Fiscal Deficit, Crowding Out and the Sustainability of Economic Growth
The Case of the Indian Economy

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Executive Summary

This study examines the long-run relationship between the fiscal deficit, the crowding out of private capital formation and net exports for the Indian economy during the period from 1980-81 to 2008-09. Applying unit root tests and cointegration techniques that allow for endogenously determined structural breaks, the analysis is done separately with the gross fiscal deficit of the central government, and the combined deficits of the central and state governments. The results do not indicate any long-run relationship among the variables, despite the balance-of-payments crisis of 1990-91 and sudden jump in deficits from 1997-98 onwards. Our finding supports neither a *crowding out* nor a *crowding in* hypothesis between government spending and private investment. On the contrary, our result hints at the Ricardian Equivalence Theory on public debt, implying thereby that it does not matter whether a government finances its spending with debt or a tax increase, the effect on the total level of demand in an economy will be the same.

The fiscal adjustment carried out as a combination of revenue augmenting measures as well as appropriate expenditure adjustment has helped to achieve sustained high economic growth with macroeconomic stability. While the actual numbers for disciplining fiscal deficit is debatable, the way forward for India is the recognition that fiscal responsibility rules are imperative for sustaining macro output growth. Further, standalone fiscal deficit targets would not be sufficient if not supported by targets on revenue or primary deficit.

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Introduction

For a developing country like India, fiscal policy is an important developmental tool. Following the twin objectives of *growth* with *macroeconomic stability,* the government's tax and expenditure policies have often resulted in resource – expenditure imbalances and sharp increases in public debt. Rising public debt can adversely affect savings and investment either directly or indirectly through interest rates and inflation, that can dampen the potential macro economic growth prospects. Therefore, it is not surprising that most of the macroeconomic stabilization models prescribe low levels of government deficit and public debt. The empirical evidence, however, does not suggest a strong association between growth, stabilization and low government deficit. In fact, it has been argued that if the government's structure of expenditure promotes fixed capital formation, then the country's output potential would rise. Then, fiscal deficit can in fact result in macroeconomic growth. In such a situation, the short-term macroeconomic stabilization issues that may follow need to be effectively addressed for sustained macroeconomic growth with stabilization.

The objective of this paper is to review the fiscal performance of India's central and state governments before and after the implementation of fiscal reform laws. In this regard, it studies the relationship between fiscal deficit, crowding out of private capital formation and net exports for the Indian economy during the period from 1980-81 to 2008-09.[1] The analysis is done separately with the gross fiscal deficit of the central government, and the combined deficits of the central and state governments. For this analysis, the study employs recent time-series econometric methods like the unit root test in the presence of an endogenous structural break (Perron, 1997) and cointegration techniques that allow for endogenously determined structural breaks (Gregory and Hansen, 1996).

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[1] The financial year for the Indian economy ranges from April (of the current calendar year) to March (of the next calendar year).

This paper is organized in the following way: The first section summarizes the theoretical debate on the relationship between fiscal deficits, investment and growth and discusses the place of this study within the debate. The second section then briefly reviews India's fiscal policy issues, while the third section provides an empirical analysis of India's case. The conclusion will provide a number of observations from this exercise, including a brief comparison of the EU's experience with the fiscal rules under the Maastricht Treaty with that of India's FRL experience.

Fiscal Deficit, Crowding Out and Debt Financing in the Indian Context

In understanding the relationship between fiscal deficit, investment and growth, theoretical and empirical analyses have highlighted three contrasting viewpoints. The neoclassical economists have argued that financing of increased fiscal deficit through public borrowing can cause the interest rate to increase and thereby result in *crowding out* of private sector investments (see studies by Blejer and Khan, 1984, Shafik, 1992, Beck, 1993, Heijdra and Ligthard, 1997, Kulkarni and Balderas, 1998, Voss, 2002, Ganelli, 2003). Within this broad framework, *crowding out* can take place when public investment substitutes for private investment, as has been the case with India (Chakraborty, 2006). This substitution takes place when the government steps up its borrowing in the domestic market (mainly to finance current consumption needs), resulting in the reduced availability of lendable funds to the private sector and leading to a fall in private investment. Moreover, with no interest rate differences between the government and the private firms[2], banks prefer lending to the government as there would not be any risk of default. Thus, an increase in the size of public sector spending would be at the expense of the private sector and can adversely affect economic growth.

In contrast to this substitution effect, the complementary relationship between public spending and private investment, advocated by the Keynesians, underlines how an increase in government spending can stimulate the domestic economic activity by a greater proportion (through the multiplier process) and thereby *crowds in* private investment, especially when the economy is not operating at the full employment level. The extent of the crowding in will depend on the composition of government expenditure. The proponents of the Keynesian viewpoint stress that the private sector can benefit only if the public sector investment is in infrastructure, education and health

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[2] Prior to the reforms, government borrowed from the banks at a lower interest rate. Administered interest rates were changed infrequently and the changes too were usually quite small. Perhaps the single most important element of the financial sector reforms has been the deregulation of interest rates. The government reduced its pre-emption of bank funds and moved to market-determined interest rates on its borrowings (Source: http://www.iimahd.ernet.in/~jrvarma/papers/vik23-1.pdf).

that involve large fixed costs and long gestation period (Hussain *et. al.*, 2009). Thus, the nature of the two investments is complementary[3].

Between these approaches of substitutability and complementarity, the third view, based on the Ricardian Equivalence Theorem, argues that the deficit in the current period will be equal to the present value of future taxation that would be required to finance the deficit. This will result in an individual's rise in savings as household spending decisions take into account their future tax liabilities. This extra saving will increase the national savings and therefore offset any increase in interest rate, leaving the investment unchanged. Thus, the interest rates and private investment are left unchanged (Barro, 1978, Ghatak and Ghatak, 1996, Bahmani-Oskooee, 1999). Argued thus, fiscal deficits will not have much impact on aggregate demand if household spending decisions are based on the present value of their incomes that takes into account the present value of their future tax liabilities (Rangarajan and Srivastava, 2005).

In addition to these macroeconomic effects, there is another important dimension of fiscal imbalances: the effect on the current account balance. Empirical studies suggest varying views concerning the effect of fiscal deficit on the balance of payments (see Bussiere, Fratzscher and Müller, 2005; Cavallo, 2005, etc.). The proponents of twin-deficit hypothesis – high fiscal deficit leads to high current account deficit – advocate that when government increases its spending, some of the additional incomes are used by domestic consumers to boost their private consumption, which in turn causes national savings – public and private – to decline (Nickel and Vansteenkiste, 2008). The reduced supply of lendable funds in the market induces the country to either borrow from abroad or temporarily reduce its foreign lending, which decreases domestic investment enough to offset the saving shortfall. This leads to a wider current account deficit.

