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Does Internet stimulate the accumulation of social capital? A macro-perspective from Australia

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Abstract

Based on the premise that the Internet has the potential to generate trust, this study estimates the effects of the Internet and real GDP per capita on the creation of social capital (measured by trust) for Australia for the period 1985-2013. We use ARDL bounds testing approach (Pesaran et al. 2001) to estimate the short- and long-run relationship and Granger (1969) causality test to assess the causal linkages among the variables. Findings indicate that Internet use reduces social capital in the long-run but contributes slightly to its enhancement in the short-run. There is positive significant association between the level of real GDP per capita and the stock of social capital in the long-run while the relationship in the short-run is negative and significant. No causal link is found between Internet use and social capital while a unidirectional causality running from social capital to real GDP per capita is observed. The negative association between Internet use and the formation of social capital in the long-run may occur because the trust generated through greater online interaction is outweighed by the loss in trust arising from reduced face to face interaction.

Keywords: ARDL, Australia, economic growth, social capital, Granger causality, Internet usage

1. Introduction

Most studies of determinants of economic growth focus on factors such as physical and/or human capital, technological capacity and innovation, managerial and leadership skills in business and state sectors, and trade liberalization of domestic and international markets. Less attention is paid to the important role of social factors such as culture, social norms and cohesion

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in promoting economic growth. This study addresses this issue by examining the effect of the use of the Internet on the stock of social capital and the consequences of this effect for economic growth. Therefore, the variables of interest in this study are social capital proxied by trust, the use of Internet and an interaction term between social capital and Internet usage.

The term 'social capital' was first coined by L. J. Hanifan (Putnam 2000, p. 443) who highlighted the importance of the social relationships of people having business and economic interests. The concept was later popularized by Bourdieu (1980, 1986), Coleman (1988, 1990) and Putnam (1993, 1995, 2000). Coleman (1990) defines social capital as '..... social organization that constitutes social capital, facilitating the achievement of goals that could not be achieved in its absence or could be achieved only at a higher cost'. In their seminal work, *Making Democracy Work*, Putnam et al. (1993) define social capital 'as the collective values of all social networks and the inclinations that arise from these networks to do things for each other'. Also he views social capital as encompassing features of social organization such as trust, social norms and networks that can improve the efficiency of society by facilitating coordinated actions. Given this point of view, Putnam et al. use indices of civil society and political participation to measure the stock of social capital. The World Bank offered another similar definition for social capital. It defines social capital as 'the norms and networks that enable collective action'.

However, the empirical literature on the measurement of social capital is very disparate. Existing studies vary substantially in their methods of measuring social capital and in the type of data collected for this measurement. One of the most recent studies (Righi, 2013) claims that the three main attributes of social capital which should be measured are generalized trust, the intensity of the associative links, and civic and political participation expressed in various ways. Nevertheless, so far, the most frequent indicators used in the literature on social capital are trust

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and associational activities. A recent meta-analysis study (Westlund and Adam, 2010) covering 65 studies on social capital conclude that trust is the most widely used measure of social capital.

Australia has experienced spectacular growth in Internet usage during the last two decades (Figure 1), and this has significantly transformed the Australian economy (Deloitte Access Economics, 2011).

<Please insert Figure 1 here>

Figure 2 shows the logarithmic trend in real GDP per capita of Australia during the period 1985-2012. It shows a steady upward trend.

<Please insert Figure 2 here>

Recent literature suggests that Internet use may potentially add to social capital in Australia (Notley and Foth, 2008) but no research has been completed to measure that effect. The aim of this article is to address this shortcoming. It is expected that higher levels of Internet use would lead to denser social networks resulting in increased levels of social participation. Higher levels of social interaction and participation may lead to higher levels of trust (proxy of social capital) among people. This study also includes real GDP per capita as an independent variable. The inclusion of this variable is based on the assumption that higher levels of real GDP per capita boost economic transactions in an economy which in turn is expected to enhance trust and confidence in the business community eventually adding to the level of generalized trust. Thus, this study circumvents the omission bias in the model. The current study represents the first empirical investigation of this issue in Australian context. The findings of the study point to important policy implications for Australia, especially in relation to the digital divide policy.

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However, probably more significantly they highlight the possible limitations of the Internet in building social capital when this is measured by a trust variable.

The rest of the paper is structured as follows: Section 2 provides a relevant literature review, and the methodology used in this empirical analysis is presented in Section 3. Section 4 reports the results of the study and conclusions and policy implications of the research are given in Section 5.

2. Literature Review

2.1 Internet and the stock of social capital in Australian context

Recent literature demonstrates that the residents of rural and remote areas of Australia are socially disadvantaged compared to their urban counterparts (ABS, 2013a). It has been argued that greater and improved access to the Internet could increase the social inclusion (through greater social interaction) and could reduce the social disadvantage of rural and remote communities (Broadbent and Papadopoulos, 2013).

It has also been argued that the Internet helps build citizen trust through online civic engagement (Warren et al., 2014). The ability to do so however, depends on the nature of the social obligations, connections, and network availability. Internet usage generates social capital by developing networks of relationships between different people and different communities (Lippert and Spagnolo, 2011). Thus, the Internet has emerged as the key facilitator of social networks in modern times.

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Charleson (2013) suggests that enhancing empowerment and social capital by greater use of the Internet network for those already burdened with disadvantage and marginalization is a potential means to narrow the current digital divide in Australia.

In Australia, successful digital divide policy should include a social capital framework in its agenda to ensure the digital inclusion of disadvantaged people in rural and regional areas (Notley and Foth, 2008). Internet use has been reported to have positive impacts on areas such as the pursuit of hobbies and interests, shopping, work, employment and provision of health care information (Doong and Ho, 2012). Australia has witnessed a significant growth in the use of various social network sites (SNSs) that affect our social, political and economic lives (Ferreira-Lopez et al., 2012). It is also important (Kyujin Shim, 2013) that online social network services supported by rural ICT policy should take into account social capital.

A few earlier studies addressed the potential of Internet to generate social capital in Australia but only to a limited extent. Such studies (Meredyth et al. 2004; Hopkins, 2005; Fernback 2005; Foth and Podkalicka, 2007) concluded that ICT use can have a positive impact on an individual's social inclusion and the stock of a community's collective social capital. However, most of these studies are descriptive and are dated in their policy relevance.

