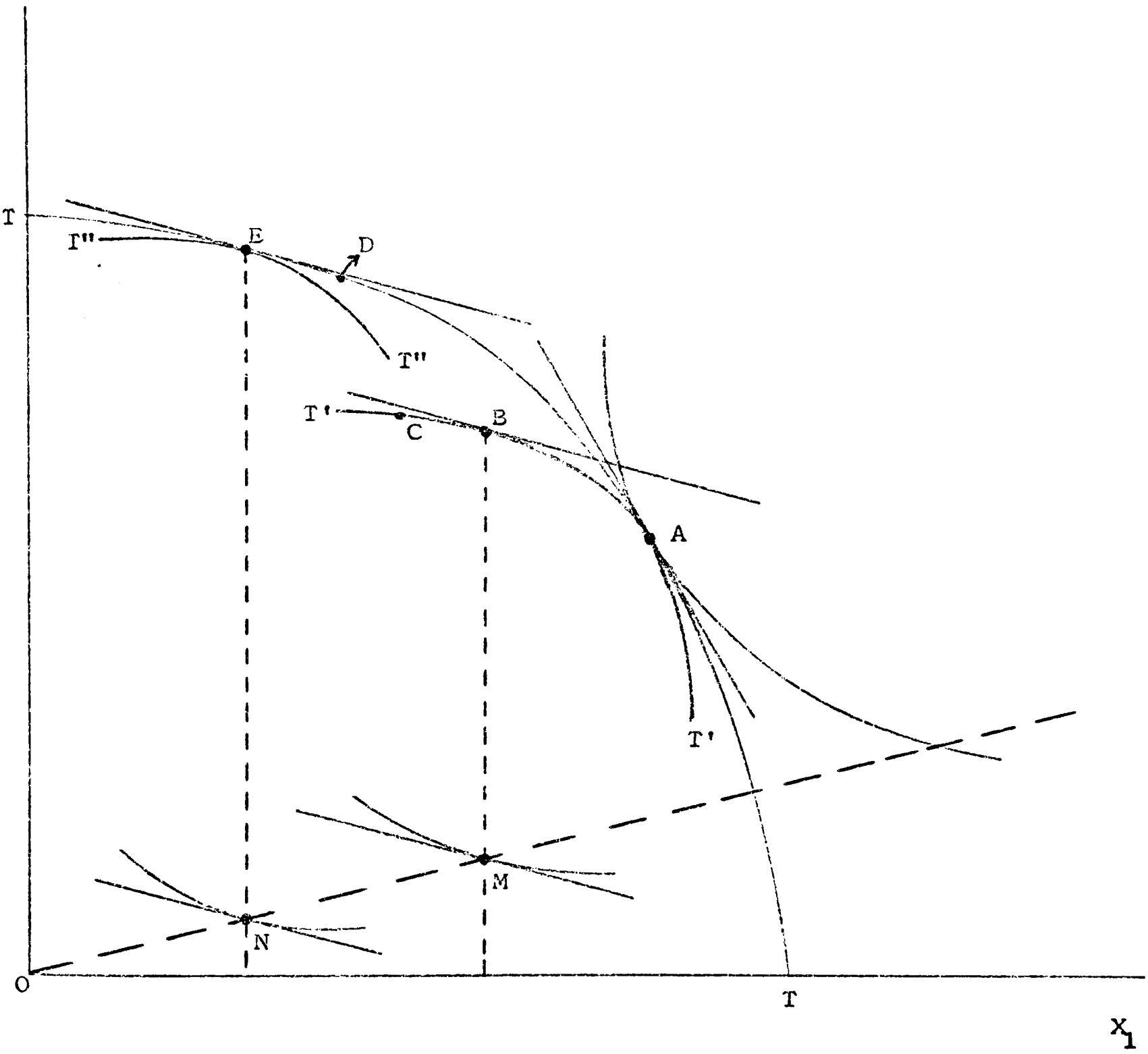


Figure 5.4

Over time, as capital reallocates, the short-run transformation curve moves upwards and to the left. The supply of non-tradeables therefore falls and (since the narrowing of the intersectoral rental differential raises real income) the demand for non-tradeables raises. Hence to choke off the resulting excess demand for non-tradeables, the government must further increase taxation, so that the balance of trade continually improves in the medium-run transition period. The consumption point moves down the Engel curve from M, and the economy converges towards a new long-run equilibrium with production at E (lying on both the long-run transformation curve, TT, and the new short-run curve T"T"), and consumption at N, both taking place at the same relative price ratio as at B and M. Clearly, provided the non-traded good is not highly inferior in domestic consumption, the trade surplus will be greater in the long run than in the short run: i.e., EN exceeds BM. (We may note that, throughout the transition period, the trade balance improves, even though the real exchange rate remains constant).

An exactly similar chain of reasoning applies to the case where the government pursues the same policy (stabilisation of the price of non-tradeables) and the traded goods sector is labour-intensive. In panel (iii) of Figure 5.3, the points A", B", and E" correspond to the respective points in panel (ii), and an analysis in output space similar to that of Figure 5.4 may be carried out. Hence, whatever the relative factor intensities of the two sectors, if the government's policy takes the form of maintaining full employment and a constant nominal price of non-tradeables, a devaluation will improve the trade balance in both the short and long runs, and no problem of instability in the approach towards

the new long-run equilibrium will arise.[1]

The next case to be considered is where the government pursues objective (b), i.e., stabilisation of the nominal wage rate, combined with the maintenance of full employment. As already noted, the post-devaluation short-run equilibrium will be at C in panel (i), to which correspond the points C' and C'' in panels (ii) and (iii) respectively. As in the case of assumption (a), these points lie below the contract curve, implying that the rental in tradeables exceeds that in non-tradeables. Once again therefore, as capital begins to reallocate, it will move into the tradeable sector. In this case however, the path of adjustment which the economy will follow is not the labour market equilibrium locus. For, since the government is stabilising the nominal wage, and since the price of tradeables does not change further following the initial devaluation, it follows that the marginal product of labour in the tradeable sector is constant. Hence, by constant returns to scale, the capital-labour ratio in the tradeable sector is fixed, and so (as indicated by the arrows) the capital reallocation will move the economy along the rays O'_TC' (in panel (ii)) or O''_TC'' (in panel (iii)) in a north-easterly direction. When tradeables are capital-intensive, as in panel (ii), this means that the new long-run equilibrium must be at D', where the ray O'_TC' intersects the contract curve. This point must lie to the left of E', the new long-run equilibrium when the government pursues policy (a), because, as Jones and Corden note (compare their footnotes 8 and 9), under policy (b), the long-run

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1. The only "paradoxical" aspect of the case where non-tradeables are capital-intensive is that, since the rays $O''E''$ and $O''E''$ are steeper than O''_NA'' and O''_TA'' respectively, the capital-labour ratio, and hence the real wage in each sector, is increased in the long run by the devaluation. This is, of course, merely a corollary of the Stolper-Samuelson theorem.

change in the relative price of tradeables to non-tradeables is less than that under policy (a). This may be contrasted with the short-run situation, since, as noted already, under policy (b) the nominal price of non-tradeables must fall in the short run, and so the change in the relative price of tradeables to non-tradeables is greater under policy (b) than under policy (a). These differences are shown in Figure 5.4: under policy (b), of wage stabilisation, the new short-run equilibrium is at C, to the left of B; while the new long-run equilibrium is at D, to the right of E. However, since it is clear from Figure 5.3 (ii) that the output of non-tradeables falls in moving from C' to D', it follows that D must lie to the left of C in Figure 5.4. All this shows that, when tradeables are capital-intensive, policy (a) leads to a smaller trade surplus than policy (b) in the short run, but to a relatively larger trade surplus in the long run.

What can be said about the change in the surplus during the adjustment period when tradeables are capital-intensive and the government pursues policy (b)? It turns out that the answer to this is ambiguous, because the trade balance is subject to two conflicting influences: on the one hand, the inflow of capital into the traded good sector reduces the supply of non-traded goods, and the increased real income resulting from the reduced inter-sectoral rental differential raises the demand for non-tradeables. Both of these effects operate exactly as under policy (a) to lead to excess demand for non-tradeables, obliging the government to raise taxes and so further improve the trade balance. On the other hand, the process of capital reallocation itself raises the domestic price of non-tradeables and so reduces the real exchange rate; this may be seen by noting that as the economy moves along the ray $O_T R'$ from C' to D' in Figure 5.3 (ii), the capital-labour

ratio in the non-traded sector falls, so reducing the marginal product of labour there, which (since the nominal wage is fixed) must imply an increase in the price of non-tradeables. Now it is clear from the diagram that the net supply effect of moving from C' to D' involves a fall in the output of non-tradeables, but it is conceivable that the price effect on demand could offset the income effect and lead to an even greater fall in the demand for non-tradeables. During the adjustment period therefore, an excess supply of non-tradeables would emerge, forcing the government to reduce taxes in order to preserve equilibrium in the market for non-tradeables, and so worsening the balance of trade.[1] The balance of trade would therefore exhibit an "inverted-V" curve over time, first improving and then deteriorating during the adjustment period. However, relative to the initial equilibrium, the surplus must improve on balance in the long run: this follows from the fact that the move from A' to D' in Figure 5.3 (ii) (and from A to D in Figure 5.4) necessarily involves a rise in the real exchange rate, obliging the government to increase taxes in order to preserve equilibrium in the non-traded good market.

From Figure 5.3(ii), it is clear that the new long-run equilibrium D' will be approached in a monotonic and stable fashion along $O_T'C'$. However, under policy (b), when tradeables are labour-intensive, as illustrated in panel (iii), precisely the opposite will occur. From equation (4) above (with $1-\pi-\rho = 1$ and $\theta < 0$), the new long-run equilibrium must be at D", representing a fall in the relative price of tradeables in terms of non-tradeables and so a devaluation-induced trade deficit. But in fact the economy will

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1. Jones and Corden (op.cit., p.159, footnote 17) claim that this outcome is impossible, but they do not substantiate their claim.

not converge towards this new long-run equilibrium, moving progressively instead to the right along $O_T''C''$.[1] Hence, under the short-run capital specificity adjustment process, the new post-devaluation long-run equilibrium at D'' is unstable, and will never be approached if the capital market is competitive.

This analysis hopefully brings out the peculiar implications of the assumption that the government pegs the nominal wage. For we may note that throughout the adjustment period the labour-intensive tradeable sector is expanding, and so there is an excess demand for labour in the economy. Hence the government's action has the objective of suppressing a wage <u>increase</u>, and if only they desist from this misguided policy and allow the wage to rise, the ray $O_T''R''$ will swing in a counter-clockwise direction, and a new long-run equilibrium somewhere to the northeast of A'' on the contract curve will be approached in a stable fashion.[2] However this argument is not symmetric, in the sense that it does not apply to a revaluation (a fall in the price of tradeables). In this case (not considered by Jones and Corden) the same diagrammatic apparatus may be used to show that: when the government pegs the nominal wage, the new long-run equilibrium is again stable if

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1. As the equilibrium moves to the right away from C'', the capital market disequilibrium is actually intensified, for the rental in the tradeable sector remains constant, but the rental-wage ratio, and hence the nominal rental, in the non-tradeable sector falls. Note that there cannot be any equilibrium other than D'' along the ray $O_T''C''$, because of the property of the contract curve that when tradeables are labour-intensive the capital-labour ratio in the tradeable sector must increase monotonically as we move along the curve away from O_T''. See Takayama (1972, Appendix to Chap. 3).
2. In practice it will frequently be impossible in any case for the government to keep up its policy of stabilising the nominal wage as the equilibrium moves to the right along $O_T''C''$. For example, if capital is "essential" in the production of non-tradeables (which would be the case if the non-tradeables production function were of the C.E.S. type with elasticity of substitution less than unity), then point R'' represents a zero output of non-tradeables. This can only be consistent with the non-tradeable market's clearing if taxation is increased to such an extent that private sector income falls to zero, for in moving to the right along $O_T''C''$ the price of non-tradeables must be <u>falling</u>.

tradeables are capital-intensive and unstable if they are labour-intensive; but now with tradeables labour-intensive the new equilibrium requires a fall in the nominal wage, which may be more difficult to engineer (or negotiate) than an increase.

So far, we have followed Jones and Corden in assuming that the government's objective is to accommodate a stable nominal wage rate. However if it is assumed instead that a general wage restriction of the kind studied by Helpman (op.cit.) prevails, then some of the foregoing conclusions must be revised. To see this, we derive the relationship between the nominal and real exchange rates in the short run in the presence of a wage restriction. We first differentiate the full employment constraint, written as an equation between the two labour demand schedules and the aggregate labour endowment:

$$L_1\left[\frac{w}{p_1},\ K_1\right] + L_2\left[\frac{w}{p_2},\ K_2\right] = L \qquad (7)$$

Differentiating (7) yields:

$$\hat{w} = \xi_1 \hat{p}_1 + \xi_2 \hat{p}_2 + \frac{\lambda}{\lambda_{K2}\ \Delta} \hat{K}_1 \qquad (8)$$

where:

$$\xi_i = \Delta\, \lambda_{Li}\, \frac{\sigma_i}{\theta_{Ki}}, \qquad i = 1,2$$

$$\Delta = \lambda_{L1} \frac{\sigma_1}{\theta_{K1}} + \lambda_{L2} \frac{\sigma_2}{\theta_{K2}}$$

$$\xi_1 + \xi_2 = 1$$

Equating (8) to the wage restriction (3) gives the desired relationship:

$$\hat{p}_2 - \hat{p}_1 = \frac{1-\pi-\rho}{\xi_1 - \pi}\ \hat{p}_2 + \frac{1}{\lambda_{K2}\Delta}\ \frac{\lambda}{\xi_1 - \pi}\ \hat{K}_1 \qquad (9)$$

This equation is the short-run equivalent of (4). It is clear that, in the case considered by Jones and Corden ($\pi = \rho = 0$), a

given devaluation of the nominal exchange rate requires a greater increase in the real exchange rate if the wage is to be stabilised (since $1/\xi_1 > 1$). However if the degree of money illusion in the wage restriction is less than 100%, this need not be the case. Moreover, if the proportional impact of changes in the price of non-tradeables on the nominal wage is greater than the contribution of the non-tradeable sector to the aggregate short-run labour demand elasticity (i.e., if $\pi > \xi_1$), then a devaluation will have a perverse effect in the short run, leading to a fall in the real exchange rate and so a deterioration in the trade balance.

It might be expected that consideration of stability would throw light on the plausibility of this paradoxical case. To investigate this issue, we consider the short-run effects on the intersectoral rental differential of devaluation and of intersectoral capital movements. By manipulating the price-equal-to-unit-cost equations (equations (1) and (2) above), this rental differential may be written as a function of changes in commodity prices and the wage rate:

$$\theta_{K1}\,\theta_{K2}\,(\hat{r}_1 - \hat{r}_2) = \theta_{K2}\,\hat{p}_1 - \theta_{K1}\,\hat{p}_2 - \theta\,\hat{w} \qquad (10)$$

Using (8) and (3) to eliminate $\hat{p}_1$ and $\hat{w}$, we obtain the desired equation:

$$\theta_{K1}\,\theta_{K2}\,\Delta(\hat{r}_1 - \hat{r}_2) = -\frac{\pi\theta_{K1} + (1-\pi)\theta_{K2}}{\lambda_{K2}}\,\frac{\lambda}{\xi_1-\pi}\,\hat{K}_1 - (1-\pi-\rho)\,\frac{\sigma_1\lambda_{L1} + \sigma_2\,\lambda_{L2}}{\xi_1-\pi}\,\hat{p}_2 \qquad (11)$$

The coefficient of $\hat{K}_1$ in (11) shows that the stability condition in terms of factor intensities derived from the earlier diagrammatic analysis is valid only if $\xi_1 - \pi$ is positive; otherwise it must

be precisely reversed, and stability requires that the non-tradeable sector be relatively capital-intensive. Moreover, the coefficient of $\hat{p}_2$ in (11) shows that when $\xi_1-\pi$ is negative a devaluation raises r_1 relative to r_2 and thus encourages a flow of resources into the non-traded good sector in the medium run. This of itself raises the output of non-tradeables, and so tends to lead to excess supply of non-tradeables, thus forcing the government to reduce taxes and so worsen the trade balance. However the intersectoral capital reallocation has two other effects which operate in the opposite direction (in the stable case): firstly, the reduction in the intersectoral rental differential represents a real income gain, and therefore raises the demand for non-tradeables; secondly, the capital reallocation itself raises the real exchange rate, from equation (9), which also encourages excess demand for non-tradeables. If these two effects outweigh the direct effect of the increased supply of non-tradeables, then the time path of the trade balance exhibits a "J-curve", first deteriorating and then improving, though in the long run the net effect of the devaluation is a worsening of the trade balance relative to the initial situation.

To sum up, the dynamic analysis of the Jones-Corden model, extended to incorporate a general wage restriction, reveals four possible cases, depending on relative capital intensities and on the difference between the contribution of the non-traded good sector to the aggregate labour demand elasticity (ξ_1) and the degree to which the wage restriction is indexed to changes in the price of non-tradeables (π). The four possible cases are shown in the following table:

	$\lambda > 0$	$\lambda < 0$
$\xi_1 > \pi$	(a) Stable convergence to long-run equilibrium (b) Devaluation improves the trade balance in both short run and long run (c) "Inverted-V" curve possible	Unstable
$\xi_1 < \pi$	Unstable	(a) Stable convergence to long-run equilibrium (b) Devaluation worsens the trade balance in both short run and long run (c) "J-curve" possible

While this model clearly exhibits a rather rich set of properties, the assumption that the government continually intervenes to maintain full employment is highly implausible. We turn therefore in the next section to consider the models of Helpman which abandon this assumption in favour of placing the burden of adjustment following a devaluation on the level of employment.

