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Paper 2:

# Exploring the Impact of Provincial Expenditure on EPWP on Economic Growth and Labour Dynamics: *An Econometric Analysis*

by

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Presentation prepared for 7th Annual PSEF Conference,
Forever Resort, Warmbath, Bela-Bela, Limpopo,
27 November, 2015

**EAD Staff Working paper series**

# Presentation Layout

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- Synoptic Review of Literature
- Theoretical and Empirical Evidence
- Research Motivation, Contribution, Aim and Question
- Putting it all together (Findings)
- Policy Recommendation
- References

# Synoptic Review of Literature

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- Theoretically, the interrelationship between economic growth, poverty incidence and unemployment can be explored via 3 channels, viz:

  ⇨ Direct (job creation and positive income shock) and indirect (TFP and aggregate demand);

  ⇨ Macro (aggregate economy) and micro (sector)levels, and

  ⇨ Supply and demand channel – using labour as an intermediary input and/or complementary input.

- Mostly in developing countries: unemployment rate and level of education are inversely related, this is evident in South Africa (cf. StatsSA, 2014b), whereas, poverty and education are inversely correlated (cf. Islam, 2004)

- Empirics and theory indicates intensive investment in human capital (training and skill development) is a key channel for high economic growth to benefit the unemployed and/or working age poor (see, e.g., McCutcheon, 2009; McCord and Meth, 2007; McCord and Seventer, 2004; McCord, 2001, 2002)

- Similar to other developing countries in SSA, unemployment rate in SA is acutely high and structural in nature due to lack of appropriate skills and employment opportunities (see McCutheon, 2014, Meth, 2011; Triegaardt, 2009; McCord et al., 2004a amongst others).

# Theoretical & Empirical Evidence

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- In theory, an increase in public investment spending on (infrastructure projects) induces a stimulatory effect on economic growth via 2 main channels, viz:
  - ⇨ *Direct* – high demand for labour as ouput/production increases. Sizeable supply of labour to firms, in effect, lower unemployment rates and raises household income spent on produced goods.
  - ⇨ *Indirect* – Innovation and technology spillover accompanying a surge in productivity growth indirectly raise total factor productivity (TFP), which in turn, boost growth.

- Concrete empirical evidence confirmed positive effects of high public infrastructure investment on:
  - ⇨ **GDP growth** (cf. Ashaeur, 1989 for US; Canning, 1999, Calderón and Servén 2008 for ASEAN countries; Jong-A-Pin and de Haan, 2008 for OECD countries)
  - ⇨ **TFP growth** (cf. Pereira and Andraz, 2013; Fedderke and Garlick, 2008 and Romp and de Haan, 2005)

- Other findings shows that high **public spending on infrastructure reduce poverty incidence** (cf. Estache et.al, 2013; World Bank, 2006) and improve income distribution (cf. Chong and Calderón, 2001; Calderón and Servén, 2004) . Recent by Seneviratne and Sun (2013) reported similar findings for ASEAN-5 countries (Indonesia, Malyasia, Phillipines, Thailand and Vietnam)

- Fedderke et al. (2008; 2006) found that high infrastructure investment in South Africa leads to growth in TFP, income and aggregate demand

# Motivation, Contribution, Aim & Research Question

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## Motivation for Research:

- ⇨ Contrary to theories and empirics: the significant rise in public spending by the national government on EPWP schemes in FS failed to dent prevailing high unemployment rate ( slightly > 30%) and labour market absorption rates dwindles (slightly < 40%) in FS. This creates a policy conundrum
- ⇨ Then again, the unresponsiveness of persistent unemployment rate, acute poverty incidence and fractured labour market in FS to high public spending on EPWP initiatives (in particular, infrastructure projects) presents a theoretical puzzle that only be solved by empirical investigation.

## Research Contribution:

To the best of our knowledge, in the extant literature (both international and regional – i.e. in South Africa), this is the first empirical work to explore. EPWP expenditure, GDP growth and labour dynamics nexus using multivariate model.

## Specific Aim of Research:

This paper seeks to investigate if an increase in public spending on EPWP initiatives in FS has a mitigating effect on unemployment rate and economic growth using multivariate models.

## Research Question:

Does an expansion of EPWP initiatives (explicit focus on the use of labour intensive work approach) act as an effective short-term policy strategy to stimulate economic growth, labour absorption rate and productivity in FS?

# Constructed Models, Data Treatment & Sources

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## Models

- OLS – fitted ARMA model
- Vector Error Correction Model (VECM)
- Vector Autoregressive Model (VAR) – the wild card!

