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THE ROLE OF TRANSACTIONS COSTS IN ECONOMIC GROWTH

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ABSTRACT

This paper deals with the role of reductions in transactions costs as a cause of economic growth. The core of the paper consists of three analyses of this issue. First, an intuitive analysis based on the “make versus buy” decision, relating the scope of trading to production cost differences and transactions costs. Secondly, the paper presents a quite general theoretical analysis of consumption and production activities, and of exchange activities with transactions costs, in the context of mathematical programming, to show how reductions in transactions costs affect the economic welfare and growth of an overall economy. Lastly, linear programming and duality is used to relate the earlier results more closely to GDP and economic growth.

Optimising consumption, for an agent, involves a Lagrangean function, and Lagrange multipliers for commodities, which can be interpreted as prices. An important aspect of the approach here is that each agent has their own prices, so the analysis is rather different to that of conventional demand theory. Agent-specific prices follow from significant transactions costs. The power of conventional demand theory is obtained by ignoring transactions costs, enabling prices to be equalised across agents. Consumption here is optimized where the constraint for each commodity is that goods and services can only come from stock, production, or exchange. Each agent can own and operate production processes, which are assumed to be linear. To operate a production process, an agent must “own” the required input commodities. This assumption is necessary to keep track of the associated transactions costs. Each agent can acquire some of one commodity from another agent, in exchange for giving up some of another commodity of its own, while incurring some transactions costs. The agent’s Lagrangean function is then differentiated in order to assess the effects of a reduction in transaction costs, using comparative statics. The paper ends by applying the earlier analysis to some episodes of the economic history of growth and development, and also to government policies for reducing transactions costs.

Key words: transactions costs, economic growth and development, comparative statics.

JEL Classification: C4, C6, E1, D9.

THE ROLE OF TRANSACTIONS COSTS IN ECONOMIC GROWTH

1. INTRODUCTION

The purpose of this paper is to show that reductions in transactions costs, or improvements in exchange technology, are an important cause of economic growth and development, as well as the recognized causes of growth in resources, and improvements in production technology. This is done, firstly as an intuitive analysis using the "make versus buy" decision, secondly as a quite general theoretical analysis of consumption and production activities, and of exchange activities with transactions costs, using mathematical programming, and also lastly as a linear programming problem, using duality to show how reductions in transactions costs affect the economic growth of an overall economy. Surprisingly, as far as the authors have found, there has not previously been any rigorous analysis of transactions costs and economic growth in the published literature.

Economic growth is generally measured from changes in gross domestic product, as measured at constant prices by either the expenditure or output methods. The standard economic growth theories (Solow (1956), Solow (1957) and Romer (1990)) attribute economic growth to growth in resources and improvements in production technologies. That analysis misses out a quite separate cause of economic growth, that is, improvements in transactions "technology", or reductions in transactions cost.

This paper sets out to prove that reductions in resource, or commodity, use per transaction increase economic growth and economic welfare. It is argued that the history of economic growth and development is primarily driven by reductions in transactions costs. Societies typically started in the distant past by hunting, gathering, or subsistence agriculture. Only subsequent reductions in transactions cost permitted exchange, specialization and increasingly efficient production. The theory of economic growth should not ignore what could be the main factor affecting the process, but that follows from inappropriately adopting the assumption of standard neoclassical microeconomics, that there are no transactions costs.

North (1981) and North, Anderson and Hill (1982) are primarily focused on the importance of property rights in growth and development, but appropriately discuss aspects relating to transactions costs as well. It is perhaps correct in logic to put property rights before transactions costs, as property rights cannot be exchanged until they exist, but that emphasis has obscured the importance of transactions costs for economic growth. Many applied development economists have no problem with the importance of transactions costs UNIDO/UNCTAD

(2011), explaining the difficulty of manufacturing in Africa, has a table (table 6, p73) containing some estimates of transactions costs as costs of infrastructure services, for example.

