State-level rural credit and economic development in India: Do elections matter in this relationship?

Sushanta Mallick[†], Banikanta Mishra[‡] and Tapas Mishra[§]

ABSTRACT:

The paper investigates the effect of the level of rural financial development on the agricultural sector in India using the state level data for 15 major states over the time period spanning 1988-2006. Several hypotheses have been tested to differentiate whether financial development and financial liberalisation have had a discernible impact on the traditional sector, which absorbs over 70% of India's labour force. The empirical results show that financial development (credit-GDP ratio) at state level has had a negative relation with per capita output in the agricultural sector. If financial development is accompanied by financial liberalisation, such reforms tend to increase per capita income in the agricultural sector. If the financial liberalisation brings in higher level of income inequality, such liberalisation contributes negatively to output in the agricultural sector. We also find support for the hypothesis that credit flows tend to increase per capita rural income during election years relative to non-election years. In addition, we find non-linearity in the relationship in that rural financial development increases growth in the agricultural sector. A panel VAR analysis has been carried out to identify four different shocks and we find that credit shocks are still an important source of variation in investment and output in agriculture, thus reinforcing the above findings.

JEL Codes: O11, O16, Q14

Keywords: Rural financial development, Financial reforms, Elections, Non-parametric methods, India

[†] School of Business and Management, Queen Mary University of London, Mile End Road, London E1 4NS, UK, Email: s.k.mallick@qmul.ac.uk

[‡] Xavier Institute of Management, Bhubaneswar 751013, India; Email: banikant@ximb.ac.in

[§] School of Business and Economics, University of Wales, Swansea, Singleton Park, Swansea, SA2 8PP, Wales, UK; E-mail: t.k.mishra@swansea.ac.uk

1. INTRODUCTION:

It is well known that the development of the financial system (or financial deepening) supports the rate of growth of an economy, particularly dependent on the non-traditional sector. Given the current downturn in the global financial market, the emerging market economies are currently facing high real interest rates, thereby probably hindering the development of their private sector. Recent empirical literature has found a strong positive effect of a country's financial development on its economic growth, without examining the sectoral impact on growth. This is because the rate of growth of an economy's modern sector could be occurring at the cost of the traditional sector which continues to see a decline in its economic activity despite the significant level of aggregate financial development in the recent decades. This relationship may vary according to the level of financial development in the key production sectors of the economy (low return versus high-return sectors). In the context of India as a key emerging market economy, its financial sector appears to have played an important role in its recent growth process. But the traditional primary (agricultural or low-return) sector, which absorbs a big part of India's labour force (nearly 70%), has very low levels of financial development, given the declining share of the sector in India's aggregate economic activity. It is therefore important to know whether financial sector development or, more broadly, the government's financial sector policies in India, have been pro-agriculture.

Credit market development in the rural sector is critical for rural financial deepening in the process of financial development at large. But it has been observed in the context of India that demand for credit is inelastic with regard to the cost of borrowing (Bell *et al.*, 1997), implying the presence of credit rationing. Most theoretical and empirical studies assume that high lending costs and a high demand

for credit result in high interest rates being charged to the rural borrowers (see, for example, Basu (1997)). The government regulation for the formal sector to lend at a subsidised rate can make the formal institutions to ration credit supply to borrowers with limited collateral. Thus market failures in rural credit markets combined with possible urban bias of financial sector policy reforms can justify the need for government-led rural financial development. At the same time, the demand for credit can still be driven by the sectoral growth and investment, which in turn can lead to the corresponding credit allocations. Since the agricultural sector is the core of the rural Indian economy, the focus in this paper is on credit to agriculture (percent of agricultural GDP) as a measure of financial development in this sector. It is well documented that the industrial and services sectors (particularly large companies) have benefitted significantly as a result of financial development in the recent decades. It is also evident from the sectoral economic activity that the share of agricultural sector in GDP dropped significantly from 55% in 1950–1951 to around 18% in 2006–2007, while the size of the industrial sector has grown from 15% to 27% and the service sector has grown dramatically from 30% to 55% over the same period. It is natural to expect that finance is more likely to flow into expanding sectors rather than the shrinking sector namely agriculture. This raises questions as to whether rural financial development matters and how it can be achieved so as to cater to the demand for credit in this sector, given that the sector absorbs a big part of labour force in India.

The literature on financial development has received considerable attention in the recent decades with cross-country and time-series empirical studies [Bencivenga and Smith (1991), King and Levine (1993a and 1993b), Levine and Zervos (1998), Arestis *et al.* (2002), Beck and Levine (2004)]. The evidence in the literature is mixed in the

sense that there exists a relationship between banking expansion as reflected in domestic credit to the private sector (as % of GDP) and long run growth and that there is a link between stock market development and growth (Levine and Zervos, 1998), with a bi-directional relationship between financial development and economic growth [Demetriades and Hussein (1996), and Greenwood and Smith (1997)]. Financial sector development can affect growth through the channel of capital accumulation as in the old growth theory, or through the channel of increases in productivity via knowledge creation as in the endogenous growth theory for growth to be sustainable. Benhabib and Spiegel (2000) find that both channels are present: financial development improves capital accumulation as well as productivity growth. But whether these channels lead to lower interest rates and boost investment growth may be questionable in the context of developing countries. De Gregorio and Guidotti (1995) found a negative relationship between financial development and growth in Latin American countries due to financial liberalisation being pursued in a poor regulatory framework.

Andrianova *et al.* (2008) have found that lower level of institutional quality continues to make state-owned banks dominating the banking sector in many countries, including India. In a cross-country context, Cooray (2011) also shows that the size of the government proxied by the government ownership of banks has a positive impact on financial sector development in the low income economies, although it has a negative effect on financial sector efficiency. This suggests that electoral cycles could drive the lending behaviour of these state-owned banks, which are the primary banking service providers in the rural economy. Although the reform process in India since the early 1990s has allowed the entry of new private banks, but these minority banks tend to cater to the credit demand in the urban areas, due in part to fears over

possible default risk in the rural areas. As India has had a history of regular elections at the central and state levels, it has been noted that the equilibrium effect of elections on public policy in the Indian states shows a pattern of policy manipulation during election-years targeting special interest groups (Khemani, 2004). So we intend to explore whether credit extension to the rural sector has been significantly more during election years relative to non-election years, which might reveal a political economy dimension of state-led banking sector development in India.

In India, priority-sector lending has been the key feature of credit extension to the agricultural sector and small and medium enterprises over the last few decades (Ketkar, 1993; Arun and Turner, 2002). Reduction in such lending in view of any financial sector reforms could hurt people engaged in this priority sector and therefore may find it difficult to access finance from these rural banks. Hence one could argue that financial sector reforms could bring in a rise in income inequality as in Ang (2010) and Claessens and Perotti (2007). We test in this paper whether state level credit flows in India have indeed contributed to a decline in per capita income when the level of financial development is accompanied by financial reforms and rise in income inequality, after having corrected for endogeneity and non-linearity in this relationship. Using per capita real GDP and financial development data disaggregated by state over a nineteen-year period, we find that while investment in irrigation is more important to growth in the agricultural sector, financial reforms are required to have a greater positive impact of financial development on growth, but as such reforms can come with rising income inequality, they are more likely to reduce or even create negative impact of financial development on growth in the agricultural sector.

The remainder of the paper is organized as follows. Section 2 describes a simple analytical setting on the link between finance and growth, from which the empirical specification is derived. Section 3 discusses the data and estimation methods, with the results being analysed in detail in section 4. A summary and discussion of implications of the findings are provided in Section 5.

