Abstract

Wagner’s hypothesis, posits a direct relationship between economic development and the size of government activities. The paper develops a re-statement of Wagner’s Law about the relationship between economic development and the role and size of government. Such a re-statement is made possible by Biehl’s new translation of Wagner’s economic writing. That translation makes it possible to retrieve a version of Wagner’s Law that builds on earlier versions. The current paper suggests that Wagner’s Law can best be represented by a sigmoid function. After presenting the case for this restatement, the paper develops this into a testable model using a sample of short time series drawn from many countries. Outcomes of the empirical analysis are consistent with the Wagner hypothesis and indicate a natural limit to the share of government in capitalist economies.

Keywords: Wagner’s Law, Economic Development, Government Activity, Sigmoid function, Industrialisation.

1 PMU Research and Conference Support is highly appreciated to complete this research.
1. INTRODUCTION

“Over the last three decades, in all industrialized countries there has been an enormous expansion of government involvement in the economy, as measured by the share of national income going to taxes or government expenditures” (Slemrod, 1995: 373)

While discussing the many conceptual and empirical difficulties in studying the relationships between government and economic growth at an international level, Joel Slemrod reminds us that a century after Wagner speculated about the link between economic growth and government activity, there still seems to be some casual empirical relationship between the two. The question remains however, whether something more systematic can be distinguished from this casual relationship. Debate about the role and size of government has been an enduring one in political and economic sciences. The problems and dilemmas that have characterised this debate continue to be imposing, as for instance (Prezeworski, 2004) in politics, and (Arrow, 2004) in economics.

Within economics, however, Wagner’s hypothesis, which posits a direct relationship between economic development and the size of government activities, offers one longstanding path into the issue. Observing a similar pattern of economic development and government growth amongst industrialising countries in the late nineteenth century, Wagner suggested that the relationship was not accidental, and that there were structural reasons why economic development stimulated the growth of government activity. A problem here however, immediately confronts researchers. Debate over Wagner’s Law has produced several interpretations and testing these has in turn produced mixed results. Indeed, in the 1980’s and early 1990’s, making use of new advances in empirical economics, research into Wagner’s hypothesis underwent an exciting new phase of testing. But in the absence of a settled agreement about Wagner’s hypothesis, research activity has again reduced.

In the late 1990’s, however, a new set of translations of Wagner’s work were produced by (Biehl, 1998). This has permitted a more comprehensive account of Wagner’s hypothesis to be established in the English speaking literature. The current work is motivated by a need to bring together the benefits of these new translations of Wagner as well as developments in economics, including but not limited to econometrics. In so doing, the paper builds on a proposition first suggested by (Gupta, 1967) that in terms of the state as a fiscal institution, government activity as a proportion of national income can understood through a stylised process similar to that of a consumption function.

The remainder of the paper is structured as follows. The next section sets out a re-statement of Wagner’s Law, making use of the new translation. Section 3 develops this into a testable model. Section 4 describes the data and summary statistics, followed by the model estimation and results. The paper concludes with some comments about the implications of these results and directions for future research in the area.

2. WAGNER’S LAW – A BRIEF RESTATEMENT

A comprehensive review of the literature on Wagner’s Law is beyond the scope of the present paper. Instead, the re-statement offered here draws mainly on key elements of Wagner’s hypothesis, now available in English from his own writings. Based on these, I offer the following as key elements of the Wagnerian project.

After observing that economic growth amongst industrialising countries in the late nineteenth century was being accompanied by a growth in the role of state activity, Wagner suggested that there were structural reasons that state activity grew during industrialisation. On the basis of this observation he suggested that this tendency may be more than simply accidental, and indeed he argued that there were good reasons why this might be so. In particular, Wagner hypothesised that, “…there exists in the state a clear tendency for an expansion of public, respectively State activities together with the progress of the economy and of culture... This expansion appears as something so regular and can so clearly be traced back to its inner
causes and prevailing conditions that it seems to be permitted to speak of a “law” of an increasing expansion of public... especially State activities in the sense in which this term is being and justifiably can be employed in the field of social and economic phenomena (Biehl, 1998: 107).

