The Impact of Research and Development on Economic Growth And Productivity in the Tamilnadu states.

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ABSTRACT:

Research and innovation have been acknowledged as critical factors for fuelling long-term sustainable economic growth and, concomitantly, employment creation and poverty alleviation in developed and developing economies. However, the overwhelming majority of studies conducted on these critical factors have tended to focus on developed economies. The purpose of this study, therefore, was to undertake an empirical investigation of the importance of research and innovation for industrial and economic growth in the developing economies of Tamilnadu states. The significance of this study therefore derives from utilising empirical findings to influence policy on R&D in sub-Saharan developing countries. The study used the Cobb-Douglas production function and panel data from a selected number of states in Tamilnadu to assess the impact and correlation between research and innovation and economic growth. From our regression results, the estimated parameters of all the independent variables, with the exception of labour, are statistically significant at the 5 percent (or better) level of significance. The coefficients (elasticities) of lagged GDP, gross fixed capital formation (investment) and R&D are all positive and statistically significant. The size of the coefficients implies that a 1% increase in investment, increases economic growth by about 0.236%. Similarly our results show that a 1% increase in gross domestic expenditure on R&D will lead to an increase of about 0.326% in economic growth. The effects of R&D are dependent on the levels of human capital and development. States with more human capital have higher own- and other-R&D elasticities. States in the lowest tier of economic development have the least own-state R&D elasticity but the highest other-R&D elasticity. The study therefore adds to the debate among researchers on the impact of R&D in Tamilnadu states, therefore enriching the literature on the subject. In addition governments in these countries should increase support for R&D in the relevant institutions and industries.

Introduction

The importance of research and innovation (technological, product, process, organisational and marketing innovations) in achieving economic growth in developed countries has been firmly established by theoretical and empirical studies. The pioneering studies on this subject include Adam Smith (1776), Schumpeter (1934), and Solow (1957). Later studies firmly establishing a critical link between innovation and growth include Pelz and Andrews (1966); Allen (1970), Rothwell and Robertson (1973), Mansfield (1977),

Much empirical and theoretical work emphasizes that research and development (R&D) is an important contributor to economic growth. R&D spending is likely to lead to growth through its positive effect on innovation and total factor productivity (TFP) (Romer, 1990; Lucas, 1988). As Grossman and Helpman (1994) note, improvements in technology through industrial innovation have been the driving force behind the inexorably rising standards of living in the developed world over the long run. When a firm invests in R&D, it is expected that new ideas, intermediate goods, methods to reduce costs, and final consumer products will be developed, allowing the firm to become more efficient and profitable. In addition to the private benefits of R&D, there are positive spillovers within and among firms, industries, and geographic regions. Knowledge developed through R&D is non-rival, so that firms can benefit from the R&D investment of other firms, even when they are in different industries or regions (Arrow, 1962; Aghion and Howitt, 1992).

The great apparent heterogeneity among nations is due to at least four factors. Most importantly, the relationship between R&D and economic growth is a long-run relationship. As Griliches and Lichtenberg (1984) note, much of the short-run variation in output and TFP is caused by fluctuations in the level of capacity utilization in industry. The R&D stock is a determinant of the long-run trend component of TFP, but may have little to do with the short-run deviations from trend. Second, R&D spending is an investment in a durable good, knowledge. Thus, the stock of knowledge is the appropriate input to the production function, not merely current-year investment (Romer 1986, 1990). Third, knowledge generally cannot be contained within national borders, and firms in one country benefit from industrial knowledge produced by R&D performed abroad (Coe and Helpman, 1995). Finally, the general level of economic development in the country, as well as its institutions and even attitudes toward risk-taking and entrepreneurship can greatly affect the relationships between R&D, innovation, and growth.

There are four key features of our study. First, to our knowledge, ours is the first study that examines the impact of total private R&D on the aggregate economies of the Tamilnadu states. Our approach is similar to the one taken by Bronzini and Piselli (2006), who study the impact of R&D on productivity in Italy by regions. For our analysis, we build a panel dataset covering all states and the District of India for the period 1963-2007. Second, our analysis looks not only at the direct effect that private R&D spending has on output and productivity at the state level, but also quantifies the spill over effect of R&D across states. As Jaffe (1989) and Jaffe et al. (1993) note, a proper foundation for public policy requires knowledge of the social rates of return to R&D at different levels of geographic aggregation. Work such as that of Jaffe (1989) examining returns to research expenditure within a state understates the social returns (as the author acknowledges) since some of the returns flow to other states. In fact, we find the spill over effect across states to be sizeable.

The third key feature of our study is that we focus on R&D performed by industry, in contrast to many studies that include publicly performed R&D. Private sector R&D is expected to play a more direct role in promoting productivity and economic growth than research performed by universities or governmental institutions. We also focus the analysis on the impacts on private sector output and productivity. Fourth, we choose empirical methodology to assess the long run effects of R&D in the economy.