Are there implications for government, and government policies? The initial stimulus for this work was the question of how to measure the benefits to individual member states of membership of the European Union, where Harald Badinger has published some excellent work, Badinger (2005) and Badinger (2008), as stated in the Baldwin and Wyplosz (2009) textbook. In the 2005 article, Badinger essentially constructs an index of transactions costs for each country from import tariffs and, more arbitrarily, monetary union. He then shows that these indices of transactions costs are significant in explaining up to 25% of the post World War 2 growth of member states of the European Union. This paper provides a theoretical support for those results. The European Union, and implementation of its policies, together with other aspects of European economic integration, has significantly reduced transactions costs compared to what they were in the 1950s, and that in itself has profoundly affected the economic growth of member states.

Oliver Williamson (2000) mentions a relevant article by R C O Matthews in his review of New Institutional Economics, Matthews (1986), in which some of the links between economic growth, transactions costs and government are discussed, together with measurement issues.
There is also an interesting series of papers on the division of labour, a concept made famous by Adam Smith in the Wealth of Nations. For example Borland and Yang (1995) and Yang and Borland (1991) rigorously derive results in the spirit of this paper, and come close to our results, but these papers lack the focus on transactions costs and growth of this paper, and are rather focused on growth and the division of labour. Adam Smith’s observation that economic growth depends on the division of labour in his chapter 1 is followed by transactions and exchange in his chapter 2, and the crucial step in his chapter 3 is that economic growth depends on the size of the market. That depends on transactions costs, which are lower in towns, and lower for water-borne transport in his day, as Adam Smith explained. Perhaps Borland and Yang should have focused more on transactions costs. Adam Smith’s insights on economic growth and development were later overlooked because the marginal revolution in economics, and in particular market supply and demand analysis, presumed that there are no transactions costs.

2. INTUITIVE ANALYSIS

At a much simpler level than what follows, in the context of a whole economy, the benefit of an individual transaction will tend to fall as the number of transactions increases. That benefit is related to differences in production costs. The number of transactions actually occurring can be expected to be (or from a normative point of view, ought to be) where the marginal benefit equals the marginal cost, of transactions (in the diagram below, MTB=MTC at E_1).

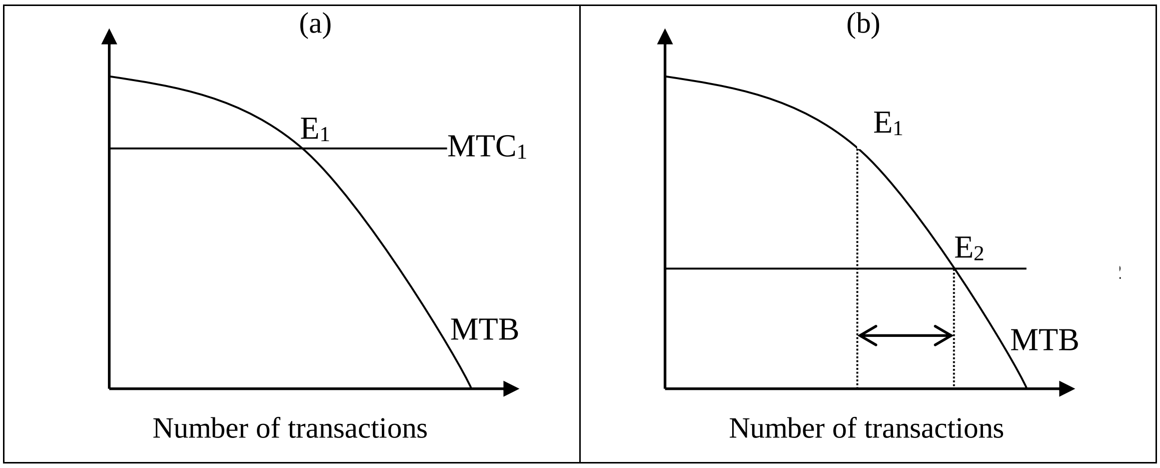
At that margin, one agent's production cost (make) just equals some other agent's production cost, plus all the transactions costs (buy). The first agent is indifferent at the margin whether to make or to buy. The transactions costs, only at this margin, just equal the first agent's high production cost, less the second agent's lower production cost, that is, the production cost differences. The number of actual transactions depends on the benefits, which are production cost differences, and the costs, which are the transactions costs. Naturally, the greatest benefits, or production cost differences, should be exploited first, and smaller benefits only in later additional transactions.