Selwyn and Facer (2007) argue that ICT use involves a wide spectrum of activities that potentially constitute 'social inclusion' - from playing an active role in one's neighborhood and community to maintaining one's personal finances. Simpson (2009) emphasizes the interplay between physical infrastructure, soft technologies and social capital for successful implementation, widespread uptake, greater social inclusion and the sustainability of ICT

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initiatives. DiMaggio et al. (2001) argue that Internet helps boost community-level voluntary associations and thus may generate social capital.

Servon (2002) perceives digital technology as being a tool of inclusion or exclusion. She notes that this technology is inclusive of certain classes of people while excluding others. The observation of Servon is important in relation to the digital divide between residents of rural and remote areas of Australia and their urban counterparts as well as to disadvantaged persons in urban areas. The elderly, less well educated and the physically or mentally handicapped are relatively lacking in skills or ability to utilize the internet. An associated problem is that it is easier and less costly to enhance the Internet skills of those residing in urban areas than in rural and remote areas. Therefore, even with high speed Internet access, the former may be disadvantaged in accumulating social capital and locked out of networking with those who are relatively skilled in using Internet.

These findings lead to consideration of what is known as 'network society thesis' (Barney, 2004; Castells, 2000). The central idea of 'network society thesis' is that contemporary social, political and economic practices, institutions and relationships are organized through and around network structures (Barney, 2004; Castells, 2000). The 'network society thesis' provides an understanding of how new forms of Internet use can facilitate an ever-expanding information society. The arrival of the Internet technology has resulted in a significant expansion of network communication (Wellman, 2001; Castells, 2001).

There are both positive and negative consequences of the network society (Barney, 2004). Nevertheless, the ICT-mediated network is transforming the social nature of developed nations like Australia (Deloitte Access Economics, 2011). The 'network society thesis' provides the

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background framework in which the current digital divide can be addressed and consideration can be given to the online needs of specific disadvantaged groups thereby enabling their increased participation in the formation of social, cultural and economic capital.

A positive view is that web-mediated social participation has the potential to protect the relational aspect of individuals' lives from the stress of time-constraint (Antoci et al. 2012). First, it is less exposed to the deterioration of the social environment that physically surrounds individuals. Second, Internet interaction is less time-consuming than face-to-face interaction and thus encourages social participation. Third, online interactions contribute towards the accumulation of Internet social capital. A salient feature of social capital is that it allows asynchronous social interactions; one can benefit from another's participation through the act of communicating a message or posting a photo even when the person who did this, is offline. Increased internet social capital may also generate positive externalities from the information spill-over to Internet non-users.

However, the social capital effect of Internet may not always be positive. In fact, it may also crowd out social participation when it is massively used for entertainment rather than for social networking. It may even lead to so called 'cyber balkanization' by stimulating the separation of communication into separate groups with specific interests leading to group separation and community fragmentation (Van Alstyne and Brinjolfsson, 1996; Gentzkow and Shapiro, 2011; Bauernschuster et al., 2014).

In summary, the above review reveals that there is a significant gap in the literature about the association between Internet and the stock social capital in the Australian context although there are plenty of studies that investigate the effects of different factors on social capital. No recent

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study has been completed to investigate the link between Internet usage and social capital in Australia even though this link is very important (Charleson, 2012; Notley and Foth, 2008).

2.2 Digital Divide Policies in Australia: From Networking The Nation (NTN) to the National Broadband Network (NBN)

In order to reduce disparity in telecommunications access, services and facilities, the Australian government approved the Networking the Nation (NTN) initiative (a digital divide policy intervention) in 1996. However, this initiative failed to adequately address the digital divide in Australia (Van Vuuren, 2007). A co-ordinated communication infrastructure scheme was then put in place in 2004 in order to boost health, education and other sectors of public interest to generate opportunities for improved broadband access and services in rural, regional and remote Australia.

At the same time, a *Communications Fund* was established to future-proof telecommunications services in rural, regional and remote Australia and the *Connect Australia* initiative to roll out broadband to people living in regional, rural and remote areas was started. These projects involved extending mobile phone coverage, building new regional communications networks and setting up of telecommunications services for remote Indigenous communities (Coonan, 2005). Recognizing that the Indigenous communities in Australia were substantially deprived of telecommunications services, two more initiatives were undertaken to address the infrastructure needs of the Indigenous communities: The 2002 Telecommunications Action Plan for remote indigenous communities and the 2006 Backing Indigenous Ability to redress low level of telecommunications access and access quality in Indigenous communities.

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A broadband future policy for Australia was first announced in 2007 with the objective of building an optical fiber network to target 98 percent Australian households and offer speeds over 40 times greater than the average at that time (Hoy, 2007). However, this policy only focused on the issue of technology access and it failed to show how this would address differences in abilities to use of Internet.

The National Broadband Network (NBN) project, the largest ever infrastructure project in the history of Australia - was announced in 2009. The construction of the $47 billion NBN is now underway and its roll out will continue until 2018. It provides an opportunity to address the digital divide and to empower people to effectively use new technologies as they become available. With the change in the Australian Government recently, the political dynamics of NBN has changed. The coalition policy (present government) on the NBN is designed to deploy FTTP (Fiber-To-The-Premises) to only twenty-two percent as against ninety-three percent targeted by the former government. Seventy-one percent is expected to be covered by the FTTN (Fiber-To -The -Node) technology where fiber is being extended to high nodes. The remainder of the distance will be covered by Telstra's copper network. Although coalition's target is to downsize the cost of the project, this may have negative cost implications for the NBN-users. Experts fear that this might even increase the digital divide especially in regional Australia where cost is still a vital factor in decisions about Internet use (Alam and Salahuddin, 2015). Politicization of NBN might negatively affect the expected benefits from this mega-project at the cost taxpayers' expense.

2.3 A review on the measurement of social capital

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Despite its historical roots and its considerable contemporary use, there has been increasing debate on the development of tools for measuring social capital empirically. The appropriate measurement of social capital is one of the major challenges in social capital research today. There is not yet a consensus about the appropriate indicators for measurement of social capital (Fukuyama, 2001; Antocy et al., 2012). To date, researchers have failed to provide a unique comprehensive measure of social capital.