5.4 Short-Run and Long-Run Effects of Devaluation when Employment is Variable

As already noted, the effects of devaluation on the trade balance in terms of foreign exchange are relatively easy to determine under Helpman's assumptions because all that matters is the change in the real exchange rate. Hence equation (4) shows that the trade balance will improve in the long run if and only if the traded good sector is relatively capital-intensive. However, in the short run, the devaluation-induced change in the real exchange rate cannot be determined without a consideration of the demand for non-tradeables. (Note that a different route to analy-

sing this model must be followed from that adopted in the last section: equation (7) can only be used to determine the change in total employment required to accommodate any exogenous change, and cannot be used directly to determine the effects of such changes on the real exchange rate). We consider therefore the equation for equilibrium in the non-traded good market:

$$C_1(p_1,p_2,Z) + G_1 = X_1\left[\frac{p_1}{w}, K_1\right] \tag{12}$$

Equation (12) states that the supply of non-tradeables must equal the sum of private demand and government demand, where the former is a function of prices and of private expenditure, Z. With taxes set equal to zero by assumption, Z is simply the value of national output:

$$Z = p_1X_1\left[\frac{p_1}{w}, K_1\right] + p_2X_2\left[\frac{p_2}{w}, K_2\right] \tag{13}$$

Totally differentiating (12) yields:

$$\psi\left[e_{11}\,\hat{p}_1 + e_{12}\,\hat{p}_2 + \eta_1\,\hat{Z}\right] = \hat{X}_1 \tag{14}$$

where ψ is the ratio of private to total consumption of the non-traded good, e_{1i} is the elasticity of demand for X_1 with respect to the price of good i, and η_i is the income-elasticity of demand for good i. Totally differentiating (13) in turn, and substituting into (14) yields:

$$\psi\varepsilon_{11}\,\hat{p}_1 + \psi\varepsilon_{12}\,\hat{p}_2 - c_2\,\hat{X}_1 + \frac{\theta_2}{\theta_1}\,c_1\,\hat{X}_2 = 0 \tag{15}$$

In deriving equation (15) we have introduced some new notation: θ_i is the share of good i in the value of national output, and c_i is the private sector's marginal propensity to consume good i. Note that, by definition:

$$c_1 = \psi\ \eta_1\ \theta_1 \qquad \text{and} \qquad c_1 + c_2 = 1 \tag{16}$$

In addition, we have introduced the compensated price elasticities of demand, ε_{ij}, which are given by the Slutsky equation (in elasticity form):

$$\varepsilon_{ij} = e_{ij} + \eta_i\ \theta_j \tag{17}$$

We now substitute into equation (15) for the changes in output in each sector (the derivation of the supply function has been given in Appendix 2.A above):

$$\hat{X}_i = \hat{K}_i + \phi_i\ (\hat{p}_i - \hat{w}) \tag{18}$$

where ϕ_i is the short-run price elasticity of supply, which (recalling equation (11) of Appendix 2.A) equals: $\sigma_i\theta_{Li}/\theta_{Ki}$. Substituting therefore from (18) into (15) yields on rearrangement the equation we seek, which expresses changes in the price of non-traded goods in terms of changes in the exchange rate and in the sectoral capital allocation:

$$A\ \hat{p}_1 = B\ \hat{p}_2 - E\ \hat{K}_1 \tag{19}$$

where:
$$A = -\psi\ \varepsilon_{11} + (1-\pi)\ c_2\ \phi_1 + \pi\frac{\theta_2}{\theta_1}\ c_1\ \phi_2 \quad > 0 \tag{20}$$

$$B = \psi\ \varepsilon_{12} + \rho\ c_2\ \phi_1 + (1-\rho)\ \frac{\theta_2}{\theta_1}\ c_1\ \phi_2 \quad > 0 \tag{21}$$

$$E = \frac{\theta_2}{\lambda_{K2}}\ (\eta_1\ \lambda_{K2} + \eta_2\ \lambda_{K1}) \quad > 0 \tag{22}$$

Hence the change in the real exchange rate is given by:

$$\hat{p}_2 - \hat{p}_1 = \frac{A-B}{A}\ \hat{p}_2 + \frac{E}{A}\ \hat{K}_1 \tag{23}$$

The coefficient of $\hat{p}_2$ may be simplified by recalling that the own- and cross-price compensated elasticities of demand for X_1 sum to zero ($\varepsilon_{11} + \varepsilon_{12} = 0$), and by recalling that: $\theta_{Li}\theta_i = \lambda_{Li}\theta_L$. Hence

the equation we seek, the analogue to equation (9) in the Jones-Corden model, is:

$$A(\hat{p}_2 - \hat{p}_1) = (1-\pi-\rho)\frac{\theta_L \Delta}{\theta_1}(\xi_1 - c_1)\hat{p}_2 + E\hat{K}_1 \qquad (24)$$

This confirms the finding of Helpman (1977) that the short-run effect of devaluation on the trade balance depends on the size of ξ_1, which represents the relative importance of the non-traded sector in supply, compared with the size of c_1, which represents its relative importance in demand. We may note that this is a somewhat counter-intuitive result: a devaluation is more likely to improve the trade balance the smaller the marginal propensity to consume non-tradeables, and hence the larger the marginal propensity to consume tradeables. It is also slightly curious that a devaluation's chance of success is greater the more important is the non-traded good sector in supply, and hence the less important is the traded good sector.[1] Clearly the source of this result is the fact that, since the sole determinant of the trade balance is the real exchange rate, all that matters is whether or not devaluation leads to excess demand for the non-traded good at the initial relative price of non-tradeables. Hence it is a consequence of the peculiar assumptions of the model that the outcome of a devaluation can be ascertained solely by considering the demand and supply for non-tradeables.

Combining equations (4) and (24), it is clear that, as in the Jones-Corden model, there are four possible cases to be considered. However, as in that model too, it is necessary to consider the

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1. It will be shown in Chapter 6 that these conclusions are exactly reversed in a "neo-Keynesian" model which allows for changes in the asset position of the private sector.

stability properties of the model before all of the possible cases can be accepted as admissible. To do this, we therefore return to equation (10), which gives the change in the intersectoral rental differential, and substitute for $\hat{w}$ and $\hat{p}_1$ from (3) and (19) respectively. After some simplification this yields:

$$\theta_{K1}\,\theta_{K2}\,A(\hat{r}_1 - \hat{r}_2) = -\left[\pi\theta_{K1} + (1-\pi)\,\theta_{K2}\right] E\,\hat{K}_1 + (1-\pi-\rho)\left[-\theta_{K2}\,\frac{\phi_1}{\xi_1}\,(\xi_1 - c_1) + \theta\,(-\varepsilon_{11} + c_2\,\phi_1)\right]\hat{p}_2 \qquad (25)$$

The major point to note about equation (25) is that the coefficient of $\hat{K}_1$ is always negative. Hence we have proved a new and important result: unlike the Jones-Corden model, the Helpman model is always stable. This means that there is no presumption that the model is rather less likely to converge towards the paradoxical long-run outcome, when the non-traded sector is relatively capital-intensive. A second point to note about equation (25) is that the effect of a devaluation on the intersectoral rental differential may be broken into two components: (a) a short-run devaluation effect: as we would expect, to the extent that the devaluation is successful in the short run, it tends to reduce profitability in the non-traded good sector (and therefore to encourage the movement of capital out of that sector in the medium run); and (b) a capital-intensity effect, whereby, with the wage pegged to a level which exhibits some degree of money illusion, the devaluation tends to increase the relative profitability of the more labour-intensive sector.

Taking all four possible cases together therefore, and recalling that all four are stable, the possible outcomes may be summarised as follows:

	$\theta > 0$	$\theta < 0$
$\xi_1 > c_1$	(a) Devaluation improves trade balance in both short run and long run (b) "Inverted-V" curve possible	(a) Devaluation improves the trade balance in the short run, but worsens it in the long run (b) "Inverted-V" curve inevitable
$\xi_1 < c_1$	(a) Devaluation worsens the trade balance in the short run, but improves it in the long run (b) "J-curve" inevitable	(a) Devaluation worsens the trade balance in both short run and long run (b) "J-curve" possible

In the diagonal boxes, the short-run devaluation effect and the capital-intensity effect work in opposite directions, and so the medium-run change in the trade balance is indeterminate (indeed, since none of the coefficients in equation (25) need be constant, it is possible that the trade balance could exhibit more than one change in direction). However these medium-run changes are subject to the constraint that the long-run change in the trade balance must be in the same direction as the short-run change. By contrast, in the off-diagonal boxes, the two effects work in the same direction, and in both cases they serve to reverse the short-run change in the trade balance, leading to a long-run change which more than offsets the short-run change.[1]

1. Although the diagonal boxes exhibit the same properties as the corresponding boxes in the table in Section 5.3, it should be emphasised that the conditions for each outcome in the two models are not the same. This is obvious in the case of the short-run effects, and it is also true of the long-run effects if factor market distortions are permitted. (Unlike the model of Chapters 2 and 3, a difference in sign between λ and θ does not imply instability of these models) The only feature which is common to the Jones-Corden and Helpman models is, that the condition that a devaluation improves the trade balance in the short run in the former model (viz., $\xi_1 > \pi$), is also the condition that an increase in government purchases of non-traded goods increases employment in the short run in the latter model.

5.5 Summary and Conclusion

In this chapter we have explored two alternative assumptions concerning the factor-market underpinnings of the Salter model of a small open economy. This exploration is an essential preliminary to a full analysis of the effects of devaluation on intersectoral resource allocation, along the lines suggested by the opening quotation from Keynes's 'Economic Consequences of Mr. Churchill'. Moreover it has been shown that even fairly simple specifications of the short- and medium-run conditions in factor markets leads to a rich set of properties, and in particular permits a number of different configurations of the post-devaluation time-path of the trade balance.

It is to be hoped that these properties will be of some interest, especially since they are likely to persist in more satisfactorily specified models of devaluation. At the same time, the deficiencies of the models examined should not be forgotten. The Jones-Corden model assumes that the government intervenes continually to maintain full employment, and so makes it difficult to separate the effects of the devaluation proper from the effects of the accompanying employment-stabilisation policy. The Helpman model avoids this difficulty, but at the expense of making the trade surplus equal to the fixed government budgetary surplus (with tax revenue fixed in nominal and government expenditure fixed in real terms). As a result, a devaluation cannot affect the sign of the trade balance, and can only affect its magnitude in foreign exchange by altering the relative prices of traded and non-traded goods. Finally, the assumption of intersectoral capital mobility which both models make for the "long run" is rather implausible in a devaluation context (a point admitted by Jones and Corden), especially when coupled with

the assumption of a perfectly rigid wage. (Clearly the remarks in Sections 2.7 and 4.7 are relevant here).

In conclusion, some of the unattractive features of these models may be traced to two more fundamental problems. The first is the assumption, already noted, that the income and expenditure of the private sector are always equal. This rules out any "hoarding" or acquisition of financial assets by the private sector, and so forces the trade surplus to equal at all times the value of the government's surplus.[1] A second difficulty with these models is their insistence on the clearing of the non-traded good market at all times. This market must clear in an ex post sense if the model is to make sense, but by insisting on its clearing instantaneously in an ex ante sense, Jones and Corden and Helpman, along with most writers on the Australian model, demand an implausibly high degree of flexibility of either the price of non-tradeables or the wage rate on the one hand, and of the level of government spending or that of employment on the other hand. In a short-run context such as that with which the theory of devaluation should be concerned it seems desirable to explore the consequences of relaxing this assumption and allowing for non-clearing of the non-traded good market. In the next chapter therefore we present a model which avoids both of these difficulties and so permits a more satisfactory treatment of the impact effect of a devaluation, though at the expense of neglecting the medium-run dynamic issues with which the present chapter has been primarily concerned.

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1. In a forthcoming paper, Kuska (1978) argues that all of Keynesian balance-of-payments theory, from Meade onwards, makes this assumption implicitly, and hence is logically inconsistent. While it is fair to draw attention to the relative neglect of portfolio changes in this literature, it seems unlikely that the charge of inconsistency may be sustained against most of the writers in this tradition.

CHAPTER 6

NON-TRADED GOODS AND THE BALANCE OF TRADE IN A NEO-KEYNESIAN TEMPORARY EQUILIBRIUM

'What we need for balance-of-payments theory is a marriage of the Keynesian and the Hicksian type of analysis; and our model constitutes such an attempt'.

- J.E. Meade, The Balance of Payments: Mathematical Supplement, p.2.

6.1 Introduction

As outlined in Chapter 1, this chapter adopts a rather different approach to the analysis of factor market "disequilibrium" from that which, despite the differences between them, was shared by the intervening four chapters. The characteristic features of the present approach may best be introduced by considering the title of the chapter.

In the first place, we examine below situations of temporary equilibrium, in the sense of Hicks (1939, Chap. 10), rather than of Walrasian general equilibrium, as was implicitly assumed even in the "short run" of previous chapters. The latter is an essentially timeless concept, in that perfect information about the future is available (at least in a probabilistic sense) and complete markets for all goods, present and future, exist. By contrast, the former is an equilibrium at a point in time where there is genuine uncertainty about the future, and where complete markets for future goods may not exist. Hence agents base their current demands and supplies on their expectations of prices in future periods, and no mechanism exists to ensure that these expectations are shared by different individuals. The only good which can be carried forward (in the simplest formulations) is money, and it therefore plays the essential role of transferring

purchasing power between periods.

In the second place, and by contrast with Hicks's own version, the present chapter considers a neo-Keynesian[1] temporary equilibrium, in the sense that current markets clear by quantity rather than price adjustments. This means, since only voluntary exchange is assumed to take place, that agents on the long side of each market are rationed, and this in turn forces them to recalculate their demands and supplies in other markets. These recalculated, or "effective", demands and supplies - which reflect the "dual decision hypothesis" of Clower (1965) - need not satisfy Walras' Law, and hence the tendency to return to full (i.e., "Walrasian") equilibrium may be rather weak (even if tâtonnement-type price adjustment is assumed to take place). A further complication which quantity adjustment introduces is that agents will be influenced not only by their expectations of future prices but also by their expectations of the quantity constraints which they may face in the future. For example, the savings behaviour of a currently unemployed household will be considerably affected by whether or not it expects to remain unemployed in the next period.

All these issues have been extensively studied by general equilibrium theorists (see the literature surveyed by Grandmont, 1977), and their implications for macroeconomics are becoming widely known through the work of Barro and Grossman (1971), Malinvaud (1977) and Muellbauer and Portes (1978) among others. To date,

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1. Despite its potential ambiguity and its doubtful fidelity to Keynes's own views (see Bliss, 1975), we follow Benassy (1975) in using the term "neo-Keynesian", since it serves as a convenient contrast with neoclassical (in the sense of "neoclassical synthesis"). Grandmont (1977) and Dixit (1978) use the more precise term "temporary equilibrium with rationing".

however, only Gordon (1977)[1] and Dixit (1978) have formally explored their implications for macroeconomic theory in an open economy. The model of the present chapter and the approach adopted to analysing it owe a great deal to Dixit, but it differs from his in explicitly incorporating a non-traded good whose price is sticky in the short run. This permits a reconciliation between the very different conclusions obtained by Malinvaud and Dixit. It also, from the standpoint of international monetary economics, permits an examination of some of the issues raised by the seminal work of Salter (1959). Salter was the first to use a diagram in the space of traded and non-traded goods, and, noting that full equilibrium would take place only at the "kissing-point of tangency" between a production possibilities curve and a social indifference curve in this space, he added that all other points in his diagram are:

> 'ex ante disequilibrium positions in which the economy is always in the process of movement: overseas reserves are either decreasing or increasing; there is a rising or falling domestic price level; and either over- or under-full employment'.

Writing in the 1950s, Salter may be forgiven for assuming that disequilibrium in the non-traded good market would necessarily give rise to price adjustment; in all other respects this passage is an excellent description of the various disequilibrium characteristics of a small open economy. But while writers on the "monetary approach to the balance of payments" (e.g., Frenkel and Johnson, 1976) have paid considerable attention to the process of reserve changes, neither Salter nor subsequent writers have explicitly analysed disequilibria in the labour or non-traded good markets. It is one of the objects of this chapter to remedy this oversight.

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1. Gordon's model is similar to that of the present chapter, except that he assumes a fixed supply of labour. However he does not explicitly discuss the relationship between different regimes, and he considers the comparative static response to only a single exogenous change (namely an increase in foreign prices).

The plan of the chapter is as follows. Section 6.2 introduces the model, and examines its behaviour when wages and prices are flexible. Section 6.3 shows that when the wage rate and the price of the non-traded good are sticky the economy may lie in one of a number of possible disequilibrium regimes, each of which is characterised by a different pattern of rationing of firms and households. Sections 6.4 and 6.5 compare the comparative static properties of the model <u>within</u> different regimes, looking at the determinants of employment and the trade balance respectively, while Section 6.6 shows how changes in exogenous variables may lead to shifts <u>between</u> regimes. Section 6.7 sketches some extensions of the model and notes the importance of explicitly incorporating agents' expectations about the future. Finally Section 6.8 summarises the principal results and suggests some directions for future research.

6.2 Notional Equilibrium under Fixed Exchange Rates

For most of this chapter, we consider the behaviour of the economy within a single period. In this section we examine in turn the behaviour of the three types of agent in the economy - households, firms, and the government - on the assumption that the price of non-traded goods and the wage rate change instantaneously to equate supply and demand, so that rationing does not take place on any market.

A. Households

Households receive wage income related to the amount of labour they choose to supply, l, as well as a lump-sum income, I, consisting of money balances carried over from the previous period, $\bar{m}$, plus transfer payments received from the government, t, plus dividend payments, being the amount of last period's profits, π_{-1}.