Two things are worth noting here. First, this ‘law’ has generally been interpreted as implying an increasing share of state activity in the economy rather than the growth of activity per se. Biehl has noted that the generally accepted interpretation of Wagner's Law is that government share of economic activity will increase as national income grows. “In macroeconomic understanding, this ‘law’ means an absolute and even relative expansion of public, in particular State and community forms of organization within a national economy (Biehl, 1998: 107).”

Second, in measuring the growth of the relative share of state activity, fiscal expenditure has generally been used as the proxy. While Wagner noted that state activity can take both fiscal and regulatory dimensions, almost all subsequent studies have focused on the fiscal aspects alone. In part, this is because of the daunting problems of measuring regulatory activity over time or across countries. However, it needs to be recognised that all tests of Wagner’s Law using fiscal measures alone are partial tests.

In testing Wagner’s Law in fiscal terms, it has been widely understood that the demand for state expenditures is income elastic. The problem of testing the Law has then often been directed at elaborating the nature of that elasticity.

A key problem here, however, is that while Wagner recognised that state activity would increase faster than the growth in income during industrialisation, the rate of growth cannot be sustained forever so as to totally subsume private activity. For instance, he noted that while there must be some limit to government activity, “… a proportion between public expenditure and national income which may not be permanently overstpped” (Cooke, 1958: 8). Wagner was, however, sceptical of attempts to specify in advance what that limit would be.

The starting point of my study is therefore to reject a priori any notion of an optimal size of government in capitalist economies, and to make the case for a possible non-linear path for public sector growth. This is not simply an approach of theoretical scepticism, but a reflection, pace Wagner, that there probably cannot be a meaningful theoretical proposition about optimality. The re-statement offered here therefore suggests that any model of Wagner needs to allow for a limit to the share of government expenditure, and that this limit needs to be determined within the model.

Testing of Wagner’s Law has been quite extensive, and while many studies have found support for the general tendency of state expenditure to grow with income, the Law has not been without criticism. The two most notable critiques for my purpose are (Henrekson, 1988 and Henrekson, 1993) and (Peacock and Wiseman, 1961). Peacock and Wiseman rejected both the inherent (organic) theory of the state implicit in Wagner, and the mechanism by which any expansion in public sector activity would take place. In short, they suggest that state activity may increase, but not for the reason or in the way Wagner hypothesised. They used this critique to develop an alternative theory (the displacement hypothesis), and since then there have been several other theories offered for observed increases in the state activity (such as Fiscal Drag (Wilenski), Degree of Openness Hypothesis (Cameron), and Public Choice theory (Buchanan). While these rival explanations have emerged, Wagnerian-type explanations remain still the most widely tested explanations for the relative growth in state activity.

Henrekson, on the other hand, working within Wagner’s Law, was critical of many of the testing procedures used. He noted that many tests of the Law were faulty and that any relationship found between income (as a proxy for industrialisation) and state fiscal activity as an absolute measure were likely to be based on spurious regressions when using aggregate time series data. On this basis, he suggested that the
Law may not be as robust as research had established. For Henrekson, this critique extended to a repudiation of virtually the whole project of testing Wagner’s Law. Further, (Agell, Lindh, and Ohlsson, 1997; Fölster and Henrekson, 1999; Slemrod, 1995) pointed to the issue of a possible endogenous regressor problem in empirical tests of Wagner’s Law through the simultaneous determination of the key variables in the Wagner relationship. This criticism is based on the view that for some within endogenous growth theory at least there is thought to be a possible causal relationship from government share in the economy to economic growth. The current paper will return to this issue in the next section. For the moment, it needs to be noted only that using share data instead of fiscal outlays is one path through Henrekson’s critique along with appropriate econometric testing methods, and that there remains considerable debate about the nature of any possible endogeneity issues even within growth theory.

