

Development Policy in a Multi-provincial Economy

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1. INTRODUCTION

In this paper, we present a stylized model for the study of development policy in a less developed country with several (rural) provinces, each with its own local economy, and a federal (urban) sector with a relatively more developed economic structure. A distinguishing characteristic of the model is that labour from each province is easily distinguishable from that of any other on the basis of (say) language, race, ethnicity, caste, gender or simply, accent. Each province has economic ties to the federal sector and to the world economy but no direct ties to any other province. Inter-provincial economic relations are a consequence of the relation which each province bears to the federal sector and to the world economy.

The object of the study is to bring out how closely interwoven the economy is despite the assumption of no direct economic relations between any two provinces. In particular, we would like to study the effect of a variety of economic policies on the economy of one province when such policies are primarily directed at the economy of another province. Our model illustrates, in a rather dramatic way, how the fortunes or misfortunes of a particular province impinge on those of the others and how attempts by policy-makers to alleviate or exploit the economic successes or failures of one province have economic consequences for the economies of all the others.

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The paper is organized as follows. Section 2 presents the model and Section 3 is devoted to some methodological remarks. Section 4 presents the basic analysis of the model and Section 5 presents preliminary results which bring out the strong resemblance our model bears to the Heckscher-Ohlin-Samuelson model in international economics. Section 6 presents a variety of questions that are important both in development economics and in the theory of international trade and which can be successfully asked of, and answered by, our model. Section 7 is devoted to extensions and to future work. We conclude the paper in Section 8 with a remark.

2. THE MODEL

Consider a stylized economy which we shall name LDC and which has several provinces. Each province produces an internationally traded commodity. The amount produced by each province is "small" relative to the amount of international output of that commodity and hence each province is economically negligible in the sense that the price of its product must be taken as parametrically given. The output of each province is produced with the help of two inputs; the labour of that province and a factor which, for want of a better name, we may call *capital* or somewhat more fancifully, *foreign aid*. Thus if we would like to think of provincial output typically in terms of agricultural commodities, we are considering land to be an input which is not scarce. We are in a land surplus economy.¹ What is required is capital or foreign aid to make this land bloom. One may think in this context of land which has to be supplied with irrigation facilities or reclaimed from water-logging and/or salinity. We shall assume constant returns to scale in the conventional sense that doubling the amounts of labour and capital doubles the amount of output. We shall also assume that both factors of production have positive marginal productivity everywhere and that these marginal products are decreasing as increasing amounts are employed.

In addition to the several provinces, there is a single federal centre which also produces an internationally traded commodity and which one may think of in composite terms as manufacturing. Again, the amount produced in the urban sector is "small" relative to the amount of international output and hence the price of the urban product is also taken to be parametrically given. However, in contrast to the provinces, the urban output is produced with the help of labour from each of the provinces as well as with capital. Such a technological specification may be justified on two counts. One may be of the point of view that labour from each province possesses a skill peculiar to itself and that all of these skills are indispensable for urban production. Alternatively, we can justify the assumption on analytical grounds. The case when labour from each province is identical as regards production of the urban commodity is simply a specialization in which the production function with

¹ For a recent model emphasizing this aspect, see Bent Hansen (1979)

several inputs is seen as one with only two inputs; capital and the sum of all provincial labour. As in the case of the provincial technologies, we shall also assume constant returns to scale, positive marginal productivity of each input and decreasing marginal productivity with respect to increasing amounts of that input.

As emphasized in the introduction, labour from each province is easily identifiable and distinguishable. This is irrespective of whether it does or does not contribute identically to urban production. Each urban worker carries a label specifying the province he/she comes from and this label plays a role irrespective of whether it is of any consequence from the point of view of the worker being an input in the urban production process.

There is complete international immobility of each factor of production, be it capital or labour from any province. However, there is complete inter-provincial mobility of capital. As such we avoid all difficulties having to do with non-shiftability or irreversibility of capital. Depending on the prices of the factors of production which have yet to be introduced, capital can be instantaneously and costlessly uprooted from a particular province and employed in another province or indeed in the federal sector. On the other hand, provincial labour is inter-provincially completely immobile. A worker from a particular province cannot find employment in any other province at *any* wage. However, he/she has the possibility of finding employment in the urban or federal sector. This is a distinguishing characteristic of the model presented here and we turn to it next.

Rural urban migration, or in terms of the context of this paper, provincial-federal migration is regulated according to the Harris-Todaro hypothesis² under which the equality of provincial-federal wages as an equilibrating condition is replaced by their expected equality, bearing in mind that a provincial job is a certainty. A labourer migrates from his/her province in the expectation of a higher federal wage but fully cognizant of the fact that he/she may not get a federal job and consequently end up unemployed. The expected federal wage, then, depends on the subjective probability the worker attaches to the possibility of getting a federal job. Such a probability is made objective by letting it be proxied or measured by the unemployment rates. We shall further assume that a member of a particular province calculates his/her expected wage only on the basis of urban unemployment *specific* to members of his/her own province. This is where the fact that labour from each province is easily identifiable is crucial. We justify our assumption, in part, on the fact that information about employment possibilities in the city flows solely through members of the relevant province who are already in the urban centre. In addition, our assumption also takes into account the fact that during the period of a migrant's

² See Khan (1985 or 1988) for references to the original papers of Harris-Todaro and others. However, the hypothesis still continues to stimulate research as can be seen on a perusal of recent issues of *Economica* or *The Journal of Development Economics*.

unemployment, he/she has to fall back for support on the employed members of his/her group.³

Next, we consider the question of the determination of urban wages. There are a variety of possibilities here. One may simply follow an established tradition in the literature and assume that all of the federal wages for the various "kinds" of provincial labour are exogenously given.⁴ This may not be too implausible in several contexts. The urban wage of certain disadvantaged provinces may simply be set by government fiat. In a related set-up, one thinks of the "untouchables" in India or "local natives" in newly-independent colonies. Alternatively, one may appeal to nutritional grounds whereby the federal employer may not want to lower the wage below certain levels on the ground of diminishing long-run productivity. Yet another reason may simply be "emulation" whereby modernization demands, in keeping with other modernized countries, a certain minimal wage.