While the above theoretical perspectives provide a useful frame of reference for understanding the effect of government sector imbalances on output growth, the appropriate macroeconomic model is driven by the specific context. Therefore, it is important to delineate the various interrelationships for arriving at an appropriate fiscal stance for India. Under the New Economic Policy Programme of 1990-91, India's macroeconomic conditions have been increasingly integrated with the foreign sector, as a result household consumption & savings behavior, industry investment behavior and government expenditure behavior have exerted influence on variables like exchange rates and net exports (i.e. trade balances). Being a developing country, India has had a negative savings-investment gap,

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[3] This is highlighted in the research studies by Buiter (1977), Aschauer (1989), Greene and Villanueva (1990), Erenburg (1993), Ramirez (1994), and Baldacci, Hillman and Kojo (2004).

leading to an inflow of funds from abroad. Without exchange rate controls, this would result in appreciation of the currency, which can make domestic goods less competitive in world markets and result in trade deficits. If the saving-investment gap is triggered by government deficit, then it has been argued that fiscal deficits could lead to a current account deficit -- referred to as *twin deficits.*

The empirical research in establishing the link between fiscal and trade accounts has produced mixed and inconclusive results. While fiscal deficits may have some immediate impact on the current account, the full effect of permanent deficit shocks may take years or even decades to arrive, making it difficult to correctly capture in empirical work (Kumhof and Laxton, 2009). Also, because of exchange rate controls in India until the mid 1990s, the significance of monetary influences can rise, resulting in inflationary conditions. For this reason, in the pre-1990s and early 1990s, even when output growth was below potential, an expansionary fiscal policy stance could not be taken because of the inflationary conditions and balance of payment difficulties.

However, from the early 2000s, with the improvement in foreign exchange reserves and easing of the supply shocks, fiscal policy has been more responsive to output growth & stabilization. In this regard, an understanding of whether fiscal deficit can actually trigger crowding out (through interest rate changes) would be appropriate in light of an expansionary fiscal policy. Empirical evidence on fiscal deficits and its crowding out effects on private investment and net exports for the Indian economy have been few and mixed. Patnaik (2001) observed that, if money supply is exogenously given, fiscal deficits may raise interest rates by increasing the demand for money, which leads to crowding out. Similarly, Deepak Lal et al (2001) established that the financing of large fiscal deficits through open market operations has led to higher real interest rates and crowding out of private investment. On the other hand, using an asymmetric vector autoregressive model, Chakraborty (2006) in her study for the period from 1970-71 to 2002-03 finds no real evidence of crowding out between public (in particular, infrastructure) and private investment; rather complementarity is observed between the two. The Reserve Bank of India (2002) has highlighted that infrastructure investment by public sector crowds in private investment while public investment in manufacturing crowds out private investment.

Even when the composition of public investment (under rising fiscal deficit conditions) can have important implications for output growth, the sustainability of maintaining an expansionary fiscal policy will depend on fiscal deficit and debt conditions. Conceptually, sustainability implies that additional borrowing should lead to commensurate returns, which could be in the form of higher growth and therefore growth in government revenues. Thus, the interest payment (i.e. debt stock and interest rate) of the government is a good indicator of sustainability. In this regard, for India, it is important to differentiate between fiscal deficit and primary deficit. When

interest payments are deducted from fiscal deficit, we arrive at primary deficit, which represents the borrowing requirements of the government for current expenditures (both revenue and capital). Increases in revenue expenditures can result in a fall in government's net savings thereby necessitating higher borrowing. At the same time, if the revenue expenditure crowds out capital expenditure, then this would negatively affect output growth, thereby making fiscal deficit unsustainable.

A related dimension that is important for understanding the sustainability issue is the relative merit of alternate channels of financing fiscal deficit (i.e. domestic market borrowing, external borrowing or borrowing from the Central bank). Financing of debt through monetization can fuel inflation, while market borrowing can increase interest rates. In the pre-reform years, it was found that bond-financing debt led to high growth of government debt while monetization led to a high inflation rate. It needs to be underlined that during these years, the interest rate was highly regulated with government bond rate kept much lower than that of the market interest rate. For this reason, government borrowing emerged as a preferred option, as opposed to raising taxes or reducing expen-ditures. It is under these conditions that the exogenous limit on gover-nment borrowing was exercised through debt control and deficit control rules and targets.

In view of the above dimensions, the present study complements the existing literature in a number of ways. *First*, almost all the studies have considered the effect of deficit spending on crowding out of private investment alone. However, as suggested in Kumhof and Laxton (2009), fiscal deficit not only crowds out private investment, but also net exports. The present paper examines not only the long-run relationship between the fiscal deficit and private capital formation, but also the effects of fiscal deficit on net exports for the Indian economy during the period from 1980-81 to 2008-09.

Secondly, in most of the studies in Indian context, the deficit of only the central government is highlighted. However, the fiscal discipline at the state level is also an important dimension. While most Indian states also adopted their own fiscal responsibility laws (FRL) and have experienced significant improvements in their overall balances in the last few years, a more detailed analysis of the nature of this consolidation is necessary if India is to achieve and sustain an accelerated growth trajectory.

Fiscal Policy Developments in India

India embarked on a major economic restructuring program in 1990-91 that also covered reforms in taxation and expenditure policies of the government. With the rationalization of direct and indirect taxes, there were significant revenue losses because of narrow tax base and low tax buoyancy. At the same time, the government (both central and state)[4] was not able to contain its expenditure, which resulted in severe fiscal imbalances. The fiscal deficit[5] of the central government, which was at 7.8 percent of GDP in the crisis year of 1990-91 initially declined to 4.8 percent in 1996-97. However, during the years 1997-98 and 2001-02, the fiscal deficit, once again, increased to over 6.0 percent of GDP primarily on account of the implementation of the fifth pay commission[6]. The impact of increasing fiscal deficit was manifested in the debt-GDP ratio of the Center, which increased from 55.22 percent in 1990-91 to 63.33 percent in 2004-05 and subsequently declined to 58.9 percent in 2008-09 (see Table 1).