Although the failure to measure this concept in an entirely adequate way has been attributed to various factors, Antocy et al., (2012) have proposed three reasons for it. The first of these is the multidimensionality of the definitions of social capital. Furthermore, a range of concepts of social capital exist, several of which are vague. This can result in a situation described by Mohan (2002, p.199) as 'operational opportunism' and by Stone (2001, p.5) as 'empirical mayhem'. Second, any attempt to measure the properties of inherently ambiguous concepts such as community networks and organization is correspondingly problematic Third, there is a lack of availability of survey data for contemporary researchers to compile indexes using a range of proxies such as measures of trust in government voting trends, membership in civic organizations, hours spent in volunteering and so on.

Also, there is a gap between the theoretical concept of social capital and the concepts applied in empirical researches to measure social capital to date. Such gap has resulted in empirical confusion about the meaning, measurement and outcomes of social capital. Paxton (1999:90) identified the same problem noting that previous studies provide little rationale for how measures of social capital relate to its theoretical definition.

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The empirical literature on social capital is now very wide and studies differ in their degree of depth, methods and data collection. From the above review, it is evident that social capital is a complex multidimensional concept. Therefore, it still remains a challenge to satisfactorily represent it by a single measure or figure. This should be kept in mind when considering the following analysis.

3. Data and Methodology

3.1 Data

Data on trust variable (SC) for Australia was gathered from the World Values Survey (WVS, 2014) conducted in multiple waves from 1981 to 2014. Trust is measured as the percentage share of people who answer that "most people can be trusted" to the WVS survey question *"Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?"*. Since estimating such periodic data is likely to provide unreliable findings, we generate annual values of trust through linear interpolation (Figure 3).

<Please insert figure 3 here>

We also incorporate another explanatory variable, real GDP per capita (GDPPC) in the model in order to circumvent the omission bias. A few missing values were also observed in the Internet users per 100 people (NET) series which were replaced by 3-year moving average values. The variable real GDP per capita (GDPC) is measured at constant 2005 US$. Data on Internet users and real GDP per capita were obtained from the World Development Indicators Database, 2014 (WDI, World Bank, 2014). In order to smooth the trend, variables, GDPPC and Internet usage are expressed in natural logs.

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3.2 Methodology

3.2.1 Model

Based on the premises of social capital theory and network externality, it is believed that the Internet has the potential to generate trust by enhancing connectivity among people within the same and between groups. Internet use potentially generates social capital through creation and enhancement of online trust (Warren et al., 2014). Also, through the use of the Social Networking Sites (SNS) and by other means, it is claimed that the Internet enables people to enjoy the benefits of positive networking effects, builds trust, strengthens existing trust and social bonds between them (Bauernschuster et al. 2014).

However, Internet may also cause negative network effects through dissemination of biased information (Liang and Guo, 2015; Kaustia and Knupfer, 2012) and thus may affect trust negatively. Given these different views, we explore how Internet use influences the level of trust (either positively/negatively). Trust is arguably the most widely used indicator of social capital in empirical exercises ((Fukuyama, 1995a,b; Knack and Keefer, 1997; Glaeser et al., 2008; Zak and Knack, 2001; Westlund and Adam, 2010; Ng et al., 2014) to date. Therefore, we construct and estimate a model where the number of Internet users per hundred people and real GDP per capita are taken as explanatory variables and social capital (proxied by trust) is the dependent variable. The model takes the following form:

$$SC_t = \beta_0 + \beta_1 NET_t + \beta_2 GDPPC_t + \varepsilon_t \qquad (1)$$

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Where, SC is social capital proxied by trust, NET is the number of Internet users per hundred people and GDPPC is real GDP per capita measured at constant 2005 US$. The subscript *t* represents the time period.

3.3 Estimation Procedures

3.3.1 Unit root tests

In order to check for stationarity of data, ADF (Dickey and Fuller, 1979), PP (Phillips and Perron, 1988), and DF-GLS (Dickey and Fuller Generalized Least Squares) unit root tests are conducted. However, none of these tests consider structural break in the series, if any. Therefore, following Kumar et al. (2015), this study employs a relatively simple Perron (1997) structural break unit root test which allows single structural break in a series. In order to check for consistency and as recommended by some recent empirical works (Kumar et al. 2015; Kumar and Stauvermann, 2014) among others, we conduct another relatively advanced Zivots and Andrew (1992) structural break test.

3.3.2 ARDL bounds testing approach

In order to estimate the short- and the long-run relationship between variables, we employ Autoregressive Distributed Lag model (ARDL) developed by Pesaran (1997, 2001). The ARDL technique has several advantages over other conventional cointegration techniques: First of all, this method can be applied to a small sample size study (Pesaran et al., 2001) and therefore the application of such technique in our study seems to be justified. Secondly, it can be applied even in case of mixed order of integration of variables. Thirdly, it simultaneously estimates the short-run dynamics and the long-run equilibrium with a dynamic unrestricted error correction model (UCEM). Fourth, it estimates the short- and the long-run components simultaneously potentially

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removing the problems associated with omitted variables and autocorrelation. In addition, this technique generally provides unbiased estimates of the long-run model and valid t-statistic even when the model suffers from the problem of endogeneity (Harris and Sollis, 2003). The empirical formulation of ARDL equation for our study is specified as follows:

$$\Delta SC_t = \beta_0 + \beta_1 T + \beta_2 D + \beta_3 SC_{t-1} + \beta_4 \ln GDPPC_{t-1} + \beta_5 \ln NET_{t-1}$$

$$+\sum_{i=1}^{P} \beta_6 \Delta SC_{t-j} + \sum_{j=1}^{q} \beta_7 \Delta \ln GDPPC_{t-k} + \sum_{k=0}^{r} \beta_8 \Delta \ln NET_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta \ln GDPPC_t = \beta_0 + \beta_1 T + \beta_2 D + \beta_3 \ln GDPPC_{t-1} + \beta_4 SC_{t-1} + \beta_5 \ln NET_{t-1} + \sum_{i=0} \beta_6 \Delta SC_{t-j} +$$

$$+ \sum_{J=0}^{q} \beta_7 \Delta \ln NET_{t-k} + \sum_{k=0}^{r} \beta_8 \Delta \ln GDPC_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta \ln NET_t = \beta_0 + \beta_1 T + \beta_2 D + \beta_3 \ln NET_{t-1} + \beta_4 \ln GDPC_{t-1} + \beta_5 SC_{t-1}$$

$$\sum_{i=0}^{p} \beta_6 \Delta \ln NET_{t-j} + \sum_{j=0}^{q} \beta_7 \Delta \ln GDPC_{t-k} + \sum_{k=0}^{r} \beta_8 \Delta SC_{t-1} + + \varepsilon_t \quad (4)$$

Where, lnGDPPC, SC and lnNET indicate log values of real GDP per capita, real values of social capital (trust), and log values of Internet users per 100 people respectively. Δ is the difference operator. T and D denote time trend and dummy variable, respectively. The dummy variable is included in the equation to capture the structural break arising from the series. ε_t is the disturbance term.

