

**RESTRUCTURING AND PRODUCTIVITY GROWTH:
FURTHER EVIDENCE FROM THE ECONOMIC GROWTH
IN NINETEEN OECD COUNTRIES: 1970-1996**

D.C.A. Curtis and K.S.R. Murthy
Department of Economics
Trent University
Peterborough Ontario
Canada K9J 7B8

May 2001

Abstract

Data on the size and growth of different sectors of economies are analyzed to determine the impact of restructuring on the growth rates of real GDP in nineteen OECD countries over the period 1970-1996. We find that productivity growth and growth in real GDP were significantly and positively affected by the structural change, and the convergence of structure, caused by faster growing non-governmental service sectors. Growth in these service sector outputs enhanced aggregate productivity through the externalities that accompany sectoral specialization and inter-sector trade in intermediate service inputs. Restructuring employment toward larger service sector shares did not produce significant efficiency gains. Indeed shifts toward government services employment appears to have reduced aggregate productivity. These results are robust in experiments that address concerns about endogeneity effects through two stage estimations using panel data.

Financial support for this project was provided by the Trent University Committee on Research (SSHRC).

I: INTRODUCTION

The relationships between economic structure, restructuring, productivity growth and economic growth have been the focus of a number of recent economic studies. In an historical context, Johnson (2000) argues that the agricultural sector was unable to realize significant, sustained increases in productivity until the manufacturing and knowledge sectors emerged to supply mechanical and scientific inputs. Gemmell and Wardley (1990) identified a similar complementary role for the service sector in the history of British economic growth. In a more recent context, Feder (1983) argued that restructuring based on the growth of an export sector contributed significantly to productivity growth and economic growth. Ram (1986) made a similar argument with respect to the role of the government sector in economic growth. Curtis and Murthy (1999) and Dowrick (1989) found that restructuring arising from the growth of the service sector was a significant part of the growth process in a sample of OECD countries in the period before 1985. Looking forward, Lipsey (1993, 1996) saw technological change based on changes in the organization and structure of production arising from advances in transportation, communications and information sectors as the basis for a new paradigm for the understanding of economic growth in a global context. In addition, Bernard and Jones (1996) argued that productivity convergence across industrialized countries could be explained in part by the restructuring that is evidenced by the increased service sector share in output and employment. Alternatively, others have raised concerns about the potentially negative impact of unbalanced growth on productivity growth following Baumol (1967) and Rowthorn and Wells (1987), or about the methodologies used to evaluate the process as in the case of Dowrick and Nguyen (1989) and Sheehey (1990).

This paper makes a contribution to this exploration of the effects of restructuring on productivity growth. It builds on earlier work by Dowrick (1996) and Curtis and Murthy (1999) to explore in more depth and detail the relationships between structural change and productivity growth in a sample of OECD countries in the time period 1970-1996. Our work is motivated in part by an interest in extending the study by Curtis and Murthy (1999) by increasing the sample, and examining a broader set of sector definitions and sector dis-aggregations to explore restructuring and growth in more detail and depth. Questions also persist about the impact of the government sector, and growth in that sector, on productivity growth. Landau (1983), Ram (1989) and Dowrick (1996) have considered the government sector impact on growth, but differences in their results leave room for further work. These different possible impacts from the government sector suggest a need for a finer distinction between the commercial or non-government services sector and government services when examining the role of restructuring. A further motivation arises from results suggesting that country specific factors, including productivity growth arising from technological diffusion and “catch-up”, should be given explicit recognition when examining inter-country productivity growth rate differentials.

Figures 1 and 2 provide a basic illustration of the structure, restructuring and growth relationships of interest. Based on a sample of 19 OECD countries over the time period 1970-1996, the charts illustrate two dimensions of these relationships. Figure 1 shows growth rates in

total real GDP compared to growth rates in total real services GDP, where services GDP includes both non-government and government services. The strong positive correlation ($r = 0.88$) is consistent with observations in other studies, and reflects what might be called the standard empirical relationship. By contrast, Figure 2 presents a weak negative correlation ($r = -0.24$) between the size of the total service sector, measured by the share of real service GDP in total real GDP, which would be consistent with concerns that a larger service sector tends to lower aggregate productivity growth. To put the point another way, it is not structure, but structural change, that contributes to the overall growth rate. In that case both the growth in the service sector and its size relative to the rest of the economy are important to the growth process. The models we use to examine the contribution of restructuring to growth attempt to address both these aspects of the growth process.

The data in Figures 1 and 2 provide part of the picture. A more detailed set of descriptive statistics and additional graphics are presented and discussed in section III below. These additional configurations of the data permit an examination of the contributions of the non-government service sector and the government sector, respectively, to aggregate productivity growth. We have also constructed four panels of data covering sub periods of the overall 1970-1996 period. The panel data permit an examination of questions of simultaneity bias and country specific effects in the estimation of growth rates raised by Dowrick's (1996) and others. The next section sets out the sector growth models used to examine the impacts of restructuring on productivity and income growth. A discussion of the data, sector definitions and time periods used in the empirical estimates follows. Subsequent sections report and discuss the main findings of this study.

II: THE MODELS

Our primary interest is to examine and evaluate the impacts of economic restructuring, arising from differences in sector growth rates, on productivity growth and growth in real GDP. The data for industrial countries illustrate that the most striking aspect of this restructuring has been the very high rates of growth in service sector employment and output, compared to employment and output growth rates in the goods producing sectors. The result has been a decline in the share of output and employment in the goods producing sectors of the industrial economies. This decline is of course reflected in the rise in the shares of employment and output originating in the service producing sectors, both non-government and government. We examine this restructuring within a modified growth accounting framework that has its origins in Feder (1983), but has been subsequently extended and refined in a wide range of studies, including many of those cited above. This approach is of interest because it offers an empirical estimate of the overall impact of restructuring on growth by separating the contributions to growth arising from increased factor inputs from those arising from the efficiency gains and externalities derived from restructuring.

We start with a growth accounting approach which is of interest in its own right and provides a basis for the development of extended specifications. The basic argument is that growth in the service sector of the economy, defined in different ways in our later experiments, has the

potential to contribute to growth in aggregate real GDP in at least two ways. Assuming no idle resources, growth in the service sector will enhance real GDP and growth to the extent that inputs to production have higher marginal productivities in service production (the expanding sector) than in alternative employment. This would be an efficiency gain from restructuring inputs and outputs. Furthermore, service sector outputs (expanding sector outputs) used as inputs to the production of goods may contribute to the efficiency of goods sector production through an externality effect. A positive externality might be generated by improvements in the availability, quality, and cost of service sector inputs to goods production when these inputs are obtained from specialized suppliers rather than produced "in house". For example, improved and increased information flows, communications facilities, financial service capacity, transportation facilities and general social overhead and infrastructure flowing from a growing public and private service sector may impact positively on goods sector output and productivity. Alternatively, in the absence of growth in its relative size, a stagnant service sector might have lower productivity and productivity growth than the goods producing sector, and might be a source of inefficiencies and negative externalities which depress aggregate economic growth.

