Real Exchange Rate Volatility and Employment Growth in South Africa: The Case of Manufacturing*

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Abstract

This paper uses the Autoregressive Distributed Lag (ARDL) cointegration method to examine the impact of real exchange rate volatility on manufacturing employment growth in South Africa for the period 1995 to 2010. The results show that real exchange rate volatility has a significant contractionary effect on manufacturing employment growth. The results also show that a depreciated real exchange rate enhances manufacturing employment growth. Real manufacturing exports, sales,investment and wages; RGDP and long term interest rates are also shown to have significant impact on manufacturing employment growth. The results suggest that the government can reduce the adverse effects on manufacturing employment growth by adopting macroeconomic policies that promote employment creation and economic growth e.g less restrictive policies, measures that minimise real exchange rate volatility and by intervening to depreciate the exchange rate.

Keywords: Real Exchange Rate Volatility, Employment Growth, Manufacturing Sector, ARDL cointegration, South Africa
JEL Classification: E24, F31

1 Introduction

One of the concerns to the policymakers in South Africa is the persistent high unemployment rate. Several factors may explain why unemployment rate has remained high, these include; an increase in labour supply after the end of apartheid, skill-biased technical change,the role of trade unions and bargaining councils, labour regulation and the nature of economic growth (see e.g. Fedderke & Mariotti 2002, Banerjee, Galiani, Levinsohn, McLaren & Woolard 2008, Bhorat 2007). However, to what extent can real exchange rate

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volatility be made responsible for the negative developments in the South African labour markets?

To the best of my knowledge, no empirical study has been done in South Africa that analyses this issue. This paper fills this gap by examining the impact of real exchange rate volatility on employment growth focusing on the case of manufacturing. The paper employs the ARDL cointegration method and estimates the long run and short run effects of real exchange rate volatility, real exchange rate (RER), real manufacturing output, real manufacturing sales, real manufacturing exports, real manufacturing wages, RGDP, real manufacturing investment and interest rates on manufacturing employment growth.

The results show that real exchange rate volatility has a significant contractionary effect on manufacturing employment growth in both the short-and long-run while the depreciation of RER leads to an improvement in manufacturing employment growth using long run effects. The results also show that manufacturing sales and RGDP have significant and positive long run effects on manufacturing employment growth. Manufacturing exports, investment and wages, and long term interest rates have significant and negative long run effects on manufacturing employment growth.Using lagged employment growth to proxy rigidity, the results show that increasing rigidity leads to the reduction in employment growth. The results suggest that the adoption of measures that minimise real exchange rate volatility can improve manufacturing employment growth. However, policymakers also need to intervene in the foreign exchange market to depreciate the exchange rate to assist in enhancing the manufacturing employment growth as well as implementing policies that are not restrictive.

The rest of the paper proceeds as follows: Section 2 discusses the literature review. Section 3 shows the theoretical model that links exchange rate volatility and the labour market. Section 4 defines the data and variables used. Section 5 describes the motivation behind the study. Section 6 defines the econometric approach used while section 7 discusses the results. Section 8 concludes.

2 Literature Review

Exchange rate volatility affects employment via investment because investment is an important component of demand (Belke & Gros 1998, Belke & Gros 2002). This is also because employment decisions are branded by some degree of irreversibility in the presence of structural rigidities (Belke & Setzer 2003). This follows from the fact that hiring workers also represents an investment in the sense that there are costs incurred to reversing this decision because such a decision is like a sunk cost that cannot be recovered or easily reversed should market conditions change badly, which is also observed with investment expenditures(Caballero & Pindyck 1996).

The relationship between exchange rate volatility and employment is stimulated from the theory of uncertainty in exchange rate and investment. Exchange rate uncertainty has a negative impact on investment process when investment is characterised by irreversibilities because uncertainty increases the value of the option to wait until the next period before investing and hence affecting employment decisions. Belke (2001) calls this transmission mechanism of exchange rate volatility as the investment channel and states that its rele-

vance is determined by the openness of the economy. However, what does the empirical literature linking exchange rate volatility and employment growth say in the presence of rigidities?

Demir (2010) uses a variety of specifications and estimation techniques to analyse the impact of real exchange rate volatility on employment growth in Turkey. He uses a panel of private firms that account for 26% of total value added in the manufacturing sector over the period 1983 to 2005. His study finds that real exchange rate volatility has a significant contractionary employment effect on manufacturing firms. Demir (2010) asserts that though theoretical models that link exchange rate volatility/ uncertainty and investment that stimulate the relationship between exchange rate volatility and employment, find ambiguous results depending on assumptions made such as production technology and irreversibility problem; he states that the majority of empirical studies suggests an unambiguously direct and negative link from volatility and uncertainty to investment. This is because firstly, increasing volatility can reduce the total supply of credit available from the banking system as cited by Bernanke and Gertler (1990). Sharpe (1994) shows that in markets with capital market imperfections, financial constrains significantly affect firm level fluctuations in employment.

Secondly, increasing exchange rate volatility causes higher interest rates. The interest rates represents the monetary policy channel and the rise in them might represent a restrictive monetary policy which attracts capital flows in the presence of current account deficits and fights against inflation. As a result, increasing interest rates negatively affects employment because this causes the borrowing costs to rise and hence investments of all kinds may be reduced including the hiring of new employees (Nickell & Nicolitsas 1999). In addition, exchange rate volatility can also raise inflation uncertainty (Demir 2010). However, Seyfried & Ewing (2001) show that inflation variability reduces employment while Grier & Grier (2006) show that inflation variability reduces output growth. Thirdly, exchange rate volatility can directly affect firm's employment decisions through its effects on sales, profits and investment risk and planning[1]. This is similar to what Obstfeld & Rogoff (1995) show that if goods prices are sticky then monetary shocks can have persistent real effects on consumption, output and exchange rates due to wealth effects from changes in the current account.

Similar results are obtained by Belke & Kaas (2004) while examining the impact of real exchange rate volatility and total economy employment growth in Central and Eastern European (CEE) countries. Their study, however, employs a cross-country panel analysis and finds that real exchange rate volatility reduces employment growth. They state that another transmission channel of exchange rate volatility and employment is via higher wages. This follows that uncertainty in labour demand may cause unions to negotiate higher wages for their members and lead to higher unemployment. This is similar to the findings by Andersen & Sørensen (1988) indicating that increased exchange rate volatility increases real wages and lowers employment.Belke & Göcke (2001) using employment index also find the negative relationship between exchange rate volatility and employment performance.

Using a different approach i.e. examining the impact of exchange rate volatility on unemployment instead of employment growth,Belke & Setzer (2003) find that exchange rate volatility increases unemployment rate. Their study analyses the labour markets in the

[1]See also Sharpe 1994 about the effects of sales on employment.

four Visegrand economies (Czech republic, Hungary, Poland and Slovak republic) using a cross-country panel analysis. The same procedure is done by Stirböck & Buscher (2000) who also find similar results. Belke & Gros (2002) use vector autoregressions (VARs) in first differences to analyse the impact of exchange rate volatility on employment growth and changes in unemployment for the period 1973 to 1999 in Germany. Their study finds that an increase in exchange rate volatility reduces employment growth and increases unemployment rate. Their study uses different measures of exchange rate volatility but follows Gros (1996) whose study finds that a 1% increase in exchange rate volatility raised unemployment rate by 0.6% and a decline in employment growth of 1.3% in Germany over the period 1971 to 1995.

The paper that uses a similar methodology as the one used by this paper is the study by Belke (2001). Belke uses the labour demand equation extended to the open economy case for Germany from 1973Q4 to 1996Q2. He finds that exchange rate volatility has a negative effect on total economy employment. This paper differs with Belke's in that it focuses on manufacturing employment unlike the employment in the entire country. The reason for focusing on manufacturing sector is because it is a major source of employment expansion in South Africa given that it has a large number of unskilled workers. Hence the poor performance of the manufacturing sector contributes significantly to South Africa's unemployment problem. Moreover, manufacturing data on employment is consistent unlike the employment data for the entire economy[2].Based on these studies, the empirical literature tells us that there is a negative relationship between exchange rate volatility and employment growth.

Most empirical work on the impact of exchange rate volatility on employment performance or unemployment rate has focused on developed countries with few on developing countries as shown above. Despite the fact that several papers have been written that analyse why unemployment rate has remained high in South Africa, no empirical study has focused on explaining the impact of exchange rate volatility on employment growth. As such, this paper contributes to the analysis of the impact of exchange rate volatility on employment growth in developing countries. The studies in developing countries have examined mostly the impact of real exchange rate level on employment performance or unemployment rate. These studies begin by discussing the transmission mechanisms/ channels that link exchange rate and employment. This is important because it assists in justifying why certain variables are used in the empirical work even when analysing the impact of real exchange rate volatility on employment performance.

One of the transmission mechanism is the development channel. This channel points to the influence of the real exchange rate on the rate of economic growth and on the rate of employment generation (Frenkel & Ros 2006a, Frenkel 2004). The argument with this channel is that if the real exchange rate is competitive enough to incentivise the entrepreneurs to sell in the international market, then firms will invest and hire local labour force and the economy will grow. This will happen if the rate of capital accumulation in the tradable goods sector is positively related to profitability, and profitability in the tradable goods sector depends positively on the real exchange rate.This holds true because a depreciated real exchange rate reduces the product wage in the traded goods sector and increases the profit rate (Ngandu 2008, Frenkel & Ros 2006a).Exchange rate changes are

[2]See Bhorat & Oosthuizen (2008) for details on the sectors omitted in the calculation of the indices for employment for the entire South African economy.

assumed to affect the producer's revenue through changes in the producer's domestic and foreign sales. Thus profits depend on sales in the home and foreign market which in turn depend on aggregate demand conditions in the respective markets as stated by Ngandu (2008) and Goldberg & Tracy (2001b). Hence this channel emphasises that its important to have competitive real exchange rate for it affects the rate of growth of employment through its influence of the output growth which incentivises investment in the tradable activities.

Frenkel & Ros (2006a) examine the relationship between real exchange rate and unemployment rate in four Latin American countries namely; Argentina, Brazil, Chile and Mexico. Their study uses Ordinary Least Squares (OLS) and finds that real exchange rate appreciation increases unemployment rates in these nations. They also state that the persistence of high unemployment rates in these countries is due to slow process of capital accumulation and a pattern of trade specialisation oriented towards natural resources-intensive products. However, they state that real devaluation of a currency has many complex impacts. The net result depends on the real and financial structures of the countries and on the particular situation of the economy at the time when the devaluation is implemented. With this in mind, it remains a huge puzzle for the policymakers on how to use the exchange rate to target specific policy objectives. Exchange rate appreciation is always welcome politically because it may be expansionary at least in the short-run since it is anti-inflationary and reduces import costs. On the other hand, it can have devastating effects on resource allocation (in that a relatively weak exchange rate can help boost employment) and prospects for development (Frenkel & Taylor n.d.).

On the same channel, one of the conditions to enhance growth, trade and development is that the exchange rate level has to be undervalued. This follows some studies that have shown that developing countries that maintain undervalued exchange rate perform better than those with overvalued exchange rates. Rodrik (2009) shows that undervaluation of domestic currency assists the country in question to grow faster relative to those economies with overvalued exchange rates. This follows the fact that tradables in developing countries suffer disproportionately from institutional weakness and market failures (information and coordination externalities) that block structural transformation and economic diversification, hence keeping these countries poor. Under these conditions, sustained real exchange rate depreciations promote capacity expansion in tradables and increase growth. However, overvalued exchange rates are associated with shortages of foreign currency, rent-seeking and corruption, unsustainably large current account deficits, balance of payments crises and stop-and-go macroeconomic cycles, all of which are detrimental to economic growth.Galindo, Izquierdo & Montero (2007) show that industrial employment react positively to real exchange rate depreciation in those industries with higher export orientation. Eichengreen (2007) assert that if learning-by-doing or technology transfer is relatively rapid in sectors producing for export, then there will be additional stimulus to the overall rate of growth. In addition, he further states that nominal depreciation in conjunction with policies of wage restraint designed to prevent the real effects from being dissipated by inflation and appropriate adjustments of monetary and fiscal policies lead to economic growth.