In the aftermath of these critiques, however, it is clear that any testing of Wagner’s Law needs to deal with the potential for spurious regressions and possible biased estimation through the simultaneous solution of model variables. The next section sets up a testable model of Wagner’s Law that incorporates the key elements of the re-statement offered here.

3. A MODEL OF GOVERNMENT EXPENDITURE

Traditionally Wagner’s Law has been modelled in two ways. The most common is a linear model of the logarithm of government expenditure (GE) on the left hand side and the logarithm of real gross domestic product (GDP) on the right hand side. Sometimes the logarithms of the per capita ratios are modelled instead.

This tradition was set by (Gupta, 1967; Goffman, 1968; Goffman and Mahar, 1971; Peacock and Wiseman, 1961; Man, 1980), and it has been followed by others, usually with time series analysis of specific economies, but sometimes with pooled time series across countries. Ignoring the problems of non-stationary variables when modelling GE against GDP, the double log specification seem worthy in that it gives a constant elasticity score of GE with respect to GDP. However, there are some problems with such a model. Whilst constant elasticity is convenient, is it realistic? A constant elasticity greater than unity would mean that as GDP grows the share of GE in GDP could exceed one, which is a logical impossibility. If the elasticity is less than unity as GDP grows the share of GE in GDP falls toward a limiting value of zero. Further, because GE and GDP may exhibit strong simultaneity there is an identification problem with the log linear model, (Slemrod, 1995). The alternative specification, which avoids this endogeneity problem, is to model GE as a share of GDP (Musgrave, 1969; Pryor, 1968). Share is estimated as a linear function of per capita real GDP.

The clear problem here is that an unbounded linear relationship leads to the possibilities that predicted share could be greater than one or less than zero. (Gupta, 1968) was an early attempt to estimate non-linear relationships to test the Wagner hypothesis, but this did not address the issue of estimating a form that places sensible boundaries on government share. If government is measured by its expenditure then, following Wagner, if GE grows proportionately more than real GDP then the share of the GDP attributed to government must increase. However, this cannot increase without limit and the share must reach some maximum at a value less than one. Wagner was clear that government could not expand without limit, (Biehl, 1998). Therefore modelling government through the fiscal share of GDP, and avoiding potential identification problems requires a model based on a function with a domain \((\infty, \infty)\) and a range \([0, a]\), where \(a < 1\). That is: \(y \mid x = G(x; \theta)\); \(1\) where:

\[
G(\infty) = 0 \text{ and } G(-\infty) = a; \text{ and}
\]

\(\theta\) is a set of unknown parameters, including \(a\), which govern the function \(G\).

A candidate for the function \(G()\) is the logistics function: \(y = \frac{a}{1+be^{-x}} + \varepsilon\); \(2\)
where
\[ y \text{ is the ratio of government expenditure (GE) to gross domestic product (GDP);} \]
\[ x \text{ is real GDP per capita;} \]
\[ a, b, \text{ and } c \text{ are unknown parameters, but with } a < 1; \text{ and} \]
\[ \varepsilon \text{ is a stochastic disturbance and } \varepsilon \sim iid (0, \sigma^2). \]

(Florio and Colautti, 2003) model the share of public expenditures using a logistics equation for five countries. However, they estimate the expenditure share as a function of time, so that in terms of a test of the Wagner hypothesis there must be an implicit assumption that per capita GDP increases over time and that time proxies for real per capita GDP. A more sensible and direct test would be to estimate equation (2) with real GDP per capita as the right hand side variable.

An alternative to the logistics function of (2) is the Gompertz function. Traditionally, this has been used in growth models (Seber and Wild, 2003), where the right hand side variable is time. However, there is no reason why the right hand side cannot be taken up with conditioning variables other than time, and in the case of the Wagner hypothesis, the variable \( x \) would be some measure of economic development:
\[ y = a \exp \left( -\exp(-c(x - b)) \right) + \varepsilon. \]  