Of course, an alternative to an exogenously given wage is one in which it is endogenously given.⁵ A variety of scenarios setting out the reasons for that endogeneity can be appealed to. Labour from different provinces may have different rates of turnover depending on propensities peculiar to their province. Such propensities may include economic variables such as the provincial wage or the provincial federal unemployment rate. The federal employers now give full cognizance to the fact that they are facing a segmented labour with differing supply prices of labour and set the urban wages to minimize the costs of labour turnover.⁶ Alternatively, one may think of trade unions and/or other political groups who lobby on behalf of their particular constituency. One simple approach to a setting that is fraught with the ensuing game-theoretic difficulties is to assume that the input demand schedule of the federal employer is known and that the employer passively responds to the actions of the various groups.

The approach that we take as regards the determination of the urban wages avoids opting for any particular microfoundation and it works within a framework that is consistent with several of them. We simply postulate that the federal wage of the workers of any particular province is a function of the provincial wage, the provincial unemployment rate, the return to capital and a shift parameter. This way we leave it to the reader to specify the model to any microfoundation that appeals to

³ This wrinkle to the Harris-Todaro hypothesis was introduced in Khan (1979) and studied further in Khan-Chaudhuri (1985) in a model different from the one presented here.

⁴ This is the original formulation of the Harris-Todaro hypothesis. In addition to Harris-Todaro (1970), it also occurs in the work of Bhagwati-Srinivasan (1973, 1974), Corden-Findlay (1975), Neary (1981), Khan-Naqvi (1983) among several others.

⁵ Stiglitz is to my knowledge the first author to emphasize the endogeneity of urban wages; see, for example, a summary of his earlier work in Stiglitz (1977 and 1982).

⁶ See Stiglitz (1974) for the integration of the costs of labour turnover in a two-sector Harris-Todaro model with capital immobility.

him/her or alternatively, simply accept the function as an empirical regularity that can be empirically estimated. However, it must be emphasized that it is crucial for the analytical tractability of our model that no quantity variables enter into these federal wage functions and that each function depends only on the provincial variables to which it pertains.⁷ In the sequel, we shall also refer to these functions as *provincial wage functions* and the reader should be clear that they all refer to provincial wages in the federal sector.

Finally, we shall assume that the amount of labour in each province is exogenously given as is the amount of capital. All factors are fully employed and there is marginal productivity pricing.

We now have all the pieces of our model in place. Let us now assume for concreteness that there are n provinces. Our parameters are the international prices for the $n + 1$ internationally traded commodities, the endowment of capital and that of the n "kinds" of labour, the n shift parameters in the n provincial wage functions and, of course, the $n + 1$ technologies. The unknowns, or alternatively the variables to be determined, are the $n + 1$ output levels, the allocation of capital among the $n + 1$ sectors, the allocation of the labour of each province among the province, the federal sector and the pool of urban unemployed, and finally, the returns to capital and those to federal and provincial labour. Note that the latter involve n provincial wages and the level of n federal wages of the members of each province who are in the urban centre.

It is worth emphasizing that factor returns are unknowns to be determined. This is a direct consequence of the international immobility of capital and of provincial labour. In particular, it should be noted that whereas knowledge of factor returns and their use as parameters generates provincial-federal migration and the equilibrium levels of employment of capital and labour, these returns are themselves unknowns as a consequence of the non-marketability of these factors. In this sense, our model is one of the general equilibrium variety. It may also be mentioned here that in the case of the capital being interpreted as foreign aid, the return to capital may usefully be interpreted as the "shadow price" or "accounting price" of foreign aid. As we shall emphasize further in the sequel, it is this shadow price that should guide the allocation of foreign aid. Recall that we are taking this factor to be inelastically supplied and hence, exogenous to the model with its own "shadow price". One may even be tempted towards an interpretation of this input as "foreign exchange" but that leads to a complication in terms having an exogenously fixed amount of this commodity and yet earn it at the same time.

3. A METHODOLOGICAL EXCURSION

A natural question arises as to why we should take this toy model seriously.

⁷ See Khan (1980) for details and implications for other work of such a function.

It is important to be clear about the answer to this question before we attempt an analysis of the model. I shall attempt an answer in this section.

Let me begin by emphasizing the word "model" along with the word "analysis". It is clear from the description of the model given in Section 2 that I am not *describing* any real-world economy, and certainly not the economy of Pakistan. Indeed, my purpose is not to describe. That is as much the domain of accountants, applied statisticians, geographers and other social scientists as it is of economists. My purpose instead is to construct a stylized framework which allows me to focus on a certain set of issues and pose questions which can be answered in a way that brings out the factors that are important to these issues and ignores those that are not. In this sense, the exercise may be relevant to real-world economies, including the economy of Pakistan.⁸

The issue that I want to focus on can be broadly summarized by the word "interaction". In particular, I want to study the interaction of several competing provinces and/or groups even under the extreme assumptions of no inter-provincial economic relations and with each province concerned solely with its own interest. If we can show that in our model the welfare of one province is inextricably linked to that of another in spite of our extreme assumptions, I feel that we have learnt something which we could not have learnt by just collecting data and running regressions.⁹ Of course, to the extent that these assumptions are not fulfilled, and each province looks after the interests of the other provinces and that there are strong inter-provincial economic ties, all the better for the point that I wish to make. However, let me re-emphasize that the purpose is not to compute an estimate for a particular economic magnitude or to make a forecast of a particular index but to understand the mechanisms which make the economy work. As such, this paper is another instance of research devoted to the study of

unanticipated consequences of purposive social action,¹⁰

or the

unintended social repercussions of intentional human actions.¹¹

Once we grant¹² the importance of modelling, the question remains as to

⁸ This paragraph is prompted, in part, by a question from the floor which argued against the model presented in this paper on the grounds that the federal sector of Pakistan, namely Islamabad, is rural rather than urban.