[4] According to its constitution, India is a "sovereign socialist secular democratic republic". India has a federal form of government. Part II of the Indian constitution defines the power distribution between the central government and states in India. This part is divided between legislative and administrative powers. The legislative section is divided into three lists: Union list, States list and Concurrent list.

[5] The conventional deficit (budgetary deficit) is the difference between all receipts and expenditures, both revenue and capital. Since March 1997, conventional deficit is represented as a drawdown of cash balances. The gross fiscal deficit (GFD) is the excess of total expenditure (including loans net of recovery) over revenue receipts (including external grants) and non-debt capital receipts. Since 1999-2000, GFD excludes the states' share in small savings as per the new system of accounting. Combined GFD is the GFD of the central government plus GFD of state governments minus net lending from the central government to state governments. Revenue deficit is the difference between revenue receipts and revenue expenditure of the central and state governments adjusted for inter-governmental transactions in the revenue account. The net primary deficit denotes net fiscal deficit minus net interest payments. Primary revenue balance denotes revenue deficit minus interest payments.
(Source: http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/NTFN100909.pdf)

[6] The Pay Commission is a panel of members of the Union Cabinet of India for raising the salaries of Government employees. Since India's Independence, six pay commissions have been set up on a regular basis to review and make recommendations on the work and pay structure of all civil and military divisions of the Government of India.

Table 1: Select Fiscal Indicators of India's Central Government

Year	Fiscal Deficit as % of GDP	Revenue Deficit as % of GDP	Revenue Deficit/ Fiscal Deficit (%)	Total Debt as % of GDP
1990-91	7.84	3.26	41.6	55.2
1996-97	4.84	2.37	48.9	49.0
2001-02	6.19	4.40	71.1	59.9
2002-03	5.91	4.40	74.4	63.5
2003-04	4.48	3.57	79.7	63.0
2004-05	3.99	2.49	62.3	63.3
2005-06	4.08	2.57	63.0	63.0
2006-07	3.45	1.94	56.3	61.5
2007-08	2.69	1.11	41.4	60.1
2008-09	6.14	4.53	73.9	58.9

Source: Handbook of Statistics on Indian Economy, 2008-09

Rising fiscal deficit raises concern about macroeconomic stability and sustainability, particularly if the expenditure is mainly for current consumption needs. The revenue deficit, as a percentage of fiscal deficit, increased from 41.6 percent in 1990-91 to 79.7 percent in 2003-04. This ratio has since come down to 41.4 percent by 2007-08, but then increased to 73.9 percent in 2008-09 (Table 1). This trend is alarming because it would mean that the central government's borrowed funds are mainly used for current consumption like payment of salaries, pensions and subsidies and not for capital investment that will yield future income (Rangarajan and Subbarao, 2007).

Rising revenue deficit also has adverse implications on government savings and investment and consequently on the country's growth rate. The trend in the government's saving and investment is detailed in Table 2. From the table, two distinct phases are evident. Between 1990-91 and 2003-04, government saving was negative or low, but subsequently increased from 2.2 percent to 4.5 percent of GDP in the years that followed. Following this, government's share in fixed capital formation, which had earlier declined from 9.6 percent to 6.4 percent of GDP during 1990-91 and 2004-05, has increased thereafter. The rising capital expenditure by the government on infrastructure and other vital public goods has positively influenced the overall growth of the country. In this regard, it is important to highlight that these trends are associated with important developments like the adoption of the Fiscal Responsibility and Budget Management Act (FRBMA), which could have contributed to these positive trends.

Table 2: Gross Domestic Saving and Gross Fixed Capital Formation as percent of GDP (1999-2000 series)

Year	Gross Domestic saving				Gross Fixed Capital Formation		
	Household Sector	Private Corporate Sector	Public Sector	Total	Public Sector	Private Sector	Total
1990-91	18.4	2.7	1.8	22.8	9.6	13.4	23.0
1998-99	18.8	3.9	-0.5	22.3	6.9	15.9	22.8
2001-02	22.1	3.4	-2.0	23.5	6.5	17.1	23.6
2002-03	22.9	4.0	-0.6	26.3	6.3	17.6	23.8
2003-04	24.1	4.6	1.1	29.8	6.5	18.5	25.0
2004-05	22.8	6.7	2.2	31.7	6.4	22.0	28.4
2005-06	24.1	7.7	2.4	34.2	7.0	24.0	31.0
2006-07	24.1	8.3	3.3	35.7	7.6	24.9	32.5
2007-08	24.3	8.8	4.5	37.7	8.3	25.7	34.0

Source: Economic Survey, 2008-09

Putting the FRBMA of 2003 into practice took on a sense of urgency because of the deteriorating fiscal imbalances in the post reform years. This Act is an Indian analogy of the EU fiscal framework as laid down in the Maastricht Treaty and the Stability and Growth Pact (SGP, the Pact) that aims to maintain a budget deficit up to 3 percent of GDP and keep public debt under 60 percent of GDP. The FRBM Act of 2003, which became effective from July 5, 2004, mandates that the central government eliminate revenue deficit by March 2009 and reduce fiscal deficit to an amount equivalent to 3 percent of GDP by March 2008 (although, the deadline for achieving the FRBMA target has since been repeatedly postponed). To achieve the same, the following targets need to be worked out:

- reduction of current deficit by at least 0.5 percent of GDP in each financial year beginning with 2004-05;

- reduction of the fiscal deficit by at least 0.3 percent of GDP in each financial year so that the fiscal deficit could be brought down to no more than 3 percent of GDP at the end of March 2008;

- limitation of 0.5 percent of GDP on the incremental amount of guarantees given by the central government; and

- initial annual limitation on debt accumulation to 9 percent of GDP, to be progressively reduced by at least one percentage point of GDP each year.

The FRBMA covers only the central government and its stated objective is 'to ensure inter-generational equity in fiscal management, achieve fiscal sustainability necessary for long-term macro-economic

stability, and improve the transparency of central government fiscal operations' (Simone and Topalova, 2009). Indian states were encouraged by the Twelfth Finance Commission[7] (TFC) through incentives to implement their own fiscal responsibility laws (FRLs) in the form of conditional debt restructuring and interest rate relief, provided that the states pass and implement FRLs targeting revenue balance by 2008-09 and a 3 percent of GDP overall deficit by 2009-10. The TFC recommended an increase in the share of central government revenue (from 29.5 to 30.5 percent) and the amount of grants received by states. The enactment of the FRLs coincided with a process of fiscal consolidation at the state level. According to Simone and Topalova (2009), the consolidated deficit of the Indian states was more than halved from 4.5 percent of GDP in 2003-04 to 2.5 percent in 2007-08. The debt levels of the states also declined; as of 2007-08, most of the states were well ahead of the stipulated time schedule in reaching their current and overall balance targets. This can be attributed to states' own fiscal efforts on the one hand, and higher resource transfers from the central government on the other[8]. As a result, the overall deficit of the Central and State Governments as a percent of GDP shows a modest decline by more than 2 percentage points between 2004-05 and 2007-08 (Table 3).