In (3) \( y \) is GE/GDP, \( x \) is GDP per capita and the parameters \( a, b \) and \( c \) serve similar functions to their notational counterparts in (2). Following the restrictions on the range of \( y \) in (1) the upper and lower bounds of the range of \( y \) in (2) and (3) are:
\[ y = \begin{cases} \lim_{x \to \infty} a & \text{if } a > 1 \\ \lim_{x \to \infty} 0 & \text{if } a < 1 \end{cases} \]

There are two practical issues with these bounds. Firstly, \( a > 1 \) is possible in (2) and (3). This leads to two alternatives. Firstly, to estimate any empirical model associated with the logistics and Gompertz curves with the restriction \( a < 1 \). However in terms of a test of the Wagner hypothesis, this would be Procrustean. Alternatively, an estimate of both empirical specifications could be attempted without restriction to test to see if \( 0 < a < 1 \).

If equations (2) and (3) are used as tests for the Wagner hypothesis, then one would expect that parameter \( c \) would be significant and positive. This parameter controls the rate of increase of \( y \) with \( x \) and it would have to be positive with \( x \) as GDP per capita and \( y \) as government expenditure share of GDP in Wagner economies. Further, one would expect the estimate of \( a \) to be significant and fall between zero and one. Estimating the Gompertz along with the logistics function allows for the possibility that the estimated Wagnerian relation is skew symmetric. This would manifest itself in clear differences between the estimates of the two different models. The logistics and Gompertz specifications could be estimated using short time series data pooled across a large number of economies.

Prior to estimating specifications (2) and (3) as suitable tests of Wagner’s hypothesis; the issues of spurious regression and simultaneity must be addressed. Following (Henrekson, 1988), long time series such as the logarithm of government expenditure and the logarithm of GDP per capita are unlikely to be mean reverting. They are likely to be integrated series, possibly to order one and analysis of such time series using ordinary least squares will be subject to spurious regression. However, it must be clear that government share, measured by the ratio of government expenditure to GDP must be stationary. As a share measure, it is limited to the interval \([0, 1]\) and therefore in time series, it must converge to a long run mean with a stable variance. That is, it must be co variance stationary. Notwithstanding this, short time series, pooled over a large number of countries allow empirical analysis with temporal data, but avoid the problem of non-stationary series. Even though in principle one would expect government share to be stationary in the long run, modelling specifications (2) and (3) by non-linear least squares using a short wide panel of data over many countries avoids potential problems of non-stationary data.
Modelling with government fiscal share of GDP as a measure of government in the economy overcomes endogenous regressors brought about by the simultaneous solution of government expenditure in levels and GDP. However there is the possibility, alluded to in the previous section, with the simultaneous solution of government share and GDP through the endogenous growth model, that there is a possible causal relationship flowing from government share to GDP. Particularly, (Agell et al. 1997) stimulated a debate on the empirical analysis of government expenditure share and GDP based on the issue of simultaneous determination. (Fölster and Henrekson, 1999) and (Fölster and Henrekson, 2001) are more confident about the possibilities of linear models with cause flowing from government share to growth of GDP using fixed effects panel models. They argue that the fixed effects specification overcomes any problem of simultaneity brought about by the Wagner hypothesis where the causal link is from GDP in levels to government share.

It is not the place of this article to deal with this debate in detail. However, recent empirical outcomes (Agell, Ohlsson, and Skogman Thoursie, 2006), using panel data, point to the fragility of any causal relationship from government share to economic growth. This is an indication that estimation of models (2) and (3) may be used as a test of Wagner’s hypothesis, where an estimated parameter $c > 0$ is consistent with the Wagner hypothesis and an estimate parameter $a < 0$ is indicative of some maximum share of government in the economy. Furthermore, (Slemrod, 1995) stated that whilst some of those who wished to empirically test the relationship from government expenditure share to growth were reticent to do so because of issues of endogeneity, those who investigated the reverse (the Wagner) relationship were perfectly prepared to do so. This paper follows in that latter tradition.

4. THE DATA AND SOME SUMMARY STATISTICS
Prior to examining the methods used in and the results of the empirical analysis, this section examines the pooled data used. It describes the data sources and how the data were transformed into variables suitable to test the Wagner hypothesis and to enable international comparisons of those variables.

