INTERNATIONAL CAPITAL MOBILITY
AND THE DUTCH DISEASE

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1. Introduction

One of the striking features of the 1970's and early 1980's has been the importance of major resource shocks, in the form both of discoveries and exploitation of new reserves, and of dramatic changes in resource prices. As might be expected, such resource-based booms have, in general, been of more benefit to resource-rich countries than to others. However, it is just as true in practice, although less immediately evident, that resource booms have created major internal problems for resource-rich countries. Such problems have arisen because of the structural adjustments which resource booms have induced, problems which have been given the title of the "Dutch Disease".

Academic economists have not been slow to investigate these issues, and a sizable literature has now emerged dealing with both theoretical and empirical aspects of the Dutch Disease. However, a characteristic feature of most of this literature to date is that it assumes that all factors of production are trapped within national boundaries. The implications for the analysis of the Dutch Disease of potential international mobility of some factors have not yet been explored, despite the fact that, as we hope to show, a number of interesting possibilities are introduced when these two phenomena are examined together. Such an exploration is particularly appropriate in a volume of essays in honour of Max Corden, since he has made important contributions to the literature on both of these topics.

The model used most frequently in discussing the implications of a resource boom for output changes is the specific-factors model. Two traded sectors make use in common of a mobile resource, which we shall refer to as labour, as well as of a resource or type of capital that is adapted for
specific use in only one sector. A boom that takes the form of an expansion in one of these specific factors causes the transformation schedule to shift outwards, thus opening up the potential for both sectors in the economy to expand. However, if both sectors are trading outputs at given world prices, the sector making use of the booming resource must expand at the expense of the other sector. In this basic model the phenomenon of the Dutch Disease is not only possible, it cannot be avoided.

The model we wish to develop in this paper is richer in its productive base, and this opens up the possibility that the severe consequences of the Dutch Disease may be moderated, if not altogether averted. Furthermore, it is a model which allows us to consider international mobility of capital without implying an implausible degree of specialization in the output of tradeable goods. Although it turns out that the Dutch Disease is still highly prevalent even in this expanded setting, the model reveals how certain types of internal or external links may ease the adjustments required in the rest of the economy following a boom specific to one sector.

In our discussion of the Dutch Disease we limit ourselves to the case of a resource boom. An alternative scenario, one in which the world price of a country's export commodity rises, is explicitly ignored, even though its analysis is similar in many respects. However, there is one important difference. In a context of a model in which rates of return to capital may be set on world markets, it is inappropriate to analyze a small open economy's reaction to a change in world commodity prices without at the same time investigating the likely consequence of such price changes on world
returns to capital. International capital mobility thus adds a further dimension to the Dutch Disease by drawing attention to this significant difference between price and quantity booms. In what follows we ignore the issues raised by price booms and concentrate on productive relationships within a small price-taking economy faced with a resource boom which is purely internal in its origins.

2. The Model with Nationally-Trapped Capital

The extended version of the specific-factors model we wish to analyze considers two tradeable commodities, which we refer to as the booming sector, and the traditional manufacturing sector. Both sectors are assumed to use three factors of production, but the extent and kind of mobility of each of these factors is different. As in the standard specific-factors model, labour is assumed to be perfectly mobile between both sectors of the economy, but such mobility stops at the water's edge. By contrast, capital will, in the subsequent treatment, be considered to have a world market, but nonetheless be restricted in its use by functional specificity. Thus capital used in traditional manufacturing is never appropriate as an input in the booming sector. Finally, there is a third type of factor, which we call resources. This is both functionally specific, like capital, and internationally immobile, like labour.

Although we are interested in the consequences of international capital mobility for the phenomenon of the Dutch Disease, it is useful to begin by considering a resource boom when capital is tied down both geographically and functionally. Such an exploration provides a point of comparison when we consider international factor mobility, and, as well, serves to reveal how this extended model allows a moderation of the form of the Dutch Disease found
in the traditional specific-factors model. We begin with the competitive profit conditions of change in the booming sector. Let $L_B$, $K_B$, and $V_B$ denote, respectively, the quantities of labour, capital, and resources used in the booming sector. If output prices remain unaltered, a boom in resources will affect factor prices but unit costs in this sector must remain constant. This requires a weighted average of factor price changes, with the weights provided by the distributive factor shares, to vanish. Let $\theta_{1B}$ refer to factor 1’s distributive share in the booming sector, and the returns to labour, capital, and the resource be denoted by $w_B$, $r_B$, and $s_B$ respectively:

$$\theta_{LB} \hat{w} + \theta_{KB} \hat{r}_B + \theta_{VB} \hat{s}_B = 0.$$ (1)