To examine these possibilities consider first an economy with two producing sectors, one producing goods (G) and the other producing services (S). Real GDP is then:

$$(1) \quad Y = G + S, \text{ where}$$

$$(2) \quad G = G(K_G, L_G, S),$$

$$(3) \quad S = S(K_S, L_S),$$

$$(4a) \quad K = (K_G + K_S), \text{ and}$$

$$(4b) \quad L = (L_G + L_S).$$

K and L are capital stock and labour inputs respectively. Service sector output, S, is an input to goods sector production to capture the externality effect of increased service sector output on goods sector production and on GDP growth.

Including efficiency effects from the resource re allocations arising from the restructuring of production and inputs can be accomplished in several different ways. Feder (1983) and Dowrick (1996) both assume, at least initially that marginal productivities for both factor inputs differ between sectors by a factor δ , such that

$$(5) \quad S_K/G_K = S_L/G_L = 1 + \delta.$$

The sign of δ indicates which of the two sectors has the higher marginal productivity and thus the direction of factor re-allocation that would increase Y through efficiency gains, in the absence of externalities.

The production functions (2) and (3) along with (4) and (5), using the assumption that the marginal productivity of labour in goods production $G_L = \beta(Y/L)$, can be manipulated to derive the following approximation of the growth of real GDP:

$$(6) \quad \dot{Y} = \alpha(I/Y) + \beta \dot{L} + \left[\frac{\delta}{1+\delta} \right] \dot{S}(S/Y)$$

In this equation α is the marginal product of capital in the goods sector, G_K , and β is the impact of employment growth on GDP growth. More importantly the parameter $[\{\delta/(1+\delta)\} + G_S]$ gives the total effect of service sector growth, \dot{S} on \dot{Y} . However, this specification does not separate this total effect into its component efficiency and externality effects, an extension considered in more detail below.

First, a criticism of this specification arising from Sheehey (1993), is that it ignores the possibility of cross-sectoral externalities. Goods sector outputs might be treated as inputs to service sector output, in an intermediate input sense rather than a capital sense, just as service sector outputs are treated as intermediate inputs to goods sector production in (2). While this is intuitively a more challenging view of the production of services, it is not inconsistent with the value added to goods in the food services or restaurant industry, in electronic equipment service and repair industry, and perhaps more broadly in the retail trade industry. The potential for such cross externalities has been examined in Curtis and Murthy (1999), with positive results.

Cross-sector externalities can be introduced through a simple modification of the production functions underlying (6). As before, let real GDP (Y) include output from two sectors namely goods and services, but amend the service sector production function to include the possibility that goods are intermediate inputs to services production. These intermediate inputs of goods are additional to the capital inputs to services. Accordingly we amend (3) above to give:

$$(3a) \quad S = S(K_S, L_S, G).$$

Then using (2), (3a) and assumption (5) yields:

$$(7) \quad \dot{Y} = \alpha(I/Y) + \beta \dot{L} + \left[\frac{\delta}{1+\delta} \right] \dot{S}(S/Y) + \left[\frac{S_G}{1+\delta} \right] \dot{G}(G/Y)$$

which allows contributions to total real GDP growth from efficiency gains and externalities in both sectors. As with (6), this equation measures total effects of restructuring without separation of efficiency gains and externalities. These effects might be positive in both cases through externalities although clearly both sectors cannot contribute to efficiency gains based on factor marginal productivity differentials between sectors.

The patterns of restructuring observed in the OECD, and in most other countries, is a growth in service sector employment and output relative to goods sector employment and output. As a result the service sector share of total output and total employment has increased substantially through a process of unbalanced growth while the goods sector has experienced a corresponding relative decline. Our primary concern in this study is to examine in more detail the relationship between this unbalanced growth, or restructuring toward services, and the rate of growth of aggregate real GDP. As a result we return to the initial production functions (2) and (3) and consider modified assumptions about productivity differentials that permit separate identification of efficiency gains and externalities in the growth process.

First consider the case in which the marginal productivity of capital is the same in both sectors of the economy:

$$(8) \quad G_K = S_K ,$$

but marginal productivities of labour differ by ϵ , such that:

$$(9) \quad S_L/G_L = 1+\epsilon ,$$

and G_L the marginal productivity of labour in goods production is related to average labour productivity, as before, $G_L = \beta(Y/L)$. It might be argued that this is a more realistic approach to factor marginal productivity differentials for industrial countries with well developed and integrated capital markets. Then the following approximation for the growth of real GDP is the result of replacing (5) with (8) and (9), and using the service sector production as defined initially by (3):

$$(10) \quad \dot{Y} = \alpha(I/Y) + \beta\dot{L} + \epsilon\beta \dot{L}_S (L_S/L) + G_S \dot{S}(S/Y)$$

The composite parameter $\epsilon\beta$ provides a measure of the efficiency gains or losses resulting from the re-allocation of labour from the goods producing sector to the services producing sector, based on differences in marginal labour productivities between sectors. G_S measures the externality effect of service sector growth, operating through goods sector production, on growth in aggregate real GDP. This approach is consistent with the concern that lower labour productivity in services production may prevail, and would depress aggregate productivity growth and real GDP growth if the service sector grew faster than the goods sector.

Second, as an alternative, consider the case in which marginal productivities of labour are linearly related to sector average labour productivity. For example, assume that:

$$(11) \quad G_L = \mu(G/L_G) \text{ and } S_L = \lambda(S/L_S),$$

which is consistent with a quasi-Cobb-Douglas production function. Once again this recognizes concerns about sector labour productivity differences. Then using production functions (2) and (3) along with assumptions (8), and (11) in place of (9), yields:

$$(12) \quad \dot{Y} = \alpha(I/Y) + \mu \dot{L}_G(G/Y) + \lambda \dot{L}_S(S/Y) + G_S \dot{S}(S/Y)$$

This specification provides an alternative way to separate the efficiency and externality effects of restructuring. The effects of sectoral employment growth are separated by sector and weighted by sector output shares, which permits inferences about the efficiency effects of employment restructuring. The externality effects remain separate as in equation (10). Dowrick and Gemmell (1991) have used this approach to sectoral productivity differentials in their examination of restructuring between agricultural and industrial sectors in the aggregate growth process.

These models account for efficiency gains and externalities arising from restructuring but they do not give explicit consideration to the role of technology and technological change as contributors to GDP growth. However, the restructuring process itself is a change in the technology of production, particularly in as much as it reflects an increase in sectoral specialization and inter-sectoral trade, characterized by the increased use of intermediate inputs by one sector that are produced in the other sector. Nonetheless, other studies following Dowrick and Nguyen (1989) have given explicit recognition to the trend in productivity growth, and particularly to the productivity growth arising from “catch-up” possibilities. To this end we return to the initial production functions and extend them to include explicitly a rate of technological progress. This is consistent with the extension to the model made by Dowrick (1996).