For simplicity, we assume that aggregate household behaviour may be represented by the maximisation, subject to the budget constraint (2), of a single utility function, (1), defined over consumption of non-tradeables, x_1, and tradeables, x_2, leisure (i.e., labour endowment less hours worked), H-l, and end-of-period holdings of money balances, m:[1]

$$\text{Maximise:} \quad u(x_1, x_2, H-l, m, \theta) \tag{1}$$

$$\text{subject to:} \quad p_1 x_1 + p_2 x_2 + m \leq wl + I \tag{2}$$

$$\text{i.e.} \quad p_1 x_1 + p_2 x_2 + m \leq wl + \bar{m} + t + \pi_{-1} \tag{3}$$

Since (1) is an indirect utility function, representing in compressed form the utility derived from consumption and leisure in all future periods, it depends on expectations of future prices, as well as on expectations concerning the extent of unemployment and goods rationing in the future. In a complete analysis the dependence of utility on these expectations should be explicitly considered (for partial attempts to do this, see Benassy, 1975, Sect. 7, and Muellbauer and Portes, 1978); but here it is represented simply by the inclusion of a vector of exogenous expectation parameters, θ, in (1).

Maximisation of (1) subject to (2) leads to unconstrained or "notional" demand functions for each good, a labour supply function, and a flow demand function for savings:

$$x_1 = x_1(p_1, p_2, w, I) \tag{4}$$

$$x_2 = x_2(p_1, p_2, w, I) \tag{5}$$

---

1. We use general, rather than Cobb-Douglas, functional forms throughout, thus avoiding all but one of Kahn's (1977) objections to the Malinvaud model. The remaining objection, that labour is subject to increasing returns in the short run so that the competitive assumption is untenable, is a much more serious one. However we know of no model which provides a satisfactory treatment of general equilibrium with monopoly.

$$l = l(p_1, p_2, w, I) \tag{6}$$

$$m - \bar{m} = \Delta m(p_1, p_2, w, I) \tag{7}$$

We assume throughout that all commodities are normal (including leisure, so $\partial l/\partial I$ is negative), that all own-price elasticities of demand are negative, and that labour supply is an increasing function of the wage rate. In addition, it is convenient for diagrammatic purposes to assume that all commodities are gross substitutes; this assumption will be adopted henceforth except when otherwise stated.

B. Firms

All firms are assumed to be profit maximisers and price takers in both input and output markets, and to face diminishing returns to the only variable input, labour. Hence the behaviour of each sector may be characterised as if it were choosing employment levels e_1 and e_2 to maximise profits subject to the production functions:

$$y_1 = F(e_1, h) \qquad \text{and} \qquad y_2 = G(e_2, k) \tag{8}$$

where h and k are exogenous parameters representing the state of technology. This yields unconstrained output supply and labour demand functions for each sector:

$$y_1 = y_1(p_1, w, h) \qquad y_2 = y_2(p_2, w, k) \tag{9}$$

$$e_1 = e_1(p_1, w, h) \qquad e_2 = e_2(p_2, w, k) \tag{10}$$

Following other writers in this literature, we assume, rather arbitrarily, that profits are redistributed to consumers in the next period, and hence do not directly affect current consumption decisions. (Their indirect effect, through expectations of future dividend payments, are incorporated in the vector θ in (1)). This

assumption greatly simplifies the algebra, and, except in one important case to be noted below, it makes no qualitative difference to the results.

C. Government

The government may make transfer payments, t, to households, or it may purchase quantities of either good, the volume of such purchases being g_1 and g_2 respectively. All such transactions are financed by printing money. However the government does not engage in production nor does it intervene directly in the labour market, and its activities do not directly affect household utility. Also, though purchases of goods by the government will be referred to throughout as "fiscal policy", they do not correspond to "pure", or bond-financed, fiscal policy, since the present chapter does not incorporate an explicit monetary sector.[1]

D. Accounting Relationships

Certain accounting relationships must hold, ex post, in this model, for both notional and effective demands and supplies, i.e., irrespective of whether market clearing is brought about by price or quantity adjustment. Thus, since neither good can be stored for use in future periods, the market for the non-traded good must clear, and any domestic excess supply of the traded good must equal the balance of trade surplus, s:

$$y_1 = x_1 + g_1 \tag{11}$$

$$s = y_2 - x_2 - g_2 \tag{12}$$

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1. However the incorporation of a bond market with a flexible interest rate into the present model does not pose serious problems. See Hool (1978).

In addition, the labour market must clear in an ex post sense (though of course this does not rule out the possibility of involuntary unemployment):

$$1 = e_1 + e_2 \tag{13}$$

Substituting from (11), (12) and (13) into (2), writing π for total profits in the current period, gives, after a little manipulation:

$$(\pi - \pi_{-1}) + (m - \bar{m}) = (p_1 g_1 + p_2 g_2 + t) + p_2 s \tag{14}$$

The left hand side of (14) is the net acquisition of money balances by the private sector, made up of those acquired by firms (i.e., the excess of this period's over last period's profits) and those acquired by households; this must equal total money creation, which is the sum of the government's budget deficit and the trade surplus. Equation (14) has been the focus of much of the writings on the monetary approach to the balance of payments but while it must play a crucial role in any dynamisation of the model, it is of less importance in a short-run analysis such as that of the present chapter, because over a short time horizon the acquisition of money balances by both firms and households is not necessarily voluntary (a point stressed by Tsiang, 1977).

E. Notional Equilibrium

For a given exchange rate (i.e., a fixed p_2), the equilibrium wage and non-traded good price are determined by the interaction of the notional labour market equilibrium locus (LMEL) and the notional non-traded good market equilibrium locus (NTEL):

$$\text{LMEL:} \quad l(p_1, p_2, w, I) = e_1(p_1, w, h) + e_2(p_2, w, k) \tag{15}$$

$$\text{NTEL:} \quad y_1(p_1, w, h) = x_1(p_1, p_2, w, I) + g_1 \tag{16}$$

It is easily seen that, with gross substitutability in demand, both of these loci must be upward-sloping in (w,p_1) space; for example, starting from a point of labour market equilibrium, an increase in the wage will lead to excess supply of labour, requiring an increase in p_1 to restore equilibrium. Concerning the relative slopes of the two loci, two separate arguments, both due to Dixit (1978), suggest that the NTEL should be more steeply sloped than the LMEL, as in Figure 6.1: first, the equilibrium at A will then be stable if w and p_1 adjust according to tâtonnement-type processes (cf. the directions of the arrows in the diagram); and secondly, consideration of real-balance effects would suggest that the region of excess ~~supply~~ demand in both markets should correspond to low rather than high values of w and p_1.

F. Long-Run Effects of Devaluation and Monetary Expansion

Some of the standard conclusions of the monetary approach to the balance of payments may be illustrated by combining (15) and (16) with the expression for the notional trade balance:

$$s = y_2(p_2,w,k) - x_2(p_1,p_2,w,I) - g_2 \qquad (17)$$

Assuming gross substitutability, (17) with s equal to zero gives a downward-sloping trade balance locus (BTL) in Figure 6.1. As drawn, the locus passes through A, indicating that A is a point of both internal and external balance; all points above the locus correspond to a trade deficit, and points below to a trade surplus.

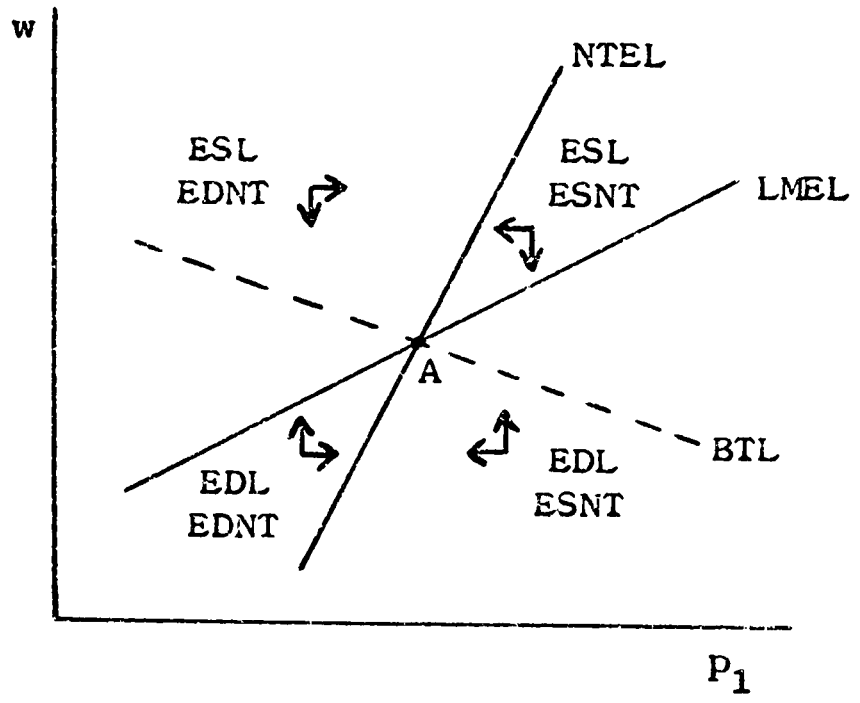


Figure 6.1

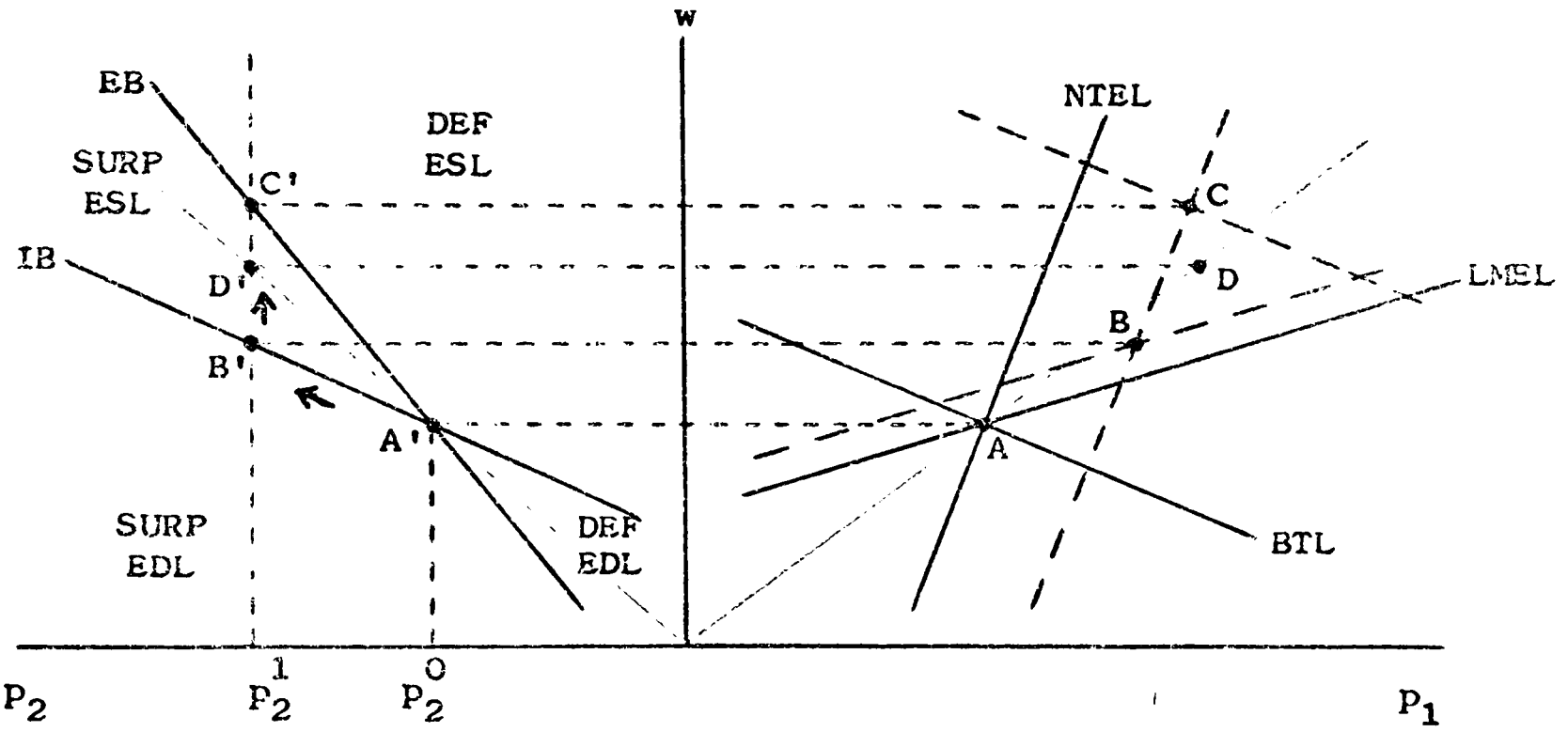


Figure 6.2

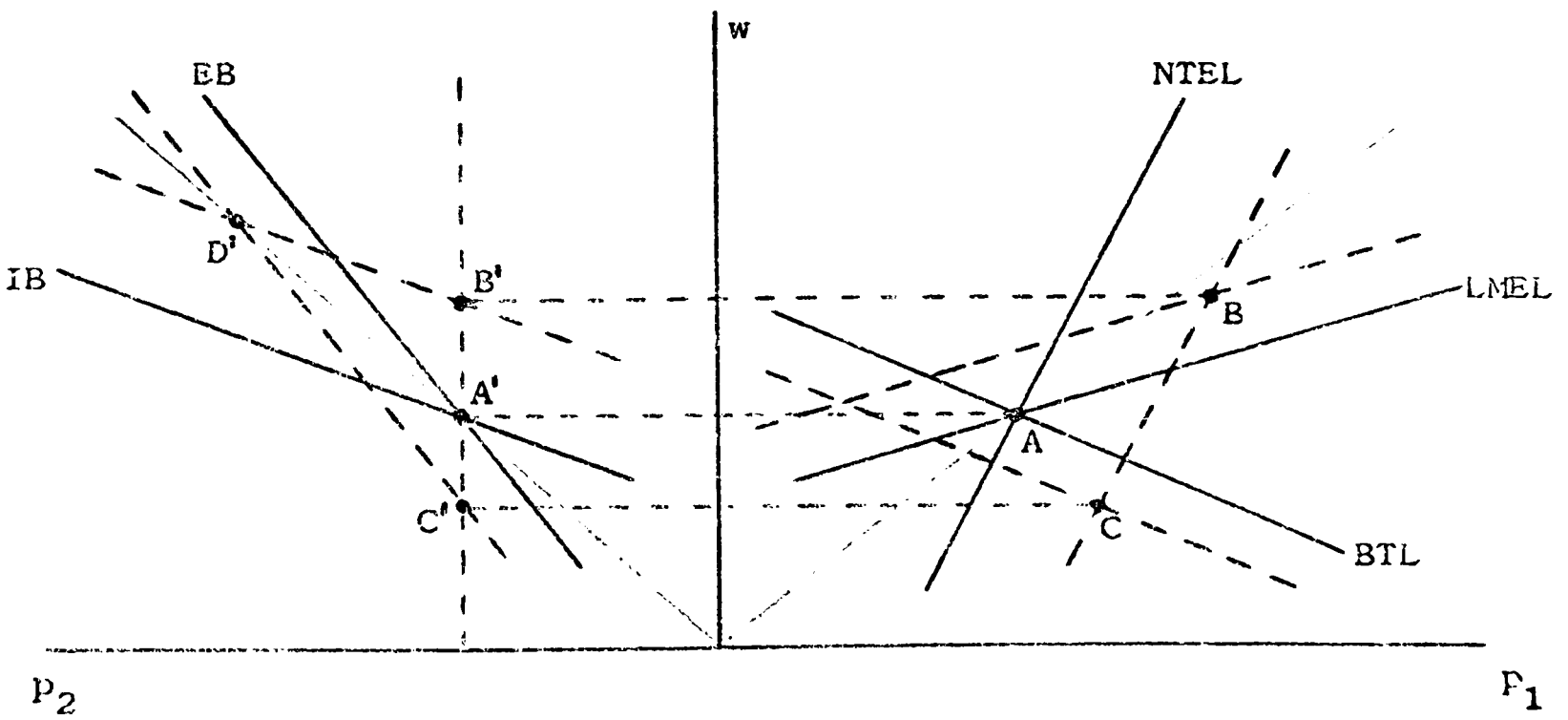


Figure 6.3

Consider now the effects of a devaluation (i.e., an increase in the home price of tradeables from p_2^0 to p_2^1). At the initial wage and non-traded good price, this leads (assuming gross substitutability) to excess demand for both labour and non-tradeables; hence the LMEL shifts upwards and the NTEL shifts rightwards, leading to a new short-run equilibrium at B in the right-hand panel of Figure 6.2. The move from A to B is matched by the move from A' to B' in (p_2,w) space, the left-hand panel of Figure 6.2, which therefore traces out an internal balance (IB) locus in the latter panel. At the same time, the BTL is shifted upwards in the right-hand panel of Figure 6.2, intersecting the new NTEL at C, which lies above B, on the assumption that the devaluation improves the trade balance. Corresponding to the move from A to C is the move from A' to C' in the left-hand panel, which therefore traces out an external balance (EB) locus contingent on instantaneous clearing of the non-traded good market. As indicated in the diagram, the IB and EB loci divide the left-hand panel into four "zones of economic unhappiness" similar to those of Swan (1963).[1] Since the balance of trade is in surplus at the new short-run equilibrium, the domestic money supply will be increased (assuming no offsetting actions on the part of the government). Over time, this increase in the money supply will shift all the loci in the diagram: starting from B, it will induce excess demand for both labour and non-tradeables; hence the NTEL will shift rightwards and the LMEL will shift upwards, causing the IB locus also to shift upwards. Similarly, starting from C, the monetary inflow will cause

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1. The left-hand panel of Figure 6.2 is identical to Figure 1 of Dixit (1978). In this and in other respects, the addition of a flex-price non-traded good to Dixit's model makes no qualitative difference to the model's behaviour, except for the inevitable complications which follow from the addition of an extra commodity (most of which complications are avoided in any case by the assumption of gross substitutability).

excess demand for tradeables, leading the BTL to shift downwards, and hence the EB locus to shift leftwards. These shifts will continue until the surplus is eliminated and a new long-run equilibrium is established at D and D', where, relative to the initial equilibrium, all domestic nominal magnitudes (viz., prices, wages and the money supply) have increased by the same proportion as the devaluation, and so all real magnitudes return to their initial values: the devaluation has no real effects in the long run.[1]

A similar analysis may be carried out for the effects of a domestic monetary expansion under fixed exchange rates. In Figure 6.3, this causes the short-run equilibrium to shift from A and A' to B and B'; but both the BTL in the right-hand panel and the EB locus in the left-hand shift downwards; hence the new short-run equilibrium corresponds to a trade deficit. If the exchange rate were flexible it would depreciate, and a new long-run equilibrium at D' would be attained. But with a fixed rate, the deficit leads to a monetary outflow which continues until all five schedules in the diagram have returned to their initial positions, and the equilibrium at A and A' is reattained.