2. AN EMPIRICAL APPROACH

A well-functioning financial system plays an important role in the process of economic growth. Financial development policy has moved away from an interventionist system (a rigidly set interest rate ceiling by the monetary authority) to a liberalised system or a market-led paradigm to development finance (see Levine, 1997). In terms of allocation of funds by economic activity, financial flows can move away from agriculture and industry (the so-called low-return sectors) to the services sector (high-return financial investments). This is particularly relevant to the emerging market economies, which have gone through financial reforms in the 1980s and 1990s. The main objective of this paper is to establish the extent to which financial development and financial liberalisation have helped economic development in the rural areas, as there is little empirical work at a micro-level in an individual country in this line of literature. In this context, the state-level variation in the extension of branch facilities by state-owned banks may have contributed to the mobilisation of saving and extension of credit, as was observed by Demetriades and Luintel (1996) in the case of India. So the regional variation in credit flows needs to be considered while examining the impact of rural financial development on economic activity in the rural sector.

We write a standard per capita GDP (y) equation as:

$$\ln y = \ln y_0 + \Delta \ln y \qquad [1]$$

Following the applied growth literature, the rate of growth of output ($\Delta\ lny$) can depend on the level of rural investment (Δk), which in turn depends on the level of credit supply or the level of bank market development in the rural areas, agricultural investment in irrigation infrastructure and price stability reflected through the variation in agricultural prices as follows:

$$\Delta \ln y_t = \beta_0 + \beta_1 \Delta k_t + \varepsilon_{1t}$$

where, $\Delta k_t = \beta_2 + \beta_3 CD_t + \beta_4 GIA_t + \beta_5 API_t + \varepsilon_{2t}$.

Here $\Delta\ lny_t$ is the growth rate in period t; CD_t is the bank credit to the agricultural sector in period t (percentage of GDP); API refers to average price inflation as an indicator of macroeconomic stability or to reflect the impact of agricultural price shocks; β_i (i=1,..., 5) are the structural parameters; ε_t is the disturbance term. Substituting Δk in Δlny equation, we obtain the following reduced form equation:

$$\Delta \ln y_t = (\beta_0 + \beta_1\beta_2) + \beta_1\beta_3 CD_t + \beta_1\beta_4 GIA_t + \beta_1\beta_5 API_t + (\varepsilon_{1t} + \beta_1\varepsilon_{2t}) \qquad [2]$$

The question that would be of interest to investigate here is the extent to which financial deepening has supported capital accumulation, fostering economic growth. A liberalized system is more likely to allow the financial markets to have more cyclical effect on interest rates. As the banking sector is the dominant source of financing in the rural areas, we consider the credit supply as the key indicator of financial development, along with including three interaction variables at the all-India level, namely the index of financial reform, the real interest rate, and the index of income inequality.

Substituting [2] in [1], the determinants of the state level per capita GDP can be written in reduced form parameters as follows:

$$\ln y_{it} = \alpha_0 + \delta CD_{it} + \mu GIA_{it} + \eta API_{it} + \varphi CD_{it} * RIR_t + \lambda CD_{it} * FRI_t + \theta CD_{it} * GIN_t + \nu_t$$

where $\alpha_0 = \beta_0 + \beta_1\beta_2 + \ln y_0$, which can be reflected state-specific fixed effects and also by directly including lagged per capita GDP as proxy for initial income; GIA, RIR, FRI, and GIN refer to Gross Irrigated Area (a proxy for agricultural investment at state level), real interest rate, financial reform index, and Gini income inequality index respectively.

The interaction term with financial reform will help provide evidence as to whether the level of financial reforms has had any significant influence on the level of rural financial development. Thus the variation in per capita GDP can depend on the level of financial development (credit-GDP ratio), real interest rates interacting with financial development, the interaction between state-level financial development and all-India-level financial reforms, and the degree of income inequality interacting with financial reforms.

3. DATA AND METHODOLOGY

We use data for fifteen major Indian states comprising Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamilnadu, Uttar Pradesh, West Bengal. All data are taken from the Centre for Monitoring the Indian Economy (CMIE) state-level database over the time period 1988-2006. State-level real GDP has been taken from different issues of CMIE and rebased to 1999-00 base year from earlier base years (1993-94 and 1980-81) for past data. The GDP deflator has been derived by taking the ratio between nominal and real GDP. Domestic agricultural credit has been expressed in real terms (adjusted by GDP deflator), which is used as a percent of real GDP as an indicator of

rural financial development. Credit data relate to scheduled commercial banks, which account for about 90 per cent of all bank credit. Overall, we have a sample size of up to 285 observations on each series. Some macro series are only available at the all-India level. We have used three such series to derive interaction terms with the financial development indicator. Real interest rate is calculated using the Fisher identity as follows:

$$r = \frac{\left(i - \pi^{e}\right)}{\left(1 + \pi^{e}\right)}$$

where r denotes the RIR, i the nominal interest rate and π^{e} is the expected inflation rate. We use the current wholesale price index inflation as a proxy for π^{e} and the 1 to 3 years commercial banks' deposit rate as a measure of i. Besides, we use the financial reform index for India from Abiad *et al.* (2008), who define FRI as capturing 7 reform measures namely credit controls, interest rate controls, entry barriers/pro-competition measures, banking supervision, privatization, international capital flows, and security markets. We have used the Gini index from Ang (2010).[1]

Different single-equation panel data models including fixed effect, random effect, instrumental variables and dynamic panel methods have been applied for estimation of parameters using the variables involved in the above framework for i = 1,...,15 states, and t = 1,. . . , 19 years. Since both random and fixed effect models are essentially static models, they may not adequately capture the dynamics of per capita GDP among states, thus justifying the use of a dynamic panel data model which can be efficiently estimated by a generalised method of moments (GMM) method using Arellano-Bond lag instruments. Intuitively, as it is possible that economic growth

[1] We would like to thank James Ang, who kindly provided this data.

could be more important in explaining variations in demand for credit across states, so we use instrumental-variable method and Generalised method of moments to correct for this endogeneity in the above formulation.

In addition to the static and dynamic analysis within a single equation framework, we also conduct a panel VAR analysis to draw conclusions about all the states in general, using the four key endogenous variables in the above framework. A panel data VAR methodology combines the traditional VAR, allowing for unobserved individual heterogeneity. This approach is useful because it will help avoid any strong priors amongst competing explanations about the determinants of variations in per capita GDP. A first order VAR model can be specified as follows:

$$Az_{n,t} = \Lambda_n + \Lambda(L)_n z_{n,(t-1)} + \varepsilon_{n,t}$$

where z_t is a k×1 vector of endogenous variables for each of the 15 states. As this equation can not be estimated directly due to contemporaneous correlations between z_t and ε_t, the standard reduced form can be derived by pre-multiplying the system by A^{-1} as follows:

$$z_{n,t} = \Gamma_n + \Gamma_n(L) z_{n,t-1} + e_{n,t}$$

where $\Gamma_n = A^{-1}\Lambda_n$, $\Gamma_n(L) = A^{-1}\Lambda_n(L)$ and $e_{n,t} = A^{-1}\varepsilon_{n,t}$. The impulse response functions can now be derived on the basis of the moving average representation of the system as follows:

$$z_{n,t} = \mu_n + \sum_{i=0}^{\infty} \Gamma_n^i(L) e_{t-i} = \mu_n + \sum_{i=0}^{\infty} \phi_i(L) \varepsilon_{t-i}$$

where ϕ_i are the impulse response functions. The standard fixed-effects estimator is inconsistent in dynamic panels if the coefficients on the lagged endogenous variables differ across countries. Hence, restricting the slope coefficients to be the same across states induces serial correlation in the residuals. This serial correlation may not be

eradicated, even when instrumental variable estimation is applied (see Pesaran and Smith, 1995), and this can lead estimated impulse response functions to display extreme persistence. [what do we mean by extreme persistence? Need to write on the bound of the persistence profile.] We, therefore, estimate the Panel VAR using the mean-group-estimator. This estimator provides a consistent estimate of the mean effects by averaging the coefficients across individual states (see Pesaran and Smith 1995).

4. RESULTS AND ANALYSIS

In this section we present results from panel regression estimated both in parametric and in non-parametric domain. Under parametric setting, which is quite conventional, we impose linear relationship among variables. This is relaxed under non-parametric setting where the true relationship between dependent variable and the regressors is recovered in order to gauge their significance from policy perspective.