The production functions (2) and (3) now include a time dimension to allow for the introduction of an exogenous rate of technological progress, giving:

$$(2a) \quad G = G(K_G, L_G, S, t) \text{ and}$$

$$(3b) \quad S = S(K_S, L_S, t).$$

The emphasis on the separation of the efficiency and externality effects, and the underlying assumptions about factor marginal productivity differentials, is omitted as we return to (5) and concentrate on the total effects of restructuring. Then following Dowrick (1996), let the rate of technological progress in the goods sector of the economy be:

$$(13) \quad \pi^G = G_t / G = \theta \log(y/y^*) + \theta^t + \theta^i + v$$

where y is per worker real GDP, y^* is the per worker real GDP in the country with the highest per worker real GDP, and θ^t and θ^i are time and country specific components respectively. Further, assume that the rate of technological progress in the services sector is either above or below that in the goods sector such that:

$$(14) \quad \pi^S = (1 + \delta)(\Gamma + \pi^G).$$

If sectoral marginal productivities were equal, service sector technological progress would differ from that in the goods sector by a constant, which might be either positive or negative, namely Γ .

Combining (2a), (3b), (5), (13) and (14) yields the following approximation for growth in real GDP:

$$(15) \quad \dot{Y} = \left(1 - \frac{S}{Y}\right) \pi^G + \alpha \frac{I}{Y} + \beta \dot{L} + \left[\frac{\delta}{1 + \delta} + G_s \right] \dot{S} \frac{S}{Y} - \frac{\delta \pi^S S}{1 + \delta Y}$$

Real GDP growth is determined by technological progress in the goods producing sector weighted by the relative size of that sector, by the growth in factor inputs, and by the effects of restructuring based on service sector growth and size. The last two terms in this equation identify the effects of restructuring in terms of the combined efficiency and externality effect, adjusted for the effects that might result from the exogenous rate of technological change in the services sector, based on the size of the service sector but not its rate of growth. There appears to be a serious problem of endogeneity in (15) in that π^G is a function of y in (13). To address this problem we have used a simple two stage method of estimation in the following section. First we estimate (13) by OLS and use the $\hat{\pi}^G$ obtained there in the estimation of (15). As a background to the later estimations of equations (6), (10), (12) and (15), the next section examines the data.

III. THE DATA, SECTOR DEFINITIONS AND VARIABLES:

Our focus is on growth and structural change in the nineteen OECD countries for which data are available on a consistent basis from 1970-1996 in OECD publications, with the exception of a very few years in the case of some countries¹. Initially, we have followed established practice in our definitions of the sectors of the economy, using the International Standard Industrial Classification of economic activity adopted by the United Nations in 1986. The OECD reports national accounts production and employment data according to this classification system. Within this framework we define the “goods producing sector” to include: primary production, manufacturing, utilities, and construction. The “service producing sector” includes the remaining activities namely: trade, transport and communications, finance, insurance, real estate and business services, community social and personal services, and government services. Our first examinations of the role of restructuring are based on this broad definition of the goods-services structure of the economy. It provides a base line examination using the sector definitions common to most previous work.

¹The countries are: Canada, the United States, Japan, Austria, Australia, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, the United Kingdom.

Subsequently, to consider issues raised in other studies about the contributions of private services versus government services, we re-define the services producing sector. First we include in services only non-government services, and second we define a service sector that includes only government services. The “goods” sector changes accordingly to include government services in the first case, and all non-government services in the second case. This gives us three patterns of restructuring which permit separate consideration of the roles of total, non- government, and government services in the growth experience of the aggregate economy. Annual data for aggregate real GDP (Y), and the alternative definitions of sector real GDP ($S_T, G_T; S_{NGV}, G_{T+GV};$ and S_{GV}, G_{T+NG}), gross fixed capital formation (I), total employment (L) and sector employment (L_S, L_G and variations), are from OECD *National Accounts: Volume II* and OECD *Labour Force Statistics* [OECD, various years].

Because our interest is in the longer term growth patterns we have followed the practice established in other studies and compounded annual growth rates over sub-periods of the 1970-1996 sample period. Rather than use simple five year periods for the calculation of these growth rates, after inspecting the data and cyclical patterns they suggest we have defined four sub-periods which run approximately from cyclical peak to cyclical peak. The sub-periods are: 1970-1976, 1977-1982, 1983-89 and 1990-1996. Growth rates for each country in each sample period were calculated by ordinary least squares estimation, using a time variable. These sub-period growth rates and values are used in two ways. First they provide a basis for constructing four panels of data for each of the countries in the sample. Then pooling these data gives a total of 73 observations for use in empirical estimates of the impact of structural change on productivity growth².

Table 1 provides some descriptive statistics on the basic growth and structural change data for each panel of data and for the pooled data. Growth rates and standard deviations in those growth rates are for outputs and employment are in the upper part of the table. Measures of structure in terms of sector shares of employment and output, standard deviations and coefficients of variation are in the lower part of the table. Several observations warrant particular mention.

In general terms the growth in total real GDP reflects a persistent unbalanced growth pattern in the countries in this sample. Service sector output growth rates are consistently higher and more stable than goods sector output growth rates, although the overall trend in growth rates is declining across the sample period. This declining trend is particularly strong in the growth rates of government services which by the last sub period are lower than the growth rates in the goods and the total services sector, although the variation across countries in the sample has increased. Growth rates for employment by sector show the same patterns, although the negative growth rates in goods sector employment are of particular note, implying strong labour productivity growth in that sector. As with output, growth in government sector employment declined over the period. In summary, the growth rate differentials describe a situation in which the

² The first sub period includes only sixteen of the nineteen countries in the sample. Data for Netherlands, New Zealand and Portugal are not available

commercial or non-governmental service sector of the economy is growing more rapidly and persistently than the other sectors in terms of output and more emphatically in terms of employment. The sector growth rate differentials suggest a clear pattern of restructuring toward the services producing sectors.

The effects of this restructuring are illustrated by the statistics in the lower part of Table 1. While the average shares of services in output and employment increase over time, the declining coefficients of variation indicate a process of structural convergence across the sample. Countries with relatively smaller service sectors in the first sub period experienced higher service sector output and employment growth than did those with initially larger service sectors. Thus the increases in the average service sector shares of employment and output were more a result of reduced differences in structure across countries than a process of generalized service sector expansion. As noted earlier, this structural convergence plays an important part in the explanation of productivity convergence offered by Bernard and Jones (1996). The implication for growth is that countries that are catching up in terms of structure, which means restructuring toward services, will experience higher rates of growth in real GDP based on higher productivity growth resulting in productivity catch-up.