Table 3: Select Fiscal Indicators of India's Central and State Governments

Year	Fiscal Deficit as % of GDP	Revenue Deficit as % of GDP	Revenue Deficit/Fiscal Deficit (%)	Total Debt as % of GDP
1990-91	9.41	4.19	44.6	64.75
1996-97	6.33	3.54	55.9	59.35
2001-02	9.94	6.99	70.4	76.05
2002-03	9.57	6.64	69.4	80.29
2003-04	8.41	5.79	70.0	81.39
2004-05	7.45	3.64	48.9	81.35
2005-06	6.68	2.77	41.5	80.29
2006-07	5.58	1.34	24.0	77.27
2007-08	5.25	0.87	16.5	76.79
2008-09	8.5	4.2	49.6	--------

Source: Handbook of Statistics on Indian Economy, 2008-09
Note: Source for 2008-09: Economic Survey 2009-2010

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[7] The Constitution of India provides for the establishment of a Finance Commission for the purpose of allocation of certain resources of revenue between the Union and the State governments. The Finance Commission is established under Article 280 of the Constitution of India by the President. So far 13 Finance Commissions have been appointed.

[8] There were, however, large variations amongst States with Assam exhibiting a fiscal surplus of 0.6 percent of the gross state domestic product (GSDP) and Mizoram having a fiscal deficit as high as 14.7 percent of GSDP in 2005-06 (Economic Survey, 2009 -10).

India's experience with fiscal rules under FRBMA has been mixed. Between the initiation of the FRBMA Act from July 5, 2004 and 2007-08, a noticeable decline in combined fiscal deficit to less than 5.5 percent of GDP was achieved. A major part of the fiscal adjust-tment over this time period was due to revenue gains with improvements in tax performance brought about by rapid economic growth. Direct tax collections during 2007-08 exceeded those of indirect taxes. Within direct taxes, the main contribution came from corporate income tax. In the case of indirect taxes, earnings from excise duty remained less buoyant, customs revenue grew gradually, and a service tax was the major driver of revenue growth (Economic Survey, 2008-09). A decline in interest payments contributed to the rest of the fiscal adjustment. Interest payments of the central government as a proportion of GDP remained above the 4 percent level in the period from 1997-98 to 2004-05, with a peak level of 4.8 percent in 2002-03. Thereafter, the proportion dropped to around 3.6 percent in 2007-08 and was budgeted at the same level in 2008-09.

Table 4 exhibits the annual average cost of borrowing of the central government, which rose steadily from a level of 8.2 percent in 1990-91 to 10.3 percent in 1999-2000. The cost of borrowing fell to 8.1 percent in 2005-06, following the softening of interest rates in the initial period of the current decade. Thereafter, it increased to 8.5 percent in 2007-08 as a result of tight monetary policy and the costs of sterilization operations undertaken to ease out the surge of institutional capital inflows on the macro economy (Economic Survey, 2008-09).

Table 4: Interest on Outstanding Interest Liabilities of Central Government[9]

Year	Outstanding Internal Liabilities	Interest on Internal Liabilities	Annual average cost of borrowing
	Rupees Crores		Percent
2003-04	1,457,583	116,869	8.8
2004-05	1,603,785	124,126	8.5
2005-06	1,752,404	129,474	8.1
2006-07	1,967,870	146,405	8.4
2007-08	2,247,104	167,099	8.5
2008-09	2,537,848	188,535	8.4

Source: Economic Survey, 2008-09

Even as the average cost of borrowing has declined over the years, the sensitivity of government debt to interest rate and

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[9] Average cost of borrowing is the percentage of interest payment in year 't' to outstanding liabilities in year 't – 1'. Outstanding internal liabilities exclude (a) Rs. 4079.62 crore towards premium on account of domestic debt buyback scheme and prepayment of external debt for 2003-04; (b) loans from the National Small Savings Fund (NSSF) to states, since there is no interest liability on the part of the central government.

exchange rate changes would be evident by looking at the composition of the government's outstanding liability. Table 5 details the composition of government debt where the internal liabilities account for over 95 percent of the outstanding liabilities. Amongst this, market borrowing accounted for about 68 percent of the total internal liabilities, implying that the low interest debt instruments are no longer easily accessible to the government. With respect to external debt, although the overall share is low, there is a rising trend in recent years. External debt as a percentage of GDP increased from 1.7 percent in 2003-04 to 2.3 percent in 2008-09. As external debt figures are based on historical rates of exchange, the fluctuations in exchange rate can influence the external debt liability. The trend in exchange rate shows that the rupee depreciated in 1998, which continued until 2006. The average rupee-US dollar exchange rate, which stood at 36.3 in 1996, decreased to 48.6 in 2002 and became 48.9 in 2008-09. This would imply that the government's dependence on external sources is rising slowly, particularly from 2005-06 onwards.

Table 5: Outstanding Liabilities of Central Government as Percentage of GDP

Year	Internal Liabilities		External Debt (Outstanding)	Total Outstanding Liabilities
	Market Borrowing	Total		
2003-04	25.7	61.4	1.7	63.0
2004-05	24.1	61.4	1.9	63.3
2005-06	24.0	60.4	2.6	63.0
2006-07	23.6	59.0	2.5	61.5
2007-08	23.1	57.7	2.4	60.1
2008-09	25.5	56.6	2.3	58.9

Source: Economic Survey, 2008-09

In view of the above, we may say that India's experience with fiscal rules under FRBMA has been mixed. Between the initiation of the FRBMA Act from July 5, 2004 and 2007-08, a noticeable decline in combined fiscal deficit to less than 5.5 percent of GDP was achieved. However, the deficit for 2008-09 far exceeded the budgetary target, apparently influenced by the global crisis, implementation of the Sixth Pay Commission and loan waivers for farmers. India's inflation spurted to double digits in June 2008 – higher than the rate of economic growth – following the high crude oil and commodity prices. At the same time, the government's decisions to raise subsidies in order to partly absorb the burden of higher crude and fertilizer prices has dramatically increased the fiscal deficit. Moreover, the government's rural development and welfare schemes, particularly the agricultural loan waiver, have further resulted in severe fiscal imbalances. The large fiscal deficits that followed translated into larger current account deficits for the Indian economy. Merchandise trade deficit during April-August 2008 widened to US$ 49.3 billion

from US$ 34.6 billion during the same period in 2007. A huge trade deficit has put downward pressure on the rupee exchange rate since March 2009. Therefore, it is not surprising that the deadline for achieving the FRBMA current account deficit targets has been repeatedly postponed.