## Data Treatment

- Converted annual data to quarterly data using Linear interpolation method. Sample period: 2005Q1 – 2013Q4
- All Quarterly data are seasonally adjusted using X-12 ARIMA programme in Eviews under the additive option.
- All quarterly data are log-transformed and adjusted to real variables
- Selected variables to capture both real economy and labour dynamics are: EPWPex ( proxy for public expenditure on EPWP schemes), real GDP (denoting R-GDP), LABF (Labour force participation rate) and UNRATE (representing provincial unemployment rate).

## Data Sources:

StatsSA, SARB, IHS Global Insights – Rex database, MIS database (National Dept. of Public Works), various NDPW quarterly reports on fiscal allocations to EPWP schemes, FS Public Works reports submitted to NDPW and various budgetary Vote speeches by FS Public works - since 2004.

# Theory-Based Assumption

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## Theory based assumptions:

$$EPWP_{\exp} = f(y_{1,t} y_{2,t}, labf_t, unrate_t, pop_t) \qquad \text{Eq.1}$$

We can expand Eq.1, as an auxiliary multivariate regression model computed as:

$$EPWP_{\exp} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_{n,t} x_{n,t} + \varepsilon \qquad \text{Eq.2}$$

## Expected results on a prior ground:

An increasing rise in pubic expenditure on EPWP initiatives is expected to:

1. $\Downarrow$ Unemployment rate $\equiv$ $\Uparrow$ Labour intensity leads to sizeable $\Uparrow$ in job creation (mostly, transitory job opportunities) as labour absorption rate improves. *Hyp 1: Unemployment reduction effect*

2. Rise in GDR/GVA $\equiv$ indirectly raise output growth and productivity as demand for labour input $\Uparrow$, in effect, labour force . *Hyp 2. Productivity/Growth rate shock*

3. $\Uparrow$ Labour force participation is an indicative of high usage of labour intensity work approach and absorption rate.

# Modelling Approach

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Dependent Variable: D(LEPWPX)
Method: Least Squares
Date: 11/24/15 Time: 00:05
Sample (adjusted): 2005Q3 2013Q4
Included observations: 34 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LGDP,2) | -0.230794 | 0.544316 | -0.424007 | 0.6747 |
| D(LEMP,2) | -2097.839 | 656.1979 | -3.196960 | 0.0033 |
| D(LLABF,2) | 2873.308 | 911.0743 | 3.153758 | 0.0037 |
| D(UNEMP,2) | -0.002771 | 0.000882 | -3.140875 | 0.0039 |
| C | 0.066586 | 0.025488 | 2.612496 | 0.0141 |

| | | | |
|---|---|---|---|
| R-squared | 0.327930 | Mean dependent var | 0.076687 |
| Adjusted R-squared | 0.235231 | S.D. dependent var | 0.163096 |
| S.E. of regression | 0.142629 | Akaike info criterion | -0.922085 |
| Sum squared resid | 0.589949 | Schwarz criterion | -0.697620 |
| Log likelihood | 20.67544 | Hannan-Quinn criter. | -0.845536 |
| F-statistic | 3.537573 | Durbin-Watson stat | 1.179225 |
| Prob(F-statistic) | 0.018095 | | |

- ADF test confirmed that all variables are *I*(2) process suggesting possible long-run relationship (cointegration)
- Results of diagnostic tests for fitted ARMA(*p*,*q*) model are available upon request
- Fitted AR(2)MA(2) is robust – pass battery of diagnostic tests.