However, the opposite pattern is evident in terms of the relative size government sector. Coefficients of variation show a divergence of structure across the sample and over time. In addition, the size of government has declined when measured in terms of output share but increased in terms of employment share. The implications of this observations for output and productivity growth are unclear and reflective of the differences of opinion about the effects of government sector size and growth on productivity growth as noted by Dowrick (1996). The difference between the structural convergence observed with respect to the total service sector, and the divergence observed with respect to the government sector underlies the sectoral disaggregations we use in our empirical estimations.

The empirical relationships between economic structure and economic growth, and the questions raised by these relationships, are evident in a preliminary graphical examination of the data. Figures 1 through 8 present the growth data based on the different definitions of structure we use in subsequent estimations. Two dimensions of the relationships are clearly evident from these plots. The first is the relationship between sector growth rates and growth rates in aggregate real GDP. Based on Figures 1, 3, and 5 there is a strong positive correlation between the rate of growth of the service producing sector and the rate of growth of aggregate real GDP. Different definitions of the services producing sector as total services in Figure 1, non-government services in Figure 3 or government services only in Figure 5, produce somewhat weaker correlations for more narrowly defined services, but the positive relationship is clear in all cases. Figure 7 presents a slightly different perspective. It illustrates the relationship between the growth rates of the government sector and the growth rates of real non-government GDP, thereby removing the direct impact of the government services sector, as a component of aggregate GDP, on total GDP growth. In this case the correlation between service sector growth and growth in the rest of the economy, although positive is much weaker. Nonetheless, across the different definitions of the

services sector there is a positive relationship between growth in the services sector real GDP and growth in aggregate real GDP. These observations on the service sector and the aggregate economy in the OECD countries, 1970-1996 are consistent with the observations in previous studies for different samples, different sectors and different time periods.

The second dimension of the relationship between structure and growth is illustrated in Figures 2, 4, 6 and 8. These illustrations consider the relationship between the size of the service producing sector, measured by its share in a aggregate GDP, and the rate of growth of aggregate GDP. In these cases there is a non-existent or very weak negative correlation between the size of the service sector, by various definitions, and the rate of growth of GDP. Again, the strength of this relationship declines as the definition of the service sector is narrowed. In general, these observations offer some support for the concerns raised by those who are pessimistic about the growth of the service economy and the prospects for future GDP growth rates. But there is little support from these data as they are presented in Figure 8 for the argument that a large government services sector significantly depresses economic growth rates.

These graphics are of course only a preliminary consideration of the data. They provide a basis for an econometric evaluation of the contributions that the restructuring of economic activity across different sectors of the economy makes to growth in aggregate productivity and real GDP. The next section presents and discusses the econometric results.

IV: EMPIRICAL RESULTS

Estimates of the impacts of restructuring based on the equations derived above are presented in a set of tables. The presentation is organized, in the left hand column, in terms of the parameters that measure investment, employment and service sector output effects on GDP growth, plus the dummy variables used to allow for different underlying conditions in the sub-periods. Tables 2, 3 and 4 present results from estimations of equations (6), (10) and (12) respectively. In each case these tables report the estimated effect of the size and growth in the (a) total service sector, (b) the non-government service sector and (c) the government service sector on growth in aggregate real GDP. Results for the different equations provide additional detail on the efficiency and externality effects of restructuring. Table 5 presents results for equation (15). As noted previously, this specification includes explicitly the estimates of the contributions made to aggregate productivity growth by the catch-up, country specific and time period effects derived from equation (13). Consequently equation (15) puts the focus more narrowly on the effects of restructuring on the growth in real GDP that is not explained by growth in factor inputs and productivity growth related to catch-up and country specific circumstances.

Our primary interest is an evaluation of the effects of restructuring on productivity growth and real GDP growth. The estimates reported in Table 2 provide the first illustrations of the importance of restructuring to the explanation of variations in growth rates of this sample of OECD countries. Measured in terms of total effect, the shift in economic activity toward the service producing sector in the process of growth has had a strong positive impact on real GDP growth rates. Moreover, the results based on different definitions of the services producing

sector, as illustrated by a comparison of columns (a), (b) and (c) in the table, suggest that the growth in the non-government or commercial services sector was the source of the positive impact of restructuring on growth. It is of note that the growth in the government services sector alone, or restructuring that involves an expansion of the government sector, did not have a significant effect on growth in real GDP. These results based on a different sample of countries and different time periods confirm and extend the results of the previous study reported by Murthy and Curtis (1999). The impact of commercial restructuring on growth and productivity is robust based on a larger sample, a longer and more specific definitions of structure. On the other hand the concerns about the effects of growth in the government sector on growth are not allayed by our preliminary results. Thus the pattern of restructuring appears to be important to the growth process. It is the growing non-government service sector makes a significant positive contribution to productivity growth and aggregate GDP growth, perhaps based on the opportunities inter-sector trade in intermediate service inputs that it generates and exploits. A more detailed examination of that contribution is provided by the results in the next tables.

Tables 3 and 4 report estimates of the effects of restructuring based on equations (10) and (12). These specifications provide a separation of the efficiency and externality components of the total restructuring effects reported in Table 2 based on equation (6). From this perspective, the total contributions of restructuring to growth reported in Table 2 reflect positive and significant externality effects of service sector growth for all definitions of the service sector and for both specifications. But the estimates do not reveal any significant efficiency gains from the growth in service sector employment. Indeed, based on equation (10), (column (c) in Table 3), there is support for the argument that growth in government sector employment has a negative effect on aggregate productivity. Considered in terms of the results in Table 2 the negative effect of government sector employment growth may overshadow the positive externality derived from the increased provision of government services. In general the dis-aggregation of the restructuring effect into efficiency and externality components gives estimates of strong significant positive externalities but no significant efficiency gains or losses. In other words, the strong positive effects of restructuring flow from the gains associated with the reorganization of production based on sector specialization and inter-sectoral trade as described above.

Table 5 reports estimates of the effects of restructuring based on equation (15). This specification responds to the possibility that the effects of restructuring estimated by the preceding specifications attribute all the increase in aggregate productivity to restructuring, regardless of source. Two important additional sources of variations in productivity growth identified in earlier work are catch-up effects and country specific effects, that are potentially unrelated to economic structure. Furthermore it is common practice to identify an exogenous time trend in productivity growth. We used a two stage approach to the estimation of the parameters reported in Table 5 for equation (15). First we derived estimates of $\hat{\pi}^G$, the growth rates of goods sector productivity based on technological progress, catch-up, time and country factors in terms of equation (13). Then we estimated the restructuring effects in equation (15), and reported in Table 5, based on residual growth rates in real GDP after adjustment for sector weighted $\hat{\pi}^G$, the estimated productivity growth arising from other sources. The results

reported in the table confirm that although catch-up factors and country specific factors explain part of the observed growth in productivity in OECD countries, there are additional strong positive effects on aggregate productivity growth and real GDP growth from the restructuring produced by higher rates of service sector growth. Moreover restructuring based on output growth in the both government and non-government parts of the service sector of the economy were an important part of the growth experience in OECD countries, although the restructuring of employment did not appear to contribute to growth.