The International Monetary Fund (IMF) International Finance Series (IFS) is the data source for:
1.) Nominal Government Expenditure in National Currency;
2.) Nominal GDP in National Currency;
3.) GDP Deflator, Base Year 1995; and
4.) Population;

The data source for the 1995 purchasing power parity rate exchange rate was the Penn World Tables V. 6.1. These tables do not report the rate directly. However, the tables contain the Price Level of Gross Domestic Product in US Dollars and the Exchange Rate (local currency to one unit of the US dollar). Following the data appendix to the Penn World Tables, the Purchasing Power Parity in Domestic Currency per $US for GDP may be obtained by dividing the Price Level of Gross Domestic Product in US Dollars by 100 and multiplying by the Exchange Rate.

These data were then used to estimate data for the models of (2) and (3) for the period 1990-1997. The value of government share was estimated as:

\[
\frac{\text{Nominal Government Expenditure in National Currency}}{\text{Nominal GDP in National Currency}}
\]

Because this share is a rate, providing the definitions of expenditure and GDP are comparable between countries, international comparisons of share can easily be made. Clearly, international comparison of real GDP per capita is less easy, requiring conversion from domestic currency to an acceptable common currency unit. The common currency unit chosen was constant US dollars, where conversion from
domestic real currency units to constant dollars was by way of a base year purchasing power parity exchange rate. The value of GDP per capita in 1995 prices expressed in 1995 purchasing power parity dollars was estimated as:

$$\text{RGDPUS95} = \frac{\text{RGDP95}}{\text{Population}}$$

where:

$$\text{RGDP95} = \frac{\text{Nominal GDP in National Currency}}{\text{GDP Deflator Base Year 1995}}$$

Because of significant gaps in the data, the number of countries is restricted to 88. The data were taken annually for the years 1990-1997. This period was determined by two factors. Missing data, data for some economies, usually the transition economies were not available prior to 1990. Similarly, data were only available to the year 2000 mainly caused by missing observations over some subsequent years for some notable western European economies. Second it was decided not to extend the annual time series much before the base price year of 1995, because of the trade-off between added observations and decreasing price index accuracy over the many countries involved.

From the sample of 704 observations (88x8) for the full pooled analysis the effective sample was 674 observations, thirty observations from several differing countries were lost due to missing data. That is the sample comprised an unbalanced pooled data sample. Summary statistics for government share and real GDP per capita in 1995 purchasing power parity dollars are given in Table 1. The relationship between the mean values for both variables and the minimum and maximum scores reflect the international distribution of income and both variables are skewed with a preponderance of scores toward the lower ranges.

"Table 1 goes about here"

5. **MODEL ESTIMATION AND RESULTS**

Equations (2) and (3) were estimated using non-linear least squares. The numerical procedure used was the Gauss Newton algorithm and the initial estimation was undertaken in GAUSS V.5.0 (Aptech 2002) Standard errors were estimated using a parameter covariance matrix estimated as the outer product of the Z matrix. These results were verified in estimation by using SHAZAM V. 9.0 (Whistler et al. 2002).

The estimated errors for both equations were heteroskedastic using standard tests. Because of the implications for hypothesis test, the standard errors using (White 1980) robust parameter covariance matrix, but with the (Hinkley 1977) degrees of freedom adjustment were estimated. These robust standard errors are reported along with the usual standard errors in Table 2. Fortunately, there are symmetric outcomes to the significance tests using the usual and robust standard errors.

Table 2 gives the results of the non-linear estimation of equations (2) and (3). Importantly, all estimated parameters are significantly different from zero at the five per cent level. Moreover, using one tail tests and robust standard errors with

1. The null hypothesis $H_0$: $\hat{\phi} \geq 1$, against the alternate $H_A$: $\hat{\phi} < 1$ and
2. The null hypothesis $H_0$: $\hat{\phi} \leq 0$, against the alternate $H_A$: $\hat{\phi} > 0$

One can reject the null hypothesis for both the logistic and Gompertz specifications, which is consistent with $0 < \hat{\phi} < 1$.