Transactions costs can be expected to depend on institutional arrangements and transaction technologies, but economies of scale in transactions costs may be limited. It might be a reasonable first approximation to assume that the costs of a transaction remain the same as the number of transactions increases.

What will happen if there is a reduction in transactions costs?

The transactions cost curve shifts down (Figure 1, part b, below), the transactions benefit curve remains where it is, and because it slopes down, the intersection of the curves will be to the right of where it was, at a higher number of transactions (E_2).

Figure 1. Response of optimal number of transactions to decrease in (marginal) transactions costs (MTC).



Source: Authors.

A higher number of transactions will mean a higher level of gross domestic product because of a greater division of labour, more specialisation, and more trade. Specialisation may enable some producers to reduce their production costs. If specialization reduces some production costs, and some other production costs remain the same, then production cost differences and the marginal benefits of exchanging goods are increased too.

Extensive economic growth can be caused and fuelled by growth of productive resources (Reynolds, 1983). However, intensive economic growth is caused not only by technological advancements in production, which increase production cost difference and increase the marginal benefits of transactions, but also by processes of transactions cost reduction . The purpose of the mathematical and linear programming sections of this paper is to make these ideas more rigorous.

3. THE MATJEMATICAL PROGRAMMING MODEL

The analysis which follows focuses on two agents within an economy, denoted i and j , but could be generalised beyond that. Commodities can be consumed by an agent from initial stocks, from production, or from exchange.

The commodities, which can be goods, services or resources, are indexed from 1 to K as k . The analysis might appear static, but if a separate "k" is used for a commodity in differing time periods, it can also have a "dynamic", or at least "metastatic" interpretation.

Optimising consumption, for an agent, involves a Lagrangean function, and Lagrange multipliers for commodities, which can be interpreted as prices. An important aspect of the approach here is that each agent has their own prices, so the analysis is rather different to that of conventional demand theory. Agent-specific prices follow from significant transactions costs. The power of conventional demand theory is obtained by ignoring transactions costs, enabling prices to be equalised across agents. In the analysis here, there is no such thing as a market price, unless the relevant transactions costs are all zero.

Assume agent i has preferences about consumption, and can consume from stock, production, or exchange. Agent i inherits some stocks of goods and services or commodities, S_i , a column vector of stocks s_{ik} for each commodity k. The problem agent i would face if consumption were only from stock could be described as maximising a preference function $u_i[Q_i]$ subject to the constraint that each consumption q_{ik} could not exceed the relevant available stock s_{ik} .

But each agent can own and operate production processes. Agent i has production processes indexed across v, and agent j has processes indexed across w. These processes operate linearly at levels z_v and z_w, respectively. The required inputs to production are $a_{vk} \times z_v$ and $a_{wk} \times z_w$. The production of commodity k (which could be joint production, more than one k) is $b_{vk} \times z_v$ and $b_{wk} \times z_w$. Each production activity is assumed to be managed by an agent, because it is necessary to keep track of the transactions costs. Denoting the production agent as i, a particular production process or activity under i's ownership and management is denoted as v. The outputs are $b_{vk} \times z_v$, and the input requirements are $a_{vk} \times z_v$. For production to be possible, agent i must "own", or have ownership control over, the required commodities for production activity v. This approach to production assumes constant returns to scale, but otherwise places few restrictions on technology as typical isoquants from neoclassical economic theory can be approximated in linear segments. A closer approximation, for example to a Cobb-Douglas production function, simply means analysing more activities z_v. The analysis here may appear static, but if a more realistic context was planning production ahead, then replication and divisibility, at least in principle, would imply constant returns to scale. In the case of joint production, there would be more than one positive b_{vk}.