V: SUMMARY AND CONCLUSIONS

We have examined the impact of the size and the growth the services sectors on growth rates of real GDP of nineteen OECD countries over the period 1970-1996. This work extends previous studies of this relationship in several ways. The number of countries and the time periods covered by the analysis have been extended to allow an evaluation of the restructuring process based on a larger sample of countries with a wider variety of experiences extending over a longer time period. We have explored the possibility that the different parts of the services sector contribute differently to the growth process by dis-aggregating the total services sector into a commercial or non-governmental services sector and a government services sector. This allowed separate estimations of the effects of growth in these different service sub-sectors on productivity growth and growth in real GDP. Using different assumptions about sector differentials in factor productivity, we have derived and estimated models that provide separate estimates of the effects restructuring arising from the efficiency gains or losses caused by factor re-allocations and externalities based on growing sector specialization and inter-sectoral trade. Finally, we have extended our model to give explicit consideration to catch-up, country specific and time specific factors. This addresses the concern that restructuring effects, in the absence of such adjustments, may simply capture all sources of total factor productivity growth.

The results confirm that productivity growth and growth in real GDP in OECD countries in the 1970-1996 period were significantly and positively affected by the shift in the structure of these economies produced by faster growing service sectors. The restructuring patterns observed produced a convergence in structure to one with a larger service sector, particularly when measured by the share of non-governmental services in GDP. We find the total impact of this pattern of restructuring is large and robust for the total service sector, and for non-government service sector, with and without explicit consideration of other exogenous sources of productivity change. However, the evidence on the total effects of the growth and size of the government services sector is not as clear. Without consideration of other exogenous factors, the government services sector and its growth did not appear to exert a significant total effect on productivity growth. Alternatively, isolating the effects of other factors uncovers a significant positive impact of government sector size and growth on aggregate growth. Some insights into the possible sources of these ambiguities in the results for government services emerged in our experiments which separated and estimated efficiency and externality effects of restructuring.

Externality effects which would arise from changes in the structure of production are the

important contribution made to GDP growth by restructuring. Growth in service sector output, in aggregate, or in terms of non-government and government services sub-sectors had large, positive and significant effects on productivity and hence on growth in real GDP. By contrast, the restructuring of employment arising from faster growth in service sector employment than in other employment did not have a significant effect, either positive or negative on the growth of real GDP, with one exception. When the service sector was narrowly defined as government services only, growth in employment in government services did have a negative impact on GDP growth rate that was significant. Such a result is consistent with the usual national accounts practice of measuring government sector output at cost and thereby assuming no factor productivity growth in that sector.

Experiments with an extended sample, with some dis-aggregation of the broad service sector and with models that include other sources of productivity growth have provided results that confirm the importance and robustness of the effects of restructuring on economic growth. Restructuring is a major contributor to total factor productivity growth, and as such will also play an important part in productivity convergence. Nonetheless it emerges that growth in service sector output rather than employment is the source of the positive externalities that contribute to growth. That raises a further question, namely: What are the prospects for productivity growth in the services sectors, and perhaps most importantly the services sectors that provide intermediate inputs to the production of GDP?

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Table 1: Descriptive Statistics: Output Growth, Employment Growth and Structure
Means, (Standard Deviations) and Coefficients of Variation

	1970-76	1977-82	1983-89	1990-96	1970-96
Sample (n):	16	19	19	19	73
Growth Rates (annual %):					
\dot{Y}	3.6 (1.0)	2.1 (1.2)	3.1 (0.9)	1.7 (1.1)	2.6 (1.3)
\dot{G}	3.0 (1.3)	1.8 (1.8)	3.0 (1.3)	1.2 (1.7)	2.2 (1.7)
\dot{S}	4.1 (1.3)	2.4 (1.3)	3.2 (0.9)	2.0 (1.2)	2.9 (1.4)
\dot{S}_{GV}	4.5 (1.6)	2.8 (1.3)	1.9 (1.4)	0.6 (1.8)	2.4 (2.0)
\dot{L}	1.2 (2.3)	0.6 (1.1)	1.3 (1.1)	-0.1 (1.5)	0.7 (1.6)
\dot{L}_{GT}	-1.0 (0.9)	-1.2 (1.5)	-0.3 (1.2)	-1.8 (1.9)	-1.1 (1.5)
\dot{L}_{ST}	2.2 (0.7)	1.9 (0.9)	2.5 (1.2)	0.9 (1.5)	1.9 (1.3)
\dot{L}_{GV}	3.4 (1.8)	2.0 (1.7)	1.7 (1.6)	0.1 (1.6)	1.7 (2.0)
Structure (ratios):					
L_S/L	0.521 (0.083)	0.565 (0.081)	0.609 (0.081)	0.653 (0.069)	0.589 (0.091)
coeff var	0.159	0.143	0.133	0.106	
L_{GV}/L	0.139 (0.062)	0.151 (0.076)	0.162 (0.082)	0.167 (0.087)	0.155 (0.077)
coeff var	0.446	0.503	0.506	0.521	
S/Y	0.640 (0.076)	0.649 (0.069)	0.652 (0.059)	0.664 (0.056)	0.652 (0.064)
coeff var	0.119	0.106	0.090	0.084	
S_{GV}/Y	0.145 (0.074)	0.146 (0.072)	0.142 (0.074)	0.138 (0.077)	0.143 (0.073)
coeff var	0.510	0.493	0.521	0.558	

Source: OECD *National Accounts, Vol II: Detailed Tables* and OECD *Labour Force Statistics*, various years.