The paper is organized as follows. In Section II, we provide a literature review where we outline the theory and empirical work related to the links between R&D, output, and productivity. In Sections III and IV we discuss the data and methodology, respectively. Section V presents the results, and Section VI touches on policy implications for the Tamilnadu and developing countries and concludes.

Objectives of the study:

The main objective of this study is to analyse the impact of research and innovation on socio-economic development in developing countries in general, and in the selected countries in sub-Saharan African countries, in particular. The specific objectives are:

- To assess the link between research intensity and economic growth in Tamilnadu states.

- To draw policy conclusions from the findings.

Hypothesis of the study:

- It is hypothesised that states with higher R&D quantity (intensity) have higher economic growth rate (higher GDP) than those with lower R&D activities.

Literature Review

Falk (2007) developed a dynamic empirical model to know significance of R&D investment in long run economic growth of OECD countries using panel data set. The study provided a new evidence for R&D-economic growth relationship. The results were derived through GMM (generalized method of moments).The study investigated whether higher R&D investment push economic growth keeping investment ratio, industrial R&D intensity and human capital constant. Five yearly and ten yearly averages were used. Higher R&D investment was found positively related to GDP growth in working age populations. The results were robust in both 5-year and 10-year cases.

Goel, Payne, and Ram (2008) premeditated the trends in various components of R&D and its contribution to economic growth in USA by using disaggregated data of half century. Surprisingly, USA experienced decline in defense R&D outlays and federal R&D expenditure. The non-federal R&D funding expanded sharply during the period. Interestingly, the estimation showed strong association of economic growth to federal R&D expenditure rather than non-federal R&D outlays. The economic growth posed strong relationship to defense R&D instead of non-federal R&D. The study proposed substantial push up in defense R&D and non-federal R&D in USA for sustainable economic growth.

Solow’s (1956) neoclassical growth model, which treats productivity, capital accumulation, and population growth as the main sources of economic growth, has been modified by later authors to add R&D as a central determinant of growth. Griliches (1979) introduced the idea that productivity growth is the consequence of expenditures on R&D. In the endogenous growth model developed by Romer (1986), firms’ expenditure on R&D results in greater aggregate output because private R&D leads to spillovers through its contribution to the public stock of knowledge.3 R&D expenditures are central to economic growth because technological change is the result of conscious economic investment, and sustained growth would not be possible without the R&D spillovers (Griliches, 1992).

Empirical evidence on the impact of R&D

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Empirical evidence on the impact of R&D

Empirical studies on the impact of R&D can be classified based on the unit or level of analysis: the firm, industry, region, or country. Firm level analyses, beginning with the early work of Mansfield (1965) and Griliches (1980a) focus on the impact that a firm's R&D expenditure has on its own productivity.4 Some of these analyses also measure spillovers from one firm's R&D expenditure to other firms and industries. Analyses at the industry level (Griliches, 1973, 1980b) also look at how R&D in a specific industry leads to higher productivity in that industry and other industries as well. Empirical analyses at the regional (Bronzini and Piselli, 2006) or country (Griliches, 1964; Nadiri 1980a, 1980b) level study the impact that R&D expenditure has on productivity and growth on the specific region or country where R&D expenditure originates, and some studies also look for spillovers to other areas or countries. The present study follows the more recent vein of regional studies.

Methodology of the Study:

The Model We conducted this study on a number of Tamilnadu states are used annual data for the ten year period, 1997 – 2007. This time period and frequency was largely dictated by the availability of data on R&D. The basic model estimated on panel data for selected developing countries is a simple Cobb-Douglas production function and the sample period is 2000- 2007.

Where GDPit = the gross domestic product for country i in time t. Lit = Labour force for the states i in time t. Kit = Investment measured by gross fixed capital formation. RDit = R&D expenditure for country i in time t. Uit = error term. Equation (1) can be rewritten in logarithmic (linear) form as follows:

For the derivation of the empirical model we use to estimate the impact of R&D on output and productivity, we follow much of the empirical growth literature (e.g., Coe and Helpman, 1995; Bronzini and Piselli, 2006) and assume a production function with Hicks-neutral TFP:

Where i is a state index, and t is a year index. Y represents private sector output, L is private sector labour, K is the private sector physical capital stock; and TFP is Total Factor Productivity. TFP is driven by technological change, which in turn is driven by R&D investment, human capital accumulation, and other factors. Testing shows that a dynamic specification of the form ARDL(1,1,1,1,1,1) is appropriate.