To examine the cointegrating relationship, Wald Test or the F-test for the joint significance of the coefficients of the lagged variables is applied with the null hypothesis, H_0: $\beta_3 = \beta_4 = \beta_5$ indicating no cointegration against the alternative hypothesis of the existence of cointegration

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between variables. F statistics are computed to compare the upper and lower bounds critical values provided by Pesaran et al., (2001) and Narayan (2005).

To check whether the cointegrating relationship between the variables from ARDL bounds test is robust, we employed Gregory and Hansen (1996) residual-based test of cointegration, which allows for a one time change in the cointegrating parameters. The Gregory and Hansen test involves the testing of four models – level, trend, intercept or shifts in the intercept, and slope. We opted for the intercept and slope model that allowed rotation in the long-run equilibrium relationship simultaneously with shift. Once the cointegrating relationship is confirmed, long-run and short-run coefficients are estimated with the application of ARDL. The short-run estimation also involves an error correction term which reflects the speed of convergence of short-run disequilibrium towards the long-run equilibrium.

3.3.3 Diagnostic tests

A number of diagnostic tests such as Lagrange Multiplier (LM) test for serial correlation, Ramsey RESET test for model specification, normality test for heteroscedasticity and model stability graphical plot tests such as CUSUM and CUSUMS are conducted.

3.3.4 The VECM Granger causality test

According to Granger (1969), once the variables are integrated of the same order, the VECM Granger causality test is appropriate for estimating their causal link. Because all of the variables in our study are first difference stationary [I(1)], this study proceeds further to determine the causal direction between them. Identifying the exact direction of causal linkage provides insight crucial to the development of better policy implications (Shahbaz, 2012). The

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potential causality pattern for our study is represented by the following VECM specification in a multivariate framework:

$$\Delta SC_t = \beta_{0i} + \sum_{i=1}^{p} \beta_{1i} \Delta SC_{t-i} + \sum_{i=1}^{p} \beta_{2i} \Delta NET_{t-i} + \sum_{i=0}^{p} \beta_{3i} \Delta GDPPC_{t-i} + \varepsilon_t \quad (5)$$

4. Results

Table 1 reports summary statistics. The standard deviations in all the series are quite low implying that the data are more or less normally distributed. Hence, it is appropriate for us to proceed with the datasets for further estimation. Table 2 provides correlation matrix which does not indicate any serious multicollinearity threat in the model.

<Please insert Table 1 and Table 2 here>

Table 3 reports results from ADF and PP unit root tests. All variables are found first difference stationary. The DF-GLS unit root test results are reported in Table 4 which also shows that all the series in our study are first difference stationary, i.e. I(1).

(Please insert Table 3 and Table 4 here).

In order to avoid the value of F statistic from bounds test being influenced by the presence of structural break, we conduct two structural break unit root tests namely; Perron (1997) unit root test with single structural break and Zivot-Andrews structural break test. The results from these tests are reported in Table 5 and Table 6 respectively. As evident from Table 5, Perron structural break test identifies the break periods for the respective series as, 1997 (LGDPPC), 1996 (LNET), 1990 (SC), 1992 (ΔGDPPC), 1997 (ΔNET) and 1995 (ΔGDPPC). In Table 6, Zivot-Andrews break test locates the break points as 2008 (LGDPPC), 2002 (LNET), 1990 (SC), 1993

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(ΔGDPPC), 1998 (ΔNET) and 1996 (ΔGDPPC). Although we have got different break periods from two tests, they are not significantly different or inconsistent.

From Table 5, the break periods 1997 and 1992 for Australian economy. The former may be attributed to Asian financial crisis while the latter may be due to productivity shock. For the Internet, the Australian Government for the first time approved the Networking the Nation (NTN) Project in 1996 to promote Internet use but this initiative was deemed inadequate. 1996-1997 was just the beginning for Australian Government to start any initiatives to promote Internet use. From Table 6, the break period of 2008 for Australian economy coincides with the Global Financial Crisis (GFC) and the SARS pandemic although it is claimed that Australia is one of the few countries which survived GFC. The break period of 1993 may be due to some productivity shocks. For the break periods of 1998 and 2002 for the Internet, Australia was still in a primary stage in terms of formulation of a sound and comprehensive digital divide policy to promote Internet use and reduce inequality in its access and use.

<Please insert Table 5 and Table 6 here>

Next, we proceed with the tests to examine the cointegrating relationship, if any, among the variables. Since ARDL is sensitive to lag order, for calculating the F statistic, first of all, we need to identify the appropriate lag order. To do this, we choose SC (Schwarz Information Criterion) as it provides better results than other lag length criteria (Luitkepohl, 2006). Table 7 reports results from the lag order selection criteria which suggests that the optimal lag is 1.

(Please insert Table 7 here).

The ARDL bounds cointegration results reported in Table 8 suggests that when social capital is dependent variable, the calculated F statistic of 7.679 is higher than the upper bound critical

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value generated by Pesaran et al. (2001) and Narayan (2005) at the 1% level of significance. Therefore, there is cointegrating relationship between social capital and the predicted variables - Internet users per 100 people, and real GDP per capita. But this test does not consider the presence of structural breaks in the series as detected by Perron and Zivot and Andrew structural break tests. Although ARDL estimate supports cointegration relationship, Hansen Gregory cointegration test that accounts for structural break is also employed which (as reported in Table 9) lends support in favor of the cointegrating relationship among the variables even in the presence of structural break in the series.