4.1 PARAMETRIC PANEL REGRESSION RESULTS

In general, the results reveal that per-capita GDP is positively and significantly related to level of financial development. The coefficient associated with the credit-GDP ratio implies that, with one percent increase in the level of financial development, the per capita income increases by 0.24 percent in a fixed and random effects model, while, with a similar one-percent increase in the credit-GDP ratio, the per capita income declines significantly by one percent in a first-differenced model. This shows that rate of growth of per capita income does not rise following financial development, which means that the effect of financial development is not occurring in

the rural sector as much as it does in the modern sector. These results are presented in Table 2.

It is possible that there is a non-linear pattern as shown in the scatter diagram in Figure 1. So we test for such non-linearity and any sign of endogeneity in the second stage, as is shown in Table 3. The results suggest that per capita income is positively and significantly influenced by credit-GDP ratio, which suggests that no major shift has taken place in the allocation of credit to the agricultural sector following financial reforms. However, the existence of non-linearity suggests that, when rate of growth in the agricultural sector has been declining, households may be resorting to borrowing but without experiencing an increase in their incomes, as such credit could be used for consumption purposes instead of investment. This implies that, as credit usually moves to the sector with highest rates of return, it is the traditional sector (which offers a lower rate of return) that could experience a decline in its share in aggregate economic activity. Besides, we also find that increase in investment does consistently have a positive significant effect on level of per capita income.

Although a large body of evidence is available on the link between financial development and economic growth, the relationship between inflation and per capita income alongside financial development is less thoroughly explored. We include inflation as a key control variable, and, as one would expect, we find that higher food price inflation negatively impacts per capita real income while controlling for the levels of financial development. Given the negative relationship, which is robust across different methods of estimation, it is possible that higher financial development may not be beneficial in the presence of high-inflation.

Besides, while examining the interaction between the real and financial variables, we also provide strong evidence for conditional convergence in per capita

GDP as shown in Table 3 (see the coefficient associated with lagged per capita GDP in last column), which means that low-income states are more likely to catch-up to the rate of growth of their middle- and high-income counterparts (for similar evidence, see Fung, 2009). While investment in irrigation is more important to growth than other forms of capital accumulation in the agricultural sector, financial reforms are required to have a greater positive impact of financial development on growth; but, as such reforms can come with rising income inequality, they are more likely to reduce the impact of financial development on growth in the agricultural sector.

While testing the effect of state-level election dummies, we find that there is some evidence of a positive impact of credit expansion during election years on per capita income, although there is no such pattern when one considers central government election dummies. But during central government election years, the growth effect seems to be positively linked. Given the mixed result, we adopt a non-parametric approach in the next section to further confirm the output effects of credit expansion during election years.

In addition, we carry out a panel VAR analysis following the methodology outlined in the previous section. We include four key variables, namely, financial development (or agricultural credit-GDP ratio), agricultural investment (gross irrigated area as a proxy), GDP per capita, and GDP deflator. So four shocks can be identified, which are agricultural credit shock, agricultural investment shock, agricultural income shock, and agricultural price shock. A balanced panel dataset with all 15 states over 19 years is used to run a panel-VAR using the mean-group estimator. In this panel VAR analysis, we find that finance or credit shocks do have a bigger impact on output (see figure 2) than the output shock driving finance development (see figure 4). The results suggest that positive credit shocks appear as a leading indicator in promoting agricultural investment and output in the agricultural

sector, although there is evidence in the literature that finance played a big-role in characterising India's development during the post-independence period (see Bell and Rousseau, 2001). Also, by carrying out a variance decomposition analysis, we find strong evidence that credit shocks explain a bigger proportion of variation in agricultural investment and output than other shocks (see figure 6).

4.2 NONPARAMETRIC ANALYSIS

So far, the analysis presented in the previous section banked upon estimated results from panel regression where linearity in variables (i..e., between dependent variable and regressors) are implicitly assumed. Although, such an assumption gives rise to simple and easily interpretable model, it seldom provides easy interpretation of the complex reality. Guided by this, it then seems reasonable to re-estimate the panel model by imposing non-linear structure between dependent variable and the regressors as evidenced in the previous section. To illustrate, our econometric specification consists of a generalized additive model (GAM) for panel data.[2] Additive models are widely used. In econometrics, this specification has the advantage of avoiding the `curse of dimensionality' which appears in nonparametric regressions when many regressors are accounted for. It also allows to capture non-linearities and heterogeneity in the effects of explanatory variables on the response variable. The structure of the model is given by

$$y_{it} = \sum_{j=1}^{p} f_j(x_{it}^j) + \mu_i + \varepsilon_{it}, \qquad i = 1, \cdots, N; \quad t = 1, \cdots, T, \qquad (1)$$

[2] See e.g., Hastie and Tibshirani (1990), and Stone (1985).

where y_{it} denotes the response variable, x_{it}^{j} are j explanatory variables for $j = 1, \cdots, p$, the f_j are unknown univariate functions to be estimated; μ_i is unobserved individual specific effects for which we allow arbitrary correlation with x_{it}^{j}. Thus, we make no assumption on $\mathsf{E}(\mu_i \mid x_{it}^{j})$ for any set of dates $t = 1, \cdots, T$. We assume that errors ε_{it} are independent and identically distributed, but no restriction is placed on the temporal variance structure. The unobserved effect μ_i can be eliminated by differencing or by computing the within transformation. Lagging the model (1) by one period and subtracting gives

$$y_{it} - y_{i,t-1} = \sum_{j=1}^{p} f_j(x_{it}^{j}) - \sum_{j=1}^{p} f_j(x_{i,t-1}^{j}) + \eta_{it}, \qquad (2)$$

where $\eta_{it} = \varepsilon_{it} - \varepsilon_{i,t-1}$, and we assume (*first difference* assumption, FDA) that $\mathsf{E}(\eta_{it} \mid x_{it}^{j}, x_{i,t-1}^{j}) = 0$, for $i = 1, \cdots, N$ and $t = 2, \cdots, T$. It should be noticed that the latter assumption is weaker than that of strict exogeneity which drives the within estimator (see, e.g., Wooldridge, 2002).[3] The FDA assumption identifies the functions

$$\mathsf{E}\left[y_{it} - y_{i,t-1} \mid x_{it}^{j}, x_{i,t-1}^{j}\right] = \sum_{j=1}^{p} f_j(x_{it}^{j}) - \sum_{j=1}^{p} f_j(x_{i,t-1}^{j}), \qquad (3)$$

with the norming condition $\mathsf{E}[f_j(.)] = 0$, otherwise there will be free constants in each of the functions. We base our estimation on the `backfitting algorithm' (Hastie and Tibshirani, 1990).

GAM Estimation results:

Given the sample range of our data (1986-2006), we do not expect problems of persistence indicating typical non-mean convergent effect of shocks in panel with

[3]Here, strict exogeneity precludes any feedback from the current value of GDP per capita growth rate on future values of population growth rate, which is not a realistic assumption.

long time dimension. In this case, first-difference assumption is not necessary while estimating the model within additive framework as in GAMS. As such over-differenced models lead to loss of information and do not always lend to linear policy implication. Therefore, we have estimated GAM with variables at level, instead of first difference where log of rural GDP is the dependent variable and the set of regressors are defined by rural credit, rural population, inequality, financial reform, and so on. These are the set of regressors used in the previous panel estimation. As pointed before, GAM also estimates panel but without any a priori restriction on the functional form. There is no fixed theoretical and empirical reason to believe that financial reform and rural credit will exert linear effect on rural GDP across cross-sections, in our case, states. Rather, it is plausible to imagine that these variables affect GDP growth non-linearly, that is, the response of GDP to financial reform and rural credit improvement may not be monotonic. An economy may respond differently with such variations over time, where the variations are conditional on the movement of other strategic variables in the regression.