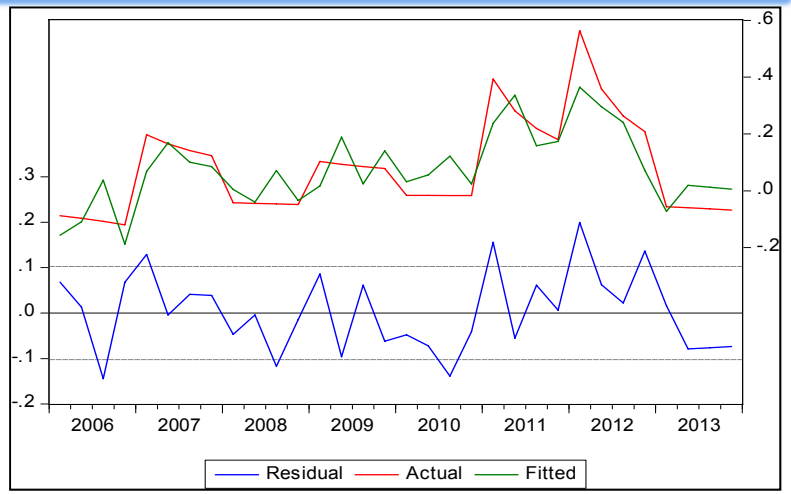
# Model I – ARMA

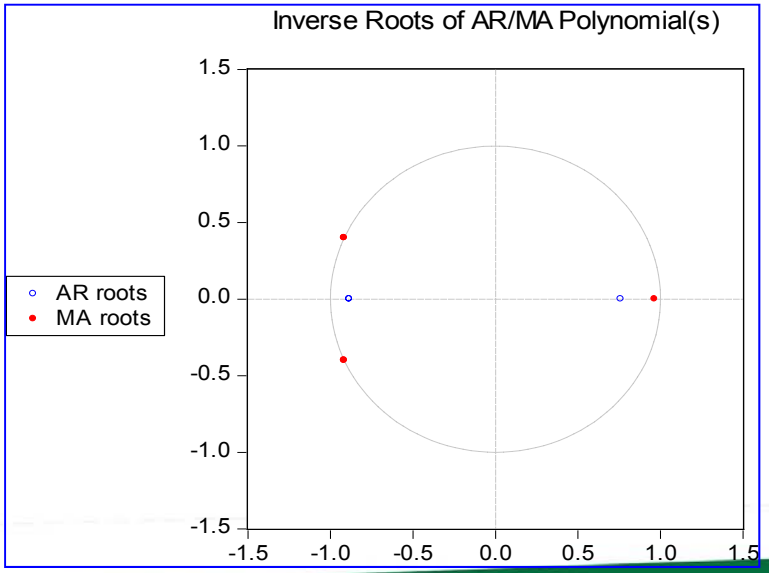
Dependent Variable: D(LEPWPX)
Method: Least Squares
Date: 11/25/15 Time: 12:31
Sample (adjusted): 2006Q1 2013Q4
Included observations: 32 after adjustments
Convergence achieved after 16 iterations
MA Backcast: 2005Q2 2005Q4

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LGDP,2) | 0.116175 | 0.348401 | 0.333452 | 0.7420 |
| D(LEMP,2) | -648.5976 | 114.2200 | -5.678492 | 0.0000 |
| D(LLABF,2) | 850.7411 | 160.4158 | 5.303349 | 0.0000 |
| D(LUNEMP,2) | -236.9978 | 47.02080 | -5.040276 | 0.0000 |
| C | 0.088813 | 0.023780 | 3.734822 | 0.0011 |
| AR(1) | -0.124528 | 0.146799 | -0.848290 | 0.4054 |
| AR(2) | 0.672209 | 0.118231 | 5.685575 | 0.0000 |
| MA(1) | 0.867292 | 0.013399 | 64.72650 | 0.0000 |
| MA(2) | -0.770628 | 0.077189 | -9.983684 | 0.0000 |
| MA(3) | -0.965881 | 0.083625 | -11.55021 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.735954 | Mean dependent var | 0.079609 |
| Adjusted R-squared | 0.627935 | S.D. dependent var | 0.167829 |
| S.E. of regression | 0.102371 | Akaike info criterion | -1.470119 |
| Sum squared resid | 0.230556 | Schwarz criterion | -1.012077 |
| Log likelihood | 33.52191 | Hannan-Quinn criter. | -1.318291 |
| F-statistic | 6.813191 | Durbin-Watson stat | 1.824543 |
| Prob(F-statistic) | 0.000119 | | |

| | | | |
|---|---|---|---|
| Inverted AR Roots | .76 | -.88 | |
| Inverted MA Roots | .97 | -.92+.40i | -.92-.40i |



# Cointegration Test – Johansen & Juselius

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$$LR_{\max}\left(\frac{r}{n+1}\right) = -T^{*}\log\left(1-\hat{\lambda}\right) \quad \text{for } r = 0,1,2\ldots n-1 \qquad \text{Eq(3)}$$

$$LR_{tr}\left(\frac{r}{n}\right) = -T^{*}\sum_{i=r+1}^{n}\log\left(1-\hat{\lambda}\right) \quad \text{for } r = 0,1,2\ldots n-1 \qquad \text{Eq(4)}$$

**UNRESTRICTED COINTEGRATION RANK TEST (TRACE)**

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.673419 | 65.98527 | 47.85613 | 0.0004 |
| At most 1 | 0.403175 | 27.93660 | 29.79707 | 0.0807 |
| At most 2 | 0.260751 | 10.38811 | 15.49471 | 0.2521 |
| At most 3 | 0.003406 | 0.115994 | 3.841466 | 0.7334 |

*Trace test indicates 1 cointegrating eqn(s) at the 0.05 level*

**UNRESTRICTED COINTEGRATION RANK TEST (MAXIMUM EIGENVALUE)**

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.673419 | 38.04867 | 27.58434 | 0.0016 |
| At most 1 | 0.403175 | 17.54849 | 21.13162 | 0.1477 |
| At most 2 | 0.260751 | 10.27212 | 14.26460 | 0.1947 |
| At most 3 | 0.003406 | 0.115994 | 3.841466 | 0.7334 |

*Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level*

# Lag Selection Criteria – Estimating VECM

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VAR Lag Order Selection Criteria
Endogenous variables: EPWPEX RGDP LABF UNRATE
Sample: 2005Q1 2013Q4
Included observations: 33

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 1 | -1327.107 | NA | 2.65e+30 | 81.40041 | 82.12599 | 81.64455 |
| 2 | -1267.366 | **90.51590*** | **1.94e+29*** | **78.74947*** | **80.20063*** | **79.23774*** |
| 3 | -1255.579 | 15.00238 | 2.77e+29 | 79.00477 | 81.18151 | 79.73718 |

*** indicates lag order selected by the criterion**

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

# Model II – VECM

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$$\Delta Y = \delta_1 + p_1 e_1 + \sum_{i=0}^{n=33} \beta_i \Delta Y_{t-1} + \sum_{i=0}^{n=33} \lambda_i \Delta X_{t-1} + \sum_{i=0}^{n=33} \phi_i Z_{t-1} \qquad \text{Eq(5)}$$

$$\Delta X = \gamma_1 + p_2 e_{i-2} + \sum_{i=0}^{n=33} \beta_i Y_{t-1} + \sum_{i=0}^{n=33} \lambda_i \Delta X_{t-1} + \sum_{i=0}^{n=33} \phi_i Z_{t-1} \qquad \text{Eq(6)}$$

Sample (adjusted): 2005Q4 2013Q4

Included observations: 33 after adjustments

D(EPWPEX) = C(1)*( EPWPEX(-1) - 10.3859335768*RGDP(-1) + 3003.86545465*LABF(-1) - 51265312.6814*UNRATE(-1) - 1480537825.15 ) + C(2)*D(EPWPEX(-1)) + C(3)*D(EPWPEX(-2)) + C(4)*D(RGDP(-1)) + C(5)*D(RGDP(-2)) + C(6)*D(LABF(-1)) + C(7)*D(LABF(-2)) + C(8)*D(UNRATE(-1)) + C(9)*D(UNRATE(-2)) + C(10)

| | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| **C(1)** | **-0.118635** | **0.120901** | **-0.981258** | **0.3367** |
| C(2) | 0.847524 | 0.205309 | 4.128045 | 0.0004 |
| C(3) | 0.082835 | 0.365880 | 0.226398 | 0.8229 |
| C(4) | 0.291985 | 2.397396 | 0.121793 | 0.9041 |
| C(5) | -1.313657 | 2.157580 | -0.608857 | 0.5486 |
| C(6) | 2117.005 | 3949.706 | 0.535991 | 0.5971 |
| C(7) | 2357.613 | 3141.113 | 0.750566 | 0.4605 |
| C(8) | -11362724 | 30992200 | -0.366632 | 0.7172 |
| C(9) | -23321455 | 23392058 | -0.996982 | 0.3291 |
| C(10) | 6241717. | 4817670. | 1.295588 | 0.2080 |
| **R-squared** | **0.560398** | Mean dependent var | | 4246242. |
| Adjusted R-squared | 0.388380 | S.D. dependent var | | 13080113 |
| S.E. of regression | 10229448 | Akaike info criterion | | 35.36449 |
| Sum squared resid | 2.41E+15 | Schwarz criterion | | 35.81797 |
| Log likelihood | -573.5140 | Hannan-Quinn criter. | | 35.51707 |
| **F-statistic** | **3.257790** | Durbin-Watson stat | | 2.134898 |
| **Prob(F-statistic)** | **0.010664** | | | |