Table 2: Estimates of the Impact of Service Sectors on GDP Growth: Equation (6):

$$\dot{Y} = \alpha(I/Y) + \beta\dot{L} + \left[\frac{\delta}{1+\delta} + G_s \right] \dot{S}(S/Y)$$

Services Defined:	(a) Total Services	(b) Non-Govt Services	(c) Govt Services
Depend Variable	\dot{Y}	\dot{Y}	\dot{Y}
Indep Variable (Parameter)			
I/Y	0.0397	0.0581	0.0863
(α)	(2.35)	(3.20)	(3.15)
\dot{L}	0.0218	0.0395	0.2062
(β)	(0.44)	(0.73)	(2.85)
$\dot{S}(S/Y)$	1.1566	1.1443	0.9737
[$\delta/(1+\delta) + G_s$]	(10.42)	(8.75)	(1.64)
Intercept	0.0064	-0.0091	-0.0010
	(1.82)	(2.34)	(0.18)
D₁	0.00252	0.0080	0.0090
	(1.10)	(3.30)	(2.26)
D₂	0.0012	0.0044	-0.0008
	(.065)	(2.12)	(0.25)
D₃	0.00483	0.00649	0.0088
	(2.42)	(2.96)	(2.75)
Adj R²	0.800	0.755	0.491

Table 3: Estimates of the Impact of Service Sectors on GDP Growth: Equation (10):

$$\dot{Y} = \alpha(I/Y) + \beta\dot{L} + \varepsilon\beta\dot{L}_S(L_S/L) + G_S\dot{S}(S/Y)$$

Services Defined:	(a) Total Services	(b) Non-Govt Services	(c) Govt Services
Depend Variable	\dot{Y}	\dot{Y}	\dot{Y}
Indep Variable (Parameter)			
I/Y (α)	0.0393 (2.30)	0.0522 (2.76)	0.0895 (3.31)
\dot{L} (β)	0.0335 (0.52)	0.0714 (1.18)	0.2456 (3.29)
$\dot{L}_S(L_S/L)$ ($\varepsilon\beta$)	-0.0400 (0.28)	-0.1600 (1.14)	-0.7156 (1.75)
$\dot{S}(S/Y)$ (G_S)	1.1650 (10.07)	1.2063 (8.54)	1.6550 (2.36)
Intercept	-0.0062 (1.71)	-0.0077 (1.89)	-0.0022 (0.37)
D₁	-0.0025 (1.09)	0.0073 (3.05)	0.0088 (2.23)
D₂	0.0013 (0.69)	0.0045 (2.19)	-0.0005 (0.15)
D₃	0.0050 (2.39)	0.0068 (3.09)	0.0089 (2.83)
Adjusted R²	0.797	0.756	0.506

Table 4: Estimates of the Impact of Service Sectors on GDP Growth: Equation (12):

$$\dot{Y} = \alpha(I/Y) + \mu \dot{L}_G(G/Y) + \lambda \dot{L}_S(S/Y) + G_S \dot{S}(S/Y)$$

Services Defined:	(a) Total Services	(b) Non-Govt Services	(c) Govt Services
Depend Variable	\dot{Y}	\dot{Y}	\dot{Y}
Indep Variable (Parameter)			
I/Y (α)	0.0431 (2.56)	0.0531 (2.97)	0.0830 (3.48)
$\dot{L}_G(G/Y)$ (μ)	0.2837 (1.75)	0.3948 (2.66)	0.4445 (5.44)
$\dot{L}_S(S/Y)$ (λ)	-0.0862 (0.72)	-0.0924 (0.84)	0.2651 (0.52)
$\dot{S}(S/Y)$ (G_S)	1.0642 (8.30)	1.0380 (7.13)	1.3092 (2.08)
Intercept	-0.0035 (0.91)	-0.0040 (0.95)	-0.0002 (0.04)
D₁	0.0039 (1.66)	0.0073 (3.26)	0.0077 (2.19)
D₂	0.0016 (0.83)	0.0030 (1.43)	-0.00248 (0.83)
D₃	0.00525 (2.56)	0.0059 (2.72)	0.0050 (1.69)
Adj R²	0.805	0.774	0.604

Table 5: Estimates of the Impact of Service Sectors on GDP Growth: Equation (15):

$$(\dot{Y} - \lambda \hat{\pi}^G) = \alpha(I/Y) + \beta \dot{L} + \left[\frac{\delta}{I + \delta} + G_s \right] \dot{S}(S/Y) - \frac{\delta \pi^S S}{I + \delta Y}$$

Services Defined:	(a) Total Services	(b) Non-Govt Services	(c) Govt Services
Depend Variable	$(\dot{Y} - \lambda \hat{\pi}^G)$	$(\dot{Y} - \lambda \hat{\pi}^G)$	$(\dot{Y} - \lambda \hat{\pi}^G)$
Indep Variable (Parameter)			
I/Y (α)	0.0054 (0.37)	0.0069 (0.47)	-0.0987 (-2.68)
\dot{L} (β)	0.0281 (0.71)	0.0526 (1.26)	0.0647 (0.62)
$\dot{S}(S/Y)$ [$\delta/(I + \delta) + G_s$]	1.0463 (12.86)	1.0578 (11.13)	3.7796 (4.14)
S/Y [$\delta \pi^S / (I + \delta)$]	0.0113 (1.20)	0.0055 (0.70)	-0.0538 (1.14)
Intercept	-0.0100 (1.28)	-0.0058 (1.05)	0.0191 (1.88)
Adj R²	0.782	0.723	0.238