Finally, although the precise characteristics of the adjustment paths in these two examples are as described above only if gross substitutability is assumed, this is not true of the long-run properties of the model. Moreover, certain equivalences between different short-run effects may be established without any assumptions other than zero degree homogeneity of all demand and supply functions. For example, the result of Kreuger (1974), that a

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1. This result may be proved by differentiating (15), (16) and (17), setting ds equal to zero, and solving for dp_1, dw and $d\bar{m}$ in terms of dp_2, invoking the homogeneity of the excess demand functions.

devaluation will worsen the trade balance if and only if a domestic monetary expansion will improve it, may be shown to hold in the present model.[1]

6.3 Effective Equilibria under Fixed Exchange Rates

We turn now to consider the model's properties when w and p_1 are assumed to be completely fixed within the current period. This extreme assumption might be justified by invoking trade-union strength, oligopolistic pricing, fixed-term contracts or informational inadequacies. But probably the only satisfactory justification is analytical tractability, combined with the need to redress the balance of attention which has hitherto favoured the widely-studied case of perfectly flexible wages and prices.

The immediate effect of this change of assumptions is that any point in Figure 6.1, not just A, is now a potential short-run, or temporary, equilibrium. But at all points other than A, at least one market is clearing by quantity rationing, and this will affect decisions on other markets, according to Clower's dual decision hypothesis. In particular, the two equilibrium loci, and hence the partitioning of (w,p_1) space into different regions, will be affected. Consider first the NTEL: when there is excess supply of labour but a rigid money wage (i.e., at all points above the LMEL in Figure 6.1), and when the non-traded good market is in equilibrium, non-traded firms are not rationed on any market; hence their effective supply function remains their notional one. However households are constrained to supply less labour than they would wish; their notional demand function for non-tradeables, $x_1(.)$,

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1. To prove this, differentiate (15), (16) and (17), and solve for ds in terms of $d\bar{m}/\bar{m}$ and dp_2/p_2.

must therefore be replaced by a constrained demand function, $\tilde{x}_1(.)$, which depends on their current wage income, and hence is essentially a Keynesian consumption function, but one with an explicitly choice-theoretic basis. The NTEL therefore becomes:[1]

$$\text{NTEL(ESL):} \quad y_1(p_1,w,h) = \tilde{x}_1\left[\tilde{l}(.);p_1,p_2,w,I\right] + g_1 \tag{18}$$

where $\tilde{l}(.)$, the effective labour supply of households, is the unconstrained demand for labour by the two sectors combined:

$$\tilde{l}(.) = e_1(p_1,w,h) + e_2(p_2,w,k) \tag{19}$$

It is natural to assume that the marginal propensities to consume out of lump sum income, and employment income (due to a change in hours worked) non-tradeables are positive and less than unity:

$$0 < \hat{c}_1' \equiv p_1 \frac{\partial x_1}{\partial I}, \hat{c}_1 \equiv \frac{p_1}{w} \frac{\partial x_1}{\partial \tilde{l}} < 1 \tag{20}$$

However the results on rationing theory of Tobin and Houthakker (1950-51), as extended by Howard (1977), suggest that this is only guaranteed if leisure is a net substitute for non-tradeables and for tradeables and money balances taken together. Making these assumptions, it follows, since $\tilde{l}(.)$ is less than $l(.)$, that $\tilde{x}_1(.)$ must be less than $x_1(.)$ whenever households are rationed in the labour market. Thus a point of notional equilibrium in the non-traded good market must be characterised by excess supply of non-tradeables when excess supply of labour prevails, and so the region of generalised excess supply in Figure 6.1 expands when we move from considering notional to considering effective equilibria.

Turning next to the NTEL under excess demand for labour, it is necessary to make some assumption about how the available labour force is allocated between the two sectors.[2] In a properly speci-

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1. We assume throughout that the government is a priority purchaser, and hence is never rationed on any market.
2. Even with only one sector a similar problem must be faced, namely, how is the labour force allocated between firms when excess demand for labour prevails. Malinvaud (1977, p.50) assumes that more efficient firms get priority, but, though this is a convenient and perhaps essential simplification, it is clearly an unsatisfactory assumption for a decentralised economy.

fied dynamic analysis, this allocation would be determined by the past evolution of the economy; in the present one-period analysis, however, the only satisfactory approach is to consider two extreme cases, where one or other of the sectors gets priority and so is not rationed on the labour market.[1] In the first case, which we designate EDL(a), the traded good sector gets priority, and so the effective labour demand by the non-traded good sector is the total available labour supply less the traded good sector's notional labour demand. The non-traded good market equilibrium locus therefore becomes:

$$\text{NTEL(EDL,a):}\quad F\left[l(p_1,p_2,w,I)-e_2(p_2,w,k);h\right] = x_1(p_1,p_2,w,I)+g_1 \qquad (21)$$

The left-hand side of (21) is the non-traded sector's constrained supply function, $\tilde{y}_1(.)$, and since this must be less than its notional supply, $y_1(.)$, for given values of w and p_1, the effective NTEL under excess demand for labour of type (a) must shift to the right in Figure 6.1, thus enlarging the region of EDL and EDNT. As for the alternative assumption about how the labour force is allocated, EDL(b), namely that the non-traded sector is unrationed, the NTEL in this case is simply the notional locus, (16).

Similar arguments may be used to determine the location of the effective labour market equilibrium locus, under different regimes in the non-traded good market. Thus, when there is excess supply of the non-traded good, households are unconstrained, but firms must produce less than their notional supply of non-tradeables. Their effective demand for labour is therefore given by the inverse of the production function, F(.), and so the LMEL becomes:

$$\text{LMEL(ESNT):}\quad l(p_1,p_2,w,I) = F^{-1}\left[x_1(p_1,p_2,w,I)+g_1;\ h\right] + e_2(p_2,w,k) \qquad (22)$$

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1. We assume throughout that the excess demand for labour is never so severe that the notional demand for labour by a single sector exceeds the total available labour supply.

Since constrained labour demand must be less than notional demand, the region of excess supply in both markets must again expand. But more than this can be said about the location of (22), for inspection confirms that it is actually identical with (21). The region of ESNT and EDL therefore vanishes, at least when assumption (a) is made about labour market rationing under excess demand for labour. This reflects the fact that when stocks cannot be carried over to the next period, and so firms' decisions are essentially of a one-period kind, it does not make sense to consider a state where non-traded good firms are rationed on both markets, simultaneously unable to hire as many workers as they wish and unable to sell as much output as they wish. As will be noted in Section 6.7, this conclusion must be modified when firms are allowed to have a two- or more period horizon.

Finally, under excess demand for non-tradeables, firms in both sectors are unconstrained, but households are unable to obtain as many non-tradeables as they wish, and so they adjust their labour supply, taking the goods market constraint into account. The LMEL therefore becomes:

$$\text{LMEL(EDNT):}\quad \tilde{l}\left[\tilde{x}_1(.);p_1,p_2,w,I\right] = e_1(p_1,w,h)+e_2(p_2,w,k) \qquad (23)$$

where the constrained consumption of non-tradeables is simply what is left over after the government makes its priority purchases:

$$\tilde{x}_1(.) \;=\; y_1(p_1,w,h) - g_1 \qquad (24)$$

Previous writers, such as Barro and Grossman (1971), have assumed that goods market constraints must reduce labour supply, thus implying that (23) must lie above the notional LMEL, (15), in the region of EDNT. Once again, however, while this is intuitively plausible, considerations from rationing theory suggest that it is only guaranteed if leisure and non-tradeables are (net) substitutes in consumption.

Figure 6.4 summarises the effects of considering the inter-relationships between constraints in different markets on the taxonomy of disequilibrium regimes. Panel (a) shows that if traded good firms are assumed to be given priority in labour allocation when there is general excess demand for labour, only three regimes are possible. Following Malinvaud, these are labelled C, for Classical Unemployment (households are rationed on both labour and non-traded good markets); K, for Keynesian Unemployment (or generalised excess supply: households are rationed on the labour market, non-traded good firms on the output market); and R, for Repressed Inflation (or generalised excess demand: households are rationed on the non-traded good market, and firms on the labour market). Panel (b) shows that, even with an atemporal theory of the firm, a fourth regime is possible if traded good firms are rationed under conditions of excess labour demand. Following Muellbauer and Portes (1978), we label this regime U, for Under-consumption; in this regime, households are unconstrained on all markets, non-traded good firms are unconstrained in the labour market but rationed in the goods market, and traded good firms are unconstrained in the goods market (as always, because of the small country assumption) but rationed in the labour market.

6.4 Comparative Statics: Determinants of Classical and Keynesian Unemployment

We turn now to examine the comparative static properties of the different regimes, beginning in this section with the determinants of employment. For convenient reference, all the results are summarised in the Appendix.

In region C, all firms are unconstrained, and so the level of employment is determined by the notional demand for labour,

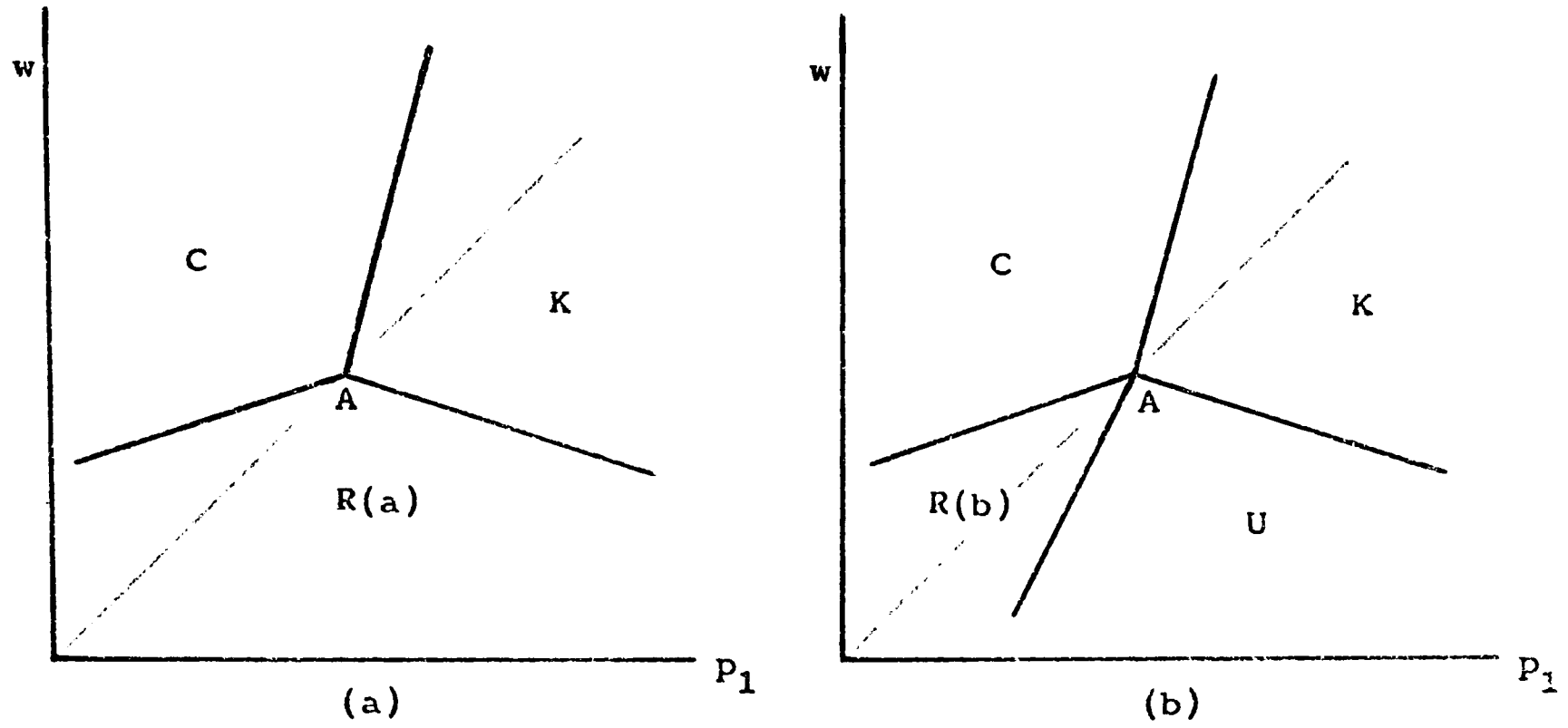


Figure 6.4

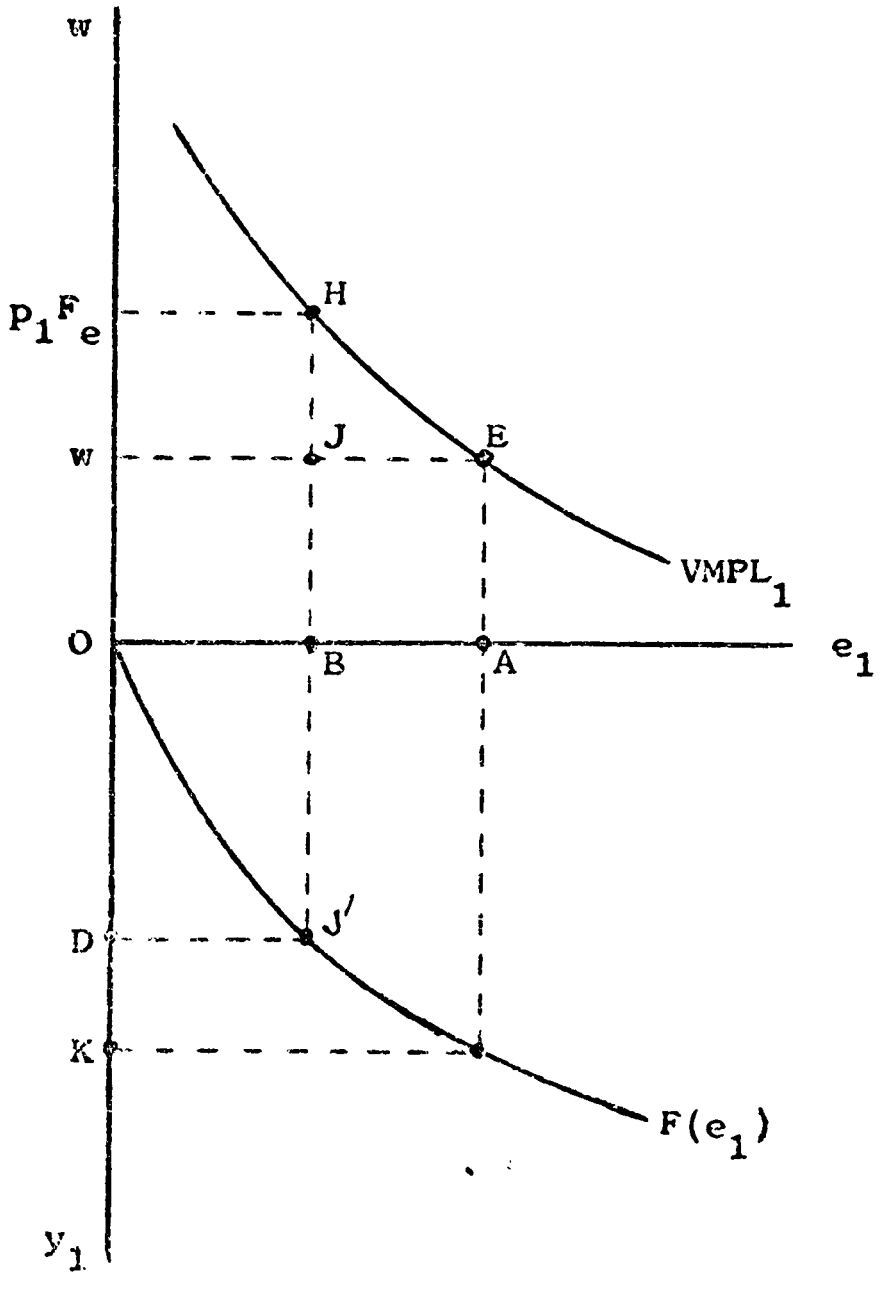


Figure 6.5

(19). This has unambiguously "classical" properties: a fall in the real wage, whether brought about by a nominal wage cut, a reduction in the price of non-tradeables, or a devaluation, increases employment; fiscal and monetary policy do not affect employment (although monetary expansion will reduce labour supply, thus lowering true unemployment); and technological progress in either sector raises employment.[1]

The situation in region K is very different. At any point in the interior of this region employment is demand-determined, but the demand for labour on the part of non-traded good firms depends on the sales constraint which they face, and this sales constraint in turn depends on the employment constraint facing households. The level of employment, $\tilde{\tilde{l}}$, is therefore given by the solution (which we assume to be unique) of the equation:

$$\tilde{\tilde{l}} = F^{-1}\left[\tilde{x}_1\ \{\tilde{\tilde{l}};\ p_1,p_2,w,I\} + g_1;\ h\right] + e_2(p_2,w,k) \qquad (25)$$

The presence of $\tilde{\tilde{l}}$ on both sides of this equation suggests that any exogenous change will have a multiplier effect, and this is indeed the case. Consider first the effect of a monetary expansion. Differentiating (25) yields:

$$\frac{\partial \tilde{\tilde{l}}}{\partial I} = \frac{1}{w}\ \frac{M'}{1-M} \qquad (26)$$

where: $$M = \frac{w}{p_1 F_e}\ \tilde{c}_1 \qquad \text{and } M' = \frac{w}{p_1 F_e}\ c_1' \qquad (27)$$

This is a familiar multiplier-type expression, its only novel feature being that the denominator is, not one minus the marginal propensity to consume non-tradeables, but one minus the latter times the ratio of the wage rate to the value marginal product of

1. This conclusion is reversed if technological progress shifts inwards the marginal product of labour schedule of the progressing sector and so lowers its demand for labour at a given wage and price level. This outcome requires that the technological progress be predominantly labour-saving (in the Hicksian sense) and that the short-run supply elasticity be less than unity (which in turn requires that the elasticity of substitution between labour and the fixed factor be rather low). See Appendix 2.A above.

labour in the non-traded sector. This ratio may be interpreted heuristically as the "shadow price" of the output constraint facing non-traded good firms, since it equals unity if these firms are unconstrained and so operate on their notional labour demand curves, whereas it is less than unity when there is excess supply of the non-traded good. For example, in Figure 6.5, if the representative firm faces the wage rate w, its notional demand for labour is OA. However, if it is constrained to sell no more than OD, then (assuming output cannot be stored) it will employ only OB. Its actual production point will therefore be at J′, and BJ over BH measures the ratio of the wage to the value marginal product of labour at the actual employment level adopted.[1] Hence equation (26) shows that the greater the extent of excess supply of non-traded goods, the lower is the multiplier relative to the usual textbook formula. (It can be shown that part of the discrepancy arises from the assumption that profits are not consumed in the current period; but even allowing for this, it remains the case that the multiplier in the present model is lower than that given by the usual formula).