The other transmission mechanism is macroeconomic channel. This channel is based on open economy Keynesian macroeconomics. It argues that given other determinants of aggregate demand, a depreciated real exchange rate leads to higher net exports and consequently higher demand on domestic activities and higher levels of output and employment. This is conditional on accompanying contractive fiscal and monetary policies intended to

compensate for the expansionary effects of devaluation and to avoid the intensification of inflationary pressures (Ngandu 2008, Frenkel & Ros 2006a, Frenkel 2004). This channel is also possible if the depreciation leads to undervaluation of the real exchange rate for this enhances the real value of exports. Frenkel (2004) examines the relationship between real exchange rate and unemployment rate in Argentina, Brazil, Chile and Mexico. He shows that economies with undervalued exchange rates tend to have low unemployment rates compared to economies with overvalued exchange rate. Frenkel (2004) asserts that real exchange rate affects employment in the short-run by its influence on determining the activity level.

Another transmission mechanism is the labour intensity channel. Frenkel & Ros (2006b) and Frenkel (2004) state that under this channel, real exchange rate influences employment by affecting the labour intensity of output mainly but not only in the tradable sector. This follows the fact that real exchange rate is influential in the determination of the labour/ capital goods relative price in developing countries because capital goods have a significant portion of imported components. Real exchange rate is also the main variable determining the imported inputs/ labour relative price. So, significant changes in these relative prices caused by changes in the real exchange rate should be expected to affect the employment/output ratio.

Ngandu (2008) investigates the impact of exchange rate on employment in all sectors in South Africa. He uses a Computable General Equilibrium (CGE) model and concludes that there is an overall positive impact on employment from an appreciation of the exchange rate. This is so because some sectors do better than others and manage to offset the employment loss in worse off sectors. For example, his results show that the services sector does better in its employment and offsets the employment losses in the manufacturing sector which has a negative relationship with the exchange rate. However, he asserts that his methodology has a disadvantage of not being able to tackle dynamic issues that arise such as currency changes (i.e. CGE models are static). This study will utilise a methodology which tackles this problem. Another example is the paper by Golub & Ceglowski (2002) who investigated the price and cost competitiveness of South Africa's manufacturing sector. Their study used OLS and found that there is a negative relationship between alternative measures of real effective exchange rate and real manufacturing exports for the period between 1970 and 1988.

Galindo et al. (2007) use a panel data analysis to test whether real exchange rate fluctuations have a significant impact on employment, and whether the impact varies with the degree of trade openness and liability dollarization in 9 Latin American countries. They find that real exchange rate depreciation increases employment growth in countries with high degrees of trade openness. They argue that increased openness in financial markets implies that emerging market economies are exposed to big swings in capital flows, and that these swings causes large fluctuations in real exchange rate which have important micro and macro-economic implications. However, their findings are reversed as liability dollarization increases.

Kim (2005) analyses the relationship between exchange rate and employment in the manufacturing sector in Korea for the period 1970 to 1995. Two estimation techniques are used in this study. First, OLS to find the patterns of response of employment to exchange rate shocks across industries. Second, panel data analysis including all industries to show aggregate patterns of employment response to exchange rate shocks. His results show that

employment increases when there is a depreciation of an exchange rate.

Faria & Leon-Ledesma (2005) use the intertemporal optimising agent's model to analyse real exchange rate and employment performance in an open economy. Employment behaviour derived from these kind of models rely on labour market fluctuations and cyclical fluctuations in employment for these are the leading forces behind the business cycle modelling.They assert that workers are rational maximising agents who compare actual and expected future real wages and adjust their labour supply. Their study uses quarterly data from 1972:1 to 2001:4 for U.S.A and U.K utilising the fully modified OLS (FMOLS) method of Phillips & Hansen (1990) and dynamic OLS (DOLS) method of Stock & Waston (1993) which are single equation estimation techniques that correct either parametrically (DOLS) or non-parametrically (FMOLS) for autocorrelation and endogeneity, and hence producing more reliable standard errors than OLS. Their study shows that for U.S.A an appreciation of the real exchange rate leads to a decrease in employment whereas for U.K an appreciation has a positive but non significant impact on employment. The difference was due to different measurements of employment. In U.S.A they used hours worked whereas for U.K they used number of employees.

Goldberg & Tracy (2001a) analyse the gender differences in the labour market effects of the U.S dollar. Their study examine three things: first, the wages of women who remain with their same jobs. Second, the wages of women who change jobs and third, the frequency of job changing following exchange rate movements. They find that a 10% depreciation of the U.S dollar raises women's wages by roughly 1%. For women who change jobs, the estimate of wage increase is over 2% while that of women who stay on their jobs is 0.75%. They assert that the strongest effects are observed among the lesser educated workers. Their results indicate that an exchange rate depreciation has positive effects on employment. These results underpin the inclusion of certain variables as shall be discussed under the econometric approach later in section 6. But first I turn to show the theoretical model that links exchange rate volatility and the labour market in the next section.

3 Exchange Rate Volatility and the Labour Market

The model of Belke & Setzer (2003) illustrates the relationship between exchange rate volatility and employment growth. I show that this model may also hold in South Africa. Consider a set up where there are three periods and a single firm in export-oriented industry that decides about job creation. During the first two periods (called 0 and 1) the firm can open, hire a worker and produce output that is sold in the foreign market during the following periods. If the job is created in period 0, the worker is hired for two periods (0 and 1) to produce output to be sold in periods 1 and 2. If the job is created in period 1 then the worker is hired only for period 1 and output is sold in period 2. To create a job, the firm pays a start-up cost c which reflects the cost of hiring, training and the provision of job specific capital. The worker is paid a wage rate w above the worker's fallback or reservation wage during every period of employment. The reservation wage measures disutility of work and all opportunity income that a worker has to give up by accepting the job. This includes unemployment benefits, collective wage set by a trade union or to a minimum wage, all of which raises the worker's fallback position.

In every period the worker produces output to be sold in the following period in a foreign

market at domestic price p which has a certain component p*(the foreign price) plus a stochastic component e (the exchange rate). The model assumes that the exchange rate follows a random walk because random walk models perform better in out-of-sample forecasting as asserted by Meese & Rogoff (1983). The exchange rate in period 1 (e_1) is uniformly distributed between -σ_1 and +σ_1. The exchange rate in period 2 (e_2) is uniformly distributed between $e_1 - \sigma_2$ and $e_1 + \sigma_2$. An increase in σ_i where i refers to period 1 and 2, means an increase in uncertainty (σ_i is proportional to the standard deviation of e_i). The wage rate is determined by bargaining solution that maximizes the product of the worker's and firm's expected net return from the job. Both the worker and the firm are risk neutral implying they both bargain about a fixed wage rate which is independent of realizations of the exchange rate so that the firm bears all the exchange rate risk.

The expected net return for a job created in period 0 is:

$$E_0(S_0) = 2p^* - 2w = 2\pi \tag{1}$$

where $\pi = p^* - w$ denotes the expected return of a filled job per period. The bargaining power of the worker is denoted by $\beta \in (0, 1)$. Taking bargaining power into account, the firm's net return from the job created in period 0 is:

$$E_0(\pi_0) = (1 - \beta)E_0(S_0) - c = 2(1 - \beta)\pi - c \tag{2}$$

The model assumes that the firm and the worker sign a binding employment contract for two periods (0 and 1) so that job termination is not an option in case the exchange rate turns out to be unfavourable. If the firm waits until period 1, it will create a job only if the exchange rate realized during period 1 and expected for period 2 is above a certain threshold or barrier denoted by b. The profitability barrier is defined by the condition that the expected net return to the firm is zero:

$$(1 - \beta)(p^* + b - w) - c = 0$$

or

$$b = \frac{c}{1 - \beta} + w - p^* = \frac{c}{1 - \beta} - \pi \tag{3}$$

whenever $e_1 \geq b$, the firm creates a job in period 1 and the expected net return to the firm is $E_1(\pi_1) = (1 - \beta)(\pi + e_1) - c \geq 0$. When $e_1 <$ b, the firm does not create a job in period 1 and its return is zero. When both events occur with positive probabilities then unconditional expected return of waiting in period 0 is given by:

$$E_0(\pi_1) = \left[\frac{\sigma_1 + b}{2\sigma_1}\right] 0 + \left[\frac{\sigma_1 - b}{2\sigma_1}\right] \left[(1 - \beta)\left(\pi + \frac{\sigma_1 + b}{2}\right) - c\right] \tag{4}$$

where the first element is the probability that it will not be worthwhile to open a job. The second term represents the product of the probability that it will be worthwhile to open the job because the exchange rate is above the barrier and the average expected value of the net return to the firm under this outcome. Given condition 3 this can be written as:

$$E_0(\pi_1) = \frac{(1 - \beta)(\sigma_1 - b)^2}{4\sigma_1} \tag{5}$$

Equation 5 is the key result because it implies that an increase in exchange rate volatility raises the value of waiting due to the equation being an increasing function of σ_1. Hence the option not to open the job becomes more valuable with more uncertainty. Using equation 2 and 5, it is clear that the firm prefers to wait if and only if:

$$\frac{(1-\beta)(\sigma_1 - b)^2}{4\sigma_1} > 2(1-\beta)\pi - c \tag{6}$$

As the left hand side is increasing in σ_1, the firm delays job creation if the exchange rate volatility is large enough. Equation 6 is satisfied with equality at the following critical value:

$$\sigma_1^* = 3\pi - \frac{c}{1-\beta} + 2\sqrt{\pi(2\pi - \frac{c}{1-\beta})} \tag{7}$$

whenever $\sigma_1 > \sigma_1^*$, firms decide to postpone job creation in period 0. Since σ_1^* is increasing in π and decreasing in the reservation wage w, decreasing in the cost of job creation c and decreasing in the worker's bargaining power β, the model by Belke & Setzer (2003) asserts that there will be a negative relationship between exchange rate volatility and employment if the labour market is characterized by rigidities that raise the option value of waiting and advocates for the postponement of job creation. An important implication of the model is that only the current i.e short term uncertainty σ_1 has an impact on the decision to wait(Belke & Gros 1998). Hence, a methodology such as cointegration that is able to separate between short run effects and long run effects, implies that the negative impact of exchange rate volatility on employment growth is stronger in the short run than the long run. This follows Belke (2001) who asserts that, " We are, however, somewhat puzzled by the fact that variability has an impact on employment even in the long run and that the size of the long run effect seems to be so strong".

Moreover, a variety of economic models (see e.g. Belke & Gros 1998, Belke 2001) indicate that employment decisions are discouraged by exchange rate volatility in the presence of rigidities. Demir (2010) further supports this notion by asserting that the level to which the employment decisions are subject to the irreversibility problem is conditional on the degree of labour market flexibility.

The question that then arises is, does this apply to the South African economy? The study by Bhorat & Cheadle (2009) shows that in the late 1990s hiring (measures all social security and health costs) and firing (financial and legislative provisions for retrenching workers) costs were fairly rigid while hiring (employment contracts) and firing(dismissal clauses) rigidities were flexible. However, by 2006 the South African economy was characterised by high levels of hiring and firing rigidities but with flexible hiring and firing costs. This is due to high values of hiring and firing rigidities and low values of hiring and firing costs for South Africa relative to other upper-middle income countries and the global averages using the World Banks' Cost of Doing Business (see table 1).

Emphasis is placed on hiring and firing costs, and hiring and firing rigidities because empirical studies linking the theory of labour market rigidities and unemployment find that these rigidities have the strongest and most statistical significant effect (Bernal-Verdugo, Furceri & Guillaume 2012, Nickell 1997). Besides, Nickell (1997) states that some rigidities do not cause high unemployment. For instance, he finds that rigidities such as union density, union coverage index and employment protection index (strength of the legal

Table 1: Mean Measures of Regulation, by Income level

Area of Regulation	UMI	South Africa	Global average
Rigidity of Hiring	29.91	44.00	34.33
Rigidity of Hours	40.57	40.00	42.40
Rigidity of Firing	33.43	40.00	33.26
Aggregate Employment Index	34.64	41.33	36.66
Hiring Costs	17.31	2.40	15.62
Firing Costs	44.63	24.00	51.34

Source: Bhorat & Cheadle (2009)

Note: UMI refers to Upper Middle Income Countries

framework governing hiring and firing) have strong impact on unemployment, meaning having these rigidities increases unemployment. However, he finds that rigidities such as tax burden on labour, the unemployment benefit system and working time have either no impact or little impact on unemployment.