⁹ For more details on this point of view, I refer the reader to Section 2 of my Quaid-i-Azam Lecture; Khan (1985).

¹⁰ See R. K. Merton (1957; pp. 61-62)

¹¹ See K. R. Popper (1965; p. 342)

¹² To anyone with even a casual acquaintance of current research in economics, this may not seem a major concession. However, it is clear that such a concession is not universally made in the world of policy-makers.

whether the model itself captures the essentials of the problem. Does it highlight those aspects of reality which deserve to be highlighted? This must ultimately remain subjective and hence there is room for genuine disagreement. But it is precisely the seeds of this disagreement that offer directions for further work. If you believe that the model is not suited to answering the question you want answered and that it ignores aspects which you consider crucial to the question, then the work for you is clearly laid out. Modify the model and show that the results you obtain are different and argue in favour of your modifications and in favour of your results. All I would say in this connection is to avoid modifications which lead to "more" realism but prevent us from getting *any* answers at all. Such concessions to reality are of little use from an analytical point of view. In summary, I would ask you not to compare this model with the real-world economy you have in mind but with the economic model you and your policy-makers have been using to make policy prescriptions for the real-world economy you have in mind.¹³

Next, I take an alternative point of view and focus on my toy model itself. Recall that the parameters of the model are, among others, international prices and endowments of capital and the various kinds of provincial labour. Recall also that the unknowns are, among others, the output levels and factor returns. Now I would like to pose the following three questions:

1. If the amount of capital increases, what is the effect on the equilibrium output levels? In particular, do all the output levels increase?
2. If the international price of the federal or any provincial output increases, what is the effect on the equilibrium level of factor returns? In particular, are the capitalists and urban labourers made uniformly better off?
3. If the international price of the commodity produced in the federal sector or that produced in any particular province increases, what is the effect on the equilibrium level of output of that commodity? In particular, does its level increase?

Now, I would like to address myself especially to those of you who are inclined towards an affirmative answer to one or all of the three questions.¹⁴ After all, the intuitive reasoning that prompts an affirmative answer to the first question is, at first blush, sound. Given positive marginal productivity, each factor of production is desirable at all levels of output and hence, given full employment, all output levels are bound to increase. A similar reasoning presumably underlies the answer to the second

¹³In this connection, it might be an interesting exercise for the reader to compare on grounds of "realism" the model presented in this paper with that presented by Haffry Johnson in his 1956 and 1958 Murree lectures to the Institute; see Johnson (1962).

¹⁴Strictly speaking, the particularizations of the three questions.

question. Given constant returns to scale, and hence the equality of revenue to costs, an increase in revenue per unit output must increase the incomes of all the factors employed in the production of that output. As for the third, we all know that supply curves are upward sloping.

The point is, of course, that all of the three answers are, at best, incomplete and, at worst, wrong. The lesson is essentially that toy models are necessary to sharpen our untrained intuition and to focus our gaze on factors where it would not normally fall. This is my second line of defense as to why we should take these analytical exercises seriously.

4. BASIC ANALYSIS

In Section 2, we completed the description of our model by noting that there are a total of $n + 1$ output levels, $n + 1$ levels of the allocation of the capital stock, $2n$ levels of the allocation of the n kinds of labour, n urban unemployment rates, n provincial wage rates, n federal wage rates and finally, the rental to capital; all to be determined. This makes a total of $6n + 2$ variables to be determined. This is a fair amount of work, even for a toy model. Let us proceed to it.

A routine count of all the relationships of the model leads us to the observation that there are $6n + 2$ equations to determine the $6n + 2$ unknowns. Even in the case of $n = 4$, this leads us to a 26 equation system to solve. Thus it is clear that brute force methods will not be very illuminating. Moreover, there are certain basic issues of analysis that have to be resolved. These relate to the nonemptiness, cardinality and differentiability of the solutions with respect to the various parameters of interest. We dispose of these next.

The essential point of introducing the model is that it is useful for doing comparative statics i.e., to chart out how the equilibrium values of the unknown variables change as a particular parameter changes. However, this presupposes that there are equilibrium values to begin with, that these are at least unique in a small enough neighborhood, and that they change differentially as the parameter changes. To put this in a somewhat explicit way, we have to make sure that the motions that we go through when we totally differentiate a system and apply Cramer's rule, make any sense.¹⁵ It is easy to draw pictures to convince ourselves that these preliminary requirements for a comparative statics investigation may remain unfulfilled in the simplest of models.¹⁶ Of course, after having reminded you of the logical priority and the importance of investigating these questions, I shall simply assume that all is well with our model on this count or less cavalierly, plead that their solution is out-

¹⁵ See, for example, Debreu's (1976) accessible paper.

¹⁶ See, for example, Khan (1980) for a discussion of these issues in the context of a two-sector Harris-Todaro model.

side the scope of the present talk.

We are now in a position to discuss the basic analytical property of the model; one that allows analytical tractability of the model. This is the *decomposability* property whereby the $6n + 2$ equations reduce to two independent subsystems of $2n + 1$ and $n + 1$ equations each.

The first subsystem derives from the fact that under constant returns to scale and profit maximization, maximum profits are zero and hence we have prices equated to the unit cost functions in each sector.¹⁷ These cost functions all depend on the capital rental and the wage rates. Given the functions determining the urban wage rates, we can substitute for these rates to obtain a system of $n + 1$ equations in $2n + 1$ unknowns, namely the capital rental, the n provincial wages and the n unemployment rates. Now, given the Harris-Todaro hypothesis relating to the equality of expected wages, we can supplement this system by n additional equations. We thus obtain the first subsystem referred to.