Turning to the multiplier for government spending, it is clear that spending on traded goods has no effect on employment; this reflects a general phenomenon, to be noted in the next section, that, as in Dixit (loc. cit.), government purchases of traded goods at a given exchange rate worsen the trade balance but do not impinge in any way on the domestic economy. Government spending on non-tradeables does have a multiplier effect, however. Differentiating (25):

---

1. The distance HJ, which might be called the "Patinkin gap" (after Patinkin, 1965, p.323), is a measure of the incentive facing firms to evade the sales constraint (i.e., the increased profit per unit of additional employment made possible by a relaxation of the sales constraint).

$$\frac{\partial \tilde{\tilde{l}}}{\partial g_1} = \frac{1}{F_e} \quad \frac{1}{1-M} \tag{28}$$

Comparing this with (26):

$$\frac{\partial \tilde{\tilde{l}}}{\partial I} \Big/ \frac{1}{p_1} \quad \frac{\partial \tilde{l}}{\partial g_1} = \tilde{c}_1' < 1$$

Thus a given monetary expansion has a smaller effect on employment than an equal government purchase of non-traded goods, because some of the first round of the monetary expansion leaks into increased saving and increased spending on traded goods. It may be noted that these conclusions apply also to the effect of the two policies on output. For example, $(1-M)^{-1}$ is the output multiplier for government spending, giving the response of non-traded output to an increase in government purchases of non-tradeables.

However the major difference in the determinants of employment between the Classical and Keynesian regions lies in the effects of a fall in the real wage. Consider first the effects of a change in the price of non-tradeables. As in region C an increase in p_1 raises the profitability of producing, and hence the notional supply of, non-tradeables. However in region K this increase in notional supply cannot become effective, because the demand for non-tradeables by households is reduced by the price increase. Thus total employment falls following this change:

$$\frac{\partial \tilde{\tilde{l}}}{\partial p_1} = \frac{1}{F_e} \quad \frac{1}{1-M} \quad \frac{\partial x_1}{\partial p_1} < 0 \tag{29}$$

The effects of a change in the real wage brought about by a devaluation are less clear-cut. This has a direct effect of increasing profitability in the traded good sector, and since that sector is unconstrained in the output market this tends to raise employment. In addition, the devaluation has an indirect effect

on the demand for non-tradeables, thus affecting the output constraint faced by non-traded good firms. Assuming that tradeables and non-tradeables are gross substitutes, this effect also is expansionary, and so both effects of the devaluation tend to raise employment:

$$\frac{\partial \tilde{l}}{\partial p_2} = \frac{1}{1-M} \left[\frac{1}{F_e} \frac{\partial \tilde{x}_1}{\partial p_2} + \frac{\partial e_2}{\partial p_2} \right] \tag{30}$$

Finally, what of a direct cut in the nominal wage? The analyses of Malinvaud and Dixit gave very different predictions concerning its effect on employment: in the closed economy model of Malinvaud, a wage cut in region K unambiguously reduced employment through its depressing effect on aggregate demand, whereas in Dixit's open-economy model firms were never constrained on the output market, and so a wage cut always increased output and employment. In the present model, both these effects are present, the former applying to the non-traded good sector, and the latter to the traded good sector. The net effect of a wage cut therefore depends on the relative strengths of these two effects, though since the multiplier applies to <u>both</u> effects, there is no presumption that the "Keynesian" effect is likely to dominate:

$$\frac{w}{\tilde{l}} \frac{\partial \tilde{l}}{\partial w} = \frac{1}{1-M} \left[M + \lambda_{L2} \frac{w}{e_2} \frac{\partial e_2}{\partial w} \right] \tag{31}$$

where λ_{L2} is the proportion of $\tilde{l}$ employed in the traded good sector. It should be noted that the prediction that a wage cut will lower aggregate demand and so tend to reduce employment depends in this model (and in Malinvaud's) on the assumption that profits are not consumed in the current period. It can be shown that if this assumption is dropped and profits are assumed to be consumed instantaneously, then a wage cut will have no direct effect on employment in the non-traded sector. (However this is

the only comparative static prediction of this chapter which is qualitatively affected by this change in assumptions).

The only remaining determinant of employment to be considered is technological progress. Here again, the present model yields results which are midway between those of Malinvaud and Dixit. Technological progress in the traded good sector raises employment, as in Dixit's model;[1] whereas technological progress in the non-traded good sector has, as in Malinvaud's model, an unambiguously depressive effect on employment: although notional supply of non-tradeables rises, aggregate demand, and so the demand constraint facing non-tradeable firms, is not affected, and so the only effect of the technological improvement is to reduce the employment required to produce the given constrained level of output.

In summary, it is clear that the behaviour of employment in region K is very different from that in region C: expansionary policies, especially direct purchases of non-traded goods, have a multiplied expansionary effect on employment; a change in the real wage has different effects, depending on whether it is brought about by a higher price of non-tradeables (which definitely reduces employment), a devaluation (which probably increases it), or a nominal wage cut (which is more likely to raise employment the smaller the multiplier, the smaller the importance of non-traded goods in the labour market and the shorter the lag with which profits are spent on current consumption); and technological progress will raise or lower employment depending on whether it occurs in the traded or non-traded good sectors.

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1. Subject to the qualification in footnote 1 on page 188 above.

6.5 Comparative Statics: Determinants of the Trade Balance

Turning next to the determinants of the trade surplus, we consider these first in region C, where the surplus equals the difference between the notional supply of traded good firms and the effective demand by households, with the latter constrained in both the labour and the non-traded good markets:

$$s = y_2(p_2, w, k) - \underset{\approx}{x}_2\left[\tilde{l}(.), \tilde{x}_1(.), p_1, p_2, w, I\right] - g_2 \qquad (32)$$

The constraints facing households, $\tilde{l}(.)$ and $\tilde{x}_1(.)$, are given by equations (19) and (24) respectively.

The major focus of interest is the effect of a devaluation, which has both a price (or "elasticities") effect, tending to improve the surplus by increasing home supply of and reducing home demand for tradeables, and an income (or "absorption") effect, tending to reduce the surplus:

$$\frac{\partial s}{\partial p_2} = \frac{\partial y_2}{\partial p_2} - \frac{\partial \underset{\approx}{x}_2}{\partial p_2} - \frac{\partial \underset{\approx}{x}_2}{\partial \tilde{l}} \frac{\partial \tilde{l}}{\partial p_2} \qquad (33)$$

This is consistent with the fact (noted in Chapter 5) that, according to the elasticities approach, a devaluation must improve the trade balance in a small open economy, and also with the statement by Dornbusch (1975) that a necessary condition for the elasticities approach to give a complete answer to the effects of a devaluation is that the domestic marginal propensity to consume tradeables must be zero. However, even when the latter is not the case, equation (33) may be manipulated to show that a devaluation must always improve the trade surplus in region C:[1]

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1. ~~By the Le Chatelier principle~~, the marginal propensity to consume tradeables in region K, $\tilde{c}_2$, ~~is likely to be~~ greater than and that in region C, $\underset{\approx}{c}_2$; in general ~~the two~~ will be equal only by coincidence, a fact which raises questions about the interpretation of conventional estimates of the consumption function.

$$\frac{\partial s}{\partial p_2} = \frac{\partial y_2}{\partial p_2}\left[1 - \tilde{\tilde{c}}_2\right] - \frac{\partial \tilde{\tilde{x}}_2}{\partial p_2} > 0 \qquad (34)$$

The effects of changes in other exogenous variables on the trade balance in region C are summarised in the Appendix. Of chief interest are the effects of monetary and fiscal policy: monetary expansion encourages spending on tradeables and so inevitably worsens the trade balance, and similarly government purchases of traded goods effectively bypass the domestic economy and are reflected in a pari passu deterioration of the trade balance. The effect of government purchases of non-tradeables however depends on the effect of their reduced availability on household demand for tradeables (i.e., on the sign of $\partial \tilde{x}_2 / \partial \tilde{x}_1$). Once again, following Howard (1977), the assumption that the two goods are net substitutes makes it likely that this term is negative, implying that government purchases of non-tradeables will worsen the trade balance.

In region K, traded good firms are also unconstrained in both markets, and households are constrained in the labour market only. Hence the expression for the trade surplus is:

$$s = y_2(p_2,w,k) - \tilde{x}_2\left[\tilde{\tilde{l}}(.),\ p_1,p_2,w,I\right] - g_2 \qquad (35)$$

where $\tilde{\tilde{l}}(.)$ is the solution to (25). In this region the effect of a devaluation is given by:

$$\frac{\partial s}{\partial p_2} = \frac{\partial y_2}{\partial p_2} - \frac{\partial \tilde{x}_2}{\partial p_2} - \frac{\partial \tilde{x}_2}{\partial \tilde{\tilde{l}}}\frac{\partial \tilde{\tilde{l}}}{\partial p_2}$$

Substituting from (30) this becomes:

$$\frac{\partial s}{\partial p_2} = \frac{\partial y_2}{\partial p_2}\frac{1-M-\tilde{c}_2}{1-M} - \frac{\partial \tilde{x}_2}{\partial p_2} - \frac{w}{p_2 F_e}\frac{\tilde{c}_2}{1-M}\frac{\partial \tilde{x}_1}{\partial p_2} \qquad (36)$$

The first and second terms in (36) are unambiguously positive, reflecting the direct (price) effects of the devaluation in increa-

sing supply of and reducing home demand for tradeables respectively. (Although as in (34) the former is damped by the tendency for the increased employment induced by the devaluation to lead to greater consumption of tradeables). The third term represents an additional effect of the devaluation which could lead it to worsen the trade balance in precisely that case which has so far yielded conventional predictions, i.e., when tradeables and non-tradeables are gross substitutes. In this case, the devaluation increases the demand for non-tradeables, so relaxing the goods market constraint facing non-traded sector firms. The resulting expansion in employment, and so in income, could lead to a sufficiently large increase in spending on tradeables to offset the first two terms in (36) and so to worsen the trade balance. Of course, this outcome is impossible if tradeables and non-tradeables are independent in demand, which is another of the conditions given by Dornbusch (1975) as necessary for the simple elasticities approach to be valid. It may be noted that in both (34) and (36) (i.e., in both regions C and K) the improvement in the surplus is greater, the greater the supply elasticity in the traded good sector (or, equivalently, the greater its elasticity of demand for labour), and the smaller the home marginal propensity to consume tradeables. Both of these conditions directly contradict the results of Helpman (1977), which were considered in Section 5.4 above.[1]

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1. This is all the more surprising, since, in the neoclassical literature, Helpman's model is the one which most resembles that of the present chapter. The probable source of the difference in results is not that his model is neoclassical (and so assumes a Keynesian consumption function rather than deriving it as the outcome of constrained maximising behaviour), nor his assumption of a flexible price of non-tradeables, but rather that he does not allow any acquisition of financial assets by the private sector. From equation (14), this means that the trade deficit equals the government's budget deficit, whence a devaluation "works" if and only if it reduces the value of the latter in foreign currency. This in turn requires (since government spending is fixed in real terms) that the price of non-tradeables must not rise by more than the extent of the devaluation.

Some other determinants of the trade balance in region K may be briefly mentioned. As before, a one pound increase in government purchases of traded goods lead to a one pound deterioration in the trade balance. Also, monetary expansion leads to a direct increase in spending on tradeables, though its effect on the trade balance will be greater than in region C because of the operation of the multiplier. Finally, government purchases of non-traded goods will worsen the trade balance, because their expansionary effect on employment raises household income and hence household purchases of tradeables.

We consider next the trade balance in region R, under assumption (a) concerning the allocation of labour between the two sectors: that traded good firms get priority, and hence are not rationed on any market. Since households are constrained in the amount of non-tradeables they can purchase, the expression for the trade balance is therefore:

$$s = y_2(p_2,w,k) - \tilde{x}_2\left[\tilde{\tilde{x}}_1(.),\ p_1,p_2,w,I\right] - g_2 \qquad (37)$$

The employment-constrained level of non-traded good production, $\tilde{\tilde{x}}_1$, is in turn determined by the solution to the equation:

$$\tilde{\tilde{x}}_1 = F\left[\tilde{l}\ \{\tilde{\tilde{x}}_1,p_1,p_2,w,I\}\ -e_2(p_2,w,k);\ h\right] - g_1 \qquad (38)$$

As in the case of $\tilde{\tilde{l}}$ in equation (25), the appearance of $\tilde{\tilde{x}}_1$ on both sides of this equation suggests the presence of a multiplier, in this case the "supply multiplier" of Barro and Grossman (1974). Thus, an increase in government purchases of non-traded goods in region R(a) has a direct "first-round" effect of reducing the quantity of non-tradeables available for household consumption, and, faced with a tighter constraint on the non-traded good market, households respond by adjusting their labour supply. Assuming that leisure and non-tradeables are substitutes in consumption, the

response implied will take the form of a reduction in households' labour supply, and this will serve to exacerbate the excess demand for labour, so leading to a sequence of further falls in output and consumption of non-tradeables. The total effect is therefore given by the multiplier:

$$\frac{\partial \tilde{\tilde{x}}_1}{\partial g_1} = -\frac{1}{1-N} \qquad (39)$$

where $N = \frac{p_1 F_e}{w} \hat{c}_l$

The term $\hat{c}_l$ is the marginal propensity to consume leisure when households are constrained in their consumption of non-tradeables; we assume throughout that it is positive and that, when weighted by the "shadow price" $p_1 F_e / w$, it is less than unity. The trade balance implications of an increase in government purchases of non-traded goods can now be seen by differentiating (37), invoking (39):

$$\frac{\partial s}{\partial g_1} = -\frac{p_1}{p_2}\frac{\hat{c}_2}{1-N} \qquad (40)$$

where $\hat{c}_2$ is the marginal propensity to consume traded goods when households face a constraint on their purchases of non-tradeables. Equation (40) shows that, once again, an expansionary domestic policy will worsen the trade balance, although the mechanism by which this is brought about is very different from those which operated in regions C and K.

The effect of a devaluation on the trade balance may be established in a similar manner: in addition to the usual direct price effects, the devaluation changes the employment constraint facing non-traded good firms, and hence the non-traded purchases constraint facing households, in two ways: firstly, by changing the total available labour supply, and secondly, by raising the profitability of traded good production, and so leaving less labour

available for non-traded sector firms:

$$\frac{\partial s}{\partial p_2} = \frac{\partial y_2}{\partial p_2} - \frac{\partial \tilde{x}_2}{\partial p_2} - \frac{\partial \tilde{x}_2}{\partial \tilde{\tilde{x}}_1} \frac{\partial \tilde{\tilde{x}}_1}{\partial p_2}$$

$$= \frac{\partial y_2}{\partial p_2} \frac{1}{1-N} \left[1 - \frac{p_1 F_e}{w} (\hat{c}_1 + \hat{c}_2) \right] - \frac{\partial \tilde{x}_2}{\partial p_2} \qquad (41)$$

$$+ \frac{p_1}{p_2} \hat{c}_2 \frac{F_e}{1-N} \frac{\partial \tilde{l}}{\partial p_2}$$

The first term in (41), representing the supply effect of the devaluation, is positive, except when the initial excess demand for labour is sufficiently large that the term $p_1 F_e/w$ is considerably greater than unity; the second, demand, term is always positive. However the final term, representing the induced change in labour supply, is negative provided leisure and traded goods are gross substitutes. Hence, the presumption that a devaluation must improve the trade balance is no stronger in this region than it is under conditions of Keynesian unemployment.