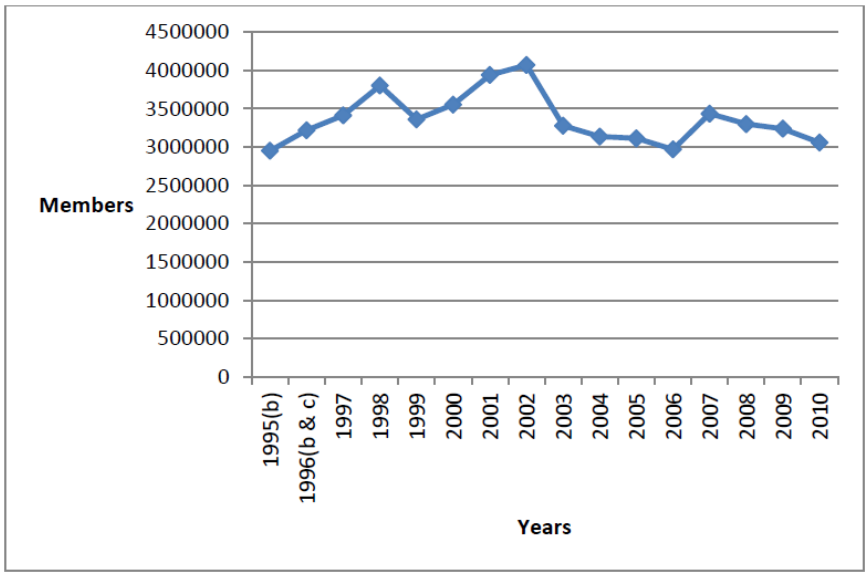
Bhorat (2007) states that trade unions and bargaining councils (institutionalised labour market rigidity) are one of the usual suspects of the causes of high unemployment in South Africa. As a result, figure 1 shows the union members in South Africa. This graph shows that union members increased from about 3 million in 1995 to about 4 million in 2002 before declining to about 3 million in 2010. Despite the decline unions are still an important player in the South African labour market, and this may have contributed to the labour market rigidity due to the protection offered to the trade union members by the trade unions (indirect cost of labour) which then excludes large numbers of the unemployed.

The behaviour of trade unions is the result of the labour legislation governing their decisions. The main labour laws in South Africa include the Labour Relations Act (LRA) 66 passed in 1995, the Basic Conditions of Employment Act (BCEA) 75 passed in 1997 and the Employment Equity Act (EEA) 55 passed in 1998. The LRA is the centerpiece of labour law and all other labour laws are subordinate to this law. The LRA states that every worker has the right to form and join a trade union, to participate in the activities and programmes of a trade union and to strike. The BCEA addresses issues such as hours of work, overtime, meal intervals, annual leave, sick leave and remuneration to mention but a few. The EEA promotes equal opportunity and fair treatment as well as affirmative action to redress racial imbalances that negatively affected the Black people (Africans, Coloured and Indians), women and people with disabilities[3].

However, some problems do arise regarding the definition of rigidity. For instance, collective rights index (the right to freedom of association and the right to join a union) is viewed as a regulatory in nature yet it is not regarded as such by legal practitioners. This is because it constitutes a fundamental human right and cannot be regarded as a regulation (Bhorat & Cheadle 2009). Based on the above theory, I can conclude that exchange rate volatility

[3]These legislations have amendments: as amended by Labour Relations Amendment Act 42 of 1996, Labour Relations Amendment Act 12 of 2002; as amended by Basic Conditions of Employment Amendment Act 11 of 2002. Other Acts mentioned in line with these amendments include: Intelligence Services Act 65 of 2002, Electronic Communications Security (Pty) Ltd Act 68 of 2002, General Intelligence Laws Amendment Act 52 of 2003, Prevention and Combating of Corrupt Activities Act 12 of 2004, Public Service Amendment Act 30 of 2007, and Skills Development Amendment Act 37 of 2008.

Figure 1: Total Trade Union Membership



Source: South Africa Survey 2012-South African institute of Race Relations.

Notes: (b) includes membership of unregistered trade unions. From 1997 onwards, total trade union membership

Figures do not include the membership of unregistered trade unions. In terms of the Labour Relations Act of 1995

The Department of Labour is no longer required to keep records of unregistered trade unions.

(c) The 1996 figures assess unions in terms of the Labour Relations Act of 1995.

is more likely to have a negative effect on employment growth in the manufacturing sector in South Africa.

4 Data

This paper uses quarterly time series data ranging from 1995 to 2010. This period is chosen because the South African government adopted the floating exchange rate regime in 1995 which exposes the currency to swings. The sources of the data include DataStream,OECD, South African Reserve Bank (SARB), Statistics South Africa (Stats SA) and South African Department of Trade and Industry. The employment data comes from Stats SA based on the Survey of Employment and Earnings (SEE) and the Quarterly Employment Statistics (QES) survey . The SEE covered both employing and non employing value added tax registered enterprises with an annual turnover of R300000 or more. The QES covers a sample of approximately 24000 private and public enterprises registered for Income tax.The employment index data of the same variable from SARB shows similar pattern of which the SARB asserts that the index is based on sources from Stats SA. As such, I can say that the time series version of the employment data is consistent. The variables are defined as follows.

The dependent variable is employment growth which is measured as the logarithmic growth rate of the number of employees in the manufacturing sector. From the literature, it is advisable to test for dynamic effects so that the well-known path dependence of the

employment growth is captured. To proxy this, the lagged value of employment growth is used.

Real exchange rate volatility (ExrateV) is measured using the moving sample standard deviation. It is a time varying measure of exchange rate volatility that accounts for periods of low and high exchange rate volatility. It is expressed as

$$Vol_{t+m} = \left(\frac{1}{m} \sum_{i=1}^{m} [R_{t+i-1} - R_{t+i-2}]^2 \right)^{\frac{1}{2}} \tag{8}$$

where R is the rate of change of real exchange rate . m is the order of moving average and I use m=12. Based on the discussion in section 2, I expect a negative relationship between real exchange rate volatility and employment growth. Figure 6 (see the appendix) shows the trend of real exchange rate volatility measured by the moving sample standard deviation. This graph shows that real exchange rate fluctuated significantly over the studied period which indicates that it is volatile. The same is seen in figure 7 (see the appendix) which shows real exchange rate volatility measured using the simple standard deviation of monthly percentage changes in real exchange rate. Both figure 6 and 7 indicate that real exchange rate volatility increases with major global economic disturbances such as the Asian crises in 1997, the Mexican crises in 1998 and the global financial crises from 2008 because of the spikes seen during this period.

< **Insert Figure 6 and 7 Here**>

Real Exchange rate (RER) is measured as the logarithmic growth rate of real exchange rate . It is used to control for the level effects and the study uses the direct quotation system (South African rands per U.S dollar), meaning an increase refers to depreciation. Based on the discussion in section 2, I expect a positive relationship between real exchange rate and employment growth i.e depreciation of RER increases employment growth. The paper uses CPIs as deflators to come up with the RER from nominal rates.

Output is the logarithmic growth rate of manufacturing gross value added at 2005 constant prices and seasonally adjusted. It is used to control for manufacturing demand shocks and productivity changes. I expect a positive relationship with employment growth.

Wages is the logarithmic growth rate of real wages in the manufacturing sector at time t-1.Lagged values are used to control for the possibility of contemporaneous effects of exchange rate volatility on employment growth through higher wages and the reverse causality from labour demand (Demir 2010) . I expect a negative relationship between wages and employment growth as economic theory asserts.

RGDP is the logarithmic growth rate of real GDP. One period lagged values are used to control for possible endogeneity between current GDP growth and exchange rate volatility. The variable is used to control for aggregate demand shocks. I expect a positive relationship with the dependent variable.

Sales is the logarithmic growth rate of manufacturing sales at 2005 constant prices and seasonally adjusted. It is used to proxy profitability. I expect a positive relationship between sales and employment growth.

Exports is the logarithmic growth rate of manufacturing exports using volumes at time t-1. Lagged values are used to control for potential endogeneity between exports performance and exchange rate volatility. It is used to show tradability and competitiveness of the manufacturing sector.I expect a positive relationship with the dependent variable.

Invest is the log of manufacturing investment. This is proxied by the gross fixed capital formation in the manufacturing sector. Since exchange rate volatility influences employment growth through investment, I expect the coefficient of the investment variable to be negative.

Interestr is the interest rate. This paper uses the yield on government bonds-10 years and more which represents the long term interest rates.

Dummy variables (D_i). Find0809 is the dummy variable for the 2008/2009 global financial crisis. This variable takes the value of 1 (one) from 2008-2009 and 0 otherwise. BCEA97 is the labour legislation dummy for the years in which the Basic Conditions of Employment Act was passed. It takes the value of 1 (one) from 1997 onwards and 0 otherwise. EEA98 is the labour legislation dummy for Employment Equity Act. It takes the value of 1 (one) from 1998 onwards and 0 otherwise. GEAR96 is the dummy for changing macro policy positions. It takes the value of 1 (one) from 1996 to 2005 and 0 otherwise. Seasonal dummies are also used following other papers that use them when using quarterly dataset.Other dummy variables available are Asgisa06 for the changing macro policy positions taking the value of 1 (one) from 2006 onwards and 0 otherwise, and the labour relations act (LRA95). However, they are not used to avert the dummy trap that leads to multicollinearity.

5 Descriptive Statistics

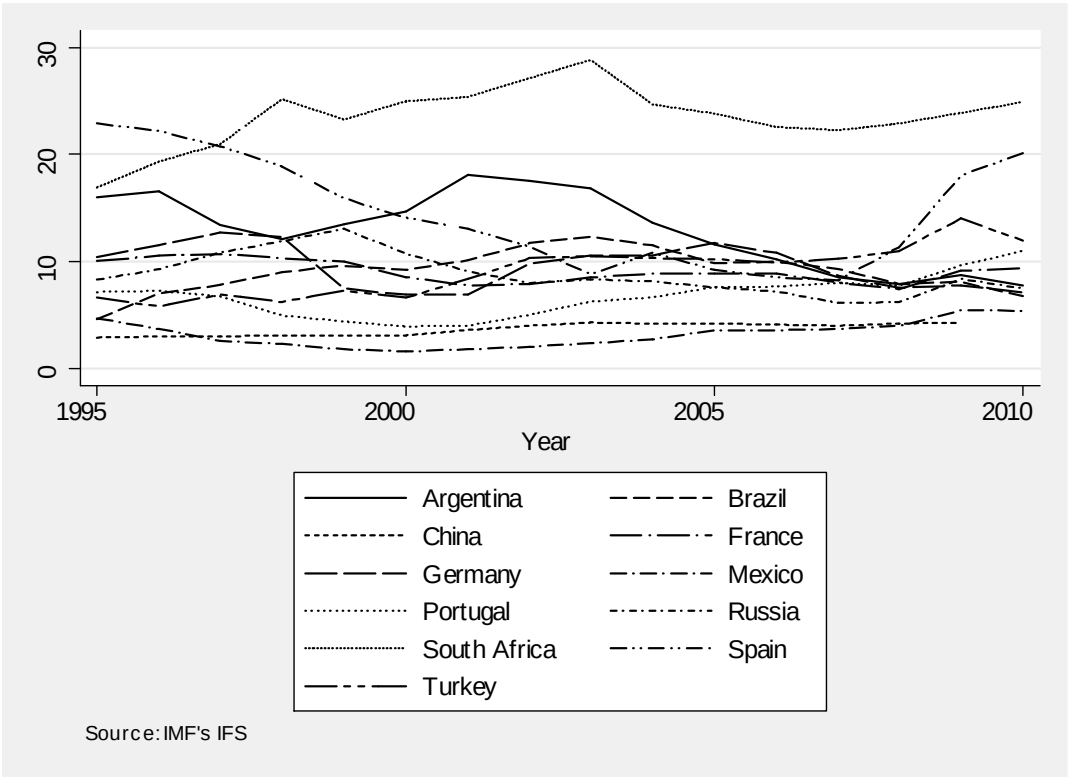
This paper is motivated by the pressure that the government was in during the period of 2010/2011 wherein it was pressured to intervene in the foreign exchange market and depreciate the currency in order to stimulate exports and job creation in the manufacturing sector due to the sustained appreciation of the rand between 2002 and 2010. Due to this, I examine the period between 1995 and 2010 because the government adopted strategies that led the South African economy to be integrated with the rest of the world post apartheid era. Though the government was under pressure due to the appreciation of the rand, it is inadequate to focus only on the level of the exchange rate because integration with the rest of the world increases openness of the country and exposes its currency to swings. As a result, it is more important to examine the impact of real exchange rate volatility on employment growth in manufacturing.