"Table 2 goes about here"
The \( R^2 \) of the fitted and actual GE/GDP for each sample estimate is given in the last row of Table 3. Whilst these scores may appear low, it must be recalled that only one independent variable was included in both specifications. In this context, the goodness of fit across a very wide cross section of countries is remarkable, considering the great many others, potentially country specific, determinants of expenditure share. This combined with the overall significance of parameters \( a, b \) and \( c \) indicates that equations (2) and (3) may be reasonable replications of that process which generated the GE/GDP ratio.

Figure 1 gives the “fitted and actual” for the estimates of the logistics equation given in row two of Table 2. There is little point in including the fitted values for the Gompertz equation of column three as these values at the scales in the graph virtually replicate the logistics fitted values.

Figure 1 goes about here

Note that the estimated curve of Figure 1 has no point of inflection. This should not be unexpected. Even the least developed of economies requires some significant aggregate decision making. Further, Figure 1 is consistent with the Wagner hypothesis. Government share in GDP in developing economies is growing faster than in developed economies. Therefore low and medium income economies exhibit a fast rate of growth of government expenditure relative to the development of income. Post industrial economies approach the asymptotic level of government share. That is, for these economies the expansion of fiscal government is relatively less rapid and simply keeps pace with the expansion of the economy. However, because the point of inflection is absent, it is not possible to discriminate between the logistic and the skew symmetric Gompertz curves and both are equally likely as candidates for the true data generating process.

Table 3 gives the estimated marginal effects, which is the first derivative of GE/GDP with respect to GDP per capita. Because of the scale of GDP per capita the first derivative is multiplied by 100 and the marginal effect is the increase in GE/GDP brought about by a US $100 increase in real GDP per capita. The marginal effect is computed for the two different specifications, with the logistics in column three and the Gompertz in column four of the table. Row two gives the marginal effect at mean GDP per capita and subsequent rows give the marginal effect at the 25%, 50% and 75% range of GDP per capita. The relevant GDP per capita scores are given in column two of the table.

"Table 3 goes about here"

The results of Tables 2 and 3 are consistent with the hypothesis that the share of GE in GDP increases as GDP per capita grows, and that this share approaches a limit that is less than one. In Table 2, all the estimated parameters for both specifications using either the usual or the robust standard errors are significantly different from zero. Particularly, the parameter \( c \) is significant in both cases and is of the right sign, which is consistent with GE/GDP increasing with GDP per capita. Further, the estimated parameter \( a \), the upper bound on GE/GDP, for both specifications is significantly different from zero and one. This is consistent with an upper bound and that upper bound is less than one. The estimated lower bound on GE/GDP is 0.201 and 0.194 for the logistics and Gompertz equations respectively.

These results carry over to Table 3. Here, for example, the marginal effect at mean GDP per capita for the logistics equation should be interpreted as an increase in GE/GDP by 0.00071 with a $100 increase in real GDP per capita. As would be expected from Figure 2 the marginal effects of Table 3 are high for low GDP per capita scores and are falling as GDP per capita increases. That is the share GE/GDP increases, but at a decreasing rate as GE/GDP approaches an upper limit.

These results are consistent with an interpretation of Wagner’s Law which says that fiscal government, as a share of GDP will grow as the economy grows. Further, the results are also consistent with an interpretation of the Wagner hypothesis which places a limit on the share of fiscal government in the
economy which is less than one. However, it is not possible to discriminate between the logistics and Gompertz specifications as replications of the data generating process.

6. SUMMARY AND CONCLUSION
The paper began by making a case for a restatement of Wagner’s hypothesis. Particularly, stemming from a recent translation of Wagner’s writing, the empirical analysis in the paper is founded on a more realistic model. This model has the virtue that it places sensible bounds on government in the economy when measured as the share of fiscal government in national income. Wagner himself thought that even though there is a strong relationship from economic development to government in the economy, there will be a natural limit to the share of fiscal government in the economy. Wagner did not elaborate on this natural limit and was reluctant to specify the limit a priori. Unlike previous empirical studies of the Wagner hypothesis, this paper incorporates an empirical model based on sigmoid functions which naturally find an upper limit to government share in the economy. That is, in the spirit of Wagner, the data on actual government shares is allowed to determine some upper bound on fiscal government.