FIG 1: GROWTH TOTAL GDP & SERVICE GDP

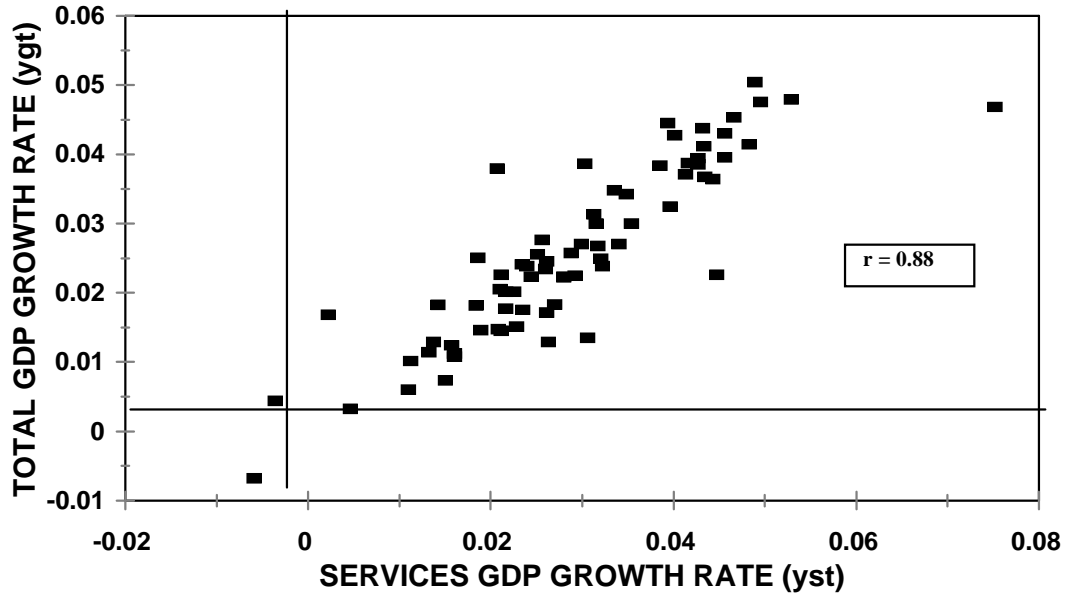


FIG 2: GDP GROWTH & SERVICES SHARE

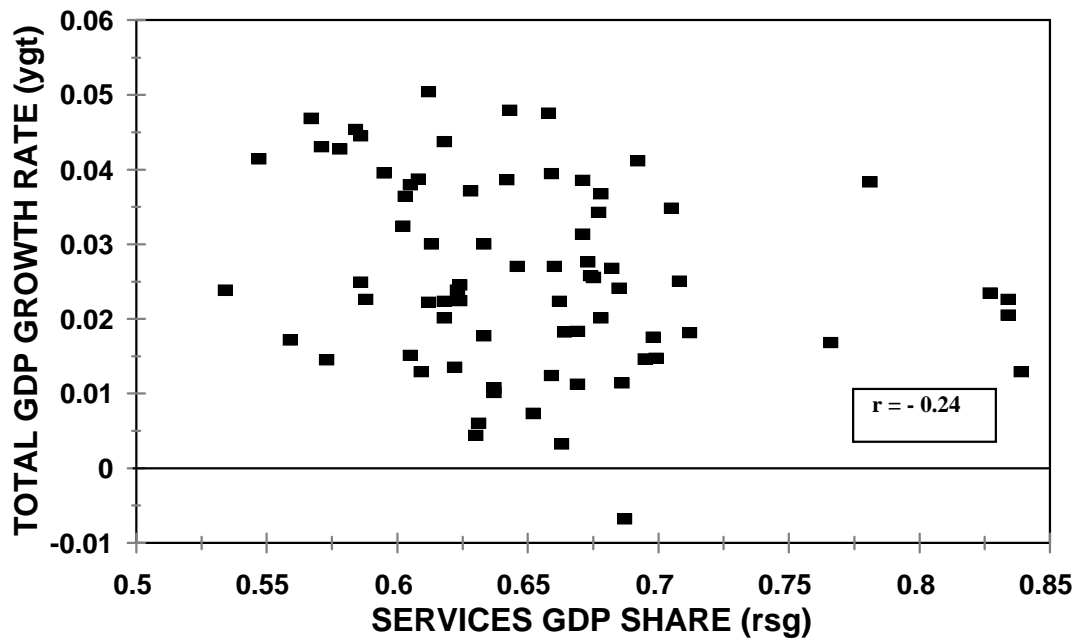


FIG 3: GROWTH GDP & NON GOVT SERVICES

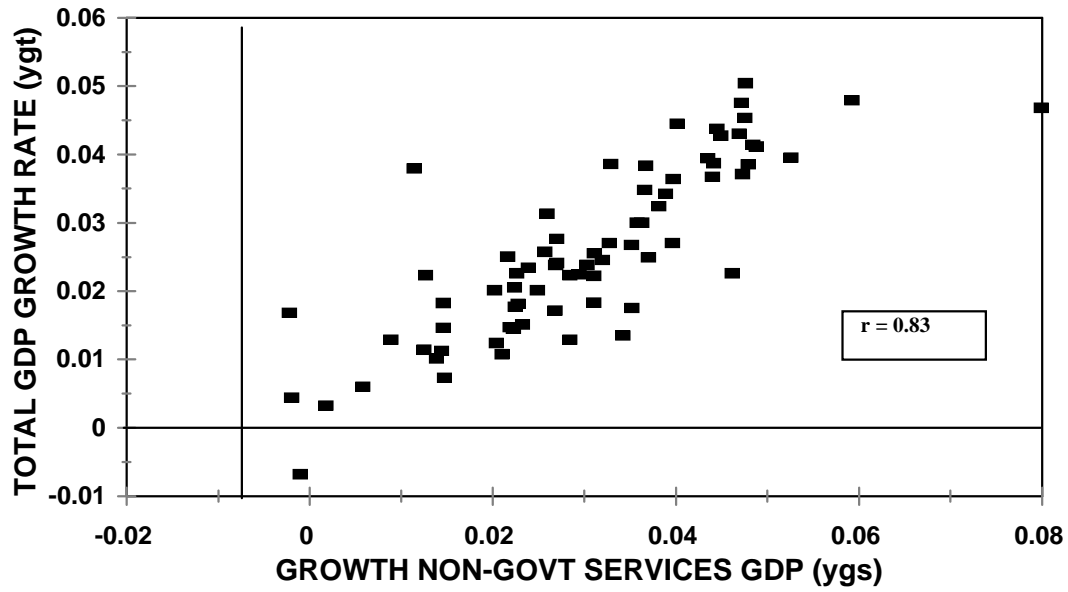


FIG 4: GDP GROW & NON GOVT SERV SHARE