As an example, consider the rearing of sheep. z_v, the level of production, in this case could be measured as the number of sheep reared. The output production coefficients would presumably include one b_{vk} indicating the amount of lamb meat obtained from one sheep, and another indicating the quantity of wool, per sheep. There could be different "$k's$" for differing time periods, as explained above. Input coefficients, a_{vk}, would presumably include an area of grassland per sheep, possibly a quantity of winter hay per sheep, shepherd time per sheep, and maybe sheepdip chemicals per sheep, for these differing commodities k.

Often output from a process might be specific to one commodity, in which case the one relevant b_{vk} coefficient could be taken as "one", or could be taken as "one" in the first time period. Other related processes might involve production of the same commodity k, so there might be a range of processes v with $b_{vk} = 1$ for the same k. These are the processes which would trace out something like a familiar isoquant on a graph with two relevant input quantities as axes.

This linear approach to production, often used in general equilibrium analysis, is different to the Cobb Douglas production function approach. The focus here is less on what is produced from combinations of resources, but more on the resource requirements that some level of production will require, similar to input-output analysis. It is explained in Hicks (1968), and is what is used in Debreu (1959).

Exchange transactions and transaction costs mean that each agent can acquire some of one commodity from another agent, but in exchange for some of another commodity, and at the cost of some transactions costs. An exchange necessarily involves at least two agents. A transaction where agent i acquires commodity k in exchange for some commodity m from agent j has a level x_{ijkm}, which is also related to x_{jimk}. The transactions costs of an exchange of commodity k for commodity m can potentially involve any other commodity n.

The quantity of commodity k acquired by agent i is $d_{ijkm} \times x_{ijkm}$. Actually, d_{ijkm} can always be taken as one, and the quantity of the transaction measured as x_{ijkm}, which is assumed in the rest of this paper. The quantity of commodity m given by agent i in exchange is $e_{ijkm} \times x_{ijkm}$. Agent i's transaction "costs" (actually commodity quantities) are $c_{ijkmn} \times x_{ijkm}$, where c_{ijkmn} is the quantity of commodity n which agent i "loses" as a cost of undertaking the transaction, per unit x_{ijkm}. The quantity of commodity m received by agent j must also be $e_{ijkm} \times x_{ijkm}$, and the quantity of commodity k given by agent j, must also be $d_{ijkm} \times x_{ijkm}$. Agent j's transaction "costs" might be different to those of agent i, for example because of a different location, say $f_{ijkmn} \times x_{ijkm}$.

The problem for agent i is to maximise $u_i[Q_i]$ subject to commodity uses being less than or equal to commodity supplies, from exchange, production and stock, for each commodity. For commodity k the constraint is:

$$q_{ik} + \sum_{v} z_v \times a_{vk} + \sum_{jm} e_{ijkm} \times x_{ijkm} + \sum_{jlm} c_{ijlmk} \times x_{ijlm} \leq s_{ik} + \sum_{v} z_v \times b_{vk} + \sum_{jm} d_{ijkm} \times x_{ijkm}$$

(the use of commodity k in exchange includes those c_{ijlmn} where $n = k$). The Lagrange multipliers for the goods and services constraints are P_i (column vector) or p_{ik}, individual to each agent as explained above, because of transactions costs.