These observations already give us our first insight into the analytics of our model. It is simply that in an equilibrium in which all commodities are produced, i.e., an equilibrium with complete diversification, the factor prices and urban unemployment rates are determined solely by the international prices. Note that we refer to the rates of unemployment and not to their levels.¹⁸ This is already a result of some consequence. The economic negligibility of our economy and the fact that all the commodities are produced in equilibrium leads as a necessary consequence to the result that changes in endowment levels of either provincial labour or of capital, provided such changes are small enough that the economy remains fully diversified in the new equilibrium, have absolutely no effect on provincial or federal wages or on capital returns. We can look at this result in another way. It says that with fixed international prices and with the qualifications spelt out above, an increase in capital (or foreign aid under our alternative interpretation) leads to *no* changes in the incomes of provincial labour or in their rates of unemployment.

The *decomposability* property has yet another consequence when taken in conjunction with a basic property of the unit cost functions. This basic property is referred in intermediate microtheory texts as the *envelope theorem* and it simply states that the partial derivative of the unit cost function with respect to a particular factor price yields the amount per unit output of that factor used in equilibrium. But then this implies that once factor prices are fixed, all the arguments of our $n + 1$ unit cost functions are fixed, and hence the values of all their partial derivatives at these prices are fixed and hence all the input-output coefficients are fixed. We thus obtain, without having so assumed them, fixed coefficient technologies of

¹⁷ Recall that there is no joint production.

¹⁸ The rate of provincial unemployment is given by the ratio of the number unemployed to the number employed in the federal sector, all these numbers pertaining to a particular province.

the Leontief variety.

This leads us into our second subsystem. This derives from the full employment equations for capital and the demand-supply equations for provincial labour, the latter including provincial unemployment.¹⁹ However, the rates of provincial unemployment are already pegged at levels determined by the international prices, and hence, on rewriting these equations in terms of output levels and the pegged input-output coefficients, we have a system of $n + 1$ equations in $n + 1$ unknowns.

Our basic analysis is now complete. For ease of reference, we shall refer to our first subsystem by P and to our second by Q .

5. PRELIMINARY RESULTS

In this section we answer the questions that we posed in Section 3. The basic analysis presented in Section 4 can still guide us without requiring us do algebra. Of course, as always, the better our economic intuition, the less need there is for paper and pencil.

Consider first Question 1 as to the effect on output levels on changes in endowment levels. For concreteness, let us consider an increase in the amount of capital which is small enough that the economy remains fully diversified. It is clear that in order to analyze this question we shall have to work with our subsystem Q . On totally differentiating this with respect to the amount of capital, we obtain a linear system of $n + 1$ equations with changes in the $n + 1$ output levels as the unknowns. Note that the matrix underlying this system is easy to invert on account of their being many zero entries. These zeroes are a consequence of our assumption of no inter-provincial migration and consequent lack of employment. The determinant of this matrix is crucial for the answer to the question that we seek. Let us assume it not to be zero.²⁰ Then the effect of changes in the amount of capital depends on the sign of this determinant. However, what is interesting is that irrespective of this sign, all the provincial output levels move *together* and in a direction *opposite* to the change in the federal output level. The intuition is the same as the one that prompted Rybczynski²¹ to prove his result for the two-sector Heckscher-Ohlin-Samuelson model. Given fixed coefficients as a consequence of the *decomposability* property of our model, an increase in any resource must be absorbed in fixed amounts and this requires a release of resources from other sectors and hence a

¹⁹ See the Footnote 18 for a definition.

²⁰ This assumption is directly related to the question of the differentiability of the solution that we disposed of in Section 3.

²¹ We refer the reader unfamiliar with these results to any good text in undergraduate trade theory.

shrinkage in their output levels. It is interesting that a slightly modified version of the same reasoning applies to a model which apparently seems more complicated. Of course, whether there is a shrinkage or expansion depends on factor intensities which in our context are measured by the sign of the determinant referred to earlier. For future reference, let us denote this by *Sign Q*.

Next, we turn to Question 2 on the effect of changes in international prices on factor rewards and provincial unemployment rates. For concreteness, let us consider an increase in the international price of the commodity produced in the federal sector. It is clear that in order to analyze this question we shall have to work with our subsystem *P*. On totally differentiating this with respect to the international price in question, we obtain a linear system of $2n + 1$ equations with changes in the n provincial wages, the n unemployment rates and the capital rental as the unknowns. The matrix underlying this system is not as easy to invert as the one we obtained in connection with our first question, but it still has enough zeroes that inversion is possible without too much difficulty, but certainly not for most of us without paper and pencil. There is some additional clutter to be taken care of on account of the provincial wage functions. This consists of the elasticities of these functions. The zeroes are, as before, a consequence of our assumption of no inter-provincial migration and the determinant of this matrix is crucial for the answer that we seek. Let us assume it not to be zero. Then the effect of changes in the international price depends on the sign of this determinant. However, as before, what is interesting is that irrespective of this sign and with a standard assumption on the elasticities of the provincial wage functions, all the provincial unemployment and wage rates move *together*. In particular, the provincial wage rates move in a direction *opposite* to the change in the rental to capital. The intuition is the same that prompted Stolper-Samuelson²² to prove their result for the two-sector Heckscher-Ohlin-Samuelson model with the only difference being that induced changes in the federal wage rates are also taken into account. As a consequence of this, the criterion governing the sign of the change also includes the elasticities which take the magnitude of these induced changes into account. But the point is essentially this; the basic insight afforded by the Stolper-Samuelson theorem remains valid once we realize that value intensities have to be adjusted by the elasticities governing how the federal wages are set. For future reference, let us denote the sign of the underlying matrix by *Sign P*.

There is an interesting implication of the answer that we obtain to Question 2 and this pertains to the distribution of income. Recall that all factor endowments, capital and provincial labour, are inelastically supplied and hence changes in factor rewards have a direct consequence on the distribution of income. We can thus restate our earlier result by saying that an increase in the international price of the com-

²² See Footnote 21.

modity produced in the federal sector either depresses *all* provincial labour incomes and leads to an increase in the income to capital or *vice versa*. The direction of the change depends on factor intensities in elasticities adjusted terms i.e., on *Sign Q*.