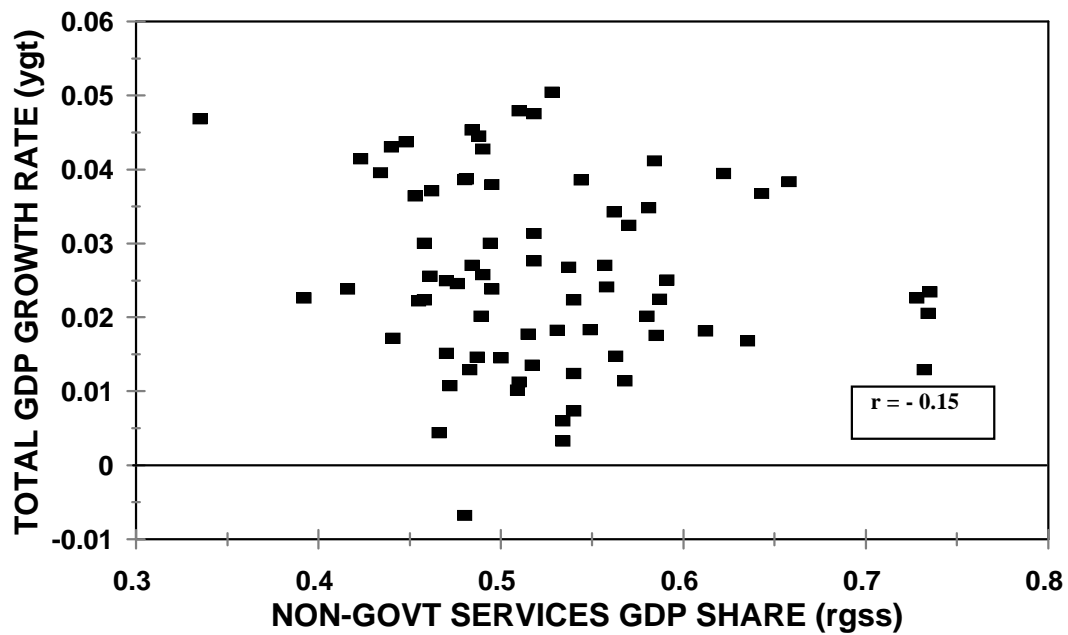


FIG 5: GROWTH TOTAL GDP VS GOVT GDP

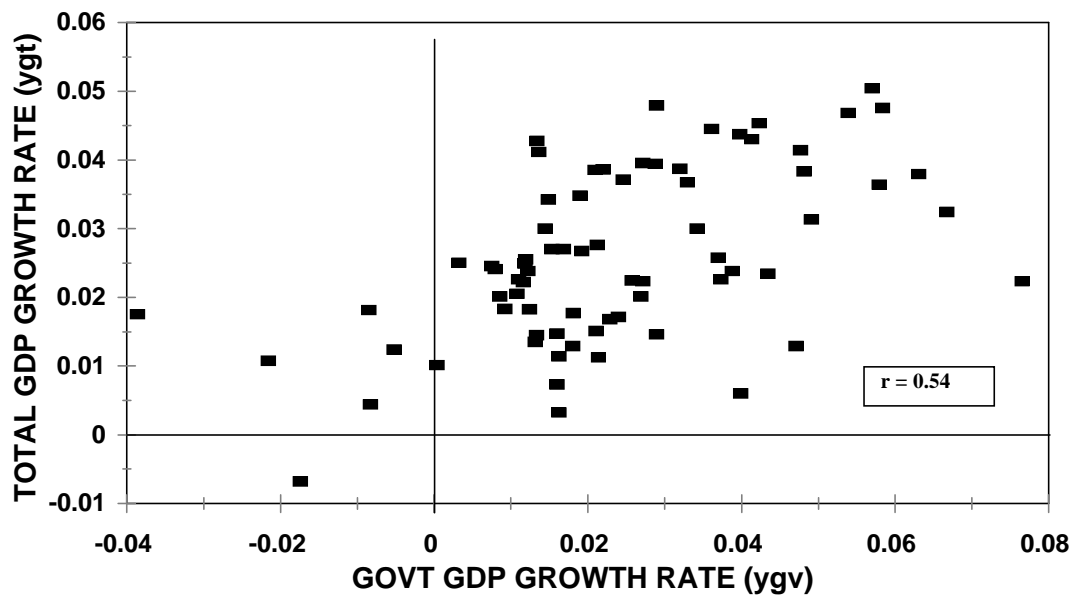


FIG 6: GDP GROWTH & GOVT GDP SHARE

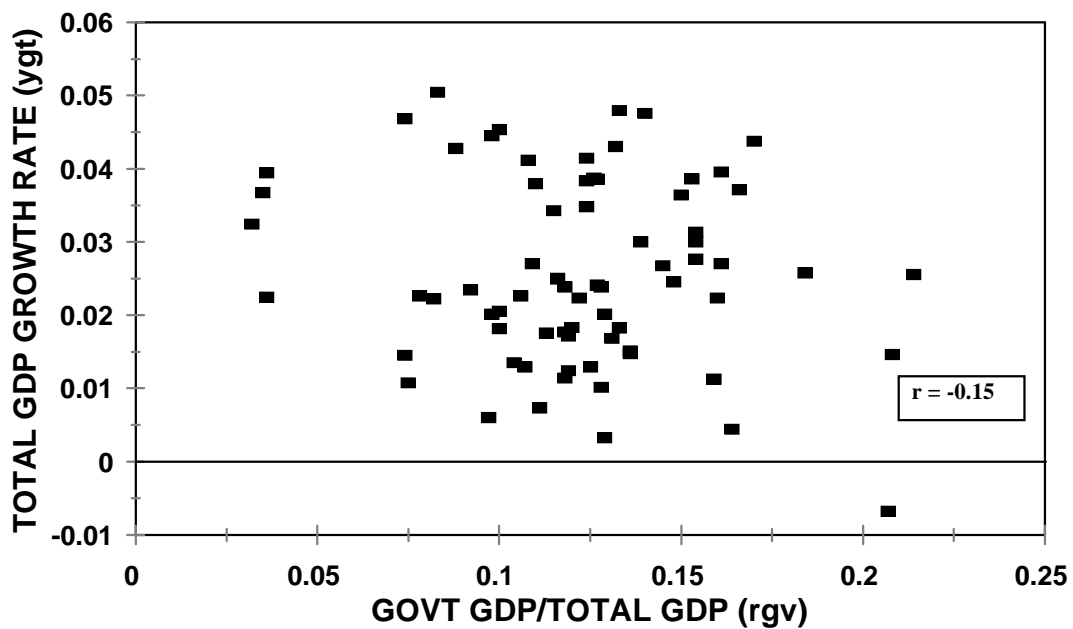


FIG 7: GROWTH NON GOVT GDP VS GOVT GDP

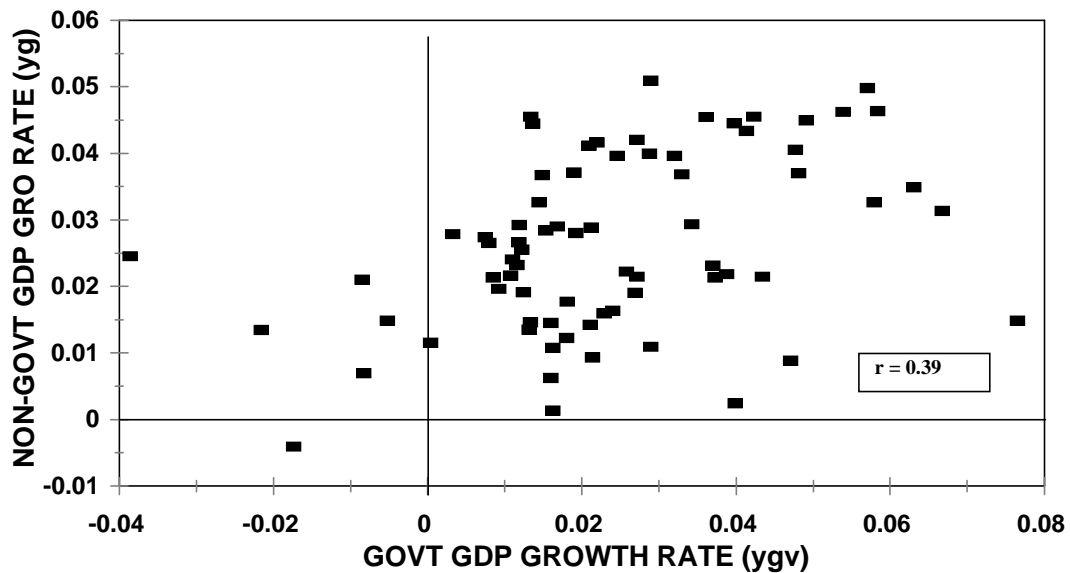


FIG 8: NON GOV GDP GROWTH & GOVT SHARE