# Stationarity of Variable residuals from VECM (p,q) model.

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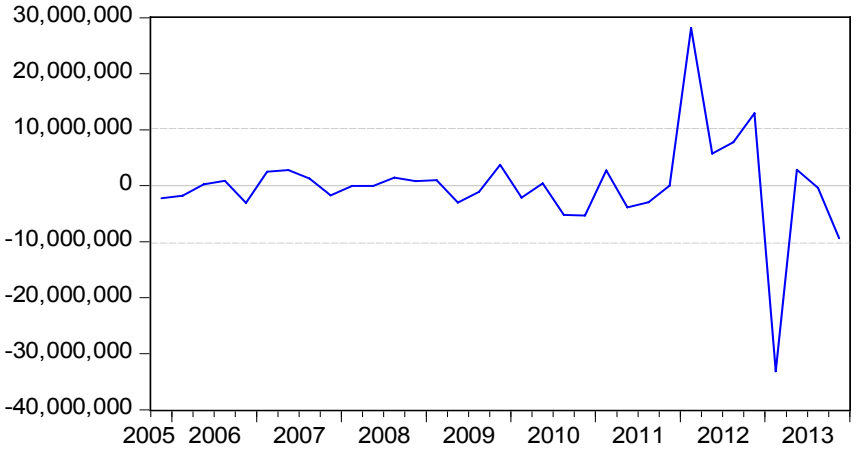
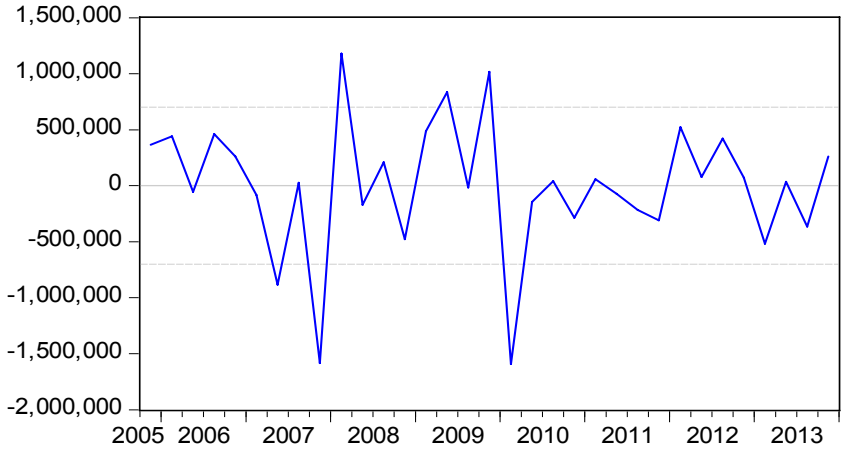
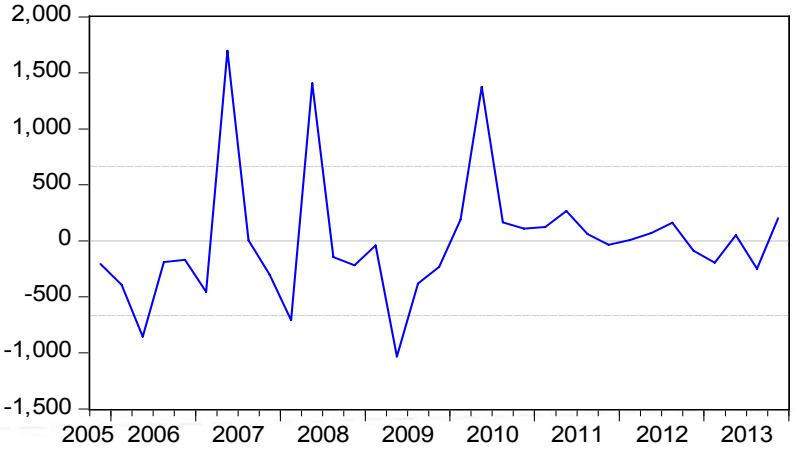
EPWPEX Residuals