Finally, we turn to our third question on supply responses. For concreteness, let us ask if more federal output is produced if the international price of this output rises. It is fair to say that supply responses are of importance in a variety of applied work as well as policy discussions. Our model sheds some light on this issue with a minimum of analytical toil. Note, to begin with, that a change in any international price changes factor rewards and unemployment rates in the way discussed above. In particular, these changes are governed by *Sign Q*. However, once factor rewards and unemployment rates change, the choice of techniques is altered. In particular, we can no longer assume fixed input-output coefficients as we did in our discussion of changes in factor endowments. Thus, in order to determine an answer to our question, we need to quantify the following two changes:

- The effect of changes in international prices on changes in the choice of technique.
- The effect of changes in choice of technique on output levels.

The direction of the first change involves unemployment adjusted factor intensities i.e., *Sign Q*, and the direction of the second involves elasticities adjusted factor intensities²³ i.e., *Sign P*.

But now we have an answer to our question. An increase in the international price of the commodity produced in the federal sector leads to increased output if and only if²⁴ *Sign Q* is identical to *Sign P*. In one sense, this seems an intuitively natural requirement. Supply responses are "well-behaved" if and only if our two notions of factor intensities agree with each other. On the other hand, this congruence can hardly be taken for granted since the economic parameters involved in one are different from those involved in another. Of course, we can appeal to stability analysis as did Neary²⁵ in another context and Neary and I in the setting of the two-sector Harris-Todaro model.²⁶ However, I doubt if clear-cut results could be obtained in our multi-sectoral set-up. In any case these stability processes are ultimately *ad hoc* and suffer from their own difficulties.²⁷

²³ These intensities were introduced in the literature in the context of a two-sector generalized Harris-Todaro model in Khan (1980). They have been emphasized in several publications of mine and, in particular, in the pages of the official journal of our Society. The reader is referred to Khan (1988) for detailed references.

²⁴ This has to be bolstered by some standard assumptions on the elasticities of the provincial wage functions.

²⁵ See Neary (1978)

²⁶ See Neary (1981) and Khan (1980a).

²⁷ See the Stability chapters in Arrow-Hahn (1971) for a discussion of these issues.

6. QUESTIONS

It is clear that I have taxed your patience long enough. I would now like to wind up the discussion of my model by listing a variety of questions that can be successfully put to it. I shall leave an investigation of these questions to future work. However, an underlying point concerning the model deserves emphasis. It is that by offering a synthesis of Heckscher-Ohlin-Samuelson theory with the Harris-Todaro hypothesis, we have a single and richer framework for asking both trade-theoretic as development oriented questions. Furthermore, to the extent that the model successfully captures inter-provincial rivalry, it also allows one to address questions pertaining to distributional issues. Let us be specific.

6.1 Commercial Policy

We begin with the question of tariffs. The model is ideally suited for studying the effect of a tariffs on factor rewards and employment rates. In particular, we can ask what is the effect on provincial incomes in relative or absolute terms if the production in the federal sector is protected by a tariff. Alternatively, one can ask if support for a tariff on the output of one province will be forthcoming from the other provinces if the mechanism for the distribution of tariff revenue is provincially neutral and well-specified. Note that we have already done the brunt of the analytical work required to answer these questions since a tariff is nothing other than an increase in the given international price. Moreover, if this price is already assumed to include a given tariff, we can ask what happens to the welfare of our economy as a whole, or indeed to the welfare of a particular province, if this tariff is raised any further. In other words, we can study questions that are traditionally studied in commercial policy such as the

- superiority of free trade to autarchy,
- superiority of less restricted trade to more restricted trade,
- desirability of terms-of-trade improvement,
- structure of optimal tariffs in the presence of domestic distortions;

but study them in a context which not only allows for urban unemployment but also one in which policy-makers are not blind to inter-provincial rivalries. Thus, we need not confine ourselves solely to the effect of tariff policy on the international value of the GNP, but also allow for other indices such as unemployment rates, provincial GNP levels, and constraints on the spread between various provincial variables.

Tariffs are, of course, only one instrument of commercial policy. We can also investigate a variety of import and export taxes as well as taxes or subsidies on production.

We conclude this subsection with an observation that deserves some emphasis.

Note that the structure of our model is inherently asymmetric. Provincial-federal migration is in one direction only and there is no unemployment in the (rural) provincial economies. This asymmetry is in contrast to models more traditional in the theory of international trade wherein the names of the sectors can be changed without any consequence to the structure of the model. It is because of this difference that answers to the questions that we have posed above depend in a crucial way on what commodity is being imported or exported.²⁸ Whether this is a strength or weakness of the model, I leave it to you to judge.

6.2 Development Policy

The original paper of Harris-Todaro was inspired by the question of the effect of urban wage subsidies on urban employment. The point of introducing shift parameters in the provincial wage functions was motivated precisely by this question. We can now inquire into the effect of the subsidization of federal employment of labour from one particular province on the unemployment rate pertaining to that province, as well as on the unemployment rates of all the other provinces. This is not an analytically difficult exercise and involves only the subsystem P which we have already discussed above. Employment levels, however, are a different matter and here we have to work with both of our subsystems P and Q .

Indeed, one can go somewhat more deeply into the question of the effect of federal wage subsidies on provincial federal employment. Recall that unlike Harris-Todaro, we need not limit ourselves to a set-up in which wages are exogenously given. This is a consequence of our provincial wage functions which allow a variety of microeconomic rationales for the determination of federal wages. Once we focus on a particular rationale, and hence on a particular microeconomic setting underlying a particular provincial wage function, we can exploit the properties of that setting to get sharper results.

Of course, changes in the minimum wage or wage subsidies are not the only interesting labour policy prescriptions. We can study the effects of employment quotas and a variety of issues related to manpower planning as, for example, Datta Chaudhuri and I have studied in the context of another model.²⁹

So far we have confined ourselves solely to the labour markets. However, subsidies to capital remain an important issue not only with respect to efficiency considerations but also with reference to distributional outcomes. Our model allows us to inquire into the effect of subsidization of capital to a particular province on the employment and GNP levels of that province, as well as on the employment and GNP levels of all the remaining provinces. Some of the issues pertaining to the effect of

²⁸ See Khan-Lin (1982) for an emphasis on this in the context of a two-sector generalized Harris-Todaro model.