Finally, what of the determinants of the trade balance when assumption (b) is made about the labour market under excess demand, namely that non-traded good firms get priority? In region R (b), with consumers constrained in the non-traded good market and traded good firms constrained in the labour market, the trade balance is given by:

$$s = G \left[\tilde{l} \{\tilde{x}_1(.), p_1, p_2, w, I\} - e_1(p_1, w, h); \quad k \right]$$

$$- \tilde{x}_2 \{\tilde{x}_1(.), p_1, p_2, w, I\} - g_2 \qquad (42)$$

where the demand constraint facing households, $\tilde{x}_1(.)$, is given by (24). While in region U, in which traded good firms are constrained in the labour market and non-traded firms in the output market, the corresponding equation is:

$$s = G\left[l(p_1,p_2,w,I) - F^{-1}\{x_1(p_1,p_2,w,I) + g_1;\ h\};\ k\right] - x_2(p_1,p_2,w,I) - g_2 \tag{43}$$

These two equations have a number of common features. In the first place, neither of them implies a multiplier effect, since in these two regions there is no good for which the corresponding labour and output markets are both subject to constraints. Secondly, fiscal and monetary expansions necessarily worsen the trade balance in both regions. Finally, the cross-price effects of a devaluation tend to worsen the trade balance in both regions, under the assumption of gross substitutability. For example, in region U, a devaluation reduces labour supply and increases demand for non-tradeables, if gross substitutability is assumed, tending on both counts to tighten the labour market constraint faced by traded good firms and so to worsen the trade balance:

$$\frac{\partial s}{\partial p_2} = G_e\left[\frac{\partial l}{\partial p_2} - \frac{1}{F_e}\frac{\partial x_1}{\partial p_2}\right] - \frac{\partial x_2}{\partial p_2} \tag{44}$$

A similar analysis applies in region R(b), except that the second term inside the brackets in (44) does not appear.

In summary, the striking feature of this section is that, despite the very different chains of causation which operate in the different regions, expansionary fiscal and monetary policies tend to worsen the trade balance in all cases, whereas the effect of devaluation, though likely to be favourable, is usually ambiguous. Moreover, although this unpredictability of the effects of a devaluation derives in part from the disaggregated nature of the model, it is enhanced rather than avoided by the assumption of gross substitutability.

Taken in conjunction with the finding of Section 6.4, that devaluation affects employment in regions C and K more predictably than do fiscal and monetary policy, this would appear to favour

the assignment of policy instruments to targets associated with the "New Cambridge" (U.K.) school - fiscal policy for external balance, exchange rate policy for internal balance - rather than the more conventional assignment assumed in most discussions of policy choice in a small open economy.[1] However, to evaluate the efficacy of different policy rules it is not enough to consider their effects within each region; it is necessary to look also at their effects on the location of the regions themselves. To this we turn in the next section.

6.6 Comparative Statics: Shifts between Regimes

The comparative static analysis of the preceding two sections applies strictly only for infinitesimally small changes in the exogenous variables, not merely for the usual reason that the linearisation implicit in taking derivatives may be invalid for large changes, but in addition because large changes may shift the economy from one region into another. To obtain some indication of the directions in which such shifts may take place, we consider in this section the effects of exogenous changes on the location of the equilibrium loci in Figure 6.4(b).

We begin by examining the effects of a monetary expansion. Inspection of the expressions for the equilibrium loci in Section 6.3 shows that in all cases an increase in lump-sum income I leads to excess demand in both labour and output markets. Hence the effect of a monetary expansion is as shown in Figure 6.6: region R(b) expands and region K contracts, with corresponding changes in the other two regions. Thus, if the economy is at point A which represents initially a point of Walrasian equilibrium, an increase in I will shift it into region R, irrespective of which assumption

1. For discussions of the New Cambridge approach, see Cripps and Godley (1976) and Spraos (1977). The same superiority of the New Cambridge assignment rule is found in the model of Helpman (1977), examined in Section 5.4 above.

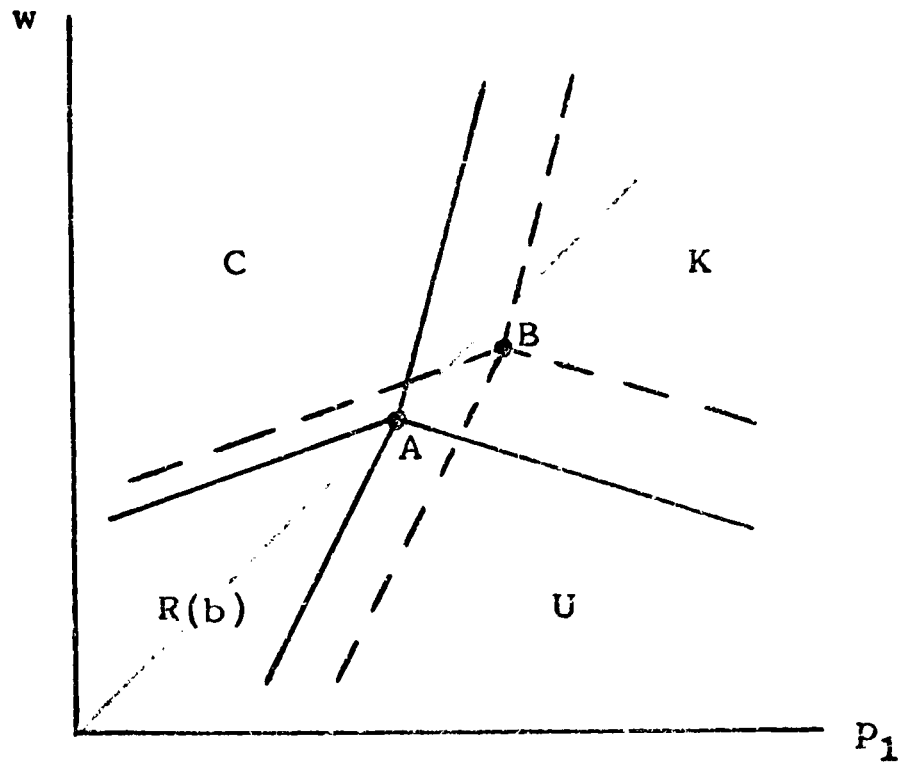


Figure 6.6

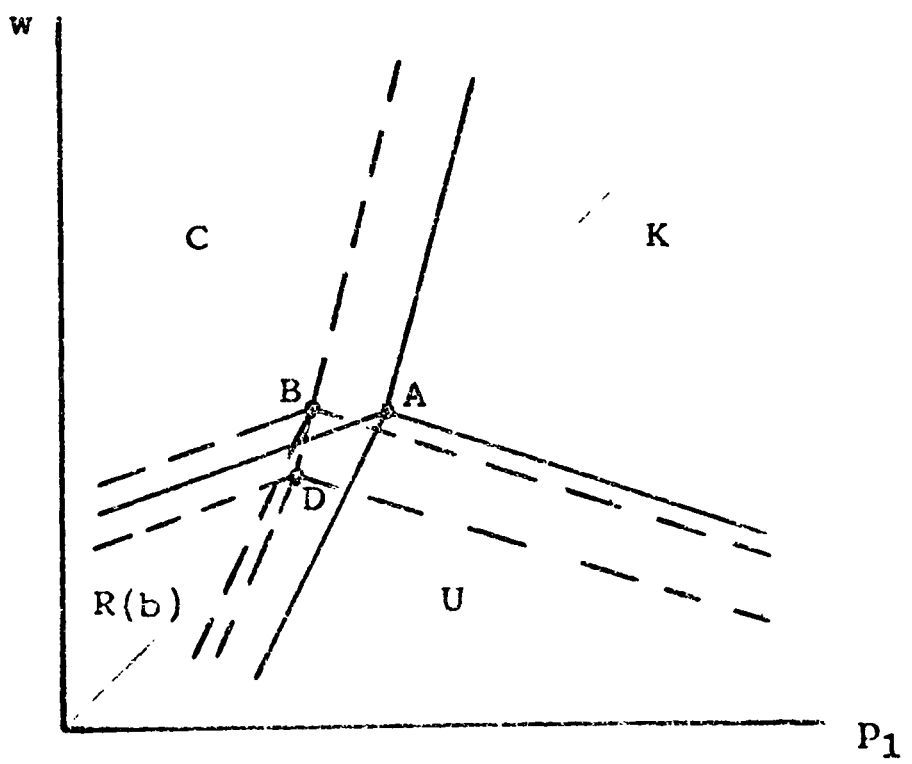


Figure 6.7

is made about the allocation of the labour force between sectors under excess demand for labour. Conversely, if the economy is at point B in initial Walrasian equilibrium and the money supply is reduced, a situation of Keynesian unemployment will ensue. These findings are identical to those of Malinvaud, and, insofar as the "normal" evolution of contemporary capitalist economies may be viewed as caused by fluctuations in the level of aggregate demand in the neighbourhood of full or Walrasian equilibrium, they provide one of his arguments as to why regions K and R are likely to be the ones most frequently observed in practice.

Turning to the effects of fiscal policy, it is clear that government purchases of traded goods have no direct effect on the location of the equilibrium loci, and so do not influence the domestic economy. However such government purchases do worsen the trade balance, which leads over time to a contraction of the domestic money supply in the manner familiar from writings on the monetary approach to the balance of payments, and this leads to shifts in the location of the equilibrium loci such as were analysed in the preceding paragraph. As for government purchases of non-traded goods, they have an immediate impact on the diagram, which does not differ qualitatively from that of monetary expansion. In quantitative terms, because it operates directly on the demand for non-tradeables, such a fiscal policy has a greater impact than monetary policy on all the equilibrium loci with the exception of the labour market equilibrium locus under excess demand for non-tradeables (equation (23)). This means that a balanced budget expansion, in the sense of a government purchase of non-traded goods financed by a lump-sum tax on households' initial money balances ($p_1 dg_1 = -dI$), will affect the diagram in a similar fashion to that of a monetary expansion as depicted in

Figure 6.6, except that the locus separating regions C and R(b) is not affected. Starting from a Walrasian equilibrium therefore, such a policy leads to excess demand for non-tradeables, though the labour market equilibrium is not disturbed. Conversely, a contractionary balanced budget shifts the economy from Walrasian equilibrium into the region of Keynesian unemployment.

Turning next to the effects of a devaluation, it has the direct effect of raising profitability in the traded good sector. This tends to expand the regions of excess labour demand, and, by relaxing the labour supply constraint facing households, and tightening the employment constraint facing non-traded good firms (in region R(a)), it tends to expand the regions of excess demand for non-tradeables. As far as these direct effects are concerned therefore, a devaluation has the same qualitative effects on the diagram as the monetary expansion depicted in Figure 6.6. However in addition, a devaluation has indirect cross-price effects, and these reinforce the direct effects only if the assumption of gross substitutability is made. Thus for example, if traded and non-traded goods were complementary in demand, a devaluation in a situation of Walrasian equilibrium could shift the economy into region U, while a revaluation could lead to Classical, rather than Keynesian, unemployment.

Finally, it is necessary to consider the effects on the diagram of technological progress and regress (where one possible interpretation of the latter is, following Malinvaud, a rise in the price of an intermediate input). As we would expect, the effects of such a change differ greatly depending on whether it is assumed to take place in the traded or the non-traded good

sector.[1] In the former case, the effect on the diagram is similar to that of monetary expansion as in Figure 6.6, except that the locus separating regions R(b) and U is not affected. Starting at Walrasian equilibrium therefore, technological progress in the traded good sector leads to excess demand for labour, but does not impinge on the non-traded good sector, provided assumption (b) about labour force allocation is made. Conversely technological regress leads to Keynesian unemployment.

By contrast, technological progress in the non-traded sector has a very different effect, resembling that which it has in the closed economy model of Malinvaud. Since the technological progress raises the output of non-tradeables at given wages and prices, the regions of excess supply of non-tradeables expand, as illustrated in Figure 6.7. In addition, since the labour required to produce a given amount of non-traded goods necessarily falls, the region of excess supply in both labour and non-traded good markets (region K) must expand at the expense of region U. This means that, starting at Walrasian equilibrium, technological progress in the non-traded sector leads to Keynesian unemployment, which is the Ricardian result of Malinvaud. However the effect of technological progress on the location of equation (23) (separating regions C and R(b)), is not so clearcut: differentiating that equation, it emerges that technological progress in non-tradeables (i.e., an increase in h) by raising the output of non-tradeables, relaxes the purchases constraint faced by households and therefore raises their labour supply, so tending to expand region C; but in addition, it

1. Its effects also depend on whether, as was implicitly assumed by both Malinvaud and Dixit, technological progress increases the demand for labour in the progressing sector at a given wage and price (and conversely for technological regress). As noted in footnote 1 on page 188 above, this outcome may not occur, in which case the conclusions of this paragraph must be reversed.

raises the demand for labour by the non-traded sector (except in the exceptional case mentioned in footnotes above) and so tends to expand region R(b):

$$\frac{\partial}{\partial h}\left[\text{ESL(EDNT)}\right] = \frac{\partial \tilde{l}}{\partial \tilde{x}_1}\frac{\partial y_1}{\partial h} - \frac{\partial e_1}{\partial h} \qquad (45)$$

There is no presumption as to which of these two effects will dominate (even when utility and production functions are of the Cobb-Douglas form, as was pointed out by Malinvaud, op.cit., p.91, fn. 4). If the first (positive) term dominates, technological progress shifts the point of Walrasian equilibrium in Figure 6.7 from A to D; in this case, the model predicts that technological regress in the non-traded sector will lead to repressed inflation. Whereas, if the second term in (45) is negative and dominates the first, the relevant points are A and B, and so technological regress in the non-traded sector shifts the economy from a state of Walrasian equilibrium into one of Classical unemployment. It is clear that the latter outcome, which underlies Malinvaud's explanation of the effects of the 1973 oil price rise on the economies of Western Europe (op.cit., pp.107 ff.), is only guaranteed if the technological regress is accompanied by a sufficiently large increase in the real wage.

6.7 Extensions of the Basic Model

This section considers briefly, without presenting results in full, three extensions of the foregoing analysis. The first involves the application of the model to an additional issue, namely the consideration of policy choice under floating as well as fixed exchange rates. The second introduces an improvement to the theory of the firm in the present model, along lines suggested by Muellbauer and Portes (1978), which enriches the model without

changing its character in any fundamental way. Finally, the third extension, the explicit introduction of expectations, raises issues which call into question the validity of the preceding comparative static derivations, and suggest directions for further research which must be carried out before the present model can be taken too seriously for policy purposes.

(A) Floating Exchange Rates

The model presented in previous sections consisted of three markets, in all of which prices were assumed to be fixed in the short run, and of which two (those for labour and non-traded goods) were assumed to be cleared by rationing, while the third (that for traded goods) was not obliged to clear, since any excess of supply over domestic demand was reflected in the trade surplus. One obvious extension of this model is to consider the alternative assumption whereby the market for traded goods is cleared domestically by price changes: in other words, where the exchange rate is allowed to float freely. It should be clear that the structure of the model as well as the approach to analysing it, are not seriously affected by this change. Since there are still only two markets which clear by quantity rationing, it remains possible to concentrate on a diagram in (w,p_1) space. The only additional complication is that p_2 is now an endogenous variable whose dependence on the exogenous variables must be explicitly considered before the location of the equilibrium loci and the comparative static properties within each region may be calculated. Although this is a complicated exercise, since the demand and supply schedules which determine p_2 differ depending on which region is under consideration, it does not pose any new problems.

One of the more interesting questions concerning the model with floating exchange rates is how its properties differ from

those of the fixed-rate model. Without considering all the ramifications of this question, it is clear that it may be approached by breaking any comparative static derivative under floating rates into two components: one, the corresponding derivative under fixed rates, and the other the effect of the induced depreciation or appreciation of the exchange rate. Thus, the change in employment in any one regime under floating rates following a change in an exogenous variable α is given by:

$$\left.\frac{\partial l}{\partial \alpha}\right|_{\text{floating}} = \left.\frac{\partial l}{\partial \alpha}\right|_{\text{fixed}} + \left.\frac{\partial l}{\partial p_2}\right|_{\text{fixed}} \left.\frac{\partial p_2}{\partial \alpha}\right|_{\text{floating}} \qquad (46)$$

A detailed consideration of the second term on the right-hand side of (46) for all possible combinations of endogenous variables, exogenous variables and regimes, would take us too far afield. However, since, as already noted, any fiscal or monetary expansion worsens the trade balance under fixed rates, and is therefore likely to depreciate a floating exchange rate irrespective of which regime prevails, and since $\partial l/\partial p_2$ is positive in all regimes, such policies must have a greater impact on employment under floating than under fixed rates. Comparisons between the effects of changes in other exogenous variables under fixed and floating exchange rates may be carried out in a similar fashion.

It may be mentioned in passing that, from a purely formal point of view, this model with floating rates is very similar to the model of Hool (1978), which also has one fix-price and one flex-price good market, though in Hool's interpretation the latter is the bond market, whose clearing is accomplished by variations in a flexible interest rate. The model of this section is even more similar to the model suggested by Leijonhufvud (1968) as an appropriate formalisation of Keynes's General Theory, namely, a model with a consumption good and an investment good sector. It

could be argued that the form of the model which would be closest to Keynes would be one with a flexible price of consumption goods and a sticky interest rate (i.e., a sticky price of investment goods). (Note that this reverses Hool's assumptions about the degree of price flexibility in the two markets). Clearly these issues merit further exploration, which could be carried out using essentially the same model as that of the present section. Regrettably, this topic cannot be pursued for the moment.

(B) An Intertemporal Theory of the Firm

Returning to the case of fixed exchange rates, one of the peculiar features of the model presented above is the asymmetry in constraint regimes which it implies. Although in regime C households are on the long side in both labour and non-traded good markets and firms are unconstrained, there is no region "dual" to this where firms are on the long side on both markets and households unconstrained. (Of course, under assumption (b) about the allocation of the labour force when excess demand for labour prevails, region U appears to be of the kind mentioned. However in that region the firms which are rationed on the labour market - those in the traded good sector - are not the same as those which are rationed on the output market - those in the non-traded good sector). The reason for this asymmetry is not hard to find: it follows from the feature of the model that, although households are implicitly assumed to plan for the future, since they derive utility from end-of-period money balances, firms are assumed to maximise profits in the current period without any consideration to their profit position in future periods. This is equivalent to assuming that output is not storable, since it implies that firms always wish to sell all their output in the current period. Hence, if a firm finds itself on the long side of both output and labour

markets, it will increase its current profits by reducing its employment and production levels until one or other of the constraints ceases to bite.