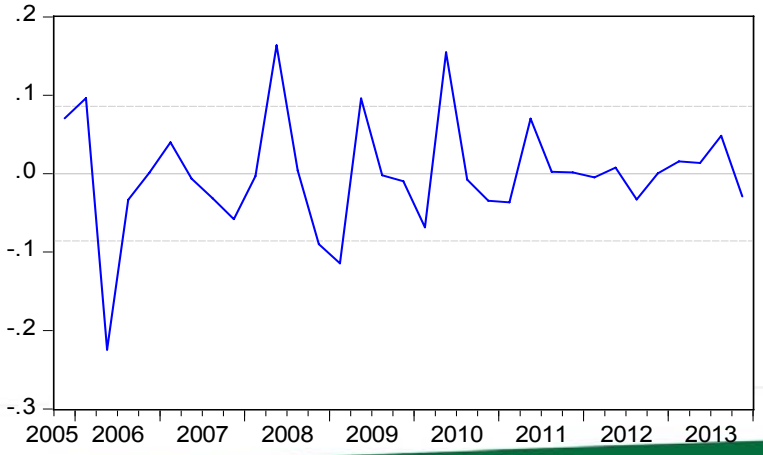

RGDP Residuals




LABF Residuals




UNRATE Residuals



# Is there any short run causality running from independent variables to EPWPex?

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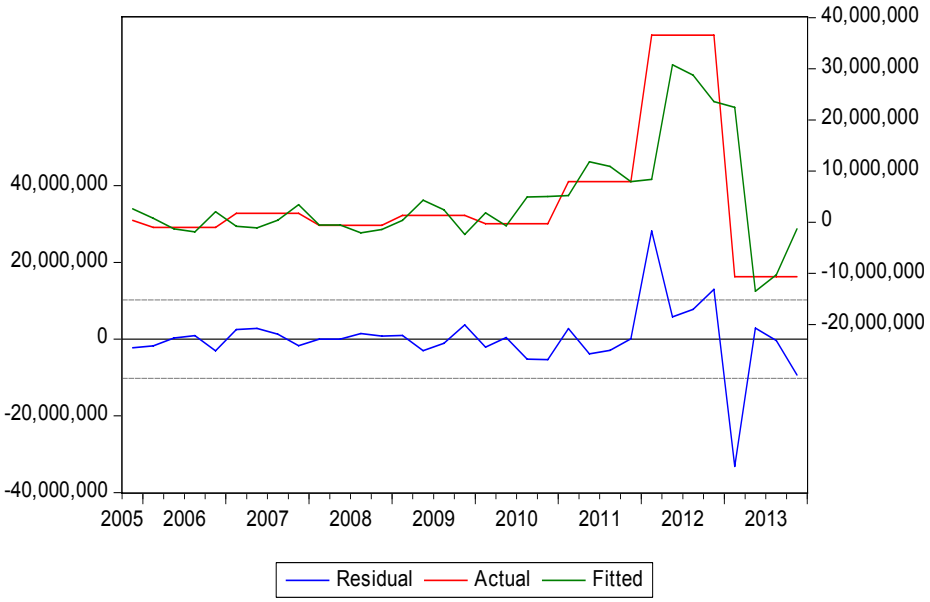
## Fitted Residuals of VECM




## Joint F test for VECM, Wald Test

| Wald Test: **SRC of RGDP on EPWPex** | | | |
|---|---|---|---|
| Null Hypothesis: C(4)=C(5)=0 | | | |
| Equation: EQ01_VECM | | | |
| | | | |
| Test Statistic | Value | df | Probability |
| F-statistic | 0.295092 | (2, 23) | 0.7472 |
| Chi-square | 0.590184 | 2 | 0.7445 |

| Wald Test: **SRC of LABF on EPWPex** | | | |
|---|---|---|---|
| Null Hypothesis: C(6)= C(7)=0 | | | |
| Equation: EQ01_VECM | | | |
| | | | |
| Test Statistic | Value | df | Probability |
| F-statistic | 0.724894 | (2, 23) | 0.4951 |
| Chi-square | 1.449788 | 2 | 0.4844 |

| **Wald Test: SRC of UNRATE on EPWPex** | | | |
|---|---|---|---|
| Null Hypothesis: C(8)=C(9)=0 | | | |
| Equation: EQ01_VECM | | | |
| | | | |
| Test Statistic | Value | df | Probability |
| F-statistic | 0.607628 | (2, 23) | 0.5532 |
| Chi-square | 1.215256 | 2 | 0.5446 |

# Impulse Response Function – VECM

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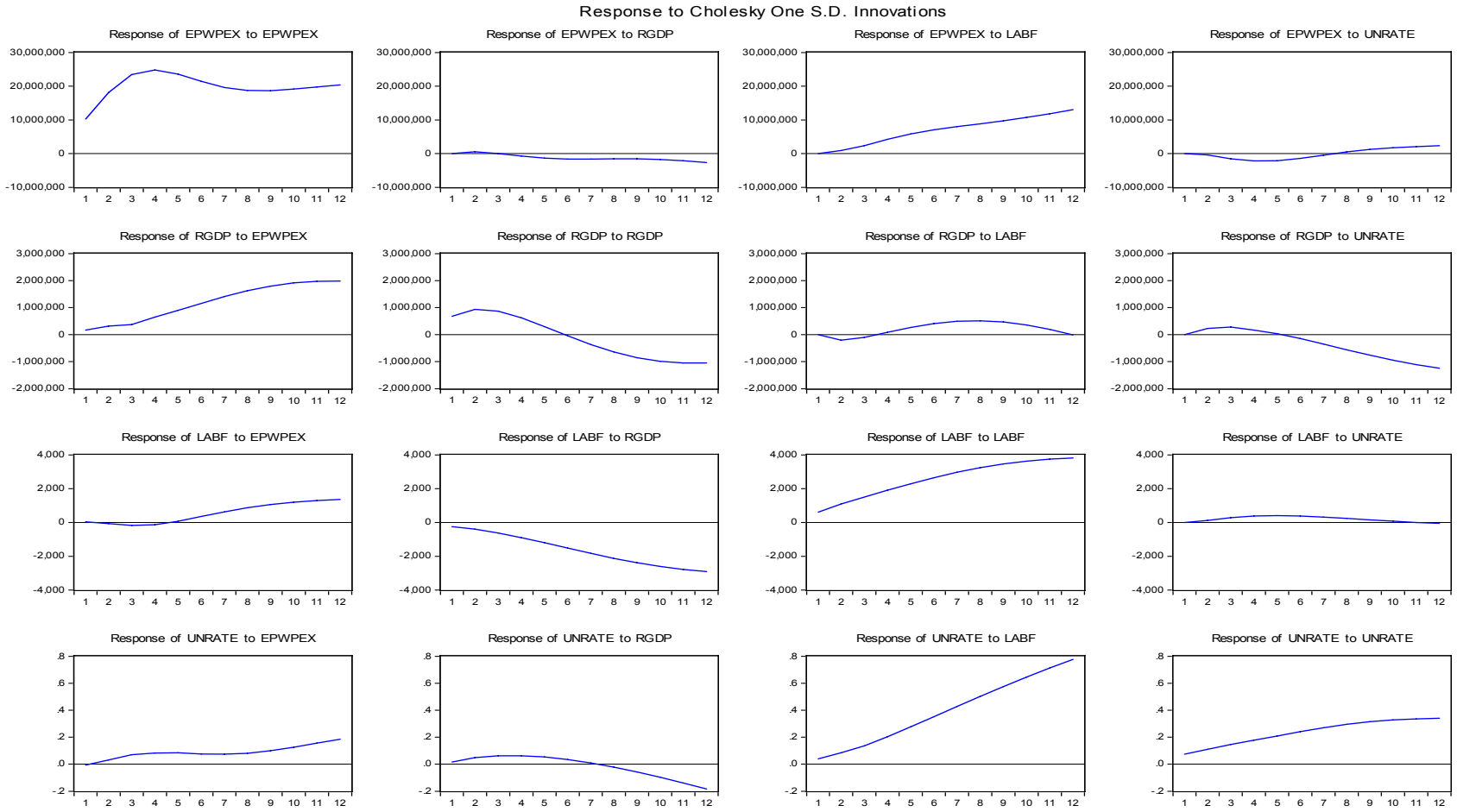