During this period the unemployment rate increased from 16.90% in 1995 using the narrow definition to 28.85% in 2003 before declining to reach 24.93% in 2010[4]. The narrow definition of unemployment is used because it is the international comparator to the definition of unemployment formally adopted by the International Labour Organisation in 1982[5].

[4]The broad unemployment also increased from 30.8% in 1995 to 41.8% in 2003 before declining to reach 38% in 2010. See Bhorat (2007) for the trend analysis of the two definitions for the case of South Africa between 1995 and 2006.

[5]Narrow unemployment is defined as unemployed who did not work in the last seven days but actively looked for work whilst broad unemployment is narrow unemployment plus those who were not working

Figure 2: Unemployment Trends for Selected Countries 1995 to 2010



Although the unemployment rate was on a downward trend since 2003, it is still one of the highest in the world. Figure 2 shows the trend of the unemployment rate in selected countries.

The next issue is how volatile was the rand and the movement in its level during this period. Exchange rate volatility is the tendency of the exchange rate to rise or fall sharply within a short period of time. However, there is no consensus in the literature on how to measure volatility because it is an unobservable variable.The methods widely used are generalised autoregressive conditional heteroscedasticity (GARCH) which allows for time varying conditional variance i.e. volatility clustering mostly observed in high frequency data sets, the moving sample standard deviation and to a less extent simple standard deviations. As such this paper will use the moving sample standard deviation in the fully specified regression analysis later on. Using the simple volatility measure i.e. the standard deviation of the monthly percentage changes in the real exchange rate, table 2 shows that the rand is relatively more volatile compared to other emerging market currencies. This is because the standard deviation of the rand is higher than the currencies of Brazil, Russia and India, and slightly below the currency of Turkey.

On the other hand, figure 3 shows that the rand per US dollar depreciated between 1995 and 2001, and then appreciated between 2002 and 2010. Relative to other currencies, the rand depreciated at a faster rate between 1995 and 2001 with the exception of the Mexican peso that appreciated during this period. The rand depreciated by about 164% while Brazil, Turkey and Argentina's currencies depreciated by about 87%,7% and 21%

but would accept a suitable job if offered even though they are not looking for work now (and in some cases includes seasonal workers and contract workers as well).

Table 2: Standard Deviations

Year	Real	Rouble	Rupee	Rand	Lira
1995	1.89[1.77]	3.17[2.96]	1.40[1.30]	1.07[1]	2.91[2.72]
1996	0.48[0.15]	0.74[0.23]	1.48[0.45]	3.27[1]	1.51[0.46]
1997	0.38[0.21]	0.23[0.12]	0.71[0.39]	1.81[1]	1.79[0.99]
1998	0.39[0.07]	9.85[1.84]	1.11[0.20]	5.34[1]	2.38[0.45]
1999	10.91[5.90]	1.22[0.66]	0.45[0.24]	1.85[1]	1.78[0.96]
2000	2.04[0.91]	2.78[1.25]	1.20[0.54]	2.23[1]	1.67[0.75]
2001	4.70[0.94]	0.97[0.19]	0.54[0.11]	5.02[1]	11.09[2.21]
2002	6.02[1.36]	0.59[0.13]	0.81[0.18]	4.43[1]	7.23[1.63]
2003	4.35[0.80]	1.67[0.30]	1.47[0.27]	5.46[1]	4.71[0.86]
2004	3.14[0.62]	0.84[0.17]	0.67[0.13]	5.03[1]	4.23[0.84]
2005	2.81[0.62]	0.27[0.06]	0.49[0.11]	4.50[1]	2.59[0.58]
2006	2.25[0.45]	0.89[0.18]	1.16[0.23]	4.99[1]	5.91[1.18]
2007	2.24[0.84]	1.01[0.38]	2.13[0.79]	2.68[1]	2.29[0.85]
2008	6.55[0.82]	0.73[0.09]	1.95[0.24]	7.96[1]	7.83[0.98]
2009	2.59[0.49]	1.61[0.30]	2.75[0.52]	5.29[1]	3.59[0.68]
2010	2.20[0.60]	0.33[0.09]	1.03[0.28]	3.67[1]	3.81[1.04]
Average	3.31[0.82]	1.68[0.42]	1.21[0.30]	4.04[1]	4.08[1.01]

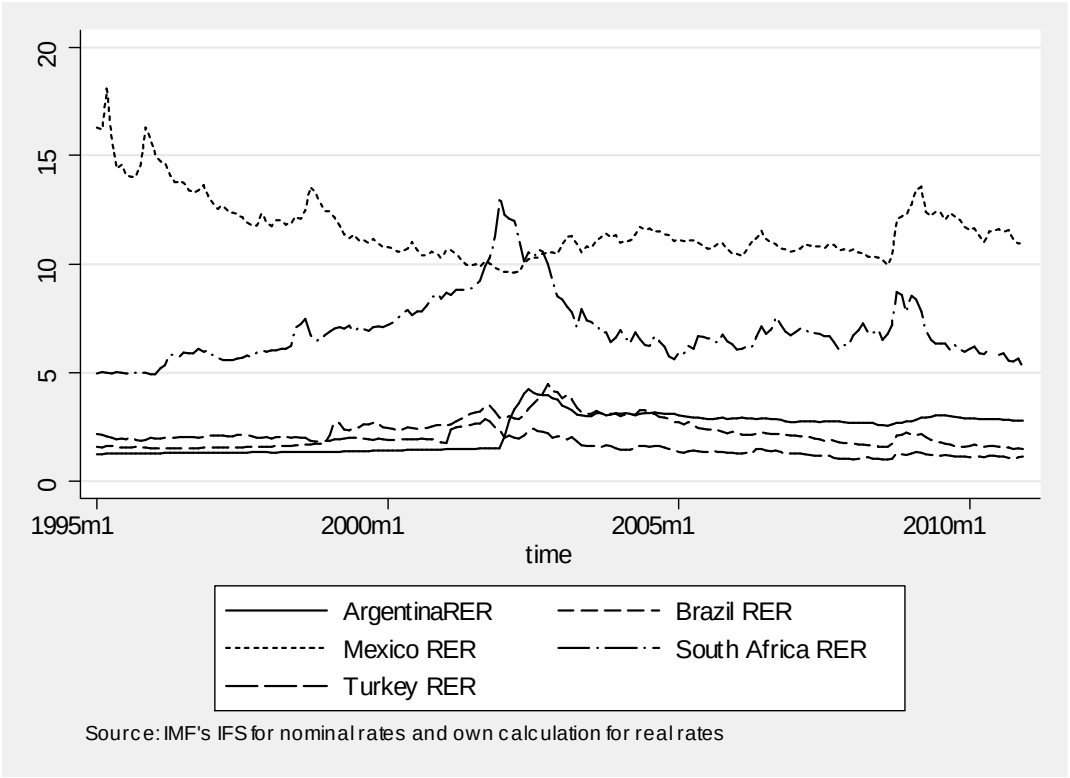
Source: IMF's IFS for nominal rates.The number in square bracket refers to how the volatility of other currencies is relative to South Africa's Rand. A value less than one implies that the currency of the country in question has less volatility when compared to South Africa's Rand.

respectively. The Mexican currency appreciated by about 40%. Between 2002 and 2010, the rand also appreciated at a faster rate relative to the currencies of Argentina, Brazil and Turkey. During this latter period, the rand appreciated by about 57% unlike Brazil and Turkey's currencies that appreciated by about 50% and 44% respectively, while Mexico's currency depreciated by about 14% . A similar trend of the rand per US dollar is observed for the rand per euro. These two rates (rand/US dollar and rand per euro) are stated because the US dollar is the currency that is widely used in the foreign transactions, and the fact that South Africa trades mostly with the United States of America and the Eurozone. Due to data availability, this paper will use the rand per U.S dollar rate.

But what could have caused the volatility and sustained appreciation of the rand between 2002 and 2010? One explanation is that the rand is volatile because it is the most traded currency in Africa and is also traded as much as other emerging market currencies. This is shown in table 3 by looking at percentage shares of average daily turnovers following the survey by the Bank for International Settlements (BIS) in 2010.

Another possible explanation for the volatility and appreciation of the rand is due to large short term capital flows as a result of relatively higher domestic interest rate because of the relative high rate of return in most emerging market economies. This follows the sluggish recovery in developed economies that have sustained low interest rates. The high interest rates in emerging markets led to increased carry trade volumes into these economies. A carry trade is a trading strategy where one invests in currencies which yield high interest rates and funds this investment by borrowing in currencies with low interest rates. This is due to the failure of uncovered interest parity (UIP) condition which states that exchange

Figure 3: Selected emerging market's real exchange rates (domestic currency per US$)



rate changes has to eliminate the interest rate margin. Moreover, empirical studies show that exchange rate changes do not compensate for the interest rate margin and that the opposite holds true, that is, high interest rate currencies tend to appreciate while low interest rate currencies tend to depreciate which yields considerable returns to currency speculation (see e.g. Menkhoff, Sarno, Schmeling & Schrimpf 2011, Hassan & Smith 2011).

Overall, the performance of the rand volatility and its level is due to the exchange rate policy followed by the South African Reserve Bank (SARB). South Africa follows a floating exchange rate system since the removal of the dual exchange rate regime in 1995. This means that the rand is determined by the forces of demand and supply. The SARB,however, can participate in the foreign exchange market and such activities can influence the exchange rate. It is because of this reason why the government was under pressure to intervene. The SARB asserts that its participation in the foreign exchange rate market is to build up the foreign exchange reserves and should be seen as the management of international liquidity and not exchange rate policy target. As from the year 2000, the sole objective of the SARB has been inflation targeting. This has led the inflation rate to be volatile. Gupta (2012) states that inflation volatility can impede growth even if inflation on average remains restrained and advocates that the SARB should respond to exchange rate fluctuations.

On the other hand,the manufacturing sector performed poorly during this period. Figure 4 shows that the manufacturing value added as percentage of GDP declined from 21.22% in 1995 to 14.64% in 2010. At the same time, the manufacturing sector has been characterised by falling employment and disappointing export performance(Faulkner & Makrelov 2008). It is disappointing because real manufacturing exports increased during the period under

Table 3: Selected Emerging Market currency distribution of global exchange market: Percentage shares of average daily turnover

Currency	1998	2001	2004	2007	2010
Korean won	0.2	0.8	1.1	1.2	1.5
Mexico peso	0.5	0.8	1.1	1.3	1.3
Indian rupee	0.1	0.2	0.3	0.7	0.9
Russian rouble	0.3	0.3	0.6	0.7	0.9
Chinese renminbi	0.0	0.0	0.1	0.5	0.9
Polish zloty	0.1	0.5	0.4	0.8	0.8
Turkish lira	.	0.0	0.1	0.2	0.7
South African rand	0.4	0.9	0.7	0.9	0.7
Brazilian real	0.2	0.5	0.3	0.4	0.7
Malaysian ringgit	0.0	0.1	0.1	0.1	0.3
Chilean peso	0.1	0.2	0.1	0.1	0.2
Argentine peso	0.1	.	0.0	0.0	0.0

Source: Bank for International Settlements

review with slight decreases in 2002/2003 and 2008/2009 period yet manufacturing employment did not increase as exports increased. This contrasting transformation between export performance and employment makes it an interesting case study to explore the effects of real exchange rate volatility and the level of exchange rate on manufacturing employment. This is due to the fact that the manufacturing exports performed relatively better whilst the employment performance did not follow similar trends yet the exchange rate is also linked to employment via the trade balance. Suggesting that the exchange rate might not have been competitive enough (even though it depreciated between 1995 and 2001) to attract more exports from the manufacturing sector.Edwards & Alves (2006) state that the lack of re-structuring exports towards the dynamic high technology products is one of the reasons why South African manufacturing exports performed poorly during the 1990s as well as lagging the exports performance of East Asian economies. They also argue that the real depreciation of the rand during the 1990s contributed extensively towards growth in manufacturing exports but the volatility of the exchange rate may have contributed to the poor export performance relative to other developing economies.Hodge (2005) states that the relationship between exchange rate and employment is less direct and contains more intervening variables. Figure 5 shows the trend of manufacturing employment and exports. Besides, the poor performance of South Africa's manufacturing sector contributes significantly to the unemployment problem. Moreover, Hausmann (2008) states that the manufacturing sector is one of the sectors mostly intensive in unskilled labour. As such, to achieve greater levels of employment, there is a need for a relative expansion of the tradable sector to create more jobs for low skilled individuals.