²⁹ See Khan-Chaudhuri (1985).

distorting a capital market in the presence of distortions of the Harris-Todaro variety have been studied before in the context of a two-sector model³⁰ but I am not aware of a framework in the development literature which allows one to study this question in a multi-provincial setting.

Instead of subsidies to capital, one can alternatively study the effect of specific capital inflows directed at a particular province. It should be noted that this question is analytically very different from the one discussed above. The former involves an examination of our subsystem *P* whereas capital inflows involve quantities and can be best studied in our context as shifts in the underlying technologies, i.e., production functions. As such, they are analogous to technical progress and hence their study necessarily involves our subsystem *Q*. Indeed, our question is analytically identical to the one inquiring into the consequences of technical progress in one province on the welfare of labour in that province as well as on the welfare of the other provinces. This is an interesting question in its own right.

We conclude this subsection by alluding to the question of the effects of changes in provincial population. In particular, one can ask whether an increase in the population of a province leads to an increase in the international value of GNP of that province or to an increase in the numbers of unemployed or both. Recall from Section 4 that unemployment rates do not change with changes in factor endowments but as emphasized in Section 5, provincial output levels all rise or fall in unison. Hence, it follows as an easy corollary that all unemployment levels simultaneously rise or simultaneously fall with an increase in the population of a particular province. The direction of change depends on employment adjusted factor intensities.

6.3 Project Evaluation

In this subsection, we turn our attention to the issue of prices a loan officer must use in the preparation of feasibility reports pertaining to a particular, (say small) project. The question that has to be faced is that the project will draw resources away from provincial and federal production but its output will also, presumably, earn (or save) foreign exchange in the international market. The question whether the project is socially desirable hinges not only on the criterion of social desirability that is used but also on the costs of the resources that are attracted to it. As we emphasized in the discussion of our model in Section 2, the international non-marketability of capital and provincial labour prevents, in principle, the computation of the resource costs in terms of international prices. There are *no* international prices that can be used. A system of "shadow prices" or "accounting prices" has to be devised. For this, the following questions have to be squarely faced:

³⁰ See, for example, my recent work with Professor Naqvi in Khan-Naqvi (1983).

- How are the shadow prices to be computed?
- Should labour from different provinces be evaluated differently even if it has the same marginal product in the federal sector?
- Does it make a difference as to where the project is to be located?

But these are questions that we can answer. Let us choose as our criterion of welfare an unweighted sum of the provincial GNP levels plus a sum³¹ of the provincial unemployment rates. Then the shadow price of labour from a particular province is simply the derivative of this welfare function with respect to the amount of labour endowment from that province. To state the matter somewhat more transparently, we use as our shadow price or as our measure of the social opportunity cost of a particular "kind" of labour, the change in our measure of social welfare as a marginal amount of that labour is increased. Since employment rates do not depend on factor endowments, this change can be measured in terms of international units of account. Now a quick back of the envelope calculation will convince you that this turns out to be precisely the market provincial wage. This is, to me, an interesting result. It obtains irrespective of the several distortions that abound in our stylized economy. Furthermore, it also precludes the possibility of immiserizing growth.³²

6.4 Inequality and other Normative Issues

My time is running out and I shall be brief. I include this subsection especially in view of the fact that the Director of your Institute has devoted so much of his time and eloquence to this topic. It is, of course, an important subject. The point I wish to make is that several of the issues of equality and equity, in so far as they relate to an economy with several provinces, or in so far as they relate to differences in the incomes of capital and labour, can be addressed in the context of the model that I present to you today.

6.5 Fiscal Policy

In this final subsection, I would like to say something about questions relating to fiscal policy. In all of our discussion so far of a variety of economic policies, there has been no mention of any government budget constraints, provincial or federal. It is commonplace that taxes have to be raised and subsidies have to be disbursed but in a way that one activity is "somehow" related to the other. Once we build this formally into the discussion of particular policies, it is clear that modifications have to be made.³³ In this context, a multi-provincial setting allows us to study several

³¹ One would need to include a weight with the correct dimensions to make this sum well-defined.

³² See Khan (1982) for an investigation of these issues in a two-sector generalized Harris-Todaro model.

³³ See, for example, McCool (1982).

possibilities for the raising and disbursement of revenues and to keep track of the interactions.

7. EXTENSIONS

Those of you who have come this far must have already thought of extensions that you would like to pursue. Let me mention three of my own.

7.1 Infrastructure and Increasing Returns to Scale

It would be of interest to allow for increasing returns to scale technologies particularly in the federal sector. In such a case, the hypothesis of profit maximization would have to be the first to be jettisoned. An obvious alternative equilibrium notion would be one in which the federal sector is regulated and the marginal rates of substitution used as the market prices in the rest of the economy. The losses would have to be covered through lump-sum taxation or if our interests and focus is on the positive³⁴ side, through distortionary taxation (say) on capital. This concept goes back to the French engineer Dupuit and to Hotelling and has come under intensive scrutiny recently.³⁵ It would be of interest to see how the presence of increasing returns exacerbates the distortions in the model.

7.2 An Informal Sector

Our equilibrating condition in the labour market assumes that a migrant is either unemployed at the zero wage or employed at the "high" federal wage. A richer possibility would be to assume the existence of an informal sector in which there is average productivity pricing and into which a migrant enters as a prelude to searching for the desirable federal job. One may assume here that unlike the formal sector, a worker's provincial background is of no consequence.³⁶ One must also assume, it seems to me, that the output of this informal sector is a non-traded commodity from an international point of view. Interesting issues arise here and it would be fruitful to see how the analytical findings relate to the imposing amount of descriptive material that has been accumulated.³⁷

7.3 Political Lobbying

One assumption that has been exploited throughout our analysis is that a particular provincial wage function depends only on the variables particular to

³⁴ As opposed to a normative one.