<Please. insert Table 8 and Table 9 here>

Once the cointegrating relationship between variables has been confirmed, it is imperative to conduct a battery of diagnostic tests that precede the estimation of long-run and short-run coefficients. In order to obtain diagnostic test statistics, this study performs the Lagrange Multiplier (LM) test of residual serial correlation (χ_{sc}^2), Ramsey's RESET test for correct functional form, (χ_{ff}^2) the normality test based on the skewness and kurtosis of residuals (χ_n^2) and the heteroscedasticity test based on the regression of squared residuals on squared fitted values (χ_{hc}^2). Overall, it is evident from Table 10 that all these test statistics are statistically insignificant at least at 5 percent level of significance implying that our model is free from any of these biases. The stability of parameters over time is also reflected through the graphical plots of CUSUM and CUSUM of Squares (Figure 4A and Figure 4B respectively).

Table 10 reports long-run coefficients from ARDL estimates. We note that the long-run association between Internet use and social capital is negative and statistically significant at 1% level of significance. A 1% rise in Internet use would cause a decline in trust by .05%. In other

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words, Internet use reduces trust among people. Real GDP per capita is found to stimulate trust and the long-run relation is statistically significant also at 1% level of significance. The findings further indicate that the level of trust rises by 0.94% for a 1% increase in real GDP per capita. This supports the expectation that a higher level of GDP is characterized by a higher volume of transactions in an economy that this leads to an increased level of trust between people involved in the transactions.

(Please insert Table 10 here).

(Please insert Figure 4A and Figure 4B here).

The short-run results are presented in Table 11. As indicated, the short-run association between Internet use and social capital is positive and statistically significant at 1% level of significance. It is demonstrated that a 1% rise in Internet use would trigger .003% increase in social capital. Real GDP per capita is negatively associated with social capital in the short-run. This negative relation is also significant at 5% level of significance. The coefficient of the error correction term ECT_{t-1} of -0.1120 is statistically significant at 5% level of significance and has the expected sign. It also implies a reasonable speed of convergence (the short-run deviations being corrected at the speed of 11% each year) towards the long-run equilibrium.

<Please insert Table 11 here>

Granger causality results are presented in Table 12. No causality is observed between Internet use and social capital. A unidirectional causality running from social capital to real GDP per capita is observed.

<Please insert Table 12 here>

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5. Conclusions, policy implications and limitations

5.1 Discussion and policy implications

The findings of the study have important policy implications for Australia. Australia has been pursuing various policies to promote Internet access and use since the early 1990s. Most of the recent literature recognizes the presence of digital divide in Australia (Bowles, 2013; Charlson, 2013; Atkinson, 2008) especially in regional and rural Australia. One of the key objectives of the currently ongoing roll out of the NBN is to narrow digital divide by expanding the high speed broadband network across the regional and remote parts of Australia.

The finding of the current study of highly significant long-run negative association between Internet use and social capital is attributed to the negative effects of Internet on social capital. While Internet use may potentially generate social capital by building and strengthening online trust through social networks, it can also cause social isolation as well for relatively disadvantaged and under-privileged section of population of a country. At the micro-level, it is possible that Internet use stimulates trust among various groups of people who are online connected through various SNSs but at the macro-level, the trade-off between increased online interaction and face-to-face interaction which may reduce the level of trust generated online among mass users. Furthermore, rapid increases in Internet use may cause so called 'cyber balkanization' or in other words, create group specific networks resulting in group fragmentation. The possible consequence of such group fragmentation in Australia is that it will further aggravate the current level of digital divide which is already in the danger of widening (Bowles, 2013).

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Apart from the potential threat of causing social isolation to the relatively disadvantaged and under-privileged people living in rural and remote Australia (as well as in some urban situations), increased Internet use may even have negative effects on trust among the socially and economically better-off Internet users by reducing the number of their offline interactions (Zhong, 2014; Bauernschuster et al., 2014). It is claimed that absence of face-to-face interactions results in the loss of transmission of much important non-verbal information (Bauernschuster et al., 2014). Several other forms of reduced social interaction due to the use of the Internet are mentioned by Tisdell (2014, pp. 14-15).

Another finding of the study, the significant positive long-run relationship exists between real GDP per capita and social capital. That income generates social capital (trust) is in line with expectations. Higher levels of income are associated with higher frequencies and volumes of transactions traded within the economy. Higher frequencies and volumes of transactions may enhance and strengthen trust among people and this may influence them to engage in more frequent transactions online.

5.2 Conclusions and limitations

This study examined the empirical relationship among social capital (proxied by trust), Internet usage and real GDP per capita using Australian annual time series data for the period of 1985-2013. Data for social capital is generated through linear interpolation for some missing data. ADF, PP and DF-GLS unit root tests, Perron and Zivots and Andrew structural break unit root tests are conducted. All the series are found to be stationary at first difference even in the presence of a structural break. Hansen Gregory and ARDL cointegration tests confirm cointegrating relationship among the variables. The findings from the ARDL estimates suggest

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that Internet use has had a highly significant negative long-run association with social capital in Australia. However, there is positive significant relation (but of small magnitude) between these variables in the short-run. Also, real GDP per capita positively influences the formation of social capital in the long-run and negatively influences in the short-run. In both cases, the relationships are statistically significant. No causal link is found between Internet use and social capital. A unidirectional causality is observed running from social capital to real GDP per capita.

Despite the novelty of the study, it suffers from a number of limitations. One major weakness is the measurement of social capital by one single indicator from WVS. It is now well documented in literature that social capital is a multi-dimensional concept. Therefore, our findings may not be robust across different measures of social capital. Another weakness of the study is that yearly observations on trust were unavailable which were generated through simple linear interpolation. Use of more data in future would certainly enhance the reliability of the findings. Finally, the findings are not expected to be invariant across different econometric specifications.

Using the only available general indicator of social capital for Australia (the WVS measure), we find that there is no convincing evidence that increased Internet usage has increased the stock of social capital when this is proxied by the WVS trust variable. Instead, the findings of the current study point in the opposite direction. Therefore, one needs to be cautious about claims found in the literature that greater Internet usage has generated social capital. Clearly, more research is needed to resolve this matter. Different dimensions of the social capital may need consideration and less aggregated studies, including case studies (for example, for different regions) would be worthwhile.