The empirical outcomes are consistent with Wagner’s hypothesis. It is not possible to dismiss the hypothesis that there is a positive relationship between the development of the economy in terms of per capita GDP and the share of government expenditure in the economy. Further, the results are consistent with a clearly identified upper limit to that share.

By utilising the limited time series associated with short, wide panels, the analysis has circumvented the problems of spurious regression associated with long time series. Using pooled time series in this way facilitates the use of least squares methods with temporal data where the relationship modelled is inherently non-linear.

The analysis is not yet able to exploit the full benefits of panel data in terms of identifying country specific effects either as a fixed effect or a random component. Whilst the former would be particularly useful, unfortunately non-linear fixed effects specifications in panel are not possible because of the incidental parameters problem (Cameron and Trivedi, 2005). Until that issue is resolved a useful avenue for further empirical research, which may allow the exploitation of panel models, but retain the asymptotic properties of the Wagner relation, might be through Spline regression methods.

Further, it is not currently possible to incorporate Wagners’s view, revealed in modern translation, that the importance of the state in the economy will not manifest itself solely in fiscal terms, but also in terms of regulation. This again is a direction for further work. The regulatory activities of state may be complementary or an alternative to the fiscal state. Thus there is potential then for different levels of the regulatory state to shift up or down the fiscal relationships identified in this paper. If it is possible to find a reasonable numerical measure for the strength or degree of regulation then a useful extension to the empirical analysis of Wagner’s state might well be to relate this to movements of the relationship between the fiscal state and economic development.
REFERENCES

Figure 1: Fitted Against Actual, Logistics Equation

![Diagram showing GE/GDP and GDP/Cap relationship]
Table 1: Summary Statistics of Data

<table>
<thead>
<tr>
<th></th>
<th>MEAN</th>
<th>ST.DEV</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>GE/GDP</td>
<td>0.28</td>
<td>0.11</td>
<td>0.06</td>
<td>0.58</td>
</tr>
<tr>
<td>GDP/Cap</td>
<td>8653.2</td>
<td>7449.5</td>
<td>648.42</td>
<td>29873</td>
</tr>
</tbody>
</table>

Table 2: Estimated Parameters, Logistics and Gompertz Functions.

<table>
<thead>
<tr>
<th>Equation</th>
<th>Logistics</th>
<th>Gompertz</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a$</td>
<td>0.341 (0.01012)</td>
<td>0.343 (0.01123)</td>
</tr>
<tr>
<td></td>
<td>(0.01122)</td>
<td>(0.01256)</td>
</tr>
<tr>
<td>$b$</td>
<td>0.75 (0.08038)</td>
<td>-3442.46 (1073.51)</td>
</tr>
<tr>
<td></td>
<td>(0.07397)</td>
<td>(1056.63)</td>
</tr>
<tr>
<td>$c$</td>
<td>0.00019 (0.00004)</td>
<td>0.00016 (0.00004)</td>
</tr>
<tr>
<td></td>
<td>(0.00004)</td>
<td>(0.00004)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.20</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Table 3: Estimated Marginal Effects

<table>
<thead>
<tr>
<th>Equation</th>
<th>GDP/Cap</th>
<th>Logistics</th>
<th>Gompertz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>8770.93</td>
<td>0.00071</td>
<td>0.00068</td>
</tr>
<tr>
<td>25%</td>
<td>2565.95</td>
<td>0.00140</td>
<td>0.00144</td>
</tr>
<tr>
<td>50%</td>
<td>5985.14</td>
<td>0.00102</td>
<td>0.00097</td>
</tr>
<tr>
<td>75%</td>
<td>14576.66</td>
<td>0.00028</td>
<td>0.00028</td>
</tr>
</tbody>
</table>