Explicit solutions for this model are worked out in the Appendix. It is clear, however, that a resource boom must serve to lower the return to resources, $s_B$, allowing a potential improvement in the return to the other two factors used in the booming sector. Whether or not both these factors indeed share in the potential gain depends upon the relative degrees of substitutability among factors. As we now investigate, if labour does not gain, the resource boom will not require any output reduction for traditional manufactures.

For an initial value of the return to resources, the $\xi$ curve in Figure 1 illustrates the possible values for the wage rate and return to capital in the booming sector as of a given product price. This curve, convex to the origin to reflect the convexity of technology, illustrates the trade-offs represented by the competitive profit equation of change, (1). When a resource boom occurs, the return to resources must fall, and this causes an upward shift in
the C curve to C'. A second curve, F, drawn with a positive slope, indicates that for the initial value of the return to resources and given factor supplies to the booming sector, an increase in the return to capital, \( r_B \), must be matched by an increase in the wage rate, \( w \), to keep the proportions of labour and capital demanded in balance with the ratio of supplies. The reasoning is straightforward: An increase in \( r_B \) must, on its own, reduce the use of capital. Moreover, if labour and capital are substitutes, the demand for labour will rise. Even if they are complements in production, we assume the degree of complementarity is limited so that an increase in \( r_B \) must lower the capital/labour ratio used. To restore this ratio to the full employment levels, the wage rate must rise. As drawn in Figure 1, the F curve is "inelastic", reflecting an assumption that a greater relative increase in \( r_B \) than in \( w \) is required to maintain full employment. As we now argue, such an asymmetry is indicative of a presumed greater degree of substitutability between resources and labour than between resources and capital in the booming sector.

From an initial equilibrium point where the C and the F curves intersect in Figure 1, imagine an equi-proportionate increase in \( w \) and \( r_B \). This is equivalent, in its effect on factor usage, to a reduction in the return to resources, \( s_B \), as of fixed \( w \) and \( r_B \). If resources are just as good a substitute for labour as for capital, this factor price change leaves undisturbed the ratio of labour to capital demanded. (In such a case the F curve would be a ray from the origin and would not be affected by changes in \( s_B \).) If labour and resources are better substitutes for each other than are capital and resources, the equi-proportionate rise in \( w \) and \( r_B \) must create an excess demand for capital (relative to labour), necessitating an equilibrating
further rise in $r_B$ to restore full employment. Such an asymmetry was assumed in drawing the $F$ curve inelastic in Figure 1, and for precisely the same reasons the fall in $s_B$ which accompanies a resource boom shifts the $F$ curve upwards to position $F'$.  

Figure 1 illustrates the way in which a greater degree of substitutability between resources and labour than between resources and capital leads to an asymmetric share of potential gains to capital and labour. A sufficient degree of asymmetry in this respect could lead to an actual reduction in the wage rate. Figure 2 illustrates the different possible outcomes from an alternative perspective, depicting relationships explicitly derived in the Appendix. In this diagram the vertical axis measures the changes in $w$ and $r_B$ relative to the change in the resource endowment. The horizontal axis measures the relative extent to which resources are a better substitute for labour in the booming sector than they are for capital. The term $E_{jb}^1$ is defined as the relative change in the quantity of factor $j$ used per unit output in the booming sector brought about by a one percent rise in the return to factor $i$. Thus $(E_{lb}^V - E_{kb}^V)$ measures the effect of a rise in the return to resources on the labour/capital ratio in production. In the case of separability, this ratio is undisturbed and an increase in the supply of resources would raise wages and the return to capital by the same relative amount. (In Figure 1 this would be shown by the intersection of an unshifting $F$ ray through the origin with the $C'$ curve; in Figure 2 it corresponds to point $A$.) But the more substitutable are resources for labour as compared with capital, the more will the increase in $V_B$ benefit capital at the expense of labour. Figure 2 illustrates how a sufficiently high degree of asymmetry (such that $[E_{lb}^V - E_{kb}^V]$ exceeds the distance $OB$) can actually cause the boom to lower the wage rate. In such a case, labour and resources are relatively
such good substitutes that an increase in $V_B$ not only lowers $s_B$, but drags $w$ down as well. That is, the increase in $V_B$ has lowered labour's marginal product in the booming sector.