³⁵ See the Symposium on Increasing Returns in the *Journal of Mathematical Economics* 1989 and the references therein.

³⁶ Fields (1975) is one of the earliest attempts to discuss these issues in a rigorous way.

³⁷ See various Symposia on the subject in, for example, *World Development*.

that province. This is violated especially in a set-up where each province has a lobby in the federal sector looking after the interests of its constituency. If we continue to assume that each lobby knows the labour demand schedule of the federal employer, it is natural that the behaviour of one particular group will be sensitive to that of another. Thus a natural game-theoretic situation arises. One possibility is to assume Cournot-Nash behaviour on the part of the lobbying groups whereby each maximizes its interests, taking as given, the actions of all the others; and in equilibrium the conditioning variables themselves turn out to be the maximizing outcomes. Once a Cournot-Nash federal wages schedule is determined, we can proceed as before. However, in this case we lose all the zero entries that we have been exploiting in our analysis of the subsystems P and Q . If one is serious about studying this extension, it is clear that one would have to start with simple, special cases first.

8. CONCLUDING REMARKS

I shall end this paper (lecture) with the following remark.

In my desire to convince you of the utility of the model that I present, I have, of necessity, focused on the problems it can solve and that too in a way that avoids any discussion of omissions. I have refrained totally from macroeconomic issues. There is no money in the model. There is no treatment of issues relating to time and sequential decision-making. In particular, calling one of the factors *capital* may sound extremely superficial in a setting which is purely static. To add to this, I have also discussed the effects of population growth and technical progress in such a setting. However, I am not alone in this and I leave it to you to decide if these omissions are essential to the uses that I want to put my model to and to the objectives with which I began this lecture.

I thank you for your patience.

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Comments on "Development Policy in a Multi-provincial Economy"

I like this paper very much, and for two reasons. First it provides a clear counter-example to often heard complaints that economic theory is too abstract and remote to be helpful in understanding real world situations. Surely here, as in earlier related papers, Professor Khan has shown beyond any reasonable doubt that a General Equilibrium framework, suitably simplified to highlight particular sets of inter-relationships, can yield considerable insight into important problems. Secondly, the paper builds an important bridge between two rather separate branches of the literature, namely that on internal migration and that on international trade by bringing out the common elements in the underlying structure of the models used in these two areas. Once more, the generality and power of economic theory is beautifully illustrated by this exercise. I have three specific suggestions about how the analysis of this paper could be carried further, and I shall deal with them in turn.

In the model presented here, Professor Khan assumes constant returns to scale in both the central and peripheral regions of his economy. To the extent that peripheral regions from which labour migrates in the real world tend to be agricultural, I wonder how appropriate this assumption is. Certainly, in land scarce areas, the existence of a fixed factor would induce diminishing returns to other inputs. Even in land abundant areas, though, it seems unlikely that all land will be of equal quality. If that is the case, Ricardian analysis of diminishing returns on the extensive margin might become relevant. In the event, of course, which assumption is the more appropriate must be a matter of empirical judgement, but I would guess that diminishing returns in the periphery will be prove to be the more generally useful case. It would be interesting, then, to have the model extended to encompass this case. The Harris-Todaro hypothesis about the effect of the expected urban wage on the migration decision seems to me to lend itself to a useful extension (which for all I known may already have been made elsewhere in the development literature). The extension involves considering the effects of risk aversion, and the insights that this might yield about certain types of welfare policies towards the urban unemployed. Suppose the latter obtain some kind of subsistence support from the proceeds of a tax levied upon the urban employed. The attraction of migration from country to city will only be independent of the size of such taxes and benefits if potential migrants are risk neutral. Increasing taxes and benefits in the city will make migra-

tion more attractive for risk averse agents, and *vice versa*. Migration rates, then, in the absence of risk neutrality become susceptible to policy influence. Now I do not claim that the above scenario is necessarily realistic, of course, but I do offer it as a simple example of the type of issue to which Professor Khan's model could be easily extended.

My final suggestion for extension is not unrelated to the above point. Less developed countries are not the only ones that suffer from "regional problems" or in which inter-regional migration raises serious policy issues. Canada is a case in point. There, however, there exist fiscal mechanisms for effecting inter-regional transfers of resources, whereby richer provinces, typically those which attract immigration, are taxed at the Federal level in order to finance subsidies to the poorer provinces. Professor Khan's framework seems to me to be a natural one to use in studying such issues, because the design of such fiscal transfer mechanisms bound to effect the incentives to migrate upon which his model focuss. In general, his models provides a starting point for the analysis of any policies designed to promote regional development which involve inter-regional transfers of resources.

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Comments on "Development Policy in a Multi-provincial Economy"

A recurring objective in presentations of Prof. M. Ali Khan in the annual meetings of the PSDE is the building of a case for the use of mathematical models in formulating development policy. In the present paper he uses such a model to show that purposive social action can lead to unanticipated consequences via the incorporated linkages. Khan discusses this time the regional model and regional development policy.

Prof. Khan performs remarkable tasks in this paper. He describes, decomposes and solves a model and goes further to analyse the impact of exogenous changes on various unknowns; all done effectively and without formulating a single equation. It is understood that the technicalities of the research will be displayed in a forthcoming paper.

In this comment we shall take the liberty of sketching the equations of the model; of course, at the risk of an incorrect formulation or at worst an alternative model. We shall reflect on its usefulness for regional development policy. We shall also comment, in a general way, on issues raised by Prof. Khan on contributions of pure economics and development economics towards policy-making in the context of the third world.

The model which Khan describes verbally distinguishes between n provinces and one federal centre which we can indicate by c . Each province has its production function, to produce a specialized volume of production Q_n at an internationally given price. Each province uses capital K_n and labour L_n and prices both factors equally to their marginal productivities resulting in fully employed factors and no unemployment.