# The wild card? IRF – VAR System

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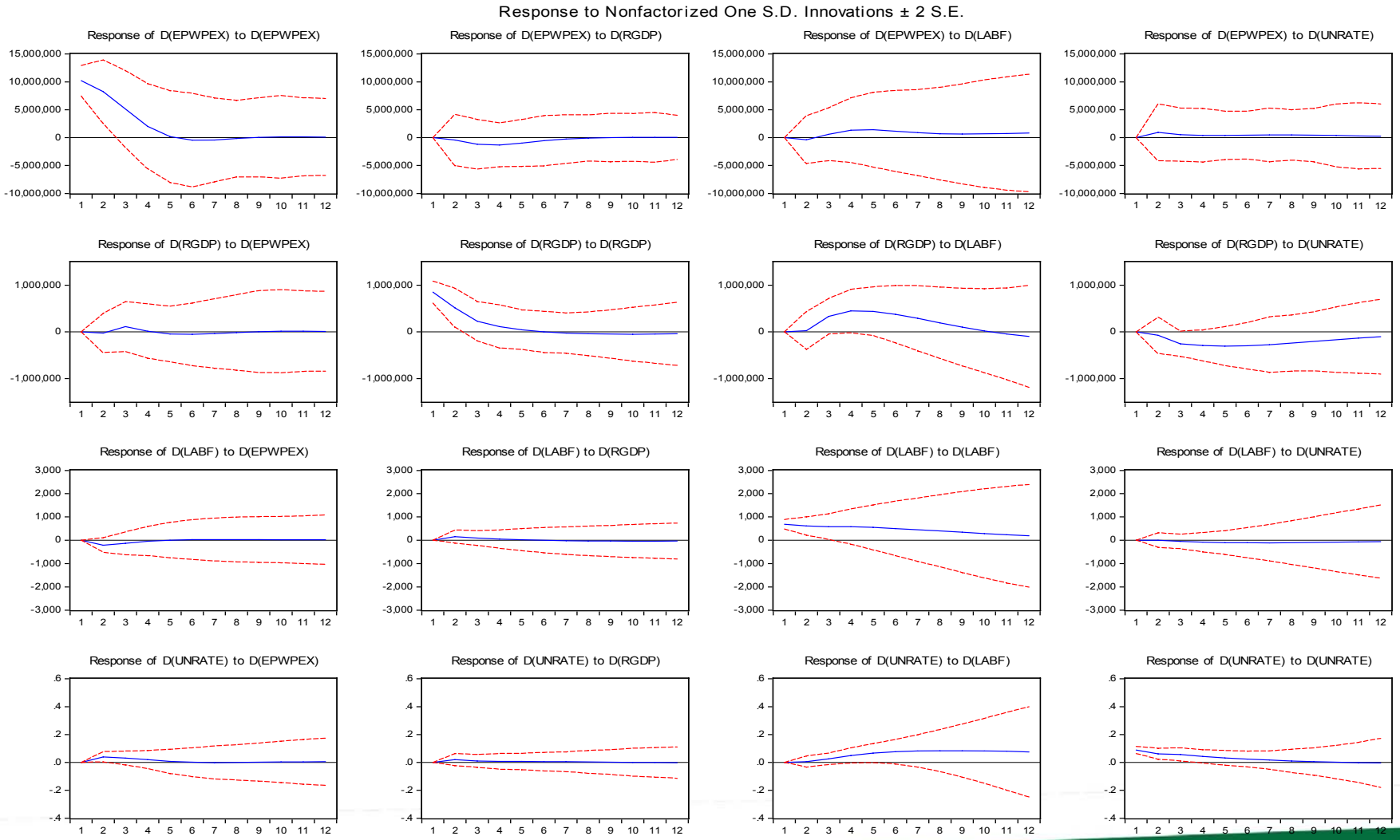