The possibility that labour and resources are relatively such good substitutes provides a rationale for the traditional manufacturing sector to avoid the Dutch Disease in our model. The reasoning is clear: With capital and the type of resources required in manufacturing fixed in supply, any lowering of the wage rate (brought about by the effect of the resource boom on the marginal product of labour in the booming sector) must serve to raise the use of labour in manufacturing. Output must rise. In effect, the sector-specific shock to the economy represented by the resource boom has been transformed into an economy-wide shock by the high degree of substitutability between mobile labour and the booming resource. (By analogy, in the specific-factors model a genuine increase in the economy's supply of labour would serve to raise outputs in both sectors). Less pronounced asymmetry in the relative degree of substitutability will not suffice to reverse the phenomenon of the Dutch Disease. However, any asymmetry whereby labour and resources are better substitutes than are capital and resources must to some extent mitigate the required output reduction in manufacturing, since it serves to limit the extent of the wage increase.

3. The Model with International Capital Mobility

In the traditional scenario describing the Dutch Disease, the manufacturing sector loses resources to the booming sector. But the possibility that manufacturing could obtain resources from abroad introduces
an alternative route whereby productive activity in the traditional manufacturing sector can avoid being hurt by the resource boom in the other sector. Although relief through world capital markets thus appears possible, note that the line of argument in the preceding section, whereby traditional manufactures could benefit if the wage rate falls, no longer applies. With capital internationally mobile, its rental rate in the booming sector is determined on world markets. As a consequence, the fall in resource rentals following the resource boom must serve to drive up the wage rate. The traditional manufacturing sector is forced to release labour to the booming sector.

Although this route for avoiding Dutch Disease is thwarted, the international mobility of capital suggests an alternative mechanism. Since the volume of resources specifically suited for use in the manufacturing sector is unchanged, any alteration in the capital flows is reflected in a change in the capital/resource ratio adopted in traditional manufactures. That is, the resource boom in the other sector serves to attract capital from abroad into manufacturing if the expression shown in equation (2) is positive:

\[ \hat{\Delta}_{KM} - \hat{\Delta}_{VM} = (E_{KM}^L - E_{VM}^L) \hat{\Delta}_L + (E_{KM}^V - E_{VM}^V) \hat{\Delta}_M. \]  

If resources and capital in manufacturing are substitutes, the second bracketed term, \((E_{KM}^V - E_{VM}^V)\), is positive. Even if these two factors are complements in production, this term is positive as long as we continue to assume that a rise in any factor return always lowers the ratio of that
factor's use compared to any other. Therefore, the drop in the return to resources used in manufacturing must by itself encourage a capital outflow. Since the wage rate must rise, attention centers on the sign of the first bracketed expression. This term contrasts the relative degree of substitutability of labour and capital, on the one hand, and labour and resources, on the other.

The significance of this term can be revealed by considering two examples. The first example assumes separability between labour and the other two factors in the sense that an increase in the wage rate does not alter the capital/resource ratio utilized in manufacturing (so that \( E^L_{KM} = E^L_{VM} \)). If this condition prevails, the reduction in \( a^M \) (forced by the increase in wages) would unambiguously lower the ratio of capital to resources; capital would flow out of the manufacturing sector to the rest of the world. International capital mobility will have accentuated the Dutch Disease difficulties faced by the traditional manufacturing sector. In the second example, suppose that the resource coefficient of manufacturing output is absolutely rigid, with the technology requiring a fixed value for \( a^M_{VM} \). In this case the term \( (\hat{a}^M_{KM} - \hat{a}^M_{VM}) \) in equation (2) reduces to \( E^L_{KM} \hat{w} \), so that the increase in the wage rate must encourage an inflow of capital into the manufacturing sector from abroad.