The poor performance of employment in manufacturing sector and high unemployment rate in South Africa could be because of the macroeconomic policies implemented. In 1994, the government adopted the Reconstruction and Development Programme (RDP) as its strategy to address the social and economic problems facing the country. This programme advocated for public works as its means to create jobs. However, in 1996 the government implemented the Growth, Employment and Redistribution (GEAR) programme as its macroeconomic strategy. GEAR was an outward-oriented strategy with the hope of expanding growth and employment via the manufacturing sector as the key driver (Golub

Figure 4: Manufacturing Value Added (% of GDP)

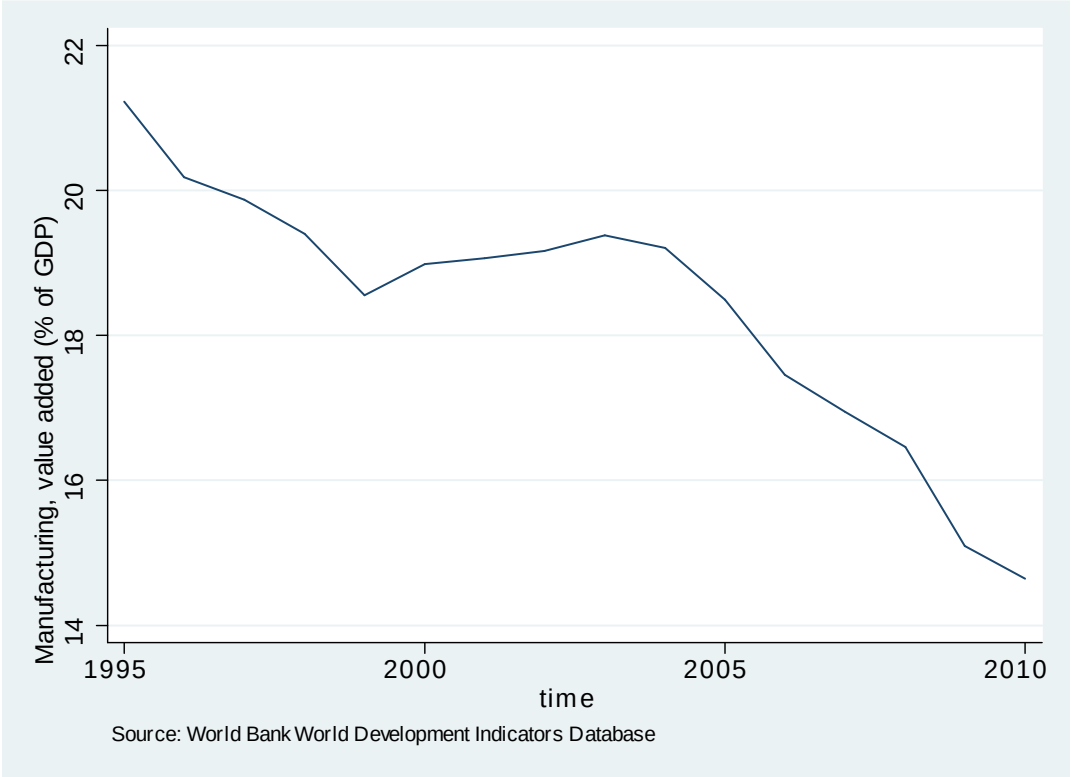
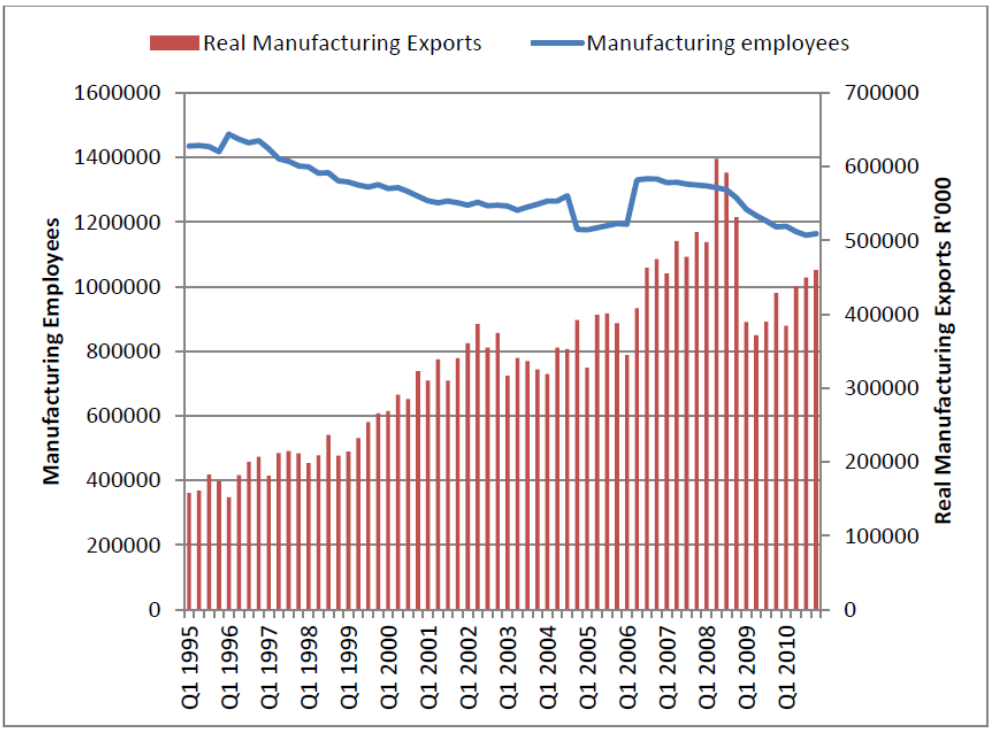


Figure 5: Manufacturing employees and real manufacturing exports



Source: DataStream for manufacturing employees. Department of Trade and Industry for nominal manufacturing exports.

Manufacturing PPI index used to deflate manufacturing exports.

& Ceglowski 2002, Edwards & Golub 2002). GEAR relied much on restrictive monetary and fiscal policies. Due to this, GEAR was successful in reducing budget deficit and inflation but failed to increase growth and employment. The failure to increase growth and employment is because it conflicted with the methods of RDP which promoted growth via public works due to lack of funds as a result of restrictive policies.

In 2006,the government adopted the Accelerated and Shared Growth Initiative for South Africa (AsgiSA) with the mandate to halve poverty and unemployment by 2014. This strategy stated that the growth rate of around 5% on average was needed till 2014. It also needed to find strategies to reduce the volatility and overvaluation of the currency for it was one of the binding constraints. The policies then followed ensured that the fiscal and monetary policies dove-tailed within the inflation targeting regime, and hence did not assist in increasing growth. As from 2010, the government came up with the new strategy called the new growth path. This strategy emphasises the need to create decent jobs to fight poverty, inequalities and address rural underdevelopment. To achieve some of its goals, economic growth should be growing at least at the rate of 6% per annum, a target which is likely to be difficult to achieve due to more emphasise placed on creating decent jobs that is viewed as a rigidity in the labour market. To uncover some key stylised facts of the data, table 4 shows the summary statistics.

Table 4: Summary Statistics

Variables	Obs	Mean	Std.Dev	Min	Max
Employgr	62	-0.0034	0.0203	-0.0845	0.1095
ExrateV	62	0.0424	0.0149	0.0158	0.0736
RER	62	0.0015	0.0700	-0.1730	0.2050
Output	62	0.0059	0.0180	-0.0686	0.0398
Wages	62	0.0063	0.0277	-0.0471	0.0693
RGDP	62	0.0079	0.0062	-0.0151	0.0186
Sales	62	0.0085	0.0365	-0.0842	0.1966
Exports	62	0.0169	0.1014	-0.3110	0.2038
Invest	62	10.790	0.2156	10.500	11.200
Interestr	62	4.9561	3.6781	-2.9600	12.460

Notes:Growth rates (except output) are in log differences.
Obs=number of observations.Std.Dev=standard deviation.
Min=minimum. Max=maximum
Variables are as defined in section 4.

6 Econometric Approach

This paper seeks to examine the impact of real exchange rate volatility on employment growth in manufacturing sector. To achieve this, the paper applies cointegration analysis. This stems from Hamermesh (1996) who asserts that in studies of dynamics of employment and worker-hours, the focus is on the rate at which labour demand adjusts to shocks to product demand and factor prices. But this depends on the data used and estimation methods. Hamermesh states that a simple form of estimating such equations is as follows

$$L_t = \alpha L_{t-1} + \beta X_t + \varepsilon_t \tag{9}$$

where α and β are parameters, X_t is a vector of variables that affect long-run equilibrium values of employment growth (L_t) and ε_t is a disturbance term. The fact that X_t is a vector of variables that affect the long-run equilibrium justifies the use of cointegration.

The Autoregressive Distributed Lag (ARDL) cointegration method is used to estimate the impact of real exchange rate volatility on employment growth in manufacturing sector for South Africa. This approach allows the estimation of both short run and long run coefficients of a single equation cointegration method. The coefficients of this approach are unrestricted and as such the short run dynamics are not dictated by the long run equilibrium relationship. It has an advantage over other cointegration methods (both single equation cointegration methods e.g. fully modified OLS and dynamic OLS; and non single equation e.g. Johansen 1988) in that it performs better in small samples (Pesaran & Shin 1999). The other advantage is that it works even when the underlying variables are integrated of order zero {I(0)} only, integrated of order one {I(1)} only or a mixture of I(0)/ I(1) unlike the cointegration methods of Engle & Granger (1987),Johansen (1988) and Stock & Watson (1988) that concentrate on cases in which the underlying variables are integrated of order one {I(1)} only (Pesaran, Shin & Smith 2001). Hence the bounds testing procedure by Pesaran et al.2001 allows to test for the existence of a level long run relationship when the orders of integration of the underlying regressors are not known with certainty. This follows the low power of unit root tests that leads to always be a certain degree of uncertainty with respect to the order of integration of the underlying variables (Belke & Polleit 2006).

Unlike other single equation cointegration methods, ARDL method offers explicit tests for identifying a unique cointegration vector but like the other single equation cointegration methods, it suffers from the weakness that it is only valid when there is a unique cointegration vector. There is no guarantee that there will always be a unique cointegration vector (Muchapondwa & Pimhidzai 2011). However, it is necessary to put appropriate lags of the regressors in ARDL cointegration method before estimation. This appropriate augmentation of the order of the ARDL model leads to two important facts. First, the OLS estimators of the short run parameters are $\sqrt{T}$-consistent with the asymptotically singular covariance matrix. Second, the ARDL based estimators of the long run coefficients are super-consistent. Hence valid inferences on the long run parameters can be made using standard normal asymptotic theory (Pesaran & Shin 1999). As such the ARDL model is advantageous for it corrects for residual serial correlation and the problem of endogenous regressors for the lags are used as instruments. It has an additional advantage of yielding consistent estimates of the long run coefficients that are asymptotically normal irrespective of whether the underlying regressors are I(0) or I(1) or mutually cointegrated (Pesaran & Shin 1999).