Moreover, the central government's fiscal deficit of 6.8 percent of GDP for fiscal year 2009-2010 (excluding below-the-line items such as oil and fertilizer bonds) was more than double the 2.7 percent recorded in fiscal year 2007-2008. And when the state government deficits[10] and off-balance-sheet items such as oil and fertilizer bonds are included, the deficit is estimated to reach about 12 percent of GDP in fiscal year 2009-2010.[11] Such high levels of government deficits are unsustainable over a length of time and raises questions about the effectiveness of the FRBMA.

It is, in this context, that fiscal consolidation assumes significance for a country like India. Some of the important reasons for consolidation that are of special significance to India are the following:

- To minimize the crowding out of private investment and/or net exports as it can lower the constraints imposed by government's financing needs on the domestic financial system (Simone and Topalova, 2009).

- To reduce excess demand pressure created by the inflow of foreign funds in the medium term. In the long term, the interest gaps – particularly with the USA, Japan, and EU – can be reduced as lower fiscal deficits will allow the economy's real domestic long-term interest rate to shrink. (Virmani, 2007).

- To reduce instability in the economy by curtailing the expectations on how the deficits will be financed. If the private sector expects that the deficit is financed through monetization then these expectations will be self-fulfilling and lead to inflation even if the Government does not monetize the deficit.

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[10] It is worthwhile to note that in 2008-09, with higher levels of disbursements, fiscal deficit of the state governments went up to a level of 2.6 percent of the GDP but was still well below the 3.0 percent level mandated by the FRLs. However, with the relaxation in state-level fiscal targets to overcome the adverse impact of the global crisis, fiscal deficit for the state governments budgeted in 2009-10 is 3.2 percent of the GDP (Economic Survey, 2009 -10).

[11] If we try to bring into equivalence with the EU, which has a 3 percent fiscal deficit limit under the Maastricht treaty, the current target is four times that of the EU.

Methodology and Empirical Analysis

Data on India's fiscal deficit suggests that during 1997-98 the central government fiscal deficit (Revised Estimates) reached 6.1 percent of GDP, well above the budget target of 4.5 percent. This was primarily due to shortfall in tax revenue and disinvestment receipts. The 1997-98 budget introduced sharp cuts in income tax rates with a view to stimulate savings and investment and encourage higher tax compliance. Personal and corporate tax rates were reduced and rationalized to bring them to internationally comparable levels (Economic Survey, 1997-98). Given the strong likelihood that the series under consideration are subject to structural breaks, the unit root test by Perron (1997) is undertaken. This test allows reducing the bias in the standard unit root tests by endogenously identifying the break date. Perron's (1997) unit root test considers two different structural breaks: the Innovational Outlier (IO) model, which allows changes to take place gradually; and the Additive Outlier (AO) model, where changes are assumed to take place instantaneously. The IO model again has two categories, namely, IO1, which allows for a gradual change in the intercept and IO2, where there is a gradual change in both intercept and slope of the trend function. The detailed methodology of Perron's (1997) unit root test is explained in the Appendix at the end of the paper.

Tables 6 and 7 contain the results of the sequential unit root tests for the variables in levels and in first differences. The results suggest that the null hypothesis of a unit root cannot be rejected for all the variables in levels. In other words, the series are non-stationary in the presence of an endogenous structural break at a 5 percent level of significance. However, if we take the first differences, the unit root for most of the series can be rejected at the 5 percent level, suggesting thereby that they are integrated of order 1, i.e., I (1).

Table 6: Perron's (1997) Unit Root Tests (At Levels)

Series	Model	Break Point	Lag	Test Statistic	Critical Values at 5%	Result
GFD	IO1	1997	4	-4.02620	-5.23	Unit Root
GFD	IO2	1997	4	-4.40541	-5.59	Unit Root
GFD	AO	1986	0	-3.47998	-4.83	Unit Root
CGFD	IO1	1997	4	-3.79576	-5.23	Unit Root
CGFD	IO2	1997	4	-4.96116	-5.59	Unit Root
CGFD	AO	1993	4	-4.19618	-4.83	Unit Root
GDCF	IO1	2002	0	-3.33012	-5.23	Unit Root
GDCF	IO2	1999	2	-4.53980	-5.59	Unit Root
GDCF	AO	2004	2	-3.90886	-4.83	Unit Root
CAD	IO1	1999	3	-4.26991	-5.23	Unit Root
CAD	IO2	2000	0	-4.89017	-5.59	Unit Root
CAD	AO	1986	3	-3.90884	-4.83	Unit Root

Note: IO1: innovational outlier with a change in the intercept
IO2: innovational outlier with a change in the intercept and in the slope
AO: additive outlier with a change in the slope only but both segments of the trend function are joined at the time break

Table 7: Perron's (1997) Unit Root Tests (At First Difference)

Series	Model	Break Point	Lag	Test Statistic	Critical Values at 5%	Result
GFD	IO1	1995	1	-6.69402	-5.23	I(1)
GFD	IO2	1995	1	-6.54467	-5.59	I(1)
GFD	AO	1991	1	-5.99324	-4.83	I(1)
CGFD	IO1	1994	0	-5.44296	-5.23	I(1)
CGFD	IO2	1994	0	-5.41460	-5.59	Unit Root*
CGFD	AO	2000	0	-5.48499	-4.83	I(1)
GDCF	IO1	2002	3	-5.90043	-5.23	I(1)
GDCF	IO2	1999	3	-6.09586	-5.59	I(1)
GDCF	AO	2000	3	-5.00367	-4.83	I(1)
CAD	IO1	2002	0	-9.34392	-5.23	I(1)
CAD	IO2	2002	0	-9.87924	-5.59	I(1)
CAD	AO	2002	3	-4.56930	-4.83	Unit Root*

* However, these series are I (1) at 10 percent level of significance

Cointegration Test Results

After determining the order of integration of each variable, we tested for cointegration to find out whether any long-run relationship exists among the variables and if so, the nature of the relationship. Standard cointegration techniques are biased towards accepting the null hypothesis of no cointegration if there is a structural break in the relationship and may produce 'spurious cointegration results' (Kunitomo, 1996). We therefore apply the Gregory and Hansen (1996) cointegration procedure that allows for an endogenously

determined structural break. The test presents three models, whereby the shifts can be in either the intercept alone, in both trend and level shift or a full break. The detailed methodology of this cointegration test is explained in the Appendix at the end of the paper.