Although international capital mobility might provide a route whereby the traditional (non-booming) sector acquires resources from overseas, can such a capital inflow ever be sufficient to guarantee that manufacturing output does not contract? Since the quantity of local resources available for manufacturing is fixed, any increase in output must be matched by a fall in the resource content per unit of output:
\( \hat{x}_m = - \hat{a}_{VM}. \)  

This change in the input/output ratio must be linked to factor price changes so that:

\[ \hat{x}_m = - \hat{E}_{VM} \hat{w} - \hat{E}_{VM} \hat{s}_m. \]  

(4)

It is immediately apparent that if labour and resources are substitutes, output must fall since the wage increase and fall in return to resources would both encourage a rise in \( a_{VM} \). What if labour and resources are complements in manufacturing (a negative value for \( E_{VM}^L \))? By well-known symmetry relationships,

\[ \frac{\partial a_{VM}}{\partial w} = \frac{\partial a_{LM}}{\partial s_m}. \]

Translating into elasticity terms yields equation (5):

\[ \theta_{VM} E_{VM}^L = \theta_{LM} E_{LM}^L. \]  

(5)

Furthermore, by the competitive profit equations of change in manufacturing (analogous to equation (1)), \( \theta_{VM} \hat{s}_m = - \theta_{LM} \hat{w} \), since the return to capital is fixed by the world market. Substitution into equation (4) reveals that:
\[ \hat{x}_M = \frac{\theta_{LM}}{\theta_{VM}} (E^V_{LM} - E^V_{VM}) \hat{w}. \]  

(6)

Our previously invoked limit on the extent of complementarity requires this entire expression to be negative, except for the limiting case which we already described, in which resources are rigidly linked to output. (In such a case \( x_M \) remains constant.) Even if capital is attracted from abroad, it can never make up for the loss of labour to the booming sector; manufacturing output must fall in the Dutch Disease fashion.

Two kinds of asymmetries in relative degrees of factor substitutability have emerged as crucial in reversing or alleviating the Dutch Disease phenomenon for traditional manufactures. If capital were immobile between countries and labour and resources were particularly good substitutes, the resource boom might actually cause the wage rate to fall. This is the only route by which traditional manufactures can expand, and it is a route that is blocked off in the case of international capital mobility. In this latter case the wage rate must rise and traditional manufactures must lose labour. The effect of this loss of labour to the booming sector on manufacturing output would be accentuated by a capital flow abroad unless labour and capital in manufacturing were particularly good substitutes (relative to labour and resources in manufacturing). With the wage rate rising and the return to resources in manufacturing falling, the manufacturing sector can attract inputs from abroad only if these inputs (capital) are particularly good substitutes for the local input that has gone up in price (labour). Even if
it succeeds in attracting capital from abroad, the effect on output is never sufficient (unless the resource/output ratio is rigid) to outweigh the internal loss of labour to the booming sector.

4. A Boom in a Traded Resource

The boom which we have analyzed above takes the form of a resource discovery, where that resource cannot be traded directly. Instead, it is used as an input into a commodity which is traded. An alternative possibility, that the resource itself can enter international trade, at a price given on world markets, has far-reaching implications for internal factor allocations and the possibility of Dutch Disease. In order to adhere to the distinctions we have already made, assume that the boom (discovery) takes place not in the form of an increase in $V_B$, but rather in the form of ownership claims to internationally traded, but functionally specific, capital used to produce output in the booming sector.

The existence of an international market for sector-specific capital serves to transform the sector-specific shock into an economy-wide wealth shock. If, further, we adhere strictly to the output assumptions made previously, whereby only two goods are produced and both are traded on world markets, the boom in owned type-B capital is absorbed with no changes in factor prices or, indeed, in output in either sector. Consumption levels rise, and this is financed by an outflow of capital from the booming sector.