The test in ARDL model is the standard Wald or F statistic for testing the significance of the lagged levels of the variables in a first difference regression. The regression is an error correction form of an ARDL model in the variables of interest. This paper will estimate the following ARDL model:

$$
\begin{aligned}
Employgr_t &= \alpha_0 + \alpha_1 D_i + \sum_{i=1}^{p} \phi_i Employgr_{t-i} + \sum_{i=0}^{q} \beta_{1i} ExrateV_{t-i} + \sum_{i=0}^{r} \beta_{2i} RER_{t-i} \quad (10) \\
&+ \sum_{i=0}^{s} \beta_{3i} Output_{t-i} + \sum_{i=0}^{t} \beta_{4i} Wages_{t-i} + \sum_{i=0}^{u} \beta_{5i} RGDP_{t-i} + \sum_{i=0}^{v} \beta_{6i} Sales_{t-i} \\
&+ \sum_{i=0}^{w} \beta_{7i} Exports_{t-i} + \sum_{i=0}^{x} \beta_{8i} Invest_{t-i} + \sum_{i=0}^{y} \beta_{9i} Interestr_{t-i} + \varepsilon_t
\end{aligned}
$$

where Employgr_t is the logarithmic growth rate of the number of employees, ExrateV_t is the real exchange rate volatility, RER_t is the logarithmic growth rate of the real exchange rate, Output_t is the logarithmic growth rate of manufacturing gross value added, Wages_t is the logarithmic growth rate of real manufacturing wages, RGDP_t is the logarithmic growth rate of the real gross domestic product, Sales_t is the logarithmic growth rate of manufacturing sales used a proxy for manufacturing profits, Exports_t is the logarithmic growth rate of manufacturing exports, Invest_t is the log of manufacturing investment, Interestr_t is the long term interest rate, α_0 is the intercept, D_i are the dummy variables for 2008 global financial crisis,labour legislation and changing policy positions, and ε_t is the error term assumed to be serially uncorrelated. Section 4 properly defines these variables. The use of variables in growth rates in similar to (Demir 2010).

To find the unique cointegration vector in the ARDL model, the bounds test is implemented as follows: First, I estimate an unrestricted error correction model (ECM) in equation (11) below where the lag length (p) is such that the error term is not serially correlated

$$
\begin{aligned}
\Delta Employgr_t &= \alpha_0 + \varphi_0 Employgr_{t-1} + \varphi_1 ExrateV_{t-1} + \varphi_2 RER_{t-1} + \varphi_3 Output_{t-1} \quad (11) \\
&+ \varphi_4 Wages_{t-1} + \varphi_5 RGDP_{t-1} + \varphi_6 Sales_{t-1} + \varphi_7 Exports_{t-1} + \varphi_8 Invest_{t-1} \\
&+ \varphi_9 Interestr_{t-1} + \sum_{i=1}^{p} \phi_i \Delta Employgr_{t-i} + \sum_{i=0}^{p} \beta_{1i} \Delta ExrateV_{t-i} + \\
&\sum_{i=0}^{p} \beta_{2i} \Delta RER_{t-i} + \sum_{i=0}^{p} \beta_{3i} \Delta Output_{t-i} + \sum_{i=0}^{p} \beta_{4i} \Delta Wages_{t-i} + \\
&\sum_{i=0}^{p} \beta_{5i} \Delta RGDP_{t-i} + \sum_{i=0}^{p} \beta_{6i} \Delta Sales_{t-i} + \sum_{i=0}^{p} \beta_{7i} \Delta Exports_{t-i} + \\
&\sum_{i=0}^{p} \beta_{8i} \Delta Invest_{t-i} + \sum_{i=0}^{p} \beta_{9i} \Delta Interestr_{t-i} + \varepsilon_t
\end{aligned}
$$

where $\varphi' s$ are long run multipliers, ϕ and $\beta' s$ are short run dynamic coefficients.

The second step involves calculating the F statistic (F_{calc}) to test H_0:$\varphi_0 = \varphi_1 = \varphi_2 = ... = \varphi_9 = 0$ against the alternative that at least one $\varphi_i \neq 0$.The test statistic is the standard F statistic with asymptotic distribution that is non-standard under the null hypothesis that there exist no long run relationship between the levels of the included variables. The critical values are provided in Pesaran et al.(2001). The critical values have a lower bound (F_L)

assuming that all the regressors are I(0) and an upper bound (F_U) assuming that all the regressors are I(1). If $F_{calc} < F_L$, one cannot reject H_0:$\varphi_0 = \varphi_1 = \varphi_2 = ... = \varphi_9 = 0$.This implies no cointegration exists. If $F_{calc} > F_U$, one has to reject H_0:$\varphi_0 = \varphi_1 = \varphi_2 = ... = \varphi_9 = 0$, implying that a cointegration relation exists. However, when $F_L < F_{calc} < F_U$, the test is inconclusive and the order of integration of the underlying variables has to be investigated to proceed further.

In the third step, the ECM in equation (11) is repeated several times with each of ExrateV, RER, Output, Wages, RGDP, Sales, Exports, Invest, Interestr as the dependent variable and testing for the joint significance of the lagged level coefficients as in the second step. The number of significant F statistics indicates the number of cointegrating vectors. To proceed with estimating the ARDL model given in equation (10), I require that only one F statistic be significant.

6.1 Cointegration data tests

To estimate empirical models using time series data requires that the variables are stationary, implying unit root tests should be done before carrying out any analysis. This is not necessary however in ARDL cointegration model because such a model tests for the long run relationship among variables even if the varaibles are I(0) only, I(1) only or a mixture of the two{ I(0)/ I(1)} i.e without knowing the order of integration of the variables. But when carrying out the bounds test procedure of Pesaran et al.(2001), some variables might fall in between the lower bound and upper bound which eventually necessitates the need to know the integration order of such variable(s) prior to proceeding further. As a result, it is sufficient to conduct the unit root tests. I apply the Augmented Dickey-Fuller (ADF) and Phillips-Perron(PP) tests to find the order of integration of the variables. Table 5 and 6 show these results. Based on these tests, some variables are I(0) whilst others are I(1). This mixture of I(0) and I(1) justifies the adoption of ARDL cointegration approach.

<Insert Table 5 and 6 Here>

Next I estimate the bounds test for cointegration. These results are shown in table 7. Table 7 indicates that there is one cointegrating vector significant at 1% level.

<Insert Table 7 Here>

7 Results

Following the bounds test for cointegration which indicates that there is a unique cointegration vector in the model, I proceed to estimate the ARDL cointegration model given in equation (10). In estimating equation (10), the most appropriate lag specification is needed. This paper uses the Akaike Information Criterion (AIC) to establish the appropriate lag specification. I set the maximum lag order at four to estimate $(m+1)^{k+1}$ (where m=maximum lag and k=number of regressors) different ARDL models. The choice of four lags is based on the VAR lag order selection criteria which chooses AIC =4 (see table 8). This is also consistent with most estimations using quarterly data. Another important factor when estimating ARDL models is that the residuals should not suffer from serial

correlation. Two methods can either be used to check for serial correlation namely: the LM test or the F-version which is also known as LMF test. Kiviet (1986) shows that the LMF test performs better in small samples than LM test. As a result, this paper reports the LMF test when doing the diagnostic tests.

<Insert Table 8 Here>

The ARDL(3,3,3,2,3,3,4,4,4,4) model is selected as showing the appropriate lag specification. This means that the set of explanatory variables include three lagged values of the dependent variable; a contemporaneous and three lagged values of the volatility and real exchange rate level variables ; a contemporaneous and two lagged values for the investment variable; a contemporaneous and three lagged values for output and wages' variables; and a contemporaneous and four lagged values for the RGDP,exports, interest rate and sales variables . Table 11 indicates that there is no serial correlation and the functional form is correct.

Given that the aim of cointegration is to determine the variables that are driving the dependent variable in the long run, I begin by interpreting the long run effects of the model. The results in table 9 indicate that real exchange rate volatility has a significant (at 10% level) contractionary effect on employment growth in the long run.Real exchange rate volatility has also a significant (at 5% level) contractionary effect on employment growth in the short run. Table 11 indicates that real exchange rate volatility negatively affects employment growth and it is significant at 5% level. The economic significance of the findings, holding other control variables at their sample means suggests that for a one standard deviation increase in real exchange rate volatility (that is 0.0149) reduces employment growth by about 1.23%[6] in the long run and by about 1.71% in the short run.The negative effect exerted by real exchange rate volatility on employment growth found in this paper is similar to other studies that used other methodologies e.g. Demir (2010) using firm level manufacturing panel, others using cross-country panel (see e.g. Belke & Setzer 2003, Belke & Kaas 2004, Belke, Kaas & Setzer 2004) and others using VAR in first difference (see e.g. Gros 1996, Belke & Gros 1998, Belke & Gros 2002).

<Insert Table 9, 10 and 11 Here>

Table 11 shows that the previous period's employment growth decreases the current employment growth. The negative effect of lagged employment growth is significant at 5% level. Given that employment growth declined during the study period, it implies that a one standard deviation reduction in employment growth in the previous period will decrease current employment growth in the range of 0.84% to 0.95%. As such, lagged employment growth can be used as a proxy for rigidity given the slightly high magnitude of the coefficient. This follows Demir (2010) who used tax to proxy rigidity but experimented with the overall unemployment rate to proxy rigidity and found similar results.

Since the paper is using the direct quotation for the RER(meaning an increase is a depreciation), the results show that the long run effects are such that a depreciation leads to an increase in employment growth at 5% significant level (see table 9). Table 11 shows similar results. However, the RER cannot continuously depreciate with the hope of stimulating exports and eventually creating jobs without problems such as increasing inflation.

[6]Employment effect of volatility= one standard deviation increase in volatility(0.0149)*beta(-0.82250)*100.

As a result, this requires a proper analysis of the determinants of the equilibrium RER for the manufacturing sector such that periods of appreciation can be separated from periods of depreciation as well as being able to analyse the periods of overvaluation and undervaluation of the RER.

Other control variables including manufacturing sales and RGDP appear to have statistically significant (at 1% and 5%) positive long run effects on employment growth as shown in table 9. Output is positive but insignificant in the long run. However, table 11 indicate that output has a positive and significant effect on employment growth with a lag. Manufacturing wages, interest rates and investment have significant (at 10%, 5% and 1% respectively) negative long run effects on employment growth as shown in table 9. Given that South African Reserve Bank follows the inflation targeting regime, the negative impact of interest rate on employment growth is as the result of the central bank increasing the interest rate in the effort of controlling inflation though this is proving not to be helpful in limiting unemployment rate.

Manufacturing exports appear to have statistically significant (at 1% level) negative long run effects on employment growth as shown in table 9. This result is not what I expected. However, Bernard & Bradford Jensen (1999) found that size, wages, productivity and capital intensity of exporting firms are higher than those of non exporting ones in the United States of America. They also find that the increase in foreign demand has three times stronger effect on employment than domestic demand. Due to this, Demir (2010) asserts that it leads to higher efficiency of exporting firms and hence a negative relationship is expected between employment growth and exports (his study find this negative relationship in Turkey). Following Edwards & Alves (2006) who state that there has been a structural shift towards high technology products in South Africa's manufacturing exports, suggests that there has been an increase in capital intensity of exporting firms in South Africa which requires skilled labour. Given this development, the negative long run effects on employment growth is correct. However, the short run effects are significant at 1% level and exert a positive effect on employment growth. This suggests that in the short run, increasing exports enhances employment growth unlike in the long run.

The dummy variable for the 2008/2009 global financial crisis is significant and negative which indicates that the financial crisis reduced employment growth. The GEAR96 dummy variable is also significant and negative. This suggests that the restrictive policies followed during this period had a reducing effect on manufacturing employment growth. The labour legislation dummies have mixed results i.e. positive and negative effect. Table 11 shows that the error correction term {ECM(-1)} is significant and has the expected/ correct negative signs. The correct sign for the ECM(-1) result confirms the existence of long run relationship and indicates that the speed of adjustment from short run dynamics to the long run equilibrium is quick.

8 Conclusion

South Africa's unemployment rate has persistently remained high and this has left concerns to the policymakers. This paper empirically examines the impact of real exchange rate volatility on employment growth in the manufacturing sector, making a contribution to how real exchange rate volatility can be made responsible for the negative developments

in the South African labour market. The ARDL cointegration method is used to analyse this impact.

The empirical results show that real exchange rate volatility has a significant contractionary effect on employment growth both in the short run and long run. The reducing effect is consistent with other studies. The results also show that depreciation of the RER increases employment growth. Sales and RGDP are found to have a positive and significant effect on long run employment growth. Manufacturing exports, investment and wages as well as long term interest rates have significant and negative long run effects on manufacturing employment growth. In addition, the results also show that increasing rigidity decreases employment growth in the manufacturing sector.