The centre has also a similar production function which contains besides capital K^c the use of segmented labourers from the different provinces L_n^c .

The two factors of production behave differently. Capital is mobile and can be instantaneously and costlessly uprooted from a particular province and employed in another province or indeed in the centre, or otherwise. There is, as a result, one rate of return to capital, R .

Capital endowments which are given for the whole economy is the sum of capital employed in the n provinces and the centre c .

On the other hand, provincial labour is interprovincially completely immobile.

A worker from a particular province cannot find employment in any province at any wage. So there is a specific wage in each province W_n equal to the marginal productivity of labour in that province.

However, the determination of wage rates of labour types n working at the centre runs differently. A labourer migrates freely from his/her province to the centre. If a provincial worker migrates to the centre and does not find work in the centre, he/she is counted as unemployed in the centre U_n^c . If he/she finds work then this is at a wage which is *specific* to the province he comes from W_n^c . Khan assumes a segmented labour market in the centre where province workers offer their work at different supply prices permitting centre employers to apply differentiated wages for labourers from different provinces. Khan assumes the centre's province wage W_n^c to be a function of the centre's province unemployment rates U_n^c/L_n , the province wage rates, the returns to capital and shift parameters.

The decision of the labourer to migrate from his province to the centre is crucial in such a model. The migration decision is made dependent on comparing his wage at his province and his expected provincial wage at the centre and the possibility of obtaining a job at the centre as proxied by his applicable provincial unemployment rate.

Remains is a definitional equation equalizing the labour endowments in each province, which is given, to its use in employment in the province, and employment or unemployment at the centre.

Making effective use of economic theory Khan decomposes the model into two subsystems. The first subsystem which contains factor prices W_n , W_n^c and unemployment U_n^c is underdetermined and Khan supplements it by the appropriate number of additional equations relating to Harris-Todaro equality of expected wages. The obtained factor prices are then entered into the second subsystem resulting in the allocation of the unknown factor quantities and production on the provinces and the centre. Now that factor prices are predetermined the production functions are transformed from performing a substitutive function in the allocation of factors to that of maintaining fixed coefficient technology relationships.

The novelty in the approach is that the formulations of the model and its decomposability allow Khan to isolate price reactions from quantity reactions. In particular, Khan maintains that "an increase in the exogenous capital or labour endowments leads to no changes in the sector prices or unemployment" (first subset). Likewise, "an increase in any resource must be absorbed along fixed coefficients in one sector and this requires a release of resources from the other sector and a shrinkage in its output level". Or in other words, all provincial output and factor levels move together and in an opposite direction to the centre's quantity variables (second subset).

One technical question may be raised, which may not have been relevant if

the algebra of the model was made available. Khan states that the model consists of $6n + 2$ equations, our count is less. Khan counts also $6n + 2$ unknowns which does not seem to be the case. We count $7n + 3$, namely, Q_n , K_n , L_n , W_n , L_n^c , W_n^c , U_n^c , Q^c , K^c and R . If indeed this count is right then it may be asked whether the model is an underdetermined one from the start. Is the extension of the "first subset" by " n additional equations" meant to close the model? If, on the contrary, the model was determined from the start (thus our count is wrong) then the question arises whether the decomposition into two subsystems and the addition of n equations to the first subsystem may not have made the model overdetermined.

Leaving technical matters as they are, judgements on the usefulness of a model require clarity about the users of the model. Who are the target users which Khan has in mind? This question is treated ambiguously in this paper. That is why the discussion of this question tends to be controversial.

Although elementary, it is helpful to distinguish between development policy-makers, development planners, development economists and pure economists working on development issues. Development policy-makers are politicians authorized to make decisions. They interact with and are regularly advised by development planners who are either civil servants in particular ministries or incidental foreign advisors. Development planners have primary and secondary tasks. The primary task is to scrutinize models on theoretical, empirical and operational grounds before they institutionalize them in a ministry. The most well-known examples of accepted models are various projection models, short-term econometric models, the open input-output models, and, in more sophisticated ministries, programming models which treat specific optimization problems. The secondary task is to communicate policy strategies to policy-makers. But planners have been very selective in what they think is useful to pass to the policy-makers this is understandable in view of the abundant and often conflicting results of econometric policy research produced by development economists and the large scale of alternative and overlapping policy implications emanating from alternative model specifications offered by the pure economists. In fact, to the development planner the status of "another research which just collects data and runs regressions" is not different than that from "another model which just respecifies a problem and reflects on if-then statements". As a development planner I find it difficult to grant less importance to a regression equation than to a theoretical model. Regressions which show a significant and negative effects of female education on birth rates have been more influential in formulating population policy than the Harris-Todaro model in migration policy.

From the above it is obvious that, if the discussed model is to be relevant for development policy, it is not worthwhile to knock on the door of the policy-maker, the development economist/itrician or the fellow mathematical economist.

The prospective user is the development planner — and clearly in his secondary

function. The burden of proving that the discussed model is not just another specification with other results lies with its authors. In this respect, it is important to show to what extent is the decomposability of Khan's model into two sub models – which determine prices and quantities separately – the result of the particular specifications of the provincial wage functions at the centre, $W_n^c = f(W_n, U_n/L_n^c, R, \text{shift parameters})$ and the equality of expected wages? How can marginal productivity pricing exist in the provinces side to side with a segmented labour market at the centre? For how long can such a disequilibrium be maintained? Which other model specifications will produce these two subsets? Or reverses their order in the solution of the model?

Although the model incorporates assumptions from general equilibrium theory the particular specification ends up in a disequilibrium model without price-quantity interactions. Substitution effects are erased while income effects do not seem to be incorporated in the model. It will be interesting to show from a comparative statics point of view how the structure of the model would change as one moves from a segmented to a general equilibrium situation and what would the relative roles be of price versus quantity adjustments under more general model specifications. In my opinion, and in conclusion, Khan's model can be most useful for development planning if the decomposability of the system into the two subsets of prices and quantities can be shown to have more general applications in other areas of development policy.

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