For the PMG estimator we require the existence of a long run relationship between the dependent variable and the control variables. Thus, the error-correcting speed of adjustment term for the long run relationship, ϕ_i , must be between zero and -2. We also will consider Hausman tests of the PMG and Mean Group (MG) estimates to test whether the assumption of a common long-run relationship is appropriate. The MG estimator (Pesaran and Smith, 1995) fits the model separately for each group, and the Hausman test looks for evidence that the restriction $\theta_i = \theta \ \forall \ i$ is invalidated by heterogeneity in the long run estimates.

Data

The model was estimated using the Cobb-Douglas production function and panel data for a selected number of Tamilnadu states for the ten year period, 1997 - 2007. The main sources of data are the World Development Indicators (WDI) of the World Bank, UNESCO Institute of Statistics, and IMF's International Financial Statistics (IFS).

Findings of the study

In this section, we present the empirical results for the testing of the econometric models' assumptions, the estimates from the baseline estimations, and the results of additional regressions designed to check the validity and robustness of our conclusions.

Tests for Nonstationarity and Order of Integration

The DOLS estimator requires that all the variables be I(1), while the PMG estimator requires that the variables be I(1) or I(0), with the order of y no greater than the order of the regressors. To test these assumptions, in Table 4 we shows the results of two different unit roots tests for the variables included in our baseline model. There are many tests for panel unit roots available; we choose two that are appropriate for large N, large T asymptotic and allow unbalanced panels. The unit root test of I'm et al. (2003) has the null hypothesis that all panels are integrated and the alternative hypothesis that at least one panel is stationary.

Baseline Estimations:

The researchers begin with three DOLS specifications. The first two estimations, for SGDP and TFP, respectively, use the raw data without removing the time means. The third DOLS estimation in Table 6 is for SGDP and uses the time-demeaned data. Regardless of which DOLS estimation is considered, we find that there is evidence of a positive effect of R&D on SGDP in the long run from R&D performed in the state. The long-run own-elasticity for R&D varies from 0.013 to 0.061 among the estimations. These elasticities fall within the range of results for R&D own-elasticity estimates from country-level panel data studies cited in Hall et al. (2010). We defer interpreting the magnitudes of the elasticities until our preferred PMG estimation. The results for the impact from other-state R&D are mixed. In the first estimation, the other-elasticity is 0.050 and highly significant. The second estimate is about the same magnitude but insignificant. Recall that the dependent variable in this regression, TFP, may not be integrated within each state, which would lead to inconsistency in the DOLS estimates. The third estimate, from the time-demeaned data, is negative, a puzzling result. There are some other unexpected results that may indicate that the assumptions of the DOLS model are not satisfied.

Robustness Checking and Extensions:

In this section, the researcher explore whether the long run effect of R&D on SGDP is robust to alternative specifications and extensions. We use the PMG estimator with the dependent variable SGDP for all these additional regressions. The researcher begin with estimating the model without including the spillover effect of R&D, to demonstrate that our finding of a large own-R&D elasticity does not depend on the spatial assumptions employed in our construction of the otherR&D

stock. The results of the PMG estimation when RD_Other is omitted are in column 1 of Table 8. The estimated own-elasticity for R&D is larger (0.076 versus the estimate of 0.056 from the baseline estimation) when we do not include other states' R&D stock. This finding is in accord with the literature, where it is emphasized that it is important to include the spillover effect when looking at the impact of R&D.

Conclusion of the study:

Using World Bank (World Development Indicators), UNESCO, and International Financial Statistics (IFS) data, this paper has assessed empirically, the link between R&D (and other variables) and economic growth for the Tamilnadu states for the period 1997 to 2007. Within the group of Indian countries, R&D expenditure and economic growth are found to be significantly correlated. Our investigation of the relationship between investment in R&D capital and productivity allows us to draw the following conclusions. First, we observe in nearly all of the many specifications estimated that R&D performed within a state has a positive, significant effect on SGDP through TFP in the long run. The finding of a positive impact of R&D on SGDP is robust to the inclusion or exclusion of other-state R&D, to allowing the elasticity to change over time, and to the lag length chosen for R&D.

Our findings have policy implications for the India and for developing countries. Many authors have long argued that the difficulties in appropriating the fruits of knowledge production gives the government a role in promoting R&D to improve social welfare (Nelson, 1959; Arrow, 1962). Note that we cannot conclude from our research alone that the private incentives to perform R&D are deficient, due to the fact that most companies that perform R&D operate in multiple states (and, indeed, multiple countries).

For further research, as more statistics become available on R&D funding by sub-national public sources, it would be interesting to explore whether privately funded R&D has different productivity effects than publicly funded R&D. Even setting aside the question of whether publicly funded R&D crowds out privately funded R&D, many studies find the returns to publicly funded R&D to be lower than returns to privately funded R&D (Griliches, 1980a, b; see Hall et al. (2011) for others).

The researcher therefore advocates that governments in these countries should increase support for R&D in the relevant institutions and industries.

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