Thus the findings suggests that the South African government should always minimise factors that increase real exchange rate volatility.For instance,the government could raise the banks' reserve requirements in order to make foreign borrowing less attractive and hence reduce foreign capital inflows that also increase the volatility of the exchange rate, or try to implement the Tobin tax which reduces short term capital flows that increase exchange rate volatility and do not enhance economic growth.The government should also intervene in the foreign exchange market to make sure the real exchange rate is depreciated if they want to see an improvement in the employment growth in the manufacturing sector. However, the rate at which the Rand should depreciate to or the range within which depreciation should fall under is beyond the analysis of this paper. Based on previous experience of how macroeconomic policies were implemented i.e. the RDP, GEAR and AsgiSA, it might be feasible to implement less restrictive policies to promote employment creation and eventually economic growth. Such macro-economic policies might support sustainable long term economic growth rate.

References

Andersen, T. & Sørensen, J. (1988). Exchange rate variability and wage formation in open economies, *Economics Letters* **28**(3): 263–268.

Banerjee, A., Galiani, S., Levinsohn, J., McLaren, Z. & Woolard, I. (2008). Why has unemployment risen in the new south africa, *Economics of Transition* **16(4)**: 715–740.

Belke, A. (2001). Exchange rate uncertainty and the german labour market: A cointegration application of the ardl approach, *Ekonomia* **5**(1): 8–46.

Belke, A. & Göcke, M. (2001). Exchange rate uncertainty and employment: an algorithm describing ŚplayŠ, *Applied Stochastic Models in Business and Industry* **17**(2): 181–204.

Belke, A. & Gros, D. (1998). Evidence on the costs of intra-european exchange rate variability, *Discussion Paper* .

Belke, A. & Gros, D. (2002). Designing eu–us atlantic monetary relations: exchange rate variability and labour markets, *The World Economy* **25**(6): 789–813.

Belke, A. & Kaas, L. (2004). Exchange rate movements and employment growth: An oca assessment of the cee economies, *Empirica* **31**(2): 247–280.

Belke, A., Kaas, L. & Setzer, R. (2004). Exchange rate volatility and labor markets in the cee economies, **23**: 24.

Belke, A. & Polleit, T. (2006). (how) do stock market returns react to monetary policy? an ardl cointegration analysis for germany, *KREDIT UND KAPITAL* **39**(3): 335.

Belke, A. & Setzer, R. (2003). Exchange rate volatility and employment growth: Empirical evidence from the cee economies, *Economics of Planning* **36**: 153–175.

Bernal-Verdugo, L., Furceri, D. & Guillaume, D. (2012). Labor market flexibility and unemployment: New empirical evidence of static and dynamic effects, *International Monetary Fund. Working Paper WP/12/64* (3).

Bernard, A. B. & Bradford Jensen, J. (1999). Exceptional exporter performance: cause, effect, or both?, *Journal of international economics* **47**(1): 1–25.

Bhorat, H. (2007). Unemployment in south africa: Descriptors and determinants, *unpublished consultant report for OECD, Paris* .

Bhorat, H. & Cheadle, H. (2009). *Labour Reform in South Africa: Measuring Regulation and a Synthesis of Policy Suggestions*, Development Policy Research Unit, University of Cape Town.

Caballero, R. & Pindyck, R. (1996). Uncertainty, investment, and industry evolution, *National Bureau of Economic Research* .

Demir, F. (2010). Exchange rate volatility and employment growth in developing countries: Evidence from turkey, *World Development* **38**(8): 1127–1140.

Edwards, L. & Alves, P. (2006). South africa's export performance: Determinants of export supply, *South African Journal of Economics* **74**(3): 473–500.

Edwards, L. & Golub, S. (2002). South africaŠs international cost competitiveness and productivity: A sectoral analysis, *Report prepared for the South African National Treasury under a USAID/Nathan Associates SEGA Project* .

Eichengreen, B. (2007). The real exchange rate and economic growth, *Social and Economic Studies* pp. 7–20.

Engle, R. & Granger, C. (1987). Cointegration and error correction: Representation, estimation and testing, *Econometrica: Journal of the Econometric Society* **55**(1): 251–276.

Faria, J. & Leon-Ledesma, M. (2005). Real exchange rate and employment performance in an open economy, *Research in Economics* **59**(1): 67–80.

Faulkner, D. & Makrelov, K. (2008). Determinants of the equilibrium exchange rate for south africa' s manufacturing sector and implications for competitiveness, *Being a Draft of a Working Paper of the National Treasury of South Africa. Cited at http://www. treasury. gov. za* .

Fedderke, J. & Mariotti, M. (2002). Changing labour market conditions in south africa, *South African Journal of Economics* **70**(5): 830–864.

Frenkel, R. (2004). Real exchange rate and employment in argentina, brazil, chile and mexico, *Iktisat Isletme ve Finans* **19**(223): 29–52.
URL: *http://EconPapers.repec.org/RePEc:iif:iifjrn:v:19:y:2004:i:223:p:29-52*

Frenkel, R. & Ros, J. (2006a). Unemployment and the real exchange rate in latin america, *World Development* **34**(4): 631–646.

Frenkel, R. & Ros, J. (2006b). Unemployment and the real exchange rate in latin america, *World Development* **34**(4): 631–646.

Frenkel, R. & Taylor, L. (n.d.). Real exchange rate, monetary policy, and employment, *Policy matters: Economic and social policies to sustain equitable development* .

Galindo, A., Izquierdo, A. & Montero, J. (2007). Real exchange rates, dollarization and industrial employment in latin america, *Emerging Markets Review* **8**(4): 284–298.

Goldberg, L. & Tracy, J. (2001a). Exchange rates and wages, *National Bureau of Economic Research* .

Goldberg, L. & Tracy, J. (2001b). Gender differences in the labor-market effects of the dollar, *The American Economic Review* **91**(2): 400–405.

Golub, S. & Ceglowski, J. (2002). South african real exchange rates and manufacturing competitiveness*, *South African Journal of Economics* **70**(6): 1047–1075.

Grier, R. & Grier, K. (2006). On the real effects of inflation and inflation uncertainty in mexico, *Journal of Development Economics* **80**(2): 478–500.

Gros, D. (1996). GermanyŠs stake in exchange rate stability, *Intereconomics* **31**(5): 236–240.

Gupta, R. (2012). Should the south african reserve bank respond to exchange rate fluctuations? evidence from the cosine-squared cepstrum, *University of Pretoria, Department of Economics Working Papers* .

Hamermesh, D. (1996). *Labor demand*, Princeton Univ Pr.

Hassan, S. & Smith, S. (2011). The rand as a carry trade target: Risk, returns and policy implications, *Economic Research Southern Africa. Working Papers* .

Hausmann, R. (2008). Final recommendations of the international panel on the accelerated and shared growth initiative for south africa (asgisa), *Harvard University, John F. Kennedy School of Government* .

Hodge, D. (2005). The effects of exchange rate volatility on trade and employment: A brief review of the literature, *Human Sciences Research Council* .

Johansen, S. (1988). Statistical analysis of cointegration vectors, *Journal of economic dynamics and control* **12**(2-3): 231–254.

Kim, W. (2005). Analyses of the relationship between exchange rates and employment in korea, *Journal of Economic Development* **30**(2): 131.

Kiviet, J. (1986). On the rigour of some misspecification tests for modelling dynamic relationships, *The Review of Economic Studies* **53**(2): 241–261.

Meese, R. & Rogoff, K. (1983). Empirical exchange rate models of the seventies: Do they fit out of sample?, *Journal of international economics* **14**(1): 3–24.

Menkhoff, L., Sarno, L., Schmeling, M. & Schrimpf, A. (2011). Carry trades and global foreign exchange volatility, *Centre for Economic Policy Research (Great Britain)* .

Muchapondwa, E. & Pimhidzai, O. (2011). Modelling international tourism demand for zimbabwe, *International Journal of Business and Social Science* **2**.

Ngandu, S. (2008). Exchange rates and employment, *South African Journal of Economics* **76**(s2).

Nickell, S. (1997). Unemployment and labor market rigidities: Europe versus north america, *The Journal of Economic Perspectives* **11**(3): 55–74.

Nickell, S. & Nicolitsas, D. (1999). How does financial pressure affect firms?, *European Economic Review* **43**(8): 1435–1456.

Obstfeld, M. & Rogoff, K. (1995). Exchange rate dynamics redux, *Journal of Political Economy* **103**(1): 624–60.

Pesaran, M. & Shin, Y. (1999). An autoregressive distributed lag modelling approach to cointegration analysis, *Cambridge University Press Cambridge* **11**.

Pesaran, M., Shin, Y. & Smith, R. (2001). Bounds testing approaches to the analysis of level relationships, *Journal of applied econometrics* **16**(3): 289–326.

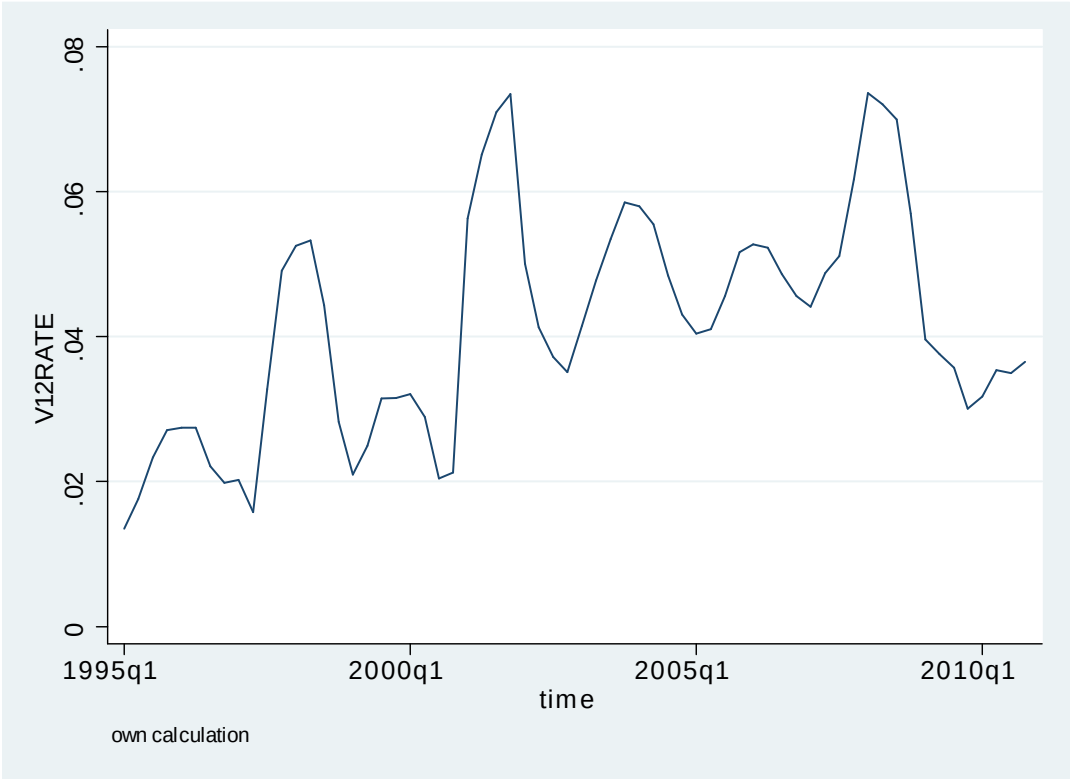
Rodrik, D. (2009). The real exchange rate and economic growth, *Brookings Papers on Economic Activity* **2008**(2): 365–412.

Seyfried, W. & Ewing, B. (2001). Inflation uncertainty and unemployment: Some international evidence, *The American Economist* pp. 33–39.

Sharpe, S. (1994). Financial market imperfections, firm leverage, and the cyclicality of employment, *The American Economic Review* **84**(4): 1060–1074.

Stirböck, C. & Buscher, H. (2000). Exchange rate volatility effects on labour markets, *Intereconomics* **35**(1): 9–22.