This asymmetry in the model is immediately avoided if firms are assumed to plan their activities beyond the present period, and output can be stored for future use. The simplest assumption along these lines, adopted by Malinvaud himself (1977, Appendix), is that firms maximise a "utility" function defined over current profits and end-of-period stocks. This is a direct analogy with the treatment of consumer choice in Section 6.2 above; however a more satisfactory (because more explicit) approach, a slight generalisation of that of Muellbauer and Portes (1978), is to assume that unsold output in the current period augments the productivity of labour in the next period. The unconstrained decision problem of a firm in either sector is therefore to choose current levels of employment, e^1, and stock accumulation, I, to:

$$\text{Max} \quad \pi^1 + \delta\pi^2 \tag{47}$$

where π^i = profits in period i

δ = firm's discount factor

$\pi^1 = p^1\left[F(e^1)-I\right] - w^1e^1$

$\pi^2 = p^2H(e^2,I) - w^2e^2$

(with superscripts denoting the period to which the variable in question refers). It may easily be seen that when this approach is substituted for the static theory of the firm of Section 6.2 above, the model is enriched to the extent that a region of "underconsumption" with households unconstrained and non-traded good firms rationed on both labour and output markets, becomes possible even when assumption (a) about rationing of the labour

force when there is excess demand for it is made. However the comparative static properties of this region are not especially surprising, and the character of the model is not changed fundamentally by this addition. In fact, a more important aspect of an explicitly dynamic theory of the firm is that it brings into focus the need to consider expectations of future prices and constraints, an issue to which we now turn.

(C) Explicit Consideration of Expectations

Unquestionably a major deficiency of the model of this chapter is its failure to explicitly incorporate the expectations of agents about future periods (other than by means of the unspecified catch-all vector θ in equation (1)). To begin with, this means that all the comparative static derivatives presented in previous sections must be interpreted with caution, since they are valid only on the implausible assumption that expectations are independent of both exogenous and endogenous variables. A more serious difficulty still is that the explicit consideration of expectations may affect the likelihood of which constraint regime will prevail in the current period. Without presenting a detailed analysis, this section notes two respects in which this dependence of the present on expectations about the future is of importance. We concentrate attention throughout, not on the more widely-studied problem of price expectations, but on an issue peculiar to neo-Keynesian temporary equilibrium, namely, agents' expectations about the constraints which they may face in future periods. (For simplicity we also consider only the case of subjectively certain point expectations).

The first aspect to be noted is that, not only will agents' expectations about the future influence which regime is likely to prevail to-day, but this influence is likely to be of a self-

fulfilling expectations kind. As an example of this effect, consider the two-period decision problem of a firm as outlined in the last sub-section. When the firm is currently unconstrained and expects to remain so in the next period, its maximisation problem is given by (47), and its current demand for labour and supply of output schedules are:

$$e^1(p^1,w^1,p^2,w^2,\delta) \text{ and } y^1(p^1,w^1,p^2,w^2,\delta) \qquad (48)$$

However, if the firm, though still unconstrained in the current period, expects to face a labour market ration of $\underline{e}^2$ in the next period, then its decisions must be recalculated, and its effective labour demand and output supply schedules become:

$$\tilde{e}^1(p^1,w^1,p^2,\delta,\underline{e}^2) \text{ and } \tilde{y}^1(p^1,w^1,p^2,\delta,\underline{e}^2) \qquad (49)$$

It is easily established that, under fairly weak assumptions about the form of the production functions F and H in (49), the partial derivatives of $\tilde{e}^1$ and $\tilde{y}^1$ with respect to $\underline{e}^2$ are likely to be negative and positive respectively. (This is intuitively plausible: the more difficulty the firm expects to face in obtaining labour in the future, the more stocks it will wish to carry over into the next period, and a higher level of stock accumulation will be achieved by increasing production and reducing sales in the current period). This means that the tighter the expected employment constraint in the next period, the greater the likelihood that excess demand for both labour and output will prevail in the current period. (Of course, if excess demand does emerge in either of these markets, assuming that households' decisions are given, firms' decisions must again be recalculated; however this does not affect the argument). Thus, the greater the expected degree of excess demand for labour in the next period, the larger will region R become in the present.

An analogous result follows if the firm expects to be constrained to sell no more than the level $\underline{y}^2$ in the next period. As before, the outcome of the maximisation problem (47) subject to this additional constraint is an effective labour demand and output supply schedule which depend explicitly on the level of the perceived constraint:

$$\tilde{e}^1(p^1,w^1,w^2,\delta,\underline{y}^2) \quad \text{and} \quad \tilde{y}^1(p^1,w^1,w^2,\delta,\underline{y}^2) \tag{50}$$

In this case, the partial derivatives of $\tilde{e}^1$ and $\tilde{y}^1$ with respect to $\underline{y}^2$ are likely to be positive and negative respectively. Thus, the greater the degree of excess supply of output which firms expect to prevail in the next period, the lower will be their demand for labour and the greater their supply of output in the present, thus tending to encourage excess supply of both labour and output in the present.

Similar arguments may be applied to the effects of households' expectations on their current behaviour: for example, the less labour households expect to be able to supply next period, the more labour they will wish to supply and the less output they will wish to consume in the current period. Once again, expectations of excess supply of labour in the future encourage excess supply of both labour and output in the present. These considerations provide a simple formalisation of some of the ideas in Keynes's General Theory, and they also call into question the relevance of the notion of rational expectations, at least when the latter are interpreted as self-fulfilling. For, if for given values of all other exogenous variables (including wages and prices), the occurrence of regime K as opposed to regime C to-day hinges on whether or not regime K is expected to prevail tomorrow, the rational expectations concept of a self-fulfilling expectations equilibrium is not unique. This suggests that its value in yield-

ing solutions of a dynamised version of the present model is likely to be limited.

It may be noted that in all the examples given so far, the greater the "pessimism" about future constraints, the greater the likelihood of either regime K or R prevailing to-day; in no case did a higher expectation that a future constraint would bind increase the likelihood that either regime C or U would prevail to-day. This brings us to the second aspect of the model to which the explicit consideration of expectations draws attention, namely the circumstances in which either of these two regimes is likely to prevail. Consider first regime C: here households are unable to supply as much labour as they wish, even though, were they to be permitted to work slightly longer, they could not consume the additional income they would earn, since they are also constrained in their purchases of goods. Conversely, at any interior point of this region, (i.e., any point where both constraints are strictly binding) a small tightening of the labour market constraint would not affect their consumption, but would merely reduce their savings (or accumulation of money balances). Hence it follows that, at any such interior point, positive savings by households are being made. But this means that households must expect to be able to spend these accumulated savings at some time in the future (since in a fully-specified dynamic utility-maximisation problem, the acquisition of money balances does not yield direct utility). Hence, adopting a two-period framework for simplicity, households must have <u>asymmetric constraint expectations</u>: they must, to some extent, be more optimistic about a relaxation tomorrow of the labour market constraint they face to-day than they are about the goods market constraint they face to-day; for otherwise, at least with subjectively certain point expectations, they would expect to be unable to spend their savings in the future

and would therefore have no incentive to save in the first place. A similar argument applies to firms in region U (assuming they adopt the two-period planning approach outlined in Section 6.7.B above). At any interior point in this region, firms must have a positive level of stock accumulation, since otherwise a small tightening of the employment constraint which they face would lead them to reduce their sales, implying that they had not been in the interior of the region in the first place. As with households in region C therefore, firms must expect to be able to sell these accumulated stocks in the future, which implies that they must be more optimistic that the sales constraint they now face will be relaxed than they are that the current employment constraint will be relaxed.

From these arguments we may conclude that, in some as yet incompletely specified sense, for either of regimes C or U to prevail, there must be relatively greater optimism concerning the future relaxation of constraints in the goods market than there is concerning constraints in the labour market. Since no such asymmetry is required for regions K or R to prevail, this suggests that, in the "space" of constraint expectations, $(\underline{e}^2, \underline{y}^2)$, regions K and R are likely to be larger than regions C and U. The explicit consideration of constraint expectations therefore provides another reason (additional to the quasi-dynamic arguments given by Malinvaud) why an economy which resembles the model of this chapter is likely to spend a predominant amount of time in one or other of the states of Keynesian unemployment or repressed inflation.

6.8 Summary and Conclusion

This chapter has presented a model of a small open economy under fixed exchange rates which, though fully consistent in the long run with the monetary approach to the balance of payments, exhibits very different properties in the short run when the wage rate and the price of non-traded goods are sticky. In many respects the model behaves rather like a hybrid of the single-traded-good model of Dixit (1978) and the fully closed model of Malinvaud (1977): for example, the comparative static effects of technological progress or of government purchases depend on the sector in which they take place: if in the traded good sector, they have effects similar tc those in Dixit's model, whereas if they occur in the non-traded good sector, their effects resemble those found by Malinvaud. In addition, the greater complexity of the model was found to lead to a richer set of properties. While some of these additional properties could be ruled out by assuming that all commodities were gross substitutes, this was not true of all: for example, it was found that a devaluation under conditions of Keynesian unemployment can worsen the trade balance (and that the conditions under which this outcome is more likely are precisely the opposite of those presented by Helpman (1977)); also, it was shown that, even with an atemporal theory of the firm, a region of "underconsumption" in the sense of Muellbauer and Portes (1978) is possible, where households are unconstrained and firms constrained on both labour and output markets (although no single firm is subject to both constraints). Finally, while the dangers of placing too much reliance on comparative static derivatives were stressed, it was noted that the model gives some support to the unorthodox policy assignment associated with the "New Cambridge" school: taking all possible regimes together, exchange

rate policy was found to exert a more predictable influence on the level of employment than fiscal or monetary policy, whereas the reverse was true of the influence of these two sets of instruments on the trade balance.

From the perspective of international monetary economics, the model of this chapter may be seen as providing a consistent micro-economic foundation for the traded-non-traded goods model of Salter (1959). By comparison with many recent contributions to the literature on international monetary economics, the model presented is in some respects relatively unsophisticated: exchange rate expectations and international capital movements are completely ignored, while other issues which have attracted recent interest such as the financing of the government's budget deficit and the effects of trade-imbalance-induced changes in the domestic money stock are treated only sketchily. On the other hand, the model provides a more secure foundation than any existing treatments for the discussion of the impact effects of policy changes in a small open economy. While this chapter has raised more questions than it has answered (especially concerning the dynamic evolution of the model, and the effects of explicitly incorporating expectations), it is to be hoped that the novel properties of the model, as well as the light it throws on matters of traditional interest to international monetary economists will be taken to justify its study.

APPENDIX TO CHAPTER 6

Each entry in the table gives the sign of the partial derivative of the endogenous variable in the region indicated with respect to the relevant exogenous variable.

Region	Endogenous Variable (with equation number in parentheses)	Exogenous Variable							
		w	p_1	p_2	h	k	I	g_1	g_2
C	$\tilde{l}$ (19)	−	+	+	+(a)	+(a)	0	0	0
K	$\tilde{\tilde{l}}$ (25)	?	−	+(b)	−	+(a)	+	+(c)	0
C	s (32)	?	?	+	?	+	−	−(c)	−
K	s (35)	−(b)	?	?	+	+	−	−	−
R(a)	s (37)	−(b)	−	?	−	+	−	−	−
R(b)	s (42)	?	?	?	?	+	−	−	−
U	s (43)	−(b)	?	?	+	+	−	−	−

Notes: (a) This sign is reversed if the technological progress shifts inwards the labour demand schedule of the progressing sector. Necessary and sufficient conditions for this outcome are given in Appendix 2.A.

(b) Gross substitutability is sufficient but not necessary for this sign.

(c) This sign is reversed if the relevant "feedback" effect does not have its normal sign. Such a reversal is unlikely if the commodities in question are net substitutes.

CHAPTER 7

CONCLUSION

> ' [In the land of Tlön] a book which does not contain its counterbook is considered incomplete'.
>
> - Jorge Luis Borges: Labyrinths, Penguin , p.37.

Most of the specific conclusions of this thesis have already been summarised in the last section of each chapter, and they will not therefore be repeated here. Instead this final chapter comments on some general issues raised by the thesis as a whole.

As outlined in Chapter 1, the thesis has explored two different approaches to the study of simple general equilibrium economic models out of long-run equilibrium. On the one hand, the thesis examined the consequences of dynamising the two-sector neoclassical model of competitive equilibrium, not in the sense of studying its evolution over long periods of time, but in the sense of making explicit the process whereby momentary equilibrium, that is, full equilibrium with a given factor endowment, is attained. On the other hand, the thesis looked in detail at some of the problems which arise in the very short run when the assumption of flexible prices and wages is abandoned. It is clear that these two directions of research are complementary, and, while a formal integration of the two approaches is unlikely to be particularly fruitful in the present state of our knowledge, the theoretical lacunae to which they draw attention are of a similar nature.

As regards the neoclassical models, one major difficulty to which attention is drawn by making explicit the process of inter-sectoral capital reallocation was noted in Section 2.7: namely, the implausibility of a rigid distinction between the reallocation of a fixed stock of capital on the one hand, and changes in this

stock over time through capital accumulation on the other. It seems obvious that these processes are simultaneous in the real world, and that a mode of analysis which ignores this simultaneity is unlikely to yield satisfactory predictions. At the same time, while recognising and remedying this difficulty is likely to reduce the importance attached to models which assume intersectoral capital mobility (and the results which this assumption implies, such as the Rybczynski and Stolper-Samuelson theorems), it does not raise any specific problems of method. On the contrary, it seems likely that a re-examination and extension of the existing work on two-sector growth models with sector-specific capital[1] could form the basis of a theory of medium-run competitive resource reallocation which would avoid this undesirable feature of the Heckscher-Ohlin-Samuelson approach.

By contrast, considerable problems of a fundamentally different kind are posed for the standard neoclassical approach by the relaxation of another of its crucial assumptions, namely the assumption that commodity prices adjust instantaneously according to tâtonnement-type processes, with no trading taking place at disequilibrium prices.[2] However it is precisely this difficulty that the "neo-Keynesian" approach, explored in Chapter 6, attempts to overcome. Unfortunately, while it permits a much more satisfactory analysis of the determination of short-run equilibrium when prices are sticky, the neo-Keynesian approach remains firmly wedded to a single-period framework: no satisfactory dynamisation of this type of model appears yet to have been completed. To a

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1. Examples of this literature, mentioned in Chapter 3, include Inada (1966) and Bosch, Mas-Colell and Razin (1973).
2. As noted in Section 3.6, no difficulty is posed for a local stability analysis by the assumption of price adjustment in response to excess commodity demand; but for any finite displacement from equilibrium the neoclassical approach breaks down.

considerable extent, this reflects the fact that any satisfactory dynamisation requires some relaxation of three of the strategic simplifications which give the simple neo-Keynesian approach its power and tractability: firstly, the fact (noted in Section 6.7) that it effectively ignores expectations; secondly, its assumption that prices and wages are exogenously given; and thirdly, its conceptualisation of behaviour under rationing as taking the form of effective demands and supplies on each market being formulated in a manner which takes account only of the constraints faced on other markets.[1] Clearly progress in all three of these areas is required before the dynamic evolution of models such as that of Chapter 6 can be satisfactorily studied.

Finally, one class of questions which has been almost completely ignored in this thesis is the welfare economic implications of the different methods and results which have been examined. However this is not to say that these implications do not merit exploration; on the contrary a number of issues are raised both for welfare economics and for the theory of public policy by the two approaches which have been studied. For example, the dynamic neoclassical models raise the question of the appropriate form which government intervention should take in the context of medium-run intersectoral factor reallocation. Some progress in this area has been made by the contributions of Lapan (1976) and Mussa (1975), but it seems likely that much more could be said which would be of interest both with a view to dynamising the existing theory of optimal intervention in the presence of factor-market

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1. Grandmont (1977, p.563) argues that the assumption of dynamic adjustment of prices in response to the gaps between notional and effective demands and supplies is inappropriate in the light of this assumption concerning behaviour under disequilibrium.

and other distortions, as well as with a view to throwing light on the considerations which should govern the appropriate design of schemes for adjustment assistance. As for the temporary equilibrium approach, the analysis of welfare issues in this framework is still an uncharted area, but it seems likely to yield results of considerable interest, as well as to throw light on the nature of the positive properties of these models.[1] One question which seems especially worthy of attention here is whether anything can be said about the optimal choice of taxes which would be robust with respect to the occurrence of different regimes. Such an exercise might permit some reconciliation of the theory of optimal taxation with the traditional issues of monetary and fiscal policy, thus taking a large step in the direction of a reconciliation between the hitherto separate macro and micro branches of public economics.

In conclusion, it is clear that the present chapter is more in the nature of a research agenda than a report on completed work. Hopefully the pursuit of some of the issues mentioned here will lead, not to the infinite regress of a Borgesian labyrinth, but to an expanded understanding of the positive and normative consequences of the short- and medium-run evolution of competitive economies.

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1. Witness, for example, the demonstration by Hahn (1978) that a temporary equilibrium with rationing necessarily involves a fundamental externality, and that for each such equilibrium there exist coupon rationing schemes at the given prices which if adopted would overcome the externality.

REFERENCES

Amano, A. (1977): 'Specific Factors, Comparative Advantage, and International Investment', Economica, Vol. 44, 133-44.

Balassa, B. (1964): 'The Purchasing-Power Parity Doctrine: a Reappraisal', Journal of Political Economy, Vol. 72, 584-96.

Ballentine, J.G., and I. Eris (1975): 'On the General Equilibrium Analysis of Tax Incidence', Journal of Political Economy, Vol. 83, 633-44.

———————, and W.R. Thirsk (1977): 'Labor Unions and Income Distribution Reconsidered', Canadian Journal of Economics, Vol. 10, 141-8.

Barro, R.J., and H.I. Grossman (1971): 'A General Disequilibrium Model of Income and Employment', American Economic Review, Vol. 61, 82-93.

———————————— (1974): 'Suppressed Inflation and the Supply Multiplier', Review of Economic Studies, Vol. 41, 87-104.