Following on with the above argument, our purpose of estimating a non-parametric regression within panel is to assess the amount of gain each coefficient receives. The gains from non-linearity from potential regressors are then summed to obtain total gain in terms of non-linearity. Accordingly, in Tables 5-7 we present estimated results of GAM for unconstrained data (Table 5) and second with constrained data (using both central and state election dummies). The purpose of the latter is to assess if election dummy has any discernible impact on GDP, and implicitly on the extent of non-linearity. Examining Table 5, it is evident that rural credit, rural population and financial reform variables are statistically significant and sizeable gains improvement from linearity assumption of the same variables. The total gain from this regression is 353.676 which is distributed as χ^2. The p value for

the estimated χ^2 is 0, indicating that the gain in non-linearity is statistically significant at 5 per cent level.

Tables 6 and 7 present results of GAM estimation first in case of central election dummy and second for state election. The election-differentiated samples show similar non-linear pattern with total gain in non-linearity for central election (χ^2 = 102.787 [p=0.000]) is higher than state election (χ^2 = 50.247 [p=0.008]). There is no significant change in the magnitude of coefficients of regressors between central and state election interventions, except for the effect of financial reform. Under central election years, the magnitude of financial reform (0.124) is higher than under state election years (0.002), which is an expected result in view of the fact that state-level GDP responds sharply to central election as the financial reform initiated at the centre permeates fairly quickly to state levels. The results are reflected in the graphs (Figures 7-8). The response of rural credit to GDP is shown in Figure 7. We find clear evidence of non-linearity between rural credit and GDP which are statistically significant, indicated by the tight confidence band. The same is true for financial reform (Figure 8) and rural population.

5. CONCLUSIONS

The paper focused on a number of conjectures on the link between rural financial development and economic activity in the rural sector, given the lopsided pattern of sectoral growth in developing economies. The idea here was to examine whether financial reforms have had any favourable impact on the traditional sector across 15 major states in India. We find a negative correlation between credit expansion and per capita GDP in the rural sector. But with financial reforms, the banking sector in the rural areas has been able to contribute positively to per capita

income in this sector, although it has been accompanied by higher degree of inequality and thereby reducing the impact of credit on per capita income. The key variable that is influenced by credit expansion is capital investment captured via gross irrigated area, which has a consistently positive impact on the level and growth of per capita income.

In addition, we examine whether credit expansion has been more during election years relative to non-election years. We have used two separate election dummies (state-level and central government election years). It is quire apparent from the results that the credit flow has increased during state-level election years, contributing to more economic activity during these years influencing growth rate of the rural economy. But the banking sector's activity relies much on the expectation about the agricultural sector, which has been shrinking over the last two decades. This pattern can reduce the supply-side potential of this sector, thereby leading to credit risks and withdrawal of funds unless there are guarantees by the state, which can only happen during election years.

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Table 1: Descriptive statistics

Variable	Obs	Mean	Std. error	Median	Min	Max
Per Capita GDP (INR)	285	6215.07	3052.85	5517.26	1750.33	16702.96
Credit-GDP ratio	285	0.1644	0.1107	0.1333	0.0246	0.7059
GDP deflator	285	0.8363	0.2893	0.9009	0.2493	1.4675
Gross Irrigated area	285	4695.88	3812.69	4074.0	161.0	18939.0
Real interest rate	19	2.0178	2.4314	1.7799	-1.5284	6.5619
Financial reform	19	0.3759	0.2093	0.4286	0.0476	0.6190
Gini index	19	32.9507	2.2650	32.5162	29.6900	37.8300

Figure 1: Scatter plot of rural GDP per capita and the key variables

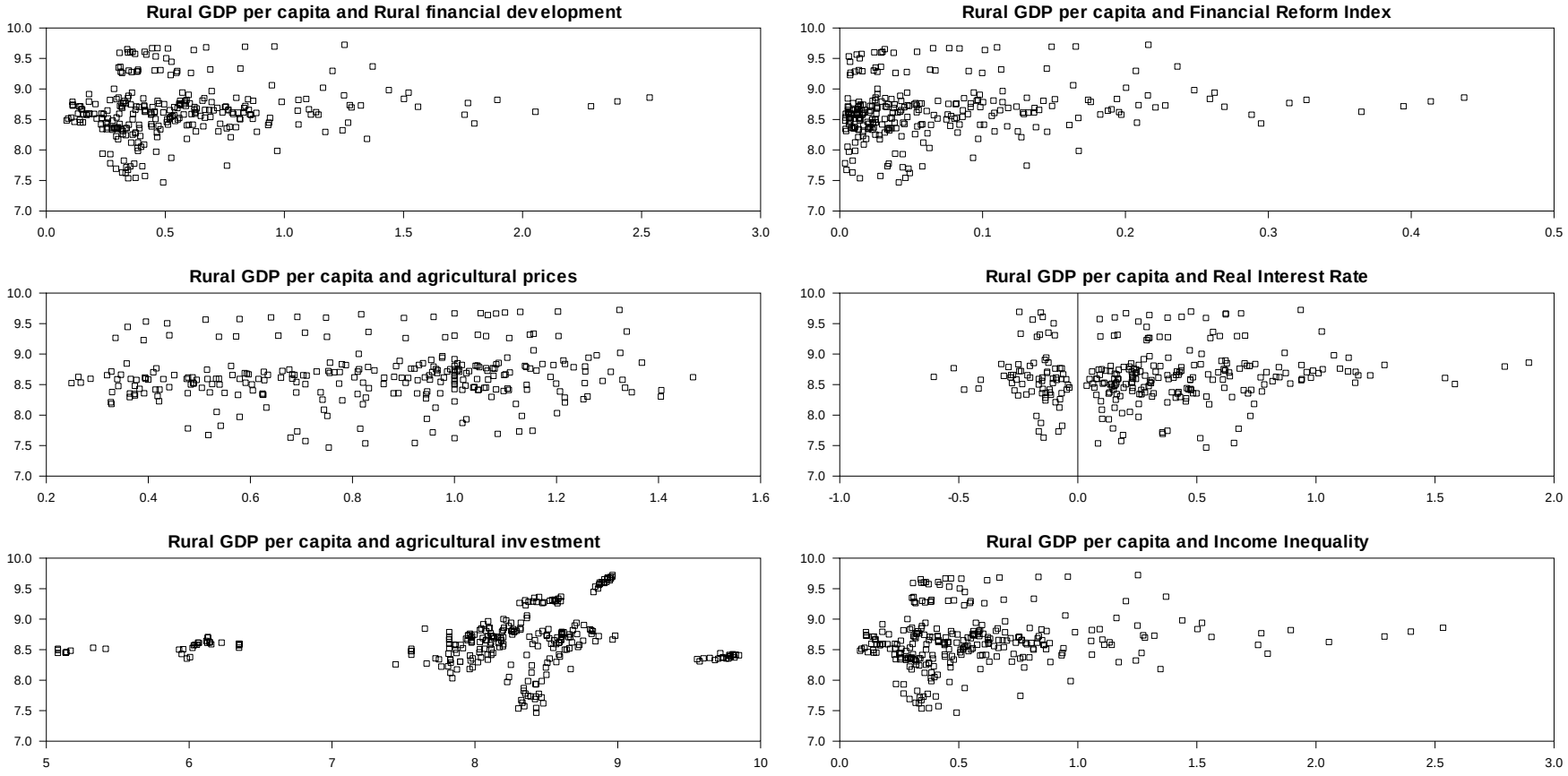


Table 2: Panel regression results of the basic model

Variable	OLS	Fixed Effects	Random Effects	SUR	FD
CD	-0.415* (0.231)	0.238*** (0.082)	0.243 *** (0.082)	0.484 (0.546)	-1.010 *** (0.187)
GIA	0.186*** (0.038)	0.215*** (0.033)	0.204 *** (0.031)	0.059 (0.062)	0.185*** (0.061)
DP	-0.541*** (0.115)	-0.370*** (0.131)	-0.370*** (0.130)	-0.144 (1.143)	-0.642*** (0.088)
Constant	7.439*** (0.276)		6.968*** (0.280)	8.092*** (0.510)	
R**2	0.957	0.937	0.937	0.937	0.275
Standard Error	0.097	0.113	0.110	0.000	0.114
Sum of Squares	2.210	3.228	3.230	0.000	3.271
White Heteroscedasticity Test	$\chi^2(2)$=11.00 (p-value= 0.004)	$\chi^2(2)$=10.73 (p-value= 0.005)	$\chi^2(2)$=11.04 (p-value= 0.004)	$\chi^2(2)$=0.0 (p-value= 1.00)	$\chi^2(2)$=1.53 (p-value= 0.465)
Observations	285	285	285	285	285
Individual and time dummies	YES	No	No	No	No

Notes: Dependant variable is log of GDP per capita in each column. Standard errors are in parentheses. Significantly different from zero: * at 10%; ** at 5%; *** at 1%. SUR denotes seemingly unrelated regression; FD is estimation by first difference.