Figure 6: Trends for the moving sample standard deviations



9 Appendix

Figure 7: The standard deviation of the monthly percentage changes in the real exchange rate (R/US$)

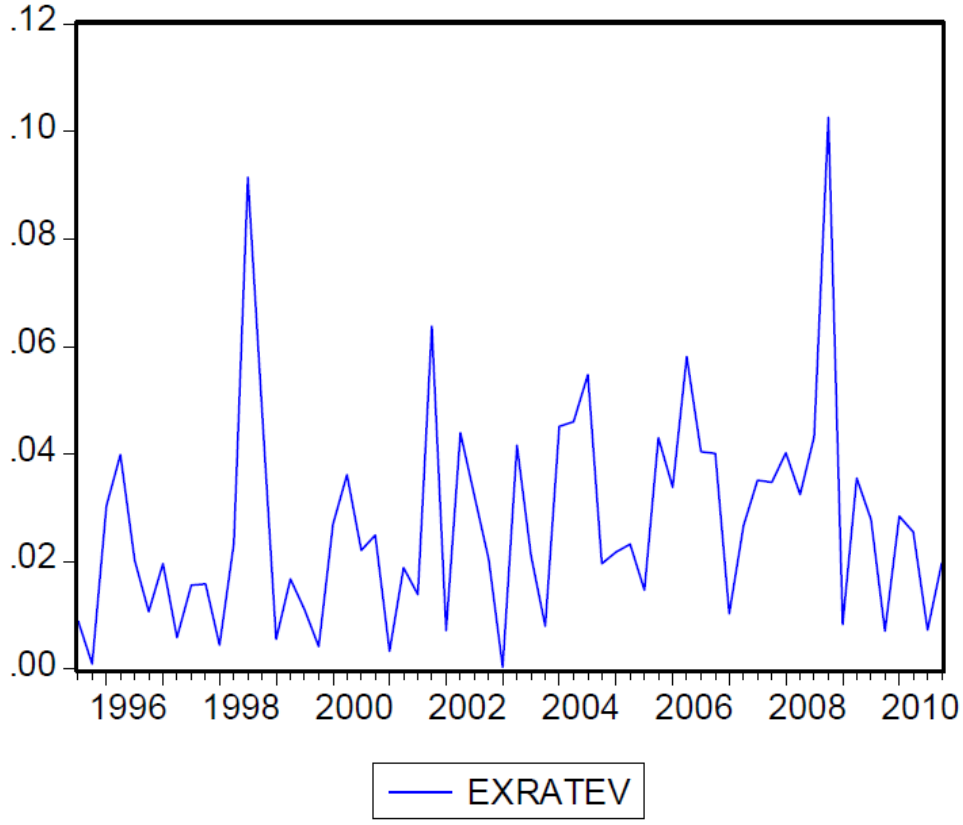


Table 5: Unit Root Tests using Augmented Dickey-Fuller method

Levels	ADF-Statistic		Critical Values			Prob
Variables	constant	constant & trend	1%	5%	10%	
Employment growth	-7.6773***		-3.5421	-2.9100	-2.5926	0.0000
Volatility	-2.2981		-3.5504	-2.9135	-2.5945	0.1761
		-4.3680***	-4.1184	-3.4865	-3.1715	0.0049
RER	-5.9000***		-3.5421	-2.9100	-2.5926	0.0000
Output	-4.3776***		-3.5421	-2.9100	-2.5926	0.0008
Wages	-4.4706***		-3.5527	-2.9145	-2.5950	0.0007
RGDP	-3.2869***		-3.5421	-2.9100	-2.5926	0.0198
Sales	-6.2158***		-3.5421	-2.9100	-2.5926	0.0000
Exports	-9.5296***		-3.5421	-2.9100	-2.5926	0.0000
Invest	-0.7792		-3.5421	-2.9100	-2.5926	0.8177
		-2.4288	-4.1184	-3.4865	-3.1715	0.3616
Interestr	-2.8137*		-3.5441	-2.9109	-2.5931	0.0623
		-3.7856**	-4.1184	-3.4865	-3.1715	0.0242
First Difference	ADF-Statistic					
Volatility	-7.3948***		-26062	-1.9467	-1.6131	0.0000
Invest	-6.0724***		-2.6041	-1.9463	-1.6132	0.0000
Interestr	-4.7886***		-2.6041	-1.9463	-1.6133	0.0000

Notes: ***,**,* means significant at 1%, 5% and 10% respectively.

Variables are defined as in section 4.

Table 6: Unit Root Tests using Phillips-Perron method

Levels	PP-Statistic		Critical Values			Prob
Variables	constant	constant & trend	1%	5%	10%	
Employment growth	-7.6816***		-3.5421	-2.9100	-2.5926	0.0000
Volatility	-2.4444		-3.5421	-2.9100	-2.5926	0.1342
		-2.3677	-4.1157	-3.4852	-3.1708	0.3923
RER	-5.8728***		-3.5421	-2.9100	-2.5926	0.0000
Output	-3.9082***		-3.5421	-2.9100	-2.5926	0.0035
Wages	-9.9106***		-3.5421	-2.9100	-2.5926	0.0000
RGDP	-3.4201**		-3.5421	-2.9100	-2.5926	0.0139
Sales	-6.2082***		-3.5421	-2.9100	-2.5926	0.0000
Exports	-12.219***		-3.5421	-2.9100	-2.5926	0.0000
Invest	-0.8696		-3.5421	-2.9100	-2.5926	0.7913
		-2.0796	-4.1157	-3.4852	-3.1708	0.5464
Interestr	-2.0547		-3.5421	-2.9100	-2.5926	0.2634
		-2.4338	-4.1157	-3.4852	-3.1708	0.3591
First Difference	PP-Statistic					
Volatility	-5.0458***		-2.6041	-1.9463	-1.6133	0.0000
Invest	-6.0725***		-2.6041	-1.9463	-1.6133	0.0000
Interestr	-4.6308***		-2.6041	-1.9463	-1.6133	0.0000

Notes: ***,**,* means significant at 1%, 5% and 10% respectively.

Variables are defined as in section 4.

Table 7: The Bounds Testing Procedure for the existence of a unique cointegrating vector

Dependent variable	Employment growth	Volatility	RER	Output	Wages	RGDP
F-Statistic	1.8237	0.9704	2.1025	0.7942	4.8368***	3.6171
Dependent variable	Sales	Exports	Invest	Interestr		
F-Statistic	2.0601	1.0643	1.4193	1.3383		

Notes: *** means significant at 1%. The critical values for the case of unrestricted intercept and no trend for k=9 are Lower bound I(0)=2.65 and Upper bound I(1)=3.97 (using Peseran et al.2001).

Table 8: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	942.13	NA	5.20e-27	-32.14	-31.79	-32.00
1	1222.94	455.15	1.07e-29	-38.38	**-34.47***	-36.86
2	1332.01	139.15	1.05e-29	-38.69	-31.23	-35.78
3	1459.74	118.93	9.88e-30	-39.65	-28.63	-35.36
4	1677.68	**127.75***	**1.60e-30***	**-43.71***	-29.15	**-38.04***

* 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

Table 9: Long Run Coefficients for ARDL(3,3,3,2,3,3,4,4,4,4)

Dependent variable is Employment growth			
Variable	Coefficient	T-Ratio	P-value
Volatility	-0.8225*	-2.1423	0.0550
RER	0.2190**	2.9274	0.014
Invest	-0.0873***	-4.4805	0.001
Output	0.1921	0.3891	0.705
Wages	-0.5386*	-1.8228	0.096
RGDP	2.1345**	2.5346	0.028
Exports	-0.7430***	-3.4584	0.005
Interestr	-0.0071**	-2.8773	0.015
Sales	1.0138***	3.4874	0.005
INPT	1.0272***	4.9476	0.000
Find0809	-0.0279**	-3.0305	0.011
GEAR96	-0.0211*	-2.1428	0.055
EEA98	0.0264***	3.3005	0.007
BCEA97	-0.0387*	-2.1117	0.058

Notes: ***, **, * indicate significant at 1%,5% and 10% respectively.

INPT refers to a constant. Find0809, GEAR96, EEA98 and BCEA97 refers to various dummy variables (see section 4 for definition of these dummies and the rest of the variables.

Table 10: Error Correction Representation(ECM) for ARDL(3,3,3,2,3,3,4,4,4,4)

Dependent variable is dEmployment growth							
Variable	Coefficient	T-Ratio	Pvalue	Variable	Coefficient	T-Ratio	Pvalue
dEmploygr	0.5203*	1.9809	0.062	dExports3	0.2898***	4.2371	0.000
dV12rate	-1.1480**	-2.4510	0.024	dInterest	-0.01231**	-2.4961	0.021
dRER	0.2490***	3.4118	0.003	dInterest1	0.0076*	1.8609	0.078
dRER1	-0.1474*	-1.8154	0.084	dInterest3	0.0206***	5.2301	0.000
dInvest	0.2383**	2.7997	0.011	dSales	0.2425*	1.9501	0.065
dOutput	-1.0307*	-2.0338	0.055	dSales1	-1.4789***	-4.8410	0.000
dWages	-0.3105**	-2.1012	0.048	dSales2	-0.7321***	-3.7209	0.001
dWages1	0.6322*	2.0651	0.052	dINPT	2.0424***	3.7759	0.001
dWages2	0.3282*	1.9219	0.069	dFind0809	-0.0554***	-3.4821	0.002
dRGDP1	-8.6144***	-5.7226	0.000	dGEAR	-0.0420*	-1.7342	0.098
dRGDP2	-8.4324***	-5.7868	0.000	dEEA98	0.0526***	4.0065	0.001
dRGDP3	-3.3083***	-3.5353	0.002	dBCEA97	-0.0770**	-2.4044	0.026
dExports1	1.0273***	4.9004	0.000	**ecm(-1)**	-1.9882***	-5.4391	**0.000**
dExports2	0.5627***	4.6444	0.000				

Notes: ***,**,* indicate significant at 1%,5% and 10% respectively.

Adj R^2 is 0.7541. dEmploygr=Employgr$_t$-Employgr$_{t-1}$.Other variables follow the same pattern.

F-stat. F(37,20) 5.9677[p-value 0.000].

Insignificant variables are not included.

Table 11: ARDL Model (3,3,3,2,3,3,4,4,4,4)

Dependent variable is Employment growth							
Variable	Coefficient	T-Ratio	Pvalue	Variable	Coefficient	T-Ratio	Pvalue
Employgr_{t-1}	-0.4679**	-2.7000	0.021	Exports_{t-2}	-0.4646***	-4.6598	0.001
Employgr_{t-2}	-0.4138**	-2.5584	0.027	Exports_{t-3}	-0.2729***	-4.1008	0.002
Volatility	-1.1480**	-2.4510	0.032	Exports_{t-4}	-0.2898***	-4.2371	0.001
RER	0.2490***	3.4118	0.006	Interestr	-0.0123**	-2.4961	0.030
RER_{t-2}	0.2071***	3.3277	0.007	Interest_{t-3}	0.0157***	3.2739	0.007
Invest_{t-2}	-0.2383**	-2.7997	0.017	Interestr_{t-4}	-0.0206***	-5.2301	0.000
Output_{t-3}	1.0307*	2.0338	0.067	Sales	0.2425*	1.9501	0.077
Wages	-0.3105*	-2.1012	0.059	Sales_{t-1}	0.2942**	2.3562	0.038
Wages_{t-2}	-0.3040*	-1.8261	0.095	Sales_{t-2}	0.7468***	4.2131	0.001
Wages_{t-3}	-0.3282*	-1.9219	0.081	Sales_{t-3}	0.6050***	4.1126	0.002
RGDP	-2.5482*	-1.9612	0.076	INPT	2.0424***	3.7759	0.003
RGDP_{t-3}	5.1241***	4.0156	0.002	Find0809	-0.0554***	-3.4821	0.005
RGDP_{t-4}	3.3083***	3.5353	0.005	EEA98	0.0526***	4.0065	0.002
Exports_{t-1}	-0.4196***	-4.2776	0.001	BCEA97	-0.0770**	-2.4044	0.035
Adj R^2=0.5204				F(46,11)		2.3445 [p-value=0.064]	
Diagnostic Tests							
Serial Correlation	F(4,7) = 0.9332 [p-value = 0.497]						
Functional Form	F(1,10) = 2.0206 [p-value = 0.186]						

Notes: ***,**,* indicate significant at 1%, 5% and 10% respectively.

Employgr refers to employment growth. $\text{Variable}_{t-(number)}$ indicates the number of lags included.

Insignificant variables are not included.