To progress to a more interesting scenario, introduce a non-traded good sector in addition to the two traded goods. One of the principal directions which the original literature on the Dutch Disease took involved exploring the
distinction between the fate of such a final, non-traded commodity and that of
a traditional traded commodity not sharing in the boom (our "manufacturing"
sector). As was pointed out in these contributions, the price of this
non-traded good is determined within the economy and, given the favorable
income effects of the boom, would be expected to rise as demand shifts
outwards. What is of interest in our present discussion is that with such
local activity taking place, the wealth effects of the increase in owned
capital will spill over and raise the return to some non-traded productive
factor, such as labour. If so, output in the "booming" sector, i.e. the
sector utilizing the kind of capital which has increased in local supply, will
actually get squeezed. 10

These remarks serve to highlight the crucial role played by international
trade in the resource. The output activity which utilizes the booming
resource benefits specifically from this boom only to the extent that input
price falls, helping to attract other inputs as well into this activity.
International trade in this resource cuts this direct link between resource
availability and output. To take an example, secondary industry in a country
such as Canada could not expect to have its external competitive position
strengthened by new discoveries of oil and natural gas if these command world
markets. Not only would income effects tend to drive up factor prices, but
any direct requirement for labour and other inputs to develop these resources
serves further to attract resources away from traditional secondary industries
using energy inputs. 11 This is a kind of "self" Dutch Disease.

5. Concluding Remarks

One of the most classic propositions in all of economics is Ricardo's
doctrine of comparative advantage. It establishes that any country can find
some commodities in the production of which it can successfully compete in world markets. It also suggests how, with the close link between a nation's consumption and production patterns dissolved by the possibility of international exchange, a nation's resources tend to get concentrated in a few lines of production. Any individual productive activity which faces a world market need no longer be supported by a reservoir of local demand. A sector-specific shock favoring one traded activity will generally draw resources out of other traded activities. When all goods are traded, the phenomenon of the Dutch disease is simply a corollary of the doctrine of comparative advantage.

The extended version of the specific-factors model explored in this paper reveals how the tendency for a traditional traded sector to lose resources to a booming sector may be moderated by asymmetries in substitution relationships among inputs. In each case these asymmetries had something in common: The traditional sector may be a net recipient of some factor which is obtainable elsewhere (labour from the booming sector in Section 2, capital from the rest of the world in Section 3), and which has fallen in price relative to some other factors used in production. Our model emphasises the pricing relationships among factors in developing these possibilities, but less formally suggests that other ways of attracting resources to the traditional sector may help moderate the Dutch Disease. Thus a resource boom typically leads to increased government tax revenues, and some of these revenues might be channelled to subsidize inputs used in the traditional traded sector. Probably the development of public inputs such as roads or other forms of social overhead capital (or development of human capital in a form of productive relevance to traditional sectors) comes most readily to
mind. The role of international trade in productive factors should not be ignored in considering this wider framework within which to view the Dutch Disease. The historical record is rich in instances of booming sectors attracting resources from abroad, and these resources, in turn, helping to develop productive potential in other lines of activity. Notwithstanding these possibilities the message of the Dutch Disease remains clear: resource gains specifically tied to one traded sector tend to attract non-traded factors, and these are to be found in other traded sectors not blessed by the resource gain.
Appendix

The basic characterization of substitution possibilities among factors utilized in Figure 2 is found in the term $E^i_{jB}$. A one percent rise in the return to factor $i$ results, by definition, in an $E^i_{jB}$ percent increase in the use of factor $j$ per unit output in the booming sector. All "own" substitution terms, $E^i_{1B}$, are negative. Furthermore, by zero degree homogeneity of factor demands,

$$E^L_{jB} + E^K_{jB} + E^V_{jB} = 0 \text{ for } j = L,K,V.$$

Figure 2 shows the effect on wages and the return to capital of an increase in the quantity of resource, $V_B$, made available to that sector assuming the quantity of labor and capital available in the booming sector is temporarily kept constant. The change in any input-output coefficient is given by the factor price changes and the appropriate elasticities:

$$\hat{a}_{jB} = E^L_{jB} \hat{w} + E^K_{jB} \hat{r}_B + E^V_{jB} \hat{V}_B.$$

Full utilization of factors available to the booming sector requires:

$$a_{LB} x_B = L_B$$
$$a_{KB} x_B = K_B$$
$$a_{VB} x_B = V_B$$

Output change is restricted by the availability of labour, so that for given $L_B$. 

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$\hat{x}_B = -\hat{a}_{LB}$.