Although opinions expressed in the relevant literature about the impact of increased Internet use

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on social capital vary, the dominant view is that it is likely to be a powerful contributor to the accumulation of social capital. However, our empirical results do not support this hypothesis. In fact, they indicate that increased use of the Internet in Australia has been associated with a long-run decline in social capital when this is measured by the average per capita level of a trust variable; an aggregate measure. We also suggest that growing aggregate use of the Internet has been accompanied by growing inequality in its use by different social groups. In Australia, this increased inequality arises from two sources:

- Differences in the quality of Internet services (and in the supply of such services) available to different groups of individuals; and
- Differences in the ability of groups having access to Internet services to use these.

These differences appear to have resulted in some groups being able to increase their stock of social capital by using the Internet whereas others have suffered absolutely or relatively in this regard.

In developing its Internet development policies, the Australian Government seems to have put greater emphasis on reducing inequality in access to Internet services rather than on reducing inequality in the ability of individuals and groups to make use of their available Internet. There is a case for giving greater attention to the latter problem. In addition, more attention could be given to reducing anti-social behaviours associated with the use of the Internet because ultimately these have a negative effect on the formation of social capital.

Finally, note the social evaluation of the socio-economic consequences of Internet use does not depend solely on its effect on the formation of social capital. Among other things, it is likely to add to the stock of human capital and increase economic productivity. For example, it can play an important role in facilitating education and in supplying information. This aspect may be especially important in rural and remote regions of Australia.

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Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
LGPDC	28	10.280	0.170	10.005	10.526
NET	28	0.441	0.041	0.400	0.481
SC	28	34.355	32.095	0.530	82.349

Table 2: Correlation Matrix

	Social Capital	LGDPC	LNET
Social Capital	1.0000		
LGDPC	0.7083	1.0000	
LNET	0.5547	0.9550	1.0000

Table 3: ADF and PP unit root tests

Variable	ADF	PP	Variable	ADF	PP
LGPDC	-0.885	-0.821	ΔLGDPC	-3.655[a]	-3.662[b]
NET	0.612	0.176	ΔNET	-2.567[c]	-2.275
SC	-0.634	1.484	ΔSC	-1.047	-0.997

Note: a, b, & c indicate 1 %, 5%, & 10 % significance level respectively

Table 4: DFGLS unit root test

Log Levels (Z_t)		Log 1st Difference (Z_t)		
Variable	DFGLS stat	Variable	DFGLS stat	I(d)
LGDPPCC	-0.563	ΔLGDPPC	-3.655[a]	I(1)
NET	-0.565	ΔNET	-1.599[c]	I(1)
SC	-1.415	ΔSC	-4.898[a]	I(1)

Note: a, b, & c indicate 1 %, 5%, & 10 % significance level respectively

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Table 5: Perron unit root test in the presence of a structural break

Variable	Perron test for level			Perron test for 1st difference		
	T-Statistic	TB	Outcome	T-Statistic	TB	Outcome
LGDPC	-3.282	1997	Unit Root	-5.068[a]	1992	Stationary
NET	-5.027[b]	1996	Stationary	-7.181[a]	1997	Stationary
SC	-2.871	1990	Unit Root	-10.149[a]	1995	Stationary

Note a, b, & c indicate 1 %, 5%, & 10% significance level respectively

Table 6: Zivot–Andrews structural break unit root test

Variable	Z&A test for level			Z&A test for 1st difference		
	T-Statistic	TB	Outcome	T-Statistic	TB	Outcome
LGDPC	-2.795	2008	Unit Root	-6.039[a]	1993	Stationary
NET	-3.531	2002	Unit Root	-4.292[b]	1998	Stationary
SC	-2.701	1990	Unit Root	-10.043[a]	1996	Stationary

Note a, b, & c indicate 1 %, 5%, & 10% significance level respectively

Table 7: Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-84.36527	NA	0.291403	7.280439	7.427696	7.319507
1	28.20765	187.6215*	5.25e-05	-1.350638*	-0.761611*	-1.194369
2	39.04103	15.34729	4.70e-05*	-1.503419	-0.472622	-1.229948*
3	44.09944	5.901486	7.29e-05	-1.174954	0.297614	-0.784281
4	53.42527	8.548674	8.90e-05	-1.202106	0.712232	-0.694232

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

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Table 8: Results from ARDL Bounds cointegration test

Dep. Var.	SC Lag	F-stat.	Probability	Outcome
F_{LGDPC}(LGDPPC|NET, SC)	1	3.787[b]	0.045	Cointegration
F_{NET}(NET|LGDPPC, SC)	1	4.222[b]	0.034	Cointegration
F_{SC}(SC|LGDPPC, NET)	1	7.679[b]	0.238	Cointegration
Critical value (Pesaran et al., 2001)	I(0)	I(1)	Narayan (2005) I(0)	I(1)
1% level of significance	3.29	4.37	4.280	5.840
5% level of significance	2.56	3.49	3.058	4.223
10% level of significance	2.20	3.09	2.525	3.560

Note: Statistically significant at 5% level of significance (b)

Table 9: Gregory-Hansen test for Cointegration with Regime Shifts, Model: Change in Regime and Trend

Test	Statistic	Breakpoint	Date	1%	5%	10%
ADF	-7.13	14	1998	-6.89	-6.32	-6.16
Zt	-7.16	14	1998	-6.89	-6.32	-6.16
Za	-36.79	14	1998	-90.84	-78.87	-72.75

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Table 10: Long Run coefficients from ARDL estimates

Regressor	Coefficient	Standard Error	T-Ratio
ln GDPC	0.940	0.235	3.99***
ln Internet	-0.059	0.006	9.84***
Constant	-3.314	0.712	-4.65***

ARDL(1,0,0) (χ_{sc}^2)*:* (χ_1^2)*=0.412, F(1, 21)=0.338;* (χ_{ff}^2)*:* (χ_1^2)*=3.522, F(1, 21)=0.338;* (χ_n^2)*:* $(\chi_1^2)$$= 0.456$*;* (χ_{hc}^2)*:* $(\chi_1^2)$$= 2.195, F(1, 24) = 0.213$; *SER=0.0029; SSR=0.458;* $\bar{x}_y = 0.458$*;* $\hat{\sigma}_y = 0.049$*; AIC=112.883; SBC =110.367; LL=116.883; F-Stat. (3, 22) =2320.00; DW-Stat. =1.866*

Note: Statistically significant at 1% (***), 5% (**) and 10% (*) levels of significance.