The results and the critical values are reported in Tables 8 and 9. Table 8 reports results for the gross fiscal deficit of the central government as a percentage of GDP, rate of gross domestic capital formation and the current account deficit as a percentage of GDP. The same for the combined gross fiscal deficit of the central and state governments are reported in Table 9. Both results fail to reject the null hypothesis of no cointegration at a 5 percent level of significance. The break dates of 1991-92 and 1997-98, as established by the Gregory and Hansen (1996) procedure, correspond with the initiation of economic reforms of India in 1991 and the sudden jump in fiscal deficit of the combined central and state governments in 1997, following the aftermath of East Asian currency crisis. As discussed earlier, the high fiscal deficit in 1997-98 was also an outcome of sharp cuts in income tax rates in the budget, with a view to stimulate savings and investment and encourage higher tax compliance.

Table 8: Gregory and Hansen (1996) Cointegration Tests with Structural Break (Dependent Variable: Gross Fiscal Deficit of Central Government)

Model	Break Point	ADF	Critical Value (5%)	Result*
C	1991	-3.42895	-4.92	Do not reject the null hypothesis
C/T	1992	-3.55614	-5.29	Do not reject the null hypothesis
C/S	1992	-3.83702	-5.50	Do not reject the null hypothesis

*The null hypothesis being no cointegration between the gross fiscal deficit of the central government as a percentage of GDP, rate of gross domestic capital formation and current account deficit as a percentage of GDP.
Note: C = CONSTANT that includes an intercept and a level shift dummy.
C/T = TREND that includes an intercept, trend and a level shift dummy.
C/S = FULLBREAK that includes no trend, but dummies for the intercept and the slopes

Table 9: Gregory and Hansen (1996) Cointegration Tests with Structural Break (Dependent Variable: Combined Fiscal Deficit of Central and State Governments)

Model	Break Point	ADF	Critical Value (5%)	Result*
C	1998	-2.91784	-4.92	Do not reject the null hypothesis
C/T	1992	-3.66742	-5.29	Do not reject the null hypothesis
C/S	1998	-3.10102	-5.50	Do not reject the null hypothesis

*The null hypothesis being no cointegration between the combined gross fiscal deficit of the central and state governments as a percentage of GDP, rate of gross domestic capital formation and current account deficit as a percentage of GDP

To sum up, applying a more robust and recent developments in time-series econometrics, our results do not support either the *complementarity hypothesis* between public and private sector investment as observed in Chakraborty (2006), neither the crowding out hypothesis as advocated by Patnaik (2001) and Deepak Lal et al (2001). On the contrary, our result hints at the Ricardian Equivalence Theory on public debt, implying thereby that it does not matter whether a government finances its spending with debt or a tax increase, the effect on total level of demand in an economy will be the same.

Concluding Observations

From a macroeconomic perspective, low levels of fiscal deficit and public debt are generally considered necessary to ensure the sustainability of high economic growth and macroeconomic stability. Fiscal consolidation began in India in the early 1990s as a part of economic liberalization, with fiscal deficits declining from 7.84 percent of GDP in 1990-91 to 4.84 percent of GDP in 1996-97. However, following the implementation of Fifth Pay Commission and rationalization in the income tax structure, fiscal deficits worsened to a level of 6.2 percent of GDP in 2001-02. It was against this backdrop that the Fiscal Responsibility and Budget Management Act (FRBMA) of 2003 became operational, which mandates that the central government eliminate revenue deficit by March 2009 and reduce fiscal deficit to an amount equivalent to 3 percent of GDP by March 2008. In the four years post-FRBMA, the economy adhered to fiscal discipline with central government's fiscal deficit at 2.7 percent of GDP in 2007-08 reflecting the attainment of the FRBMA terminal year target. However, it faltered in 2008-09, as the Indian economy was adversely affected by the unprecedented increase in crude oil and global commodity prices in the first half of 2008 and the cascading effects of global financial meltdown in the second half of 2008. The Indian government – like most other developed and developing economies – adhered to expansionary fiscal policy comprising of both tax cuts and expenditure hikes. The slippage in the FRBMA target for the terminal year has been further worsened by government's welfare schemes like a farm loan waiver, and the implementation of Sixth Pay Commission. Such resource-expenditure imbalances can potentially trigger macroeconomic problems for an emerging economy like India, as rising public debt can adversely affect savings and investment either directly or indirectly through interest rates and inflation.

The objective of the present paper was to examine the long-run relationship between the fiscal deficit, crowding out of private capital formation and net exports for the Indian economy during the period 1980-81 to 2008-09. Applying Perron (1997) unit root tests and Gregory and Hansen (1996) cointegration techniques (see Appendix) that allow for endogenously determined structural breaks, the analysis is done separately with the gross fiscal deficit of the Central government, and the combined deficits of the central and state governments. The results do not indicate any long-run relationship among the fiscal deficit as a percentage of GDP, rate of gross domestic capital formation and current account deficit as percentage of GDP. The break dates of 1991-92 and 1997-98 in the cointegrating

relationship correspond to the initiation of economic reforms of India in 1991 and the sudden jump in fiscal deficit in 1997, following a shortfall in customs and excise tax collections and the rationalization of income taxes to encourage higher tax compliance. Further, as discussed in the previous section, following a period of reasonable stability, the Indian rupee fell to a low of Rs. 40.36 per US dollar by January 16, 1998, registering a cumulative depreciation of about 9 percent from March 1997. This was partly attributed to the contagion effect of the currency turmoil in Southeast Asia, and partly an element of political uncertainty in November 1997.