The following three relationships can then be used to determine the effect of an increase in $V_B$ on factor returns:

\[
\theta_{LB} \hat{w} + \theta_{KB} \hat{r}_B + \theta_{VB} \hat{S}_B = 0
\]

\[
(E_{KB}^L - E_{LB}^L) \hat{w} + (E_{KB}^K - E_{LB}^K) \hat{r}_B + (E_{KB}^V - E_{LB}^V) \hat{S}_B = 0
\]

\[
(E_{VB}^L - E_{LB}^L) \hat{w} + (E_{VB}^K - E_{LB}^K) \hat{r}_B + (E_{VB}^V - E_{LB}^V) \hat{S}_B = \hat{v}_B
\]

The first equation is the competitive profit equation of change for the booming sector, equation (1) in the text, with $\theta_{LB}$ representing factor 1's distributive share. The second equation states that the capital/labor ratio is fixed, while the third allows the resource/labor ratio to rise only by the relative increase in the resource base, $\hat{v}_B$. Figure 1's C and C' curves illustrate the manner in which the first equation's relationship between $\hat{w}$ and $\hat{r}_B$ is altered when $\hat{S}_B$ falls (as a consequence of a rise in $V_B$). The F and F' curves in Figure 1 picture the comparable links between $\hat{w}$ and $\hat{r}_B$ found in the second equation.

Formal solutions are shown by

\[
\hat{s}_B = \frac{\theta_{LB}(E_{KB}^K - E_{LB}^K) + \theta_{KB}(E_{KB}^L - E_{LB}^L)}{\hat{v}_B - \Delta}
\]
\[ \hat{\varphi}_B = \frac{\hat{\varphi}_v \left( \theta_{KB}(E_{LB}^K - E_{KB}) + \theta_{VB}(E_{KB}^K - E_{KB}) \right)}{\Delta} \]

\[ \hat{r}_B = \frac{\hat{r}_v \left( \theta_{LB}(E_{LB}^V - E_{KB}^V) + \theta_{VB}(E_{KB}^V - E_{LB}^V) \right)}{\Delta} \]

The increase in \( V_B \) must lower own-return, \( s_B \), by the assumed concavity property of the production function. Furthermore, although complementarity is allowed, we rule out "super-complementarity" wherein a rise in a factor price would not only lower the intensity of that factor's use, but would reduce the input of a complementary factor by even more. Thus terms like \( (E_{KB}^L - E_{LB}^L) \) are all positive, as is the determinant of coefficients, \( \Delta \). Finally, since by homogeneity,

\[ (E_{KB}^L - E_{LB}^L) = (E_{LB}^K - E_{KB}^K) + (E_{LB}^V - E_{KB}^V), \]

the expression for the changed return to capital can be written as

\[ \hat{r}_B = \frac{1}{\Delta} \left\{ (1 - \theta_{KB})(E_{LB}^V - E_{KB}^V) + \theta_{VB}(E_{LB}^K - E_{KB}^K) \right\} \]
Figure 2 plots the relationship between \( \hat{\omega} \) and \( \hat{r}_B \), on the one hand, and the degree of asymmetry between resource substitutability with labour and with capital on the other. A relatively high degree of substitutability between resources and labour could lower the wage rate (labour's marginal product in the booming sector), thus releasing labour to the rest of the economy.
Footnotes

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1. For empirical evidence relating to a number of countries, see the contributions in Neary and van Wijnbergen (1986).

2. Resource booms also raise issues of depletion and stabilization policies, which we shall not consider here.

3. For overviews, see Corden (1984), Neary (1985), and Neary and van Wijnbergen (1986).


5. This model is developed in Jones (1971) and Samuelson (1971).

6. A circumflex denotes a proportional rate of change: e.g. $\hat{\chi} = \frac{d\chi}{\chi}$.

8. This strong result depends upon there being only three factors in the booming sector. With capital's return pegged to world markets a resource boom must raise the return to some factor other than capital or resources. If there were additional factors, labour's return could conceivably fall, for reasons similar to those developed in Section 2.

9. $a_{ij}$ denotes the amount of factor $i$ per unit of output in sector $j$. Thus $\hat{a}_{KM} - \hat{a}_{VM}$ is the change in the capital-resource ratio in manufacturing.


11. These themes are explored as well in Jones (1980) and Jones (1986).


Figure 1: Response to a Fall in Resource Price
Figure 2: Factor Prices and Relative Substitutabilities

\[ \alpha \equiv E_{LB}^K - E_{KB}^K > 0 \]


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