Table 11: Error Correction Representation for the Selected ARDL Model (1,0,0) selected based on AIC

Regressor	Coefficient	Standard Error	T-Ratio
Δ ln GDPC	-0.0014	0.712	2.069**
Δ ln Internet	0.0039	0.340	11.592***
Δ C	0.0480	0.016	2.901***
ecm(-1)	-0.1120	0.077	-1.449**

R^2 *=0.885;* $\bar{R}^2 = 0.875$*;* $\bar{x}_{\Delta y} = 0.0041$; $\hat{\sigma}_{\Delta y} = 0.0085$*; F-Stat. =F(2,23)=88.641*

Note: Statistically significant at 1% (***), 5% (**) and 10% (*) levels of significance.

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Table 12: VEC Granger Causality/Block Exogeneity Wald test

Dependent variable: D(LSC)

Excluded	Chi-sq	df	Prob.
D(LGDPC)	1.712792	2	0.4247
D(NET)	2.964074	2	0.2272
All	3.501177	4	0.4777

Dependent variable: D(LGDPC)

Excluded	Chi-sq	df	Prob.
D(LSC)	4.952017	2	0.0841
D(NET)	2.903874	2	0.2341
All	6.369471	4	0.1732

Dependent variable: D(NET)

Excluded	Chi-sq	df	Prob.
D(LSC)	0.306446	2	0.8579
D(LGDPC)	0.051473	2	0.9746
All	0.692207	4	0.9523

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Figure 1: Number of Internet users per hundred people (%) in Australia during 1985-2012.

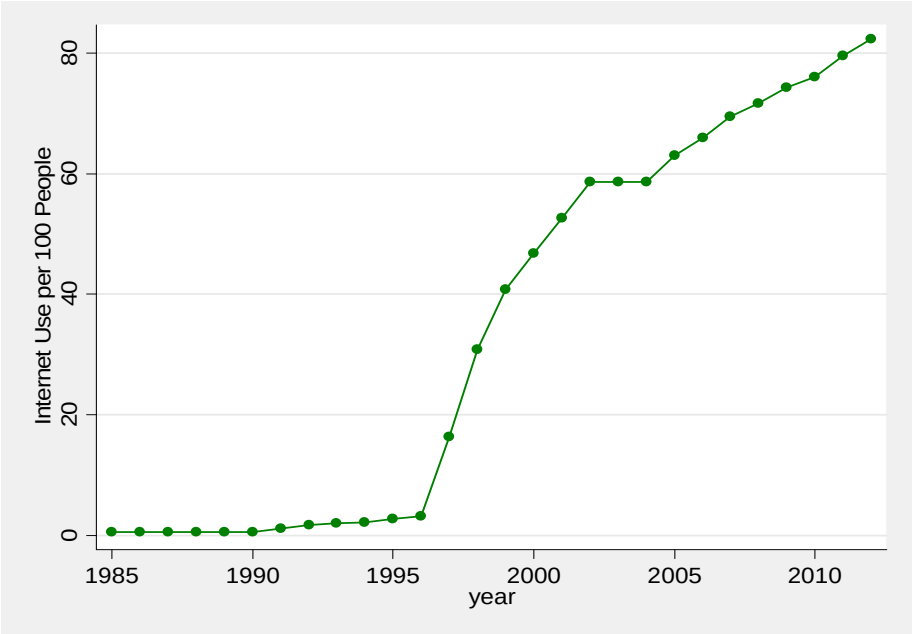
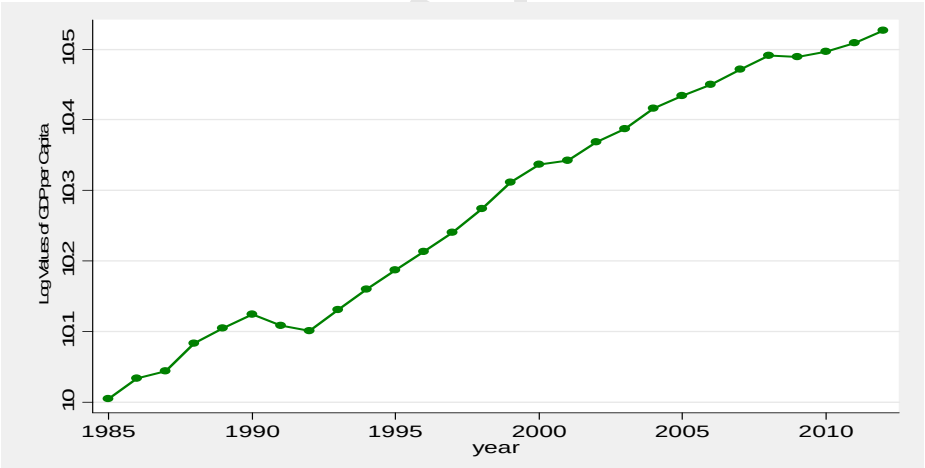


Figure 2: Logarithmic trend in per capita real GDP of Australia during the period 1985-2012



Source: The World Data Bank, World Development Indicators Database, The World Bank (2013).