To sum up, our finding supports neither *crowding out* nor *crowding in* hypothesis between government spending and private investment. On the contrary, our result hints at the Ricardian Equivalence Theory on public debt, implying thereby that it does not matter whether a government finances its spending with debt or a tax increase, the effect on total level of demand in an economy will be the same. This result calls for further clarification in the current context of the Indian macro economy. As explained in second section, post-FRBMA, barring the fiscal year 2008-09, the fiscal adjustment carried out as a combination of revenue augmenting measures as well as appropriate expenditure adjustment has helped to achieve sustained high economic growth with macroeconomic stability. As exhibited in Table 2, with the implementation of FRBMA in July 2004, government savings increased from 2.2 percent in 2004-05 to 4.5 percent of GDP in 2007-08. Following this, government's share in fixed capital formation exhibited a corresponding increase from 6.4 percent to 8.3 percent of GDP. The rising capital expenditure by the government on infrastructure and other vital public goods has positively influenced the overall growth of the country. As pointed out by Kannan and Singh (2007), the convergence in fiscal deficit and public debt has helped to accelerate the investment rate in the economy, at least in the medium run.

Considering the above, is rule-based deficit targeting the only answer to fiscal discipline across countries? The answer is not clear especially when the following points are taken into account:

- The appropriate level of fiscal deficit is very contextual and therefore may vary from country to country and from time to time. For India, defining an appropriate level of fiscal deficit would necessitate an assessment of the savings rate, existing stock of debt, interest rate, foreign exchange reserve position, degree of capital controls and defining desirable expenditure heads. Any changes in these variables will necessitate a relook at the deficit targeting rules.

- The accounting practices of defining fiscal deficit can differ between countries and may also change over the years. For example, in India, fiscal deficits are understated as some of the liabilities of the government – such as the oil bonds – are not treated

as debt. And if included, they may increase fiscal deficit by 0.7 percent of GDP. Similarly, the disinvestment proceeds of the public sector unit have been captured as revenue for calculating fiscal deficit. This would imply that the inherent imbalances in government budgeting would continue even when the fiscal deficit has been reduced.

▪ International experience on implementing target-based deficit rules is not very encouraging. The Stability and Growth pact by Europe was mainly aimed at drawing a common fiscal framework for member countries before the euro replaced national currencies. The purpose has been to restrict the effect of profligate fiscal policies in some countries on the macroeconomic situation of others. However, when France and Germany had breached the deficit ceiling of 3 percent GDP, no action was initiated. These problems of enforcement have triggered discussions on bringing flexibility and less rigidity in the deficit targeting rules (Annett and Jaeger, 2004).

The above only reiterates that any target rules for fiscal deficit should be country-specific and should have the flexibility to conform to the changing economic conditions. In the case of India, the contentious issue has been the rationale for fixing the deficit target at 3 percent of GDP. Discussions on this issue suggest that this rule has been adopted from the guidelines provided by Maastricht Treaty of EU member countries (Rangarajan and Subba Rao). Especially with the economic conditions differing in India, where a relatively higher savings rate can make higher fiscal deficit feasible, fixing the target at 3 percent of GDP does not seem justified. This can be indirectly deduced from the detailed analysis of the Twelfth Finance Commission, wherein a 6 percent fiscal deficit for central and state governments combined was suggested. Thus, while the actual numbers for disciplining fiscal deficit is debatable, the way forward for India is the recognition that fiscal responsibility rules are imperative for sustaining macro output growth. Further, stand alone fiscal deficit targets would not be sufficient if not supported by targets on revenue or primary deficit.

Coming to the future outlook on fiscal issues based on the trends available for April-December 2009, there is likely to be a shortfall in revenue receipts on account of the large decline in indirect taxes like customs and excise and the likely lower-than-budgeted non-tax revenues. The largely structural nature of fiscal deficits in India, the levels of recovery in the economy and the sustainability of the recovery without fiscal stimulus call for carrying on the process of gradual fiscal consolidation (Economic Survey, 2009-10). However, what is important from a policy perspective is the nature of the fiscal consolidation – whether it should rely on revenue growth, which is in turn linked to the growth recovery, or on greater expenditure cuts.

For India, the EU's experience on target rules can provide rich learning points. The cyclically adjusted fiscal deficit targets would be a good policy pointer. This would mean that during boom conditions, surplus is maintained which is utilized during the recessionary conditions. This would be feasible only if the debt-GDP ratio is sustainable. Further, the institutional reforms are necessary to ensure the enforcement of expenditure limits and operational transparency. This is another area that requires attention for India.

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Appendix

Data

Annual data over the period 1980-81 to 2007-08 are used to examine the long–run relationship between gross fiscal deficit of the central government as a percent of GDP (GFD), rate of gross domestic capital formation (GDCF) and current account deficit as a percent of GDP (CAD). A separate study on the nature of long-run relationship is also examined by considering the combined gross fiscal deficit of the central and state governments (CGFD). The data has been compiled from Handbook of Statistics on Indian Economy (2008-09), published by Reserve Bank of India.

Unit Root Test

The main motivation behind the unit root test lies on whether the time series are affected by temporary or permanent shocks. Traditionally, the stationary properties of variables are examined by using the Augmented Dickey Fuller (ADF) (1979)[12] unit root test. This test involves estimating the following equation:

$$\Delta y_t = (\phi - 1)y_{t-1} + \sum_{j=1}^{k} \delta_j \Delta y_{t-j} + \varepsilon_t \tag{1}$$

where $\varepsilon_t \sim$ WN $(0, \sigma^2)$ and then testing for the significance of $(\phi - 1)$.

Sometimes many series contain a drift parameter and a linear trend, and then testing methodology has to be extended in following way. Here we test for the significance of the coefficient $(\phi - 1)$ associated with y_{t-1} in the following regression:

$$\Delta y_t = \beta_0 + \beta_1 t + (\phi - 1)y_{t-1} + \sum_{j=1}^{k} \delta_j \Delta y_{t-j} + \varepsilon_t \tag{2}$$

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[12] Dickey, D.A. and W.A. Fuller, 1979, "Distribution of the Estimators for Autoregressive Time series with a Unit Root", Journal of American Statistical Association, 74 (366): 427-31.

where, β_0 is the drift parameter.

However, as suggested by Perron[13] (1989), the standard unit root tests are biased towards the non-rejection of the null hypothesis in the presence of structural breaks. "Most macroeconomic time series are not characterized by the presence of a unit root. Fluctuations are indeed stationary around a deterministic trend function. The only 'shocks' which have had persistent effects are the 1929 crash and the 1973 oil price shock" (Perron, 1989, p.1361). This is an important finding, especially because the span of time series in any empirical work is usually long enough to have had structural breaks. Given the strong likelihood that the series under consideration are subject to structural breaks, the standard unit root tests for stationarity are likely to yield misleading conclusions. Perron's (1989) procedure is characterized by a single exogenous (i.e. known) break in accordance with the underlying asymptotic distribution theory.