Table 3: Panel regression results correcting for non-linearity and endogeneity

Variable	Fixed Effects	Random Effects	First Difference	Instrumental Variable	Arellano-Bond
CD	-0.0183*** (0.0030)	-0.0285*** (0.0059)	-0.0417*** (0.0076)	-0.0089 (0.0064)	-0.2306*** (0.0369)
GIA	0.2185*** (0.0282)	0.2202*** (0.0273)	0.1862*** (0.0574)	0.0566** (0.0258)	0.0122*** (0.0015)
DP	-0.5702*** (0.1238)	-0.5776*** (0.1202)	-0.6655*** (0.0832)		-0.7327*** (0.0425)
CSQ	0.0002*** (0.0000)	0.0006*** (0.0002)	0.0008*** (0.0003)		0.0000 (0.0001)
CCU		0.0000*** (0.0000)	0.0000* (0.0000)		0.0000 (0.0000)
CD*RIR				0.0369 (0.0666)	-0.0914*** (0.0092)
CD*FRI				1.9363** (0.8802)	14.3032*** (5.7264)
CD*Gini					6.7149*** (1.0570)
CD*Gini*FRI					-4.3750*** (1.6399)
Ln y_{t-1}					-0.0030** (0.0014)
Constant		7.1704*** (0.2470)		8.1789*** (0.2173)	
R**2	0.9611	0.9620	0.3648	0.0432	0.2013
Standard Error	0.0922	0.0858	0.1071	0.4284	0.1194
Sum of Squares	1.9889	1.9428	2.8664	51.3894	3.7089
White Heteroscedasticity Test	$\chi^2(2)$= 6.80 (p-value= 0.6577)	$\chi^2(2)$= 17.62 (p-value= 0. 0.4132)	$\chi^2(2)$= 13.74 (p-value= 0. 0.3925)	$\chi^2(2)$= 14.966 (p-value= 0.0006)	$\chi^2(2)$= 58.61 (p-value= 0.2458)
Observations	285	285	285	285	285

Notes: Dependant variable is log of GDP per capita in each column, except the Arellano-Bond dynamic panel method where the dependent variable is *Δlny*. Standard errors are in parentheses. Significantly different from zero: * at 10%; ** at 5%; *** at 1%.

Table 4: Panel regression results with Election Dummies

Variable	Fixed Effects	Random Effects	First Difference	Arellano-Bond
CD	-0.0117*** (0.0018)	-0.0117*** (0.0018)	-0.0405*** (0.0049)	-0.0188*** (0.0031)
GIA	0.1799*** (0.0289)	0.1732*** (0.0277)	0.1406** (0.0572)	0.1007*** (0.0202)
DP	-0.0034*** (0.0012)	-0.0035*** (0.0011)	-0.0068*** (0.0008)	-0.0195*** (0.0018)
CD*FRI	1.8971*** (0.2197)	1.8995*** (0.2159)	2.9141*** (0.7511)	
State Election	-0.0008 (0.0251)	-0.0009 (0.0246)	-0.0108 (0.0183)	-0.6279*** (0.0926)
CD*State Election	0.0014 (0.0013)	0.0014 (0.0012)	0.0011 (0.0010)	0.0331*** (0.0056)
Central Election	0.0391* (0.0232)	0.0391* (0.0229)	0.0337** (0.0177)	0.1463*** (0.0568)
CD*Central Election	-0.0020 (0.0013)	-0.0020 (0.0013)	-0.0016 (0.0010)	-0.0075** (0.0034)
CSQ			0.0003*** (0.0001)	-0.0001 (0.0001)
Ln y_{t-1}				-0.0454*** (0.0212)
Constant		7.3003*** (0.2532)	8.1789*** (0.2173)	-0.0455 (0.1847)
R**2	0.9486	0.9620	0.3779	0.2013
Standard Error	0.0987	0.0961	0.1051	0.2810
Sum of Squared residuals	2.4093	2.4102	2.7186	3.7089
Hausman Test (7)		8.1149 (p-value=0.3226)		
Observations	285	285	285	285

Notes: Dependant variable is log of GDP per capita in each column, except the Arellano-Bond dynamic panel method where the dependent variable is *Δlny*. Standard errors are in parentheses. Significantly different from zero: * at 10%; ** at 5%; *** at 1%.

Table 5: Estimation of Generalized Additive Model: All India Level

Variables	Coeff	*Z* value	Gain	P > Gain
Rural credit	0.155	10.222	26.583	0.0053
Rural Pop	-0.696	-36.797	258.606	0.000
Gini	0.23	1.341	0.097	0.952
GIA	0.154	12.637	50.167	0.000
Financial reform	0.049	0.855	18.223	0.0011
Note: Total gain (non-linearity χ^2 = 353.676 [d.f.=29.004]) and (p = 0.000).				

Table 6: Estimation of Generalized Additive Model: The Effect of Central Election Dummy

Variables	Coeff	*Z* value	Gain	P > Gain
Rural credit	0.143	4.459	15.258	0.171
Rural Pop	-0.696	-20.261	75.775	0.000
Gini	0.362	0.912	1.232	0.978
GIA	0.145	6.222	9.746	0.0076
Financial reform	0.124	1.096	1.963	0.742
Note: Total gain (non-linearity χ^2 = 102.787 [d.f.=29.018]) and (p = 0.000).				

Table 7: Estimation of Generalized Additive Model: The Effect of State Election Dummy

Variables	Coeff	*Z* value	Gain	P > Gain
Rural credit	0.161	3.675	4.448	0.954
Rural Pop	-0.670	-11.894	29.540	0.001
Gini	0.410	0.912	0.917	0.632
GIA	0.136	3.913	11.507	0.0032
Financial reform	0.002	0.016	13.835	0.428
Note: Total gain (non-linearity χ^2 = 50.247 [d.f.=28.986]) and (p = 0.008).				