# Empirical Results and Interpretation

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- The results of the fitted ARIMA model shows a statistically significant and positive link between high public expenditure on EPWP, LABF and RGDP as expected. However, the positive sign on RGDP is not statistically significant (same result as the OLS model). This suggest that an increase in public expenditure on EPWP initiatives alone is insufficient to stimulate economic / output growth.

- **Strikingly, both the fitted ARIMA and OLS models shows a statistically significant negative relationship between EPWP expenditure variable and EMP. How do we explain this provocative result?**

- **Our result is in line with findings of Stepanyan et.al (2015) for South Africa**, strongly suggesting that **high public expenditure on public employment programmes (such as EPWP) induces a *crowding-out effect on aggregate employment in FS, in the absence of* employment creation by the private sector.** Reflecting a severely weak participation of the private sector in the economy and underscore the incapability of government to generate substantial number of jobs that will boost economic growth, as well as, dramatically reduce unemployent rate.

- In reality, currently government is the main source of employment, yet the ongoing increase in public sector employment DOES NOT have a dent on the persistently high unemployment rate and weak economic growth.

# Empirical Results and Interpretation..contd

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- The multivariate cointegration tests indicates a possible long-run relationship between high public spending on EPWP, LABF, UNRATE and RGDP.
- The VECM model reveals shows a negative error correction term (t-statistic of -0.98, p=0.3367) confirming the stability of the model.
- The coefficient on the ECM term is -0.11, indicating a slow adjustment speed back to equilibrium, given a once-off shock to the model. That is, it takes about 11% movement back towards equilibrium following a shock to the model, one time period validating the stability of the model.
- However, the positive p value=0.3367 for the ECM term indicates that there is NO LONG-RUN CAUSALITY between expenditure on EPWP and its independent variables.
- Wald Tests on the lagged terms of RGDP, UNRATE, and LABF shows that there is NO SHORT-RUN CAUSALITY running from the independent variables on EPWP expenditure variable. This suggest that EPWP does not have determining influence on economic growth, unemployment rate and the labour force, and vice-versa.
- The System of Equation (132 observations, and 40 coefficients) in the VECM for each variables as explained variables reveals that EPWPex cannot influence RGDP, LABF and UNRATE and their lagged terms. This implies that **changes RGDP, LABF and UNRATE cannot explain changes in public expenditure on EPWP initiatives.**
- 
- RGDP equation reveals that labour force participation rate has a limited impact on economic growth (lagged terms). **Contemporaneous effect of high labour force participation rate can cause dramatic surge in output growth by 15%.** Also, a surge in output growth will cause a fall in unemployment rate (1st round effect) will cause unemployement rate (one time period)
- UNRATE equation reveals that, **high expenditure on EPWP schemes has an insignificant positive effect on unemployment rate** (one time period later) [$4.49^{E}$-9 p=0.0107.]

# Putting it All Together

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- Clearly, in isolation, increasing fiscal allocation to EPWP schemes in Free State does not induce a sizeable influence on economic activities and labour market dynamics. Why? EPWP's ineffectiveness is inherently linked to low labour intensity rate, short duration of projects, multiplicity of objectives and other institutional constraints.

- Concrete empirical evidence reveals that high public expenditure on public employment programmes, such as EPWP induces a *crowding-out effect on aggregate employment in FS, in the absence of* employment creation by the private sector.

- The capacity of job creation by government is severely limited and entails enormous fiscal burden.
- Increasing public expenditure on EPWP as employment generating and poverty reducing policy tool will hardly make any dent on socioeconomic conditions.

**Some Policy Recommendation**

- It is imperative for provincial government to re-design framework to include an extensive training to ensure adequate skill development

- Re-align strategy provincial policies to facilitate a vibrant private sector participation via public private partnerships (PPP) and establishment of SMMEs, to enhance job creation and encourage self employment

- Link the current EPWP and its operational framework to other poverty and employment creating policy in FS, e.g. FSGDS

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# THANK YOU

## QUESTION SESSION…


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