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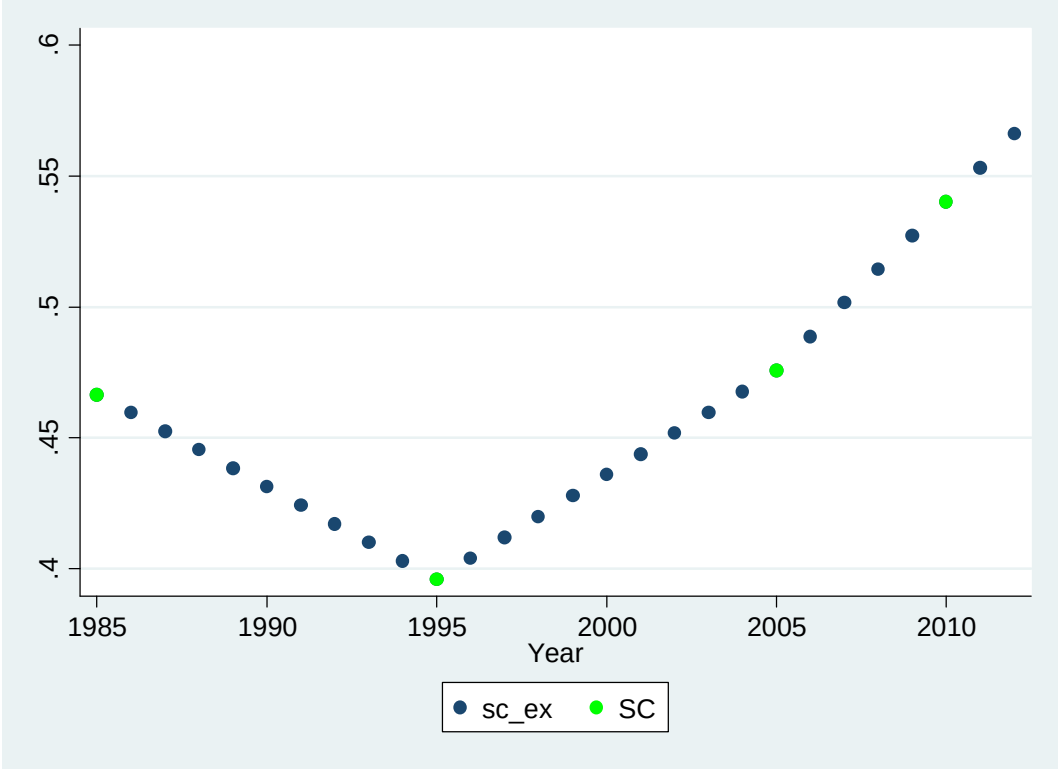
Figure 3: WVS values and interpolated values of social capital



Source: World Values Survey and author's own calculation through linear interpolation

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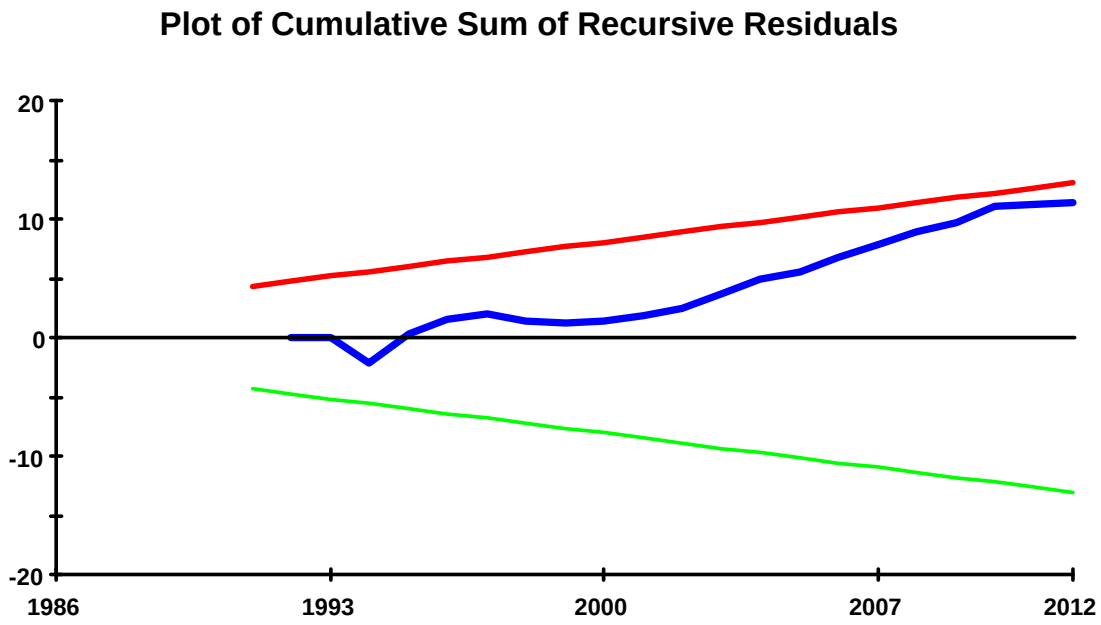
Figure 4A: Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at 5% significance level

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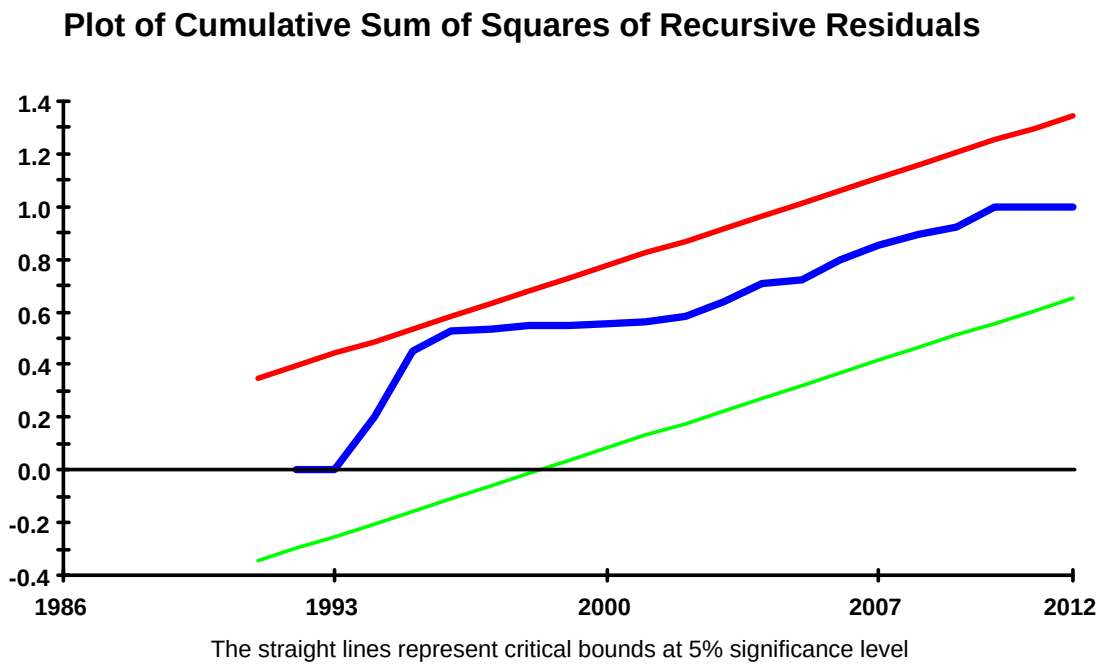
Figure 4B: Plot of Cumulative Sum of Recursive Residuals



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