Figure 2: Impact of a credit shock in a panel VAR

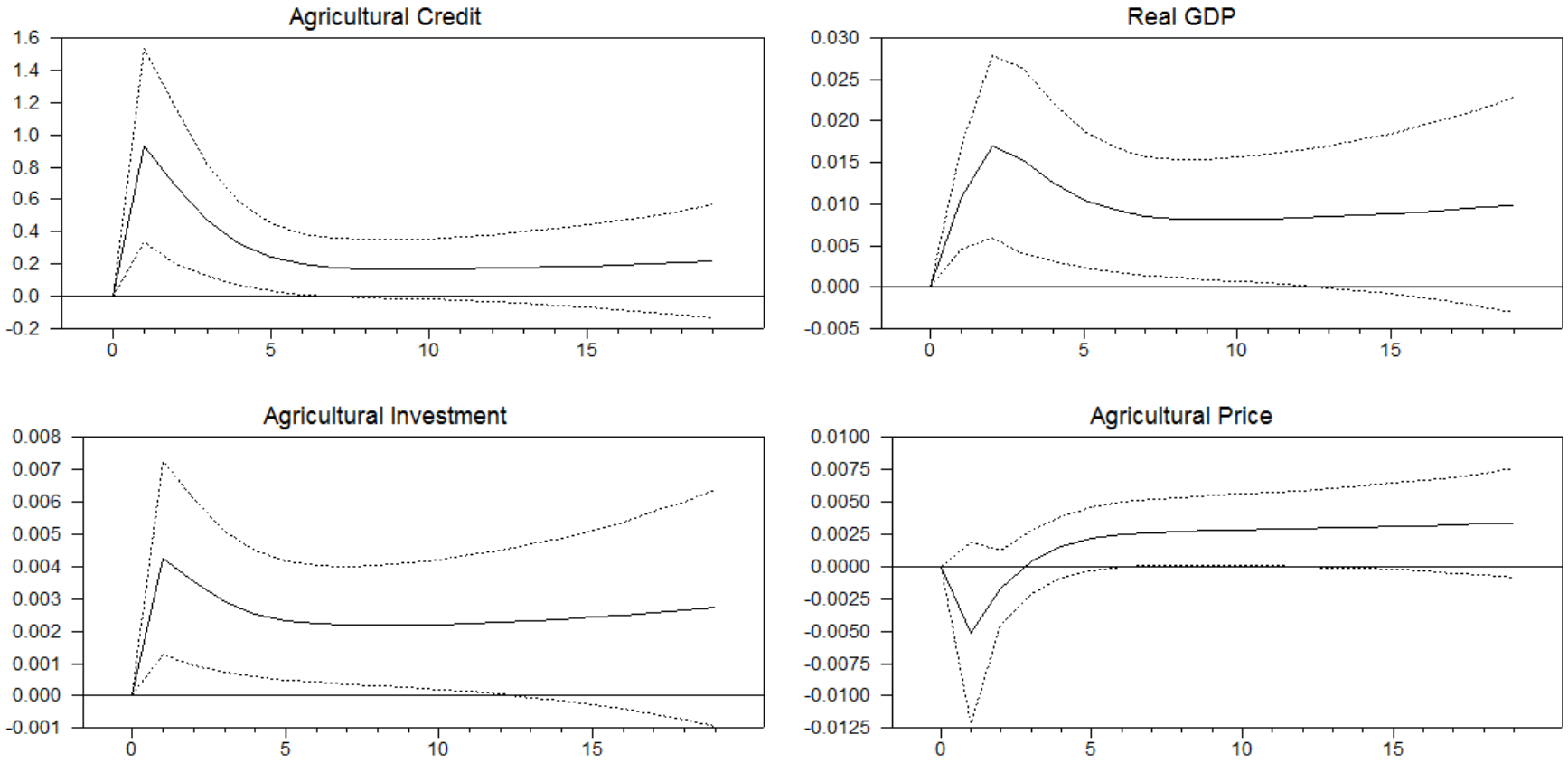


Figure 3: Impact of agricultural investment shock in a panel VAR

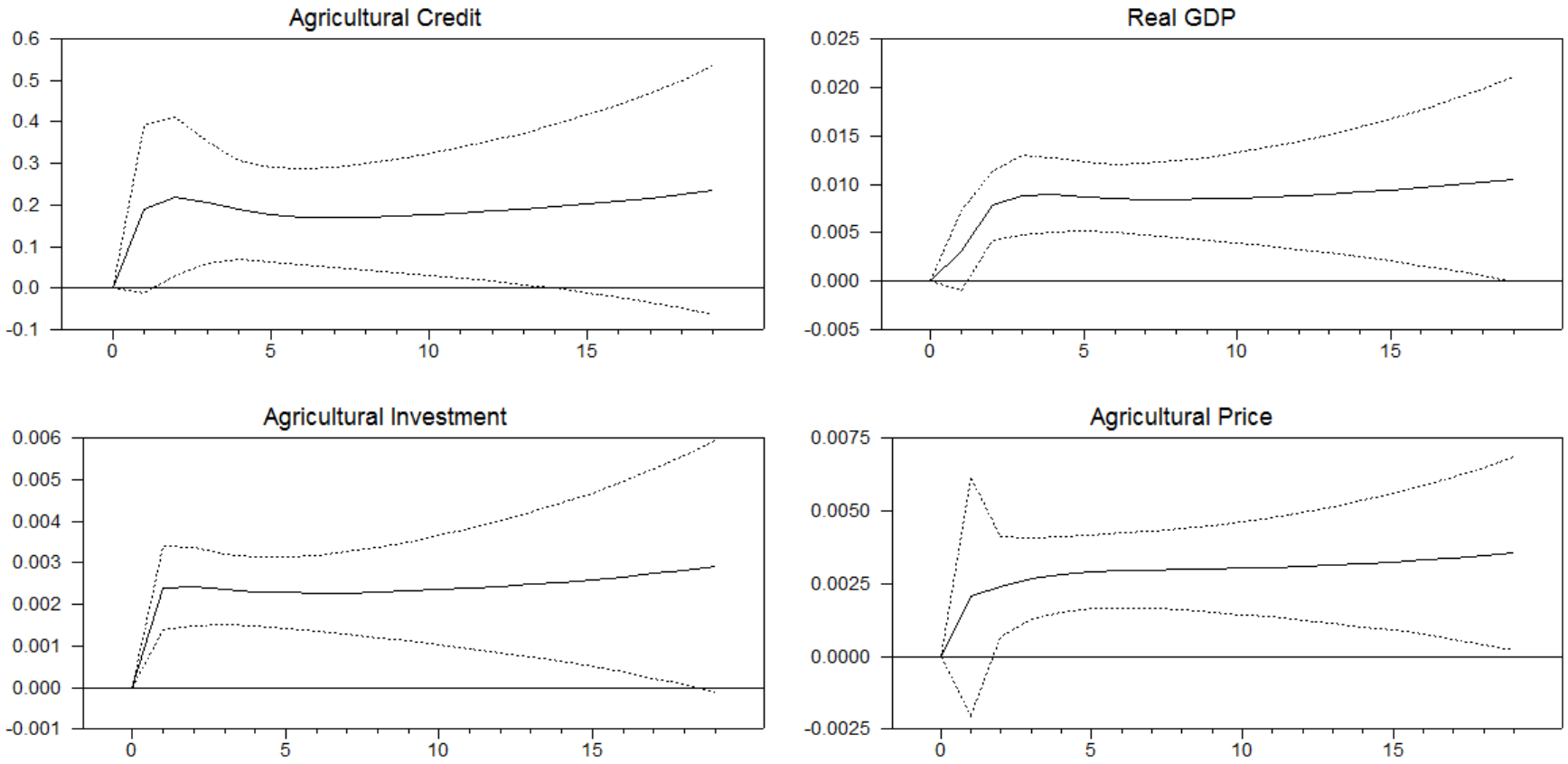


Figure 4: Impact of agricultural GDP shock in a panel VAR

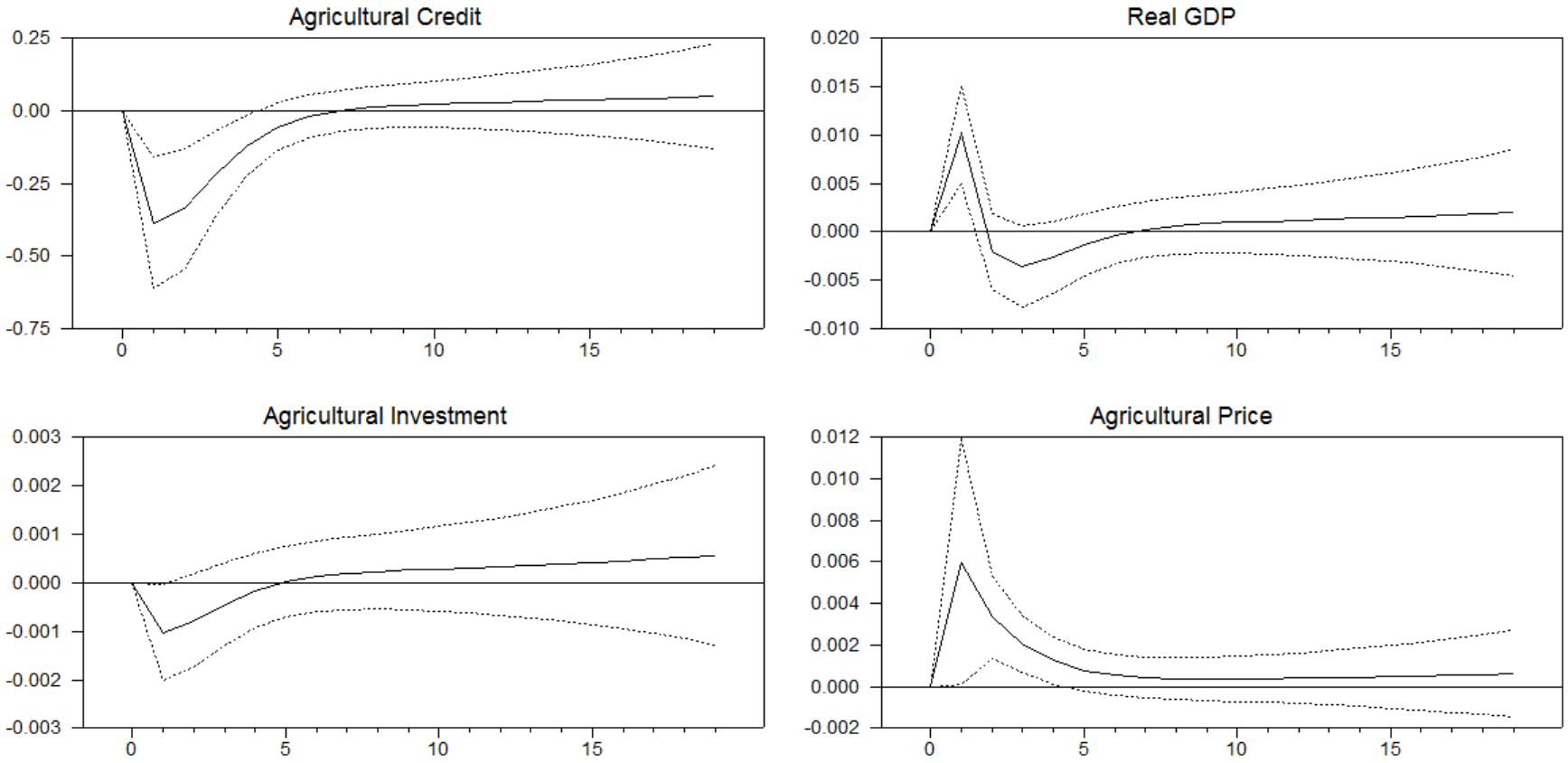


Figure 5: Impact of agricultural price shock in a panel VAR