The Lagrange function to be maximised by agent i, using K-dimensional column vectors, denoted by capital letters, for $q_{ik}, s_{ik}, b_{vk}, a_{vk}, x_{ijkm}, d_{ijkm}, e_{ijkm}, c_{ijlmn}$, where the K dimensional vector for c_{ijlmn} is over n:

$$L = u_i[Q_i] + P_i^{'} \times (S_i - Q_i + \sum_v z_v B_v - \sum_v z_v A_v + \sum_{jm} (D_{ijm}{'} \times X_{ijm} - E_{ijm}{'} \times X_{ijm} - C_{ijm} \times X_{ijm}))$$

$$\text{for } Q_{i,} P_i, z_v, X_{ijm} \geq 0 \tag{1}$$

In this problem, Q_i, P_i, z_v and x_{ijkm} are all functions of the parameters $S_i, B_v, A_v, E_{ijm}, C_{ijlm}$ (the elements of D_{ijm} are all one or zero).

The first order conditions for a maximum, from $dL = 0$, are:
With respect to Q_i,

$$\text{either } U_{iq} = P_i \qquad \text{or } q_{ik} = 0 \tag{2}$$

where U_{iq} is $\dfrac{du_i}{dq_{ik}}$ as a column vector.

With respect to P_i, either

$$S_i - Q_i + \sum_v z_v B_v - \sum_v z_v A_v + \sum_{jlm} (D_{ijm}{'} \times X_{ijm} - E_{ijm}{'} \times X_{ijm} - C_{ijlm} \times X_{ijlm}) = 0$$

$$\text{or } p_{ik} = 0 \tag{3}$$

With respect to each production process level z_v,

$$\text{either} \qquad P_i^{'} \times B_v = P_i^{'} \times A_v \qquad \text{or } z_v = 0 \tag{4}$$

With respect to each exchange $ijkm$,

$$p_{ik} \times d_{ijkm} - p_{im} \times e_{ijkm} - \sum_n p_{in} \times c_{ijkmn} = 0 \qquad \text{or } x_{ijkm} = 0 \tag{5}$$

It can be seen from the production process condition (4) above, that if $b_{vk} = 1$, and if the other output coefficients are zero, then p_{ik} is related to $i^{'}$s unit costs of production of k , if i actually produces that commodity.

There are also second order conditions for a maximum, $d^2L \leq 0$, which from condition (2) impose constraints on the partial derivatives of prices with respect to the parameters. In particular, $\frac{dp_{ik}}{ds_{ik}} \leq 0$, which can be derived from the negative definite and symmetric properties of $\frac{d^2u_i}{dq_{ik}dq_{im}}$. In this “reserve demand” sense, demand curves do slope down.

Suppose agents i and j place similar values on some commodity m so that $p_{im} = p_{jm}$, and that they are interested in an exchange for commodity k. Commodity m might be money, for example, and $p_{im} = p_{jm} = 1$.

From (5) for optimal exchange by agent i:

$$p_{ik} = p_{im} \times e_{ijkm} + \sum_n p_{in} \times c_{ijkmn} \tag{6}$$

For agent j:

$$p_{jm} = p_{jk} \times e_{jimk} + \sum_n p_{jn} \times f_{jimkn} \tag{7}$$

But what agent i gives must be the same as agent j receives, and vice versa, so $p_{im} = p_{jm}$ implies $e_{ijkm} = 1$, and if we add the conditions (6) and (7) together:

$$p_{ik} - p_{jk} = \sum_n p_{in} \times c_{ijkmn} + \sum_n p_{jn} \times f_{jimkn} \tag{8}$$

In this special case, the difference in their production costs of k must equal their combined transactions costs, as the intuitive analysis of the "make versus buy" decision above asserts is the case.

If i's problem is solved, and if there is then a reduction in an element c_{ijkmn} of C_{ijkm}, indicating a reduction in transactions costs:

$$\frac{dL}{dc_{ijkmn}} = -p_{in} * x_{ijkm} \leq 0 \tag{9}$$

A reduction in transactions costs increases welfare for agent i.

The same sort of result is also true for agent j, assuming a reduction in an element f_{ijkmn} of F_{ijkm}.

It is therefore true in an economy satisfying the above assumptions of this model, that a reduction in transactions costs increases economic welfare, and increases economic growth.