Batra, R.N. (1973): Studies in the Pure Theory of International Trade, London: Macmillan.

Benassy, J.P. (1975): 'Neo-Keynesian Disequilibrium in a Monetary Economy', Review of Economic Studies, Vol. 42, 503-23.

Berglas, E., and A. Razin (1973): 'Real Exchange Rate and Devaluation', Journal of International Economics, Vol. 3, 179-91.

Bhagwati, J.N. (1958): 'Immiserizing Growth: a Geometrical Note', Review of Economic Studies, Vol. 25, 201-5.

——————— (1973): 'The Theory of Immiserizing Growth; Further Applications', in M. Connolly and A.K. Swoboda (eds.): International Trade and Money, London: George Allen & Unwin, 45-54.

———————, and T.N. Srinivasan (1971): 'The Theory of Wage Differentials; Production Response and Factor Price Equalization', Journal of International Economics, Vol. 1, 19-35.

———————————— (1973): 'The Ranking of Policy Interventions under Factor Market Imperfections: The Case of Sector-Specific Sticky Wages and Unemployment', Sankhya, Ser. B, Vol. 35, 405-20.

———————————— (1974): 'On Reanalysing the Harris-Todaro Model: Policy Rankings in the Case of Sector-Specific Sticky Wages', American Economic Review, Vol. 64, 502-8.

———————————— (1975): 'Alternative Policy Rankings in a Large, Open Economy with Sector-Specific, Minimum Wages', Journal of Economic Theory, Vol. 11, 356-71.

Black, S.W. (1975): 'Multilateral and Bilateral Measures of Effective Exchange Rates in a World Model of Traded Goods', Institute for International Economic Studies, University of Stockholm, Seminar Paper No. 51, November.

Blackorby, C., and R.R. Russell (1976): 'Functional Structure and the Allen Partial Elasticities of Substitution: an Application of Duality Theory', Review of Economic Studies, Vol. 43, 285-91.

Blaug, M. (1968): Economic Theory in Retrospect, Second Edition, London: Heinemann.

Bliss, C.J. (1975): 'The Reappraisal of Keynes's Economics: an Appraisal', in M. Parkin and A.R. Nobay (eds.): Current Economic Problems, Proceedings of the A.U.T.E. Conference, Manchester, 1974, New York: Cambridge University Press.

Bosch, A., A. Mas-Colell, and A. Razin (1973): 'Instantaneous and Non-Instantaneous Adjustment to Equilibrium in Two-Sector Growth Models', Metroeconomica, Vol. 25, 105-18.

Brecher, R.A. (1974): 'Minimum Wage Rates and the Pure Theory of International Trade', Quarterly Journal of Economics, Vol. 88, 98-116.

Caves, R.E. (1971): 'International Corporations: the Industrial Economics of Foreign Investment', Economica, Vol. 38, 1-27.

Chang, W.W. (1970): 'The Neoclassical Theory of Technical Progress', American Economic Review, Vol. 60, 912-23.

Clower, R.W. (1965): 'The Keynesian Counter-Revolution: a Theoretical Appraisal', in F.H. Hahn and F. Brechling (eds.): The Theory of Interest Rates, London: Macmillan.

Corden, W.M. (1965): Recent Developments in the Theory of International Trade, International Finance Section, Department of Economics, Princeton University, Special Papers in International Economics, No. 7.

———— (1977): Inflation, Exchange Rates, and the World Economy: Lectures on International Monetary Economics, Oxford: Clarendon Press.

————,and R. Findlay (1975): 'Urban Unemployment, Intersectoral Capital Mobility and Development Policy', Economica, Vol. 42, 59-78.

Cripps, F., and W. Godley (1976): 'A Formal Analysis of the Cambridge Economic Policy Group Model', Economica, Vol. 43, 335-48.

Cross, R., and D. Laidler (1976): 'Inflation, Excess Demand and Expectations in Fixed Exchange Rate Open Economies: Some Preliminary Results', in M. Parkin and G. Zis (eds.): Inflation in the World Economy, Manchester: University of Manchester Press.

Dixit, A.K. (1976): The Theory of Equilibrium Growth, London: Oxford University Press.

Dixit, A.K. (1978): 'The Balance of Trade in a Model of Temporary Equilibrium with Rationing', Review of Economic Studies (forthcoming).

Dornbusch, R. (1975): 'Exchange Rates and Fiscal Policy in a Popular Model of International Trade', American Economic Review, Vol. 65, 859-71.

————————, S. Fischer and P.A. Samuelson (1977): 'Comparative Advantage, Trade, and Payments in a Ricardian Model with a Continuum of Goods', American Economic Review, Vol. 67, 823-39.

Eckaus, R.S. (1955): 'The Factor-Proportions Problem in Underdeveloped Areas', American Economic Review, Vol. 45; reprinted in A.N. Agarwala and S.P. Singh (eds.): The Economics of Underdevelopment, New York: Oxford Universtiy Press, 1963, pp.348-78.

Edgren, G., K. Faxen, and C. Odhner (1969): 'Wages Growth and the Distribution of Income', Swedish Journal of Economics, Vol. 71, 133-60.

Ethier, W. (1974): 'Some of the Theorems of International Trade with Many Goods and Factors', Journal of International Economics, Vol. 4, 199-206.

Fields, G.S. (1975): 'Rural-Urban Migration, Urban Unemployment and Under-Employment, and Job-Search Activity in LDCs', Journal of Development Economics, Vol. 2, 165-87.

Findlay, R. (1974): 'Relative Prices, Growth and Trade in a Simple Ricardian System', Economica, Vol. 41, 1-13.

————————, and H. Grubert (1959): 'Factor Intensities, Technological Progress and the Terms of Trade', Oxford Economic Papers, Vol. 11, 111-21.

Frenkel, J.A., and H.G. Johnson (eds.) (1976): The Monetary Approach to the Balance of Payments, London: Allen and Unwin.

Gordon, R.J. (1977): 'Interrelations between Domestic and International Theories of Inflation', in R.Z. Aliber (ed.): The Political Economy of Monetary Reform, London: Macmillan.

Grandmont, J.M. (1977): 'Temporary General Equilibrium Theory', Econometrica, Vol. 45, 535-73.

Hahn, F.H. (1965): 'On Two-Sector Growth Models', Review of Economic Studies, Vol. 32, 339-46.

———————— (1978): 'On Non-Walrasian Equilibria', Review of Economic Studies, Vol. 45, 1-17.

Harberger, A.C. (1962): 'The Incidence of the Corporation Income Tax', Journal of Political Economy, Vol. 70, 215-40.

Harris, J.R., and M.P. Todaro (1970): 'Migration, Unemployment and Development: a Two-Sector Analysis', American Economic Review, Vol. 60, 126-42.

Helpman, E. (1976): 'Macroeconomic Policy in a Model of International Trade with a Wage Restriction', International Economic Review, Vol. 17, 262-77.

———— (1977): 'Nontraded Goods and Macroeconomic Policy under a Fixed Exchange Rate', Quarterly Journal of Economics, Vol. 91, 469-80.

Herberg, H., and M.C. Kemp (1971): 'Factor Market Distortions, the Shape of the Locus of Competitive Outputs, and the Relation between Product Prices and Equilibrium Outputs', in J.N. Bhagwati et al. (eds.): Trade, Balance of Payments and Growth: Essays in Honor of C.P. Kindleberger, Amsterdam: North-Holland.

Hicks, J.R. (1939): Value and Capital, Oxford: Clarendon Press.

———— (1953): 'An Inaugural Lecture: 2. The Long-Run Dollar Problem', Oxford Economic Papers, Vol. 5, 121-35.

Homma, M. (1977): 'A Comparative Static Analysis of Tax Incidence', Journal of Public Economics, Vol. 8, 53-65.

Hool, B. (1977): 'Monetary and Fiscal Policies in Equilibria with Rationing', University of Wisconsin, Madison, Mimeo.

Howard, D.H. (1977): 'Rationing, Quantity Constraints, and Consumption Theory', Econometrica, Vol. 45, 399-412.

Hu, S.C. (1973): 'Capital Mobility and the Effects of Unionization', Southern Economic Journal, Vol. 39, 526-34.

Inada, K. (1966): 'Investment in Fixed Capital and the Stability of Growth Equilibrium', Review of Economic Studies, Vol. 33, 19-30.

Johnson, H.G. (1959): 'International Trade, Income Distribution and the Offer Curve', Manchester School of Economic and Social Studies, Vol. 27, 241-60.

———— (1970): 'The Efficiency and Welfare Implications of the International Corporation', in C.P. Kindleberger (ed.), The International Corporation: A Symposium, Cambridge: the M.I.T. Press.

————, and P.M. Mieszkowski (1970): 'The Effects of Unionization on the Distribution of Income: a General Equilibrium Approach', Quarterly Journal of Economics, Vol. 84, 539-61.

Jones, R.W. (1965): 'The Structure of Simple General Equilibrium Models', Journal of Political Economy, Vol. 73, 557-72.

———— (1966): 'Comments on Technical Progress', Philippine Economic Journal, Vol. 5, 313-32.

———— (1971a): 'Distortions in Factor Markets and the General Equilibrium Model of Production', Journal of Political Economy Vol. 79, 437-59.

———— (1971b): 'A Three-Factor Model in Theory, Trade and History', in J.N. Bhagwati et al. (eds.): Trade, Balance of Payments and Growth: Essays in Honor of C.P. Kindleberger, Amsterdam: North-Holland.

Jones, R.W. (1975): 'Income Distribution and Effective Protection in a Multi-Commodity Trade Model', Journal of Economic Theory, Vol. 11, 1-15.

———— (1977): "Two-ness" in Trade Theory: Costs and Benefits, International Finance Section, Department of Economics, Princeton University, Special Papers in International Economics, No. 12.

————, and W.M. Corden (1976): 'Devaluation, Non-Flexible Prices, and the Trade Balance for a Small Country', Canadian Journal of Economics, Vol. 9, 150-61.

Kahn, R. (1977): 'Malinvaud on Keynes', Cambridge Journal of Economics, Vol. 1, 375-88.

Kemp, M.C., and R.W. Jones (1962): 'Variable Labour Supply and the Theory of International Trade', Journal of Political Economy, Vol. 70, 30-6.

————————————, Y. Kimura and K. Okuguchi (1977): 'Monotonicity Properties of a Dynamical Version of the Heckscher-Ohlin Model of Production', Economic Studies Quarterly, Vol. 28, 249-53.

Keynes, J.M. (1925): 'The Economic Consequences of Mr. Churchill'; in The Collected Writings of John Maynard Keynes, Volume IX, Essays in Persuasion, London: Macmillan, 1972.

———— (1931): A Treatise on Money: 1 The Pure Theory of Money; The Collected Writings of John Maynard Keynes, Volume V, London: Macmillan, 1971.

Kreuger, A.O. (1974): 'The Role of Home Goods and Money in Exchange Rate Adjustment', in W. Sellekaerts (ed.): International Trade and Finance: Essays in Honour of Jan Tinbergen, London: Macmillan.

———— (1977): Growth, Distortions, and Patterns of Trade among Many Countries, Princeton Studies in International Finance, No. 40.

Kuska, E.A. (1978): 'On the Almost Total Inadequacy of Keynesian Balance-of-Payments Theory', American Economic Review (forthcoming).

Lapan, H.E. (1976): 'International Trade, Factor Market Distortions, and the Optimal Dynamic Subsidy', American Economic Review, Vol. 66, 335-46.

Leijonhufvud, A. (1968): On Keynesian Economics and the Economics of Keynes: A Study in Monetary Theory, London: Oxford University Press.

Magee, S.P. (1971): 'Factor Market Distortions, Production, Distribution, and the Pure Theory of International Trade', Quarterly Journal of Economics, Vol. 85, 623-43.

———— (1976): International Trade and Distortions in Factor Markets, New York: Marcel Dekker.

Magee, S.P. (1977): 'Three Simple Tests of the Stolper-Samuelson Theorem', The University of Texas at Austin, Graduate School of Business, Working Paper 77-28, February.

Malinvaud, E. (1977): The Theory of Unemployment Reconsidered, Oxford: Basil Blackwell.

Marshall, A. (1920): Principles of Economics, Eighth Edition, London: Macmillan.

Martin, J.P. (1976): 'Variable Factor Supplies and the Heckscher-Ohlin-Samuelson Model', Economic Journal, Vol. 86, 820-31.

Mayer, W. (1974a): 'Variable Returns to Scale in General Equilibrium Theory: A Comment', International Economic Review, Vol. 15, 225-35.

———— (1974b): 'Short-Run and Long-Run Equilibrium for a Small Open Economy', Journal of Political Economy, Vol. 82, 955-68.

McCulloch, J.H. (1974): 'The Effect of a Minimum Wage Law in the Labour-Intensive Sector', Canadian Journal of Economics, Vol. 7, 316-9.

McCulloch, R. (1976): 'Technology, Trade and the Interests of Labor: A Short Run Analysis of the Development and International Dissemination of New Technology', Harvard Institute of Economic Research, Discussion Paper No. 489, June.

McLure, C.E., Jr. (1974): 'A Diagrammatic Exposition of the Harberger Model with One Immobile Factor', Journal of Political Economy, Vol. 82, 56-82.

Muellbauer, J., and R. Portes (1978): 'Macroeconomic Models with Quantity Rationing', Economic Journal (forthcoming).

Mussa, M. (1974): 'Tariffs and the Distribution of Income: the Importance of Factor Specificity, Substitutability, and Intensity in the Short and Long Run', Journal of Political Economy, Vol. 82, 1191-1204.

———— (1975): 'Dynamic Adjustment to Relative Price Changes in the Heckscher-Ohlin-Samuelson Model', University of Rochester, Department of Economics, Discussion Paper No. 75-6, May.

Neary, J.P. (1976): The Incidence of Factor Taxes in Stationary and Growing Economies, B.Phil. thesis, University of Oxford.

———— (1978): 'Capital Subsidies and Employment in an Open Economy', Oxford Economic Papers (forthcoming).

O Casaide, C. (1977): 'Empirical Tests of the Role of Tradeable and Non-Tradeable Goods in the International Transmission of Inflation', Economic Affairs Department, Central Bank of Ireland, mimeo, April.

Oppenheimer, P.M. (1974): 'Non-Traded Goods and the Balance of Payments: a Historical Note', Journal of Economic Literature, Vol. 12, 882-8.

Patinkin, D. (1965): Money, Interest, and Prices: An Integration of Monetary and Value Theory, Second Edition, New York: Harper and Row.

———————— (1976): 'Keynes' Monetary Thought: A Study of its Development', History of Political Economy, Vol. 8, 1-150.

Pearce, I.F. (1961): 'The Problem of the Balance of Payments', International Economic Review, Vol. 2, 1-28.

Ricardo, D. (1821): On the Principles of Political Economy and Taxation, Third Edition; The Works and Correspondence of David Ricardo, Volume 1, (ed. by P. Sraffa), Cambridge: Cambridge University Press, 1951.

Rybczynski, T.N. (1955): 'Factor Endowments and Relative Commodity Prices', Economica, Vol. 22, 336-41.

Salter, W.E.G. (1959): 'Internal and External Balance: The Role of Price and Expenditure Effects', Economic Record, Vol. 35, 226-38.

Samuelson, P.A. (1947): Foundations of Economic Analysis, Cambridge, Mass.: Harvard University Press.

———————— (1971a): 'An Exact Hume-Ricardo-Marshall Model of International Trade', Journal of International Economics, Vol. 1, 1-18.

———————— (1971b): 'Ohlin was right', Swedish Journal of Economics, Vol. 73, 365-84.

Solow, R.M. (1961): 'Note on Uzawa's Two-Sector Model of Economic Growth', Review of Economic Studies, Vol. 29, 48-50.

Spraos, J. (1977): 'New Cambridge Macroeconomics, Assignment Rules and Interdependence', in R.Z. Aliber (ed.): The Political Economy of Monetary Reform, London: Macmillan.

Stolper, W.F., and P.A. Samuelson (1941): 'Protection and Real Wages', Review of Economic Studies, Vol. 9, 58-73.

Swan, T.W. (1963): 'Longer-Run Problems of the Balance of Payments' in H.W. Arndt and W.M. Corden (eds.): The Australian Economy: A Volume of Readings, Melbourne: Cheshire Press; reprinted in R.E. Caves and H.G. Johnson (eds.): Readings in International Economics, London: George Allen and Unwin, 1968.

Takayama, A. (1972): International Trade, New York: Holt, Rinehart and Winston.

Taylor, L. (1974): 'Short-Term Policy in Open Semi-Industrialized Countries: The Narrow Limits of the Possible', Journal of Development Economics, Vol. 1, 85-104.

Tobin, J., and H.S. Houthakker (1950-51): 'The Effects of Rationing on Demand Elasticities', Review of Economic Studies, Vol. 18, 140-53.

Todaro, M.P. (1976): 'Rural-Urban Migration, Unemployment and Job Probabilities: Recent Theoretical and Empirical Research', in

A.J. Coale (ed.): Economic Factors in Population Growth, Proceedings of a Conference held by the International Economic Association at Valescure, France, London: Macmillan.

Tsiang, S.C. (1977): 'The Monetary Theoretic Foundation of the Modern Monetary Approach to the Balance of Payments', Oxford Economic Papers, Vol. 29, 319-38.

Uzawa, H. (1961): 'On a Two-Sector Model of Economic Growth', Review of Economic Studies, Vol. 29, 40-7.

Vandendorpe, A.L., and A.F. Friedlaender (1976): 'Differential Incidence in the Presence of Initial Distorting Taxes', Journal of Public Economics, Vol. 6, 205-29.

von Neumann Whitman, M. (1975): 'Global Monetarism and the Monetary Approach to the Balance of Payments', Brookings Papers on Economic Activity, 491-536.

Woodland, A.D. (1977): 'A Dual Approach to Equilibrium in the Production Sector in International Trade Theory', Canadian Journal of Economics, Vol. 10, 50-68.