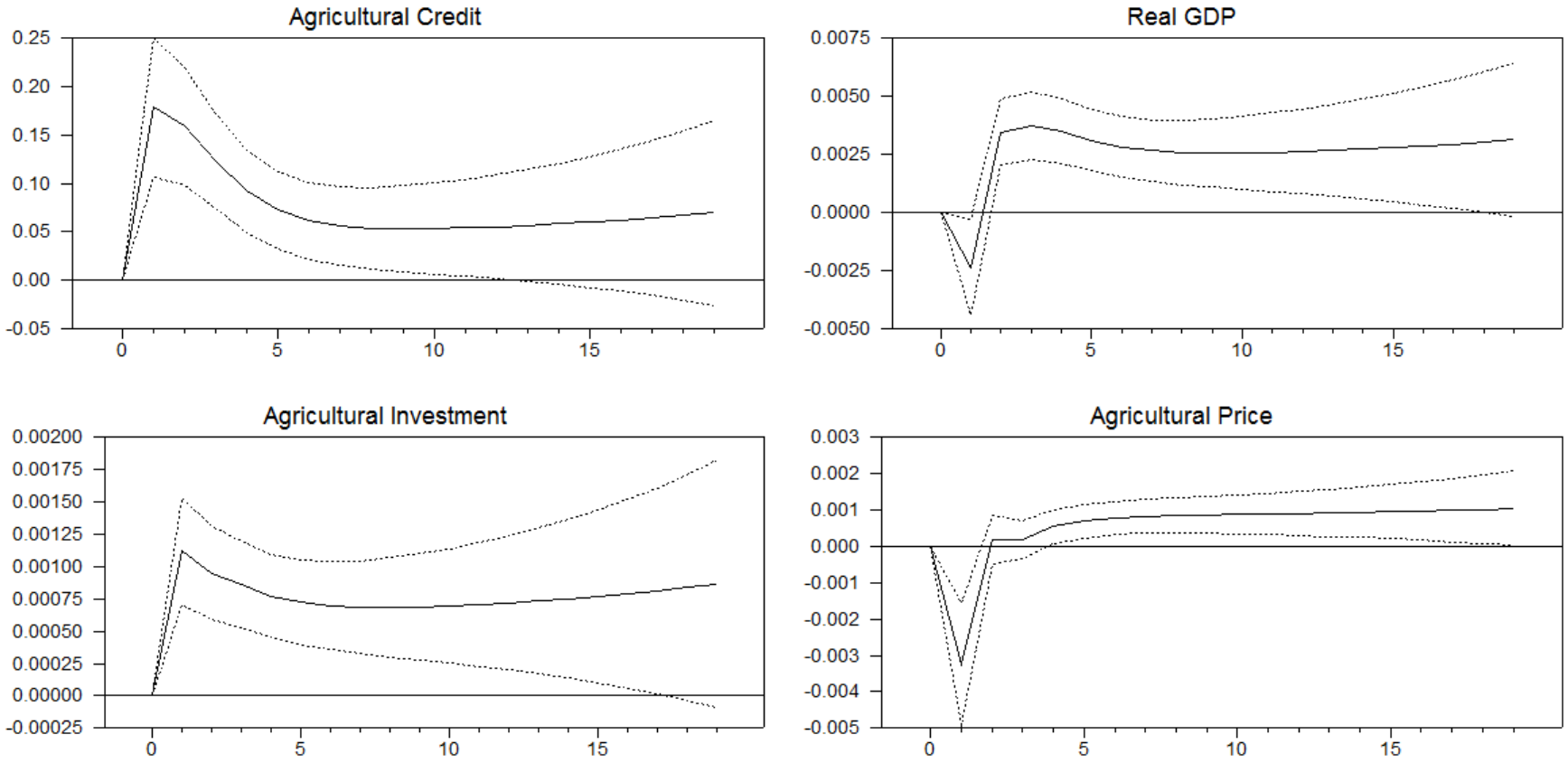


Figure 6: Variance decomposition of all four shocks in a panel VAR

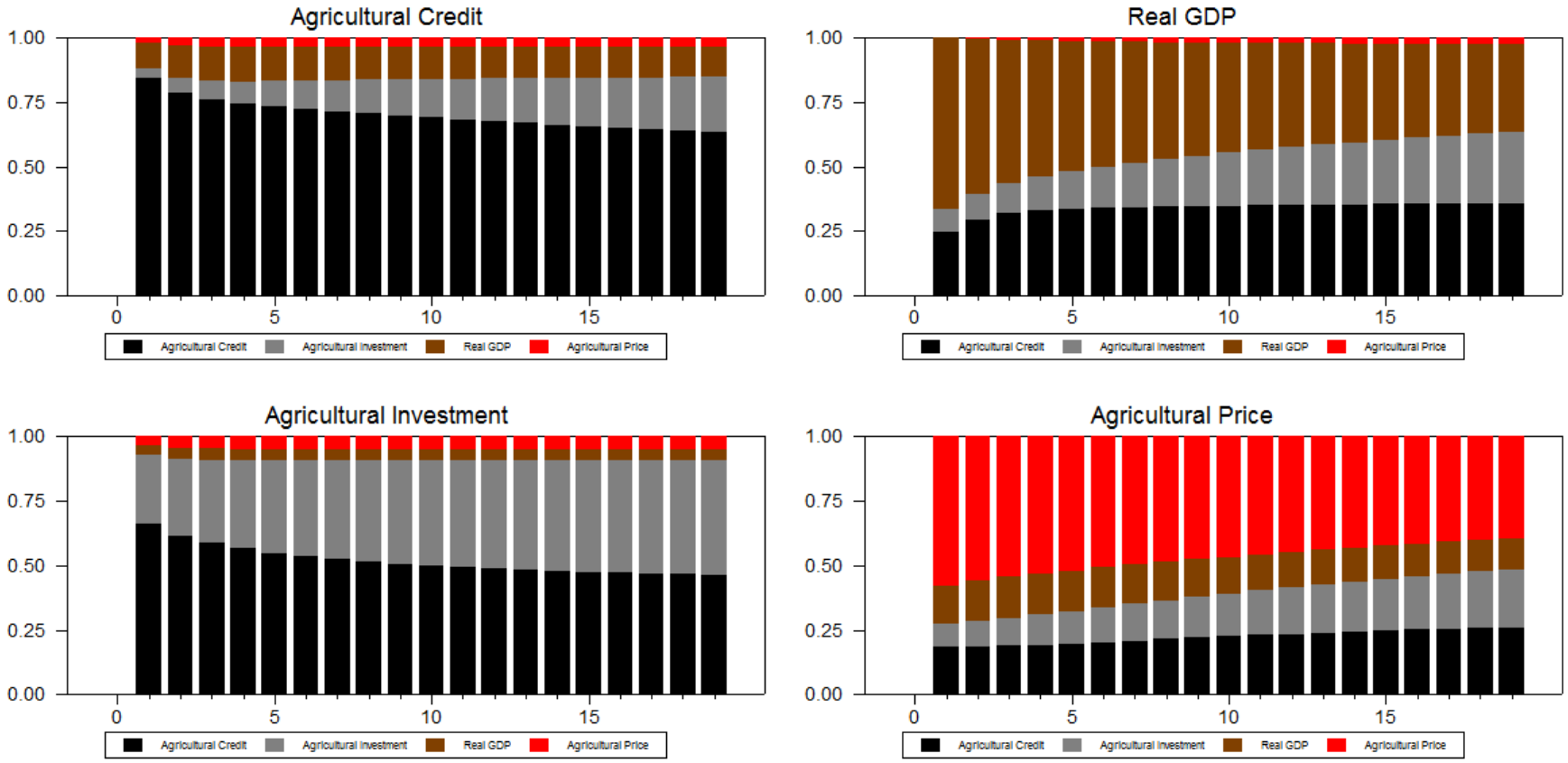
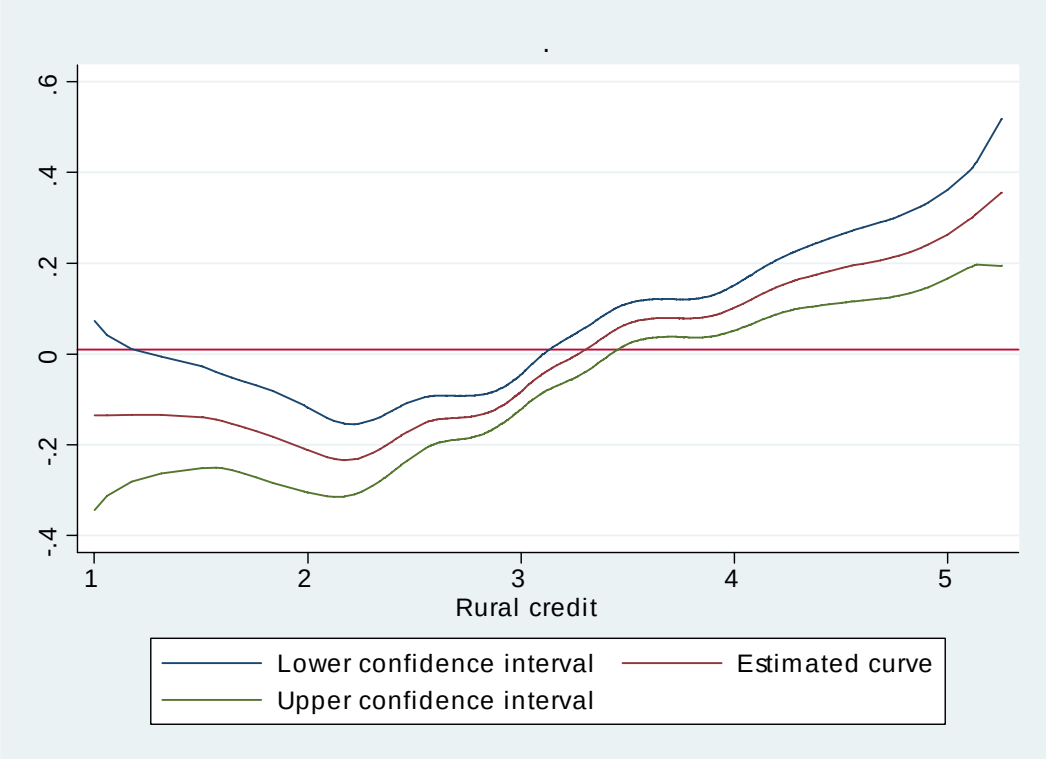
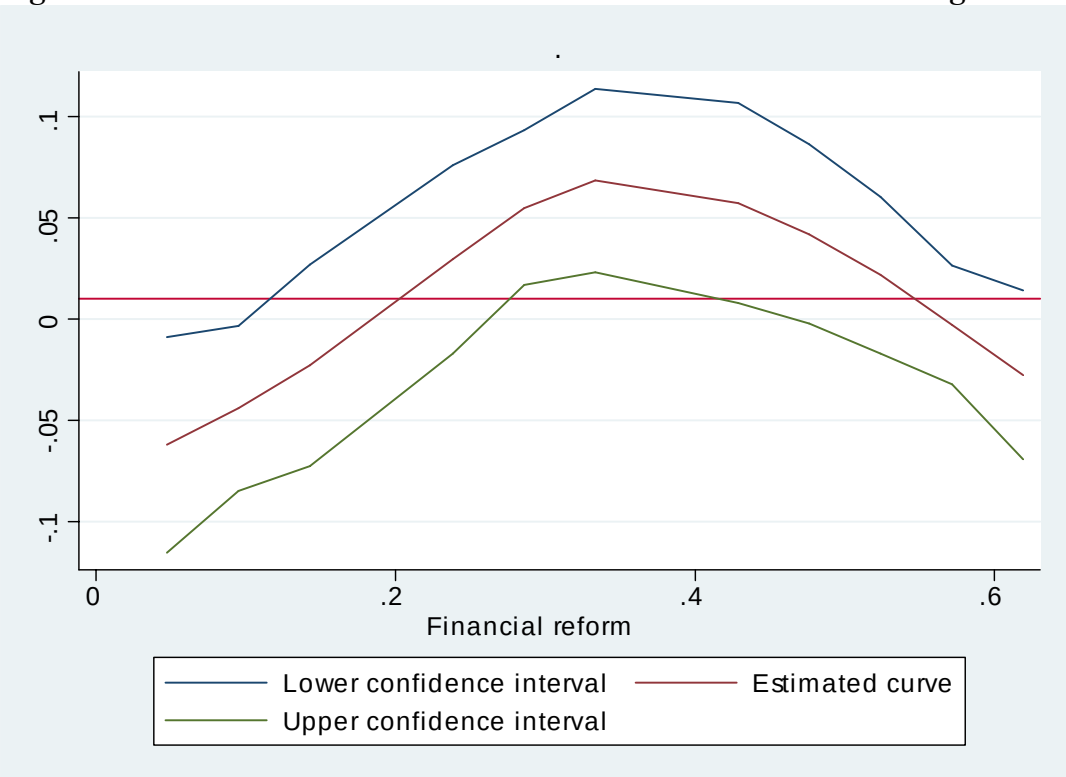


Figure 7: GAM estimation of 'rural credit' effects on economic growth



Notes: Solid lines are nonparametric fits $\hat{f}_j(.)$. Dashed lines are 95% bootstrap point-wise confidence intervals. Straight solid lines represent the zero line.

Figure 8: GAM estimation of 'financial reform' effects on economic growth



Notes: Solid lines are nonparametric fits $\hat{f}_j(.)$. Dashed lines are 95% bootstrap point-wise confidence intervals. Straight solid lines represent the zero line.