Other causes of economic growth in this framework, from inspection of $\frac{dL}{ds_{ik}}$, $\frac{dL}{db_{vk}}$ and $\frac{dL}{da_{vk}}$, are an increase in initial commodity stocks (which could include capital equipment or buildings, or labour, or natural resources), an improvement in productivity or technology as an increase in output (higher b_{vk}), or as a reduction in input requirements (lower a_{vk}). More traditional growth theory has recognised these causes of economic growth, but, because it has ignored transactions costs, it has ignored the increase in economic growth which should be attributed to reductions in transactions costs.

4. THE LINEAR PROGRAMMING APPROACH

If an agent's preference function is expanded as a Taylor Series, and the conditions for convergence are met, then the first order approximation to $u[Q_i]$ is $\sum_k \frac{du}{dq_{ik}} * q_{ik}$, apart from a constant, which will not affect a search for a maximum.

This means that often it is possible to approximate the mathematical programming problem (1) above, for an agent i by a linear programming problem. As can be seen from the first order condition (2) above, $\frac{du}{dq_{ik}} = p_{ik}$. What are required are prices, which can be denoted r_{ik} or R_i as a vector (a similar discussion to this, in the context of profit distribution in a modern economy, is in chapter 3 of Morishima (1976), translated from Japanese, Morishima (1973)).

The problem now becomes that of the maximisation of the value of consumption, $R_i^{'} \times Q_i$ subject to the same linear production constraints we had before in (1). The new Lagrangean function is:

$$L = R^{i}{}' \times Q^{i} + P_i^{'} \times (S_i - Q_i + \sum_v z_v B_v - \sum_v z_v A_v + \sum_{jlm} (D_{ijm}{}' \times X_{ijm} - E_{ijm}{}' \times X_{ijm} - C_{ijlm} \times x_{ijlm}))$$

$$\text{for } Q_{i,} P_i, z_v, X_{ijm} \geq 0 \tag{10}$$

The first order conditions are now:

With respect to Q^i,

$$R^i = P^i, \quad \text{or} \quad Q^i = 0 \tag{11}$$

(the prices given must be “sensible”)

With respect to P^i, as (3) above.

With respect to z_v, as (4) above.

With respect to x_{ijkm}, as (5) above.

As regards the effect on economic growth of a reduction in transactions costs, c_{ijkmn}, in this case it is easier to see the relationship between expenditure GDP,

$R^{i'} \times Q^i = P^{i'} \times Q^i$ and the Lagrangean function L . The effect is still given, on differentiating the Lagrangean with respect to c_{ijkmn}, by equation (9) above, that is that a reduction in transactions costs increases economic growth, expenditure GDP at constant R^i prices.

What about income GDP here? The standard, or canonical, mathematical description of this linear programming problem is:

Maximise $\left[R^{i'},\ 0, 0\right] \times [Q^i, Z, X]$ (ie., $R^{i'} \times Q^i$)

Subject to $[I, A - B, E + C - D]' \times \left[Q^i, Z, X\right] \leq S^i$

The duality theory of linear programming asserts that this problem has a solution, if, and only if, another problem has the same solution:

Minimise $P^{i'} \times S^i$

Subject to $[P^{i'} \times [I, A - B, E + C - D] \leq [R^{i'}, 0, 0]'$

Here, income GDP can be seen in the costs of using resources, both for production and for transactions, and it must be the same as expenditure GDP, from (11) above.

5. TRANSACTIONS COSTS AND THE HISTORY OF ECONOMIC GROWTH AND DEVELOPMENT

A crucial question in the economic history of growth and development is why the Industrial Revolution occurred in Britain and not in France. It was a contemporary Frenchman, Napoleon Bonaparte, who observed that the British of the time were a nation of shopkeepers. Specialization depends on trade, and trade depends on relatively low transactions costs. We argue that it was relatively low British transactions costs compared to other countries such as France, in the 18th century, that led to the Industrial Revolution.