Perron's (1989) method of exogenous break point treatment has been criticized by Christiano[14] (1992) on the grounds that the choice of break point is based on a pretest examination of the data and hence is subject to the problem of "data-mining". Using prior information to set the break point on the series has the important consequence of overstating the likelihood of the trend-break alternative hypothesis. Since then, several studies based on various methodologies have evolved to endogenise the break date (Zivot and Andrews[15], 1992; Banerjee et al.[16], 1992 etc.). In our model, Perron[17] (1997) unit root test is undertaken to examine the time series properties in the presence of endogenous structural breaks. The time of a structural change is referred to as T_B ($1 < T_B < T$). The method allows for two different forms of structural break: the Innovational Outlier (IO) model, where structural changes are assumed to take place gradually; and the Additive Outlier (AO) model, where structural changes are assumed to take place instantaneously. The IO model again may be of two types: one that allows for a gradual change in the intercept of the trend function (IO1) and the other that allows for a gradual change in both the intercept and slope of the trend function (IO2). The two models are exhibited below:

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[13] Perron, P., 1989, "The Great Crash, the Oil Price Shock, and The Unit Root Hypothesis", *Econometrica*, 57: 1361-1401.

[14] Christiano, L. J., 1992, 'Searching for a Break in GNP', *Journal of Business and Economic Statistics,* 10 (3), 237-250.

[15] Zivot, E. and D.V.K. Andrews, 1992, 'Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis', *Journal of Business and Economic Statistics,* 10, 251 -270.

[16] Banerjee, A., Lumsdaine, R. L., and J.H. Stock, 1992, "Recursive and Sequential Tests of the Unit Root and Trend-Break Hypothesis: Theory and International Evidence", *Journal of Business and Economic Statistics*, 10, pp. 271-287.

[17] Perron, P., 1997, "Further Evidence on Breaking Trend Functions in Macroeconomic Variables", *Journal of Econometrics*, 80: 355–85.

IO1:

$$y_t = \mu + \theta\, DU_t + \beta\, t + \delta\, D(TB)_t + \alpha y_{t-1} + \sum_{j=1}^{k} c_j \Delta y_{t-j} + e_t \qquad (3)$$

IO2:

$$y_t = \mu + \theta\, DU_t + \beta\, t + \gamma\, DT_t + \delta\, D(TB)_t + \alpha y_{t-1} + \sum_{j=1}^{k} c_j \Delta y_{t-j} + e_t \quad (4)$$

where DU_t = 1 if $t > T_B$

                = 0 otherwise;

      $D(TB)_t$ = 1 if t = T_B +1

                = 0 otherwise,

        DT_t = t if t > T_B

                = 0 otherwise.

and $e_t \sim$ iid $(0, \sigma^2)$.

The null hypothesis of a unit root is rejected if the absolute value of the t-statistic for testing α=l exceeds the corresponding critical value. The break point is chosen by estimating the models sequentially for each possible break date in the data set, and T_B that minimizes the t-ratio for α=l is selected.

While IO models allow for gradual change in intercept or slope or both, the AO assumes that structural changes are instantaneous. Perron presents the following AO model:

AO: $y_t = \mu + \beta\, t + \delta\, D(TS)_t + \hat{y}_t$

$$\hat{y}_t = \alpha\, y_{t-1} + \sum_{j=1}^{k} c_j \Delta y_{t-j} + e_t$$

$$(5)$$

where $D(TS)_t$ = t - T_B if t > T_B

                = 0 otherwise.

The null hypothesis of a unit root is rejected if the absolute value of the t-statistic for α is significant and exceeds the corresponding critical value tabulated by Perron (1997).

Cointegration Test

After determining the order of integration of each variable, we tested for cointegration to find out whether any long-run relationship exists among the variables and if so, the nature of the relationship. Standard cointegration techniques are biased towards accepting the null hypothesis of no cointegration if there is a structural break in the relationship and may produce 'spurious cointegration results'

(Kunitomo[18], 1996). We therefore apply the Gregory and Hansen[19] (1996) cointegration procedure that allows for an endogenously determined structural break. The test presents three models, whereby the shifts can be either in the intercept alone (C)

$$y_{1t} = \mu_1 + \mu_2 \, \varphi_{t\tau} + \alpha^T \, y_{2t} + e_t , \quad t = 1,.....,n$$

(6)

or in both trend and level shift (C/T)

$$y_{1t} = \mu_1 + \mu_2 \, \varphi_{t\tau} + \beta \, t + \alpha^T \, y_{2t} + e_t , \quad t = 1,.....,n$$

(7)

and a full break or the regime shift model (C/S)

$$y_{1t} = \mu_1 + \mu_2 \, \varphi_{t\tau} + \alpha_1^T \, y_{2t} + \alpha_2^T \, y_{2t} \, \varphi_{t\tau} + e_t , \quad t = 1,.....,n$$

(8)

where in the present model, y_{1t} and y_{2t} are the (log) of exports and imports respectively; μ_1, $\beta_1 \; and \; \alpha_1$ are the intercept, trend coefficients and slope coefficients respectively before the regime shift and μ_2, $\beta_2 \; and \; \alpha_2$ are the corresponding changes after the break. The dummy variable $\varphi_{t\tau}$ is defined as:

$$\varphi_{t\tau} = \begin{cases} 0, & if \; t \le [\eta\tau] \\ 1, & if \; t > [\eta\tau] \end{cases}$$

(9)

where the unknown parameter $\tau \in (0,1)$ denotes the (relative) timing of the change point, and [ ] denotes the integer part.

The models 6 – 8 are then estimated sequentially for each possible break date in the data set (for each τ). Then we perform a unit root test on the estimated residuals $\hat{e}_{t\tau}$ and the smallest value of the unit root test statistics are used for testing the null hypothesis of no cointegration between the relevant variables, against the alternative hypothesis of cointegration in the presence of an endogenous structural break. The asymptotic critical values are tabulated in Gregory and Hansen (1996).

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[18] Kunitomo, N., 1996, "Tests of Unit Roots and Cointegration Hypotheses in Econometric Models", Japanese Economic Review, 47: 79-109.
19 Gregory, A. and B. Hansen, 1996, "Residual-Based Tests for Cointegration in Models with Regime Shifts", Journal of Econometrics, 70: 99–126.