In the 19th century economic history of Germany one can discover another example of a relationship between transactions costs and economic growth. Germany experienced dynamic economic growth around the middle of the 19th century. There was physical capital investment in railways, and human capital investment in education, and improvements in production technologies, as conventional theory would expect, but also the development of a customs union, the Zollverein, from 1818 onwards. As Seidel (1971) notes, at the end of 18th century, in the territory of the previous German-speaking Holy Roman Empire, one could experience about 1800 customs barriers. About 1830, there were numerous trade barriers even within Prussia, including the division of Prussia into two separate parts. Travelling from East Prussia to Cologne, in West Prussia, was associated with custom borders checks, and taxing, 18 times

(Seidel 1971, p. 4). Transportation of goods was slowed down, and inspections of cargo and custom duties increased final prices. The Zollverein customs union reduced all these barriers to intra-German trade. The number of transactions increased, bringing prosperity to all engaged in production and exchange. The use of a common currency, after earlier agreement on only two German currencies, was another factor that brought transactions costs down.

A negative example in the last century was the Soviet Union and associated countries. Communism and central planning did not allow private negotiations or the legal private exchange of goods and services. Clearly, many transactions costs were extremely high in Soviet societies, with well known consequences.

There is also the post-war phenomenon of European Union and attempts towards a common market for goods and services in the 1990s, with reductions of transactions costs for the (currently) 27 EU member states. Transactions costs can be reduced by imposing common technical standards for production and by reducing import and expenditure tax rates, and other barriers to trade within the Union.

As can be seen from this brief historical review, many, if not all, periods of exceptional economic performance (or lack of it in case of Soviet Union) are associated with changes in transactions due to reductions in transactions costs.

6. POTENTIAL ECONOMIC POLICY APPLICATIONS

If the causes of economic growth, from earlier theories, are seen as increases in resources, and improvements in productive technologies, then governments have limited roles to play in stimulating growth. Private ownership of labour, natural resources and physical capital resources is generally felt to be appropriate since the collapse of communist societies in 1990, and production is generally managed in private companies. Governments, in this earlier framework, may have some responsibility for infrastructure, and educational and training systems, because of externalities, but otherwise government does not have a valid role in this theory.

The role of government policies in economic growth is very much greater when transactions cost reduction is seen as a principal cause of economic growth. Technical standards, consumer protection, common currency systems, quite apart from provision of efficient legal and contract enforcing justice systems, become very relevant. The significance of government involvement in transport and communication developments is also clearer.

Government involvement in education also has transactions cost effects. Education trains people to communicate with other, to keep records, for example of trading activity, and in some cases, for example in business schools or in history taught properly, to appropriately evaluate alternative courses of action.

The theory outlined in this paper relates to resource-using transactions costs, but the "make versus buy" arguments of the introduction show that transactions-based taxes such as import and export duties, value added tax, and excise duties, can increase transactions costs rather than reduce them, inhibiting growth. "Optimal" taxation, in the economic growth context of this paper, is taxation that is consistent with low transactions costs, for example, based on exhaustible natural resource ownership, or individual income or wealth.

7. CONCLUSION

A rigorous optimization exercise above proved that reductions in transactions costs are crucial for GDP growth in a real world of significant transactions costs, and agent-specific prices. Classical economics assumes away transactions costs, and uses the equal price assumption across agents to simplify its analytical framework. In doing so, Classical economics has assumed away a principal cause of economic growth. This paper analyses the role of transactions costs in economic growth. The main finding may be formulated in one sentence: **A reduction in transactions costs, or a reduction in resource use per transaction, increases economic growth, and economic welfare.**

Economic history gives several examples of substantial transactions cost changes and associated changes in the economic growth and welfare of societies.

A "negative" example is the Soviet Union, where failure to reduce transactions costs led to economic failure.

Future research should test these ideas empirically, measuring reductions in transactions costs against economic growth, in both developed, and developing countries. The results also have the potential to improve economic policies in a global perspective.

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