# THE REAL EXCHANGE RATE AND SECTORAL EMPLOYMENT IN SOUTH AFRICA

HAROON BHORAT
NAN TIAN
MARK ELLYNE

DPRU WORKING PAPER 201404
DECEMBER 2014

DEVELOPMENT POLICY
RESEARCH UNIT

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**HAROON BHORAT**
haroon.bhorat@uct.ac.za

**NAN TIAN**
nan.tian@uct.ac.za

**MARK ELLYNE**
mark.ellyne@uct.ac.za

Working Paper 201404
ISBN 978-1-920633-09-7

December 2014

**Abstract:**
This paper examines the impact of exchange rate fluctuations on sectoral employment in South Africa from 1975 to 2009. Using a stylised model by Chen and Dao (2011) and Campa and Goldberg (2001) we compared South Africa's results to conventional theoretical predictions. A major focus of the paper is how exchange rate fluctuations impact on employment in South Africa's formal non-agricultural sector. The results suggest a clear significant negative effect of a real exchange rate appreciation on tradable employment, while the overall and non-tradable sectors were negative and insignificant. Another relevant factor to consider is the impact skills have on the employment-exchange rate elasticity and the results, after disaggregating for skill levels, support earlier findings but also suggest higher skilled workers are more exposed to changes in the real exchange rate when compared with low skilled workers. The robustness of the estimation results was investigated via industry and sectoral input-output tables which assess external orientation and intersectoral dependence. Overall, following a real exchange rate appreciation, the results show strong support for a negative and significant employment decline in the tradable sector, limited evidence of a positive employment impact in the non-tradable sector and generally no effect on aggregate employment.

**Keywords:** Real exchange rate; Employment; South Africa

**JEL code:** F31; J21; J30

**Acknowledgements**
The research, from which this paper emanates, was commissioned by the Africa Growth Initiative (AGI), at the Brookings Institution.



**Corresponding author**
Prof. Haroon Bhorat, Director of the DPRU
Tel: +27 (0)21 650 5705
email: haroon.bhorat@uct.ac.za

**Recommended citation**
Bhorat, H., Tian, N and Ellyne, M. (2014). "The Real Exchange Rate and Sectoral Employment in South Africa". Development Policy Research Unit Working Paper 201404. DPRU, University of Cape Town.

## CONTENTS

## 1. INTRODUCTION

There is an impressively large and growing literature on the effects of exchange rate on the real economy, and although past research has clearly confirmed the importance of exchange rates, the issue of exchange rates influence on employment has received very little attention. While the focus of the limited literature has been mainly on developed countries such as the US labour market, due in part to data availability, recent attention has focused on emerging markets such as China, Turkey and a number in Latin America.

This paper examines the implications of real exchange rate changes on sectoral employment in South Africa from 1975 to 2009. South Africa has long had a reputation of having higher exchange rate volatility than other emerging economies. The impact of exchange rate movements on sectoral adjustments in employment is most clearly seen in the changes in production costs. In open economies such as South Africa, the real exchange rate plays an important role in determining the relative profitability of sectors that produce to export versus domestic consumption, and those that use imported versus local inputs. This change in relative production costs can be thought of as potentially having a significant impact on labour allocation both within and across industries.

Rodrik (2003) stated that as more and more development economists see a competitive and stable real exchange rate as crucial for economic development, the natural next step is to assess its role in creating environments favourable for employment creation. In the South African context, the relationship between exchange rate and employment could indeed be important and relevant in helping the government's policy of job creation. In recent years, the South Africa economy has experienced its fair share of fluctuations with the period 2004 to 2012 characterised by employment stagnation – as a result of the financial crisis - and exchange rate volatility[1]. In light of the recent financial crisis, policy makers in South Africa have intensified the debate with regard to the central bank's intervention ability to tackle financial volatility in an effort to increase South Africa's international competitiveness and pace of domestic economic growth[2]. Coupled with the government's job creation policy[3], the understanding of the exchange rate employment relation is clearly an issue of great importance.

While exchange rate changes are clearly an important factor in understanding the pattern and dynamics of employment trends in South Africa, thus far, scant attention has been directed towards the South Africa labour market and its adjustments to any significant real depreciation or appreciation. This relationship is further complicated by assertions that the Rand is possibly overvalued (Saayman, 2007). There are two clear implications of this assertion. Firstly, the overvaluation (should this be a technically correct estimate) has a negative impact on the tradable sector and thus an optimal outcome would be a real depreciation of the Rand. However, on the other hand, any weakening of the currency has the potential to introduce inflationary pressures, which could be detrimental for long-term growth aspirations (Hodge, 2005).

Given the above, it can be considered vital to quantify the effect of exchange rate movements on employment. Although the impact of exchange rates on employment has been heavily debated in both developed and developing countries, the answer is almost always an empirical one. To our knowledge, only Ngandu (2008) – using a CGE model – assessed the effect of the real exchange rate on sectoral employment in South Africa, there,

[1] Employment has roughly remained unchanged between the period 2008Q1 to 2012Q4 and exchange rate is seen to fluctuate dramatically, most notably the 15% depreciation in the Rand from January 2012 to June 2012.
[2] See de Jager (2012) for a detailed discussion on the SARB's role in non-intervention on the exchange rate.
[3] See Bhorat & van der Westhuizen (2011) for full description on the New Growth Path.

however, remains no empirical studies on this relation. While roughly 80 percent of South Africa's formal non-agriculture employment is situated within the non-tradable sector, an analysis that seeks to measure the full effect of exchange rate changes on the whole economy must consider the link between tradable and non-tradable sectors.

South Africa is a unique economy where even though the majority of employment and GDP are contributed by the non-tradable sector, substantial portions of this are upstream and downstream activities that are directly related to the tradable sector (for example, In 2011, the mining and quarrying sector accounts for roughly 8.8 percent of GDP, yet, when including all upstream and downstream activities, this raises the overall contribution to GDP closer to 18 percent) (DPRU, 2013). It is most definitely the case that certain non-tradable industries play an important role as intermediate inputs for tradable production, in-turn leading to output and employment shifts which mimic the tradable sector following an asymmetric shock in the form of exchange rate changes. Thus another important issue to consider is the employment spillover effects across tradable and non-tradable industries.

This paper aims to provide empirical evidence showing that movements in the exchange rate has significant effects on sectoral employment, even if certain sectors do not have any direct international exposure. It is important to emphasise that the purpose of this paper is not to argue whether the Rand is under or overvalued, but rather to provide a definitive link between two, contentious but important, variables within the South African economy, namely the exchange rate and employment. The paper is organised as follows: the next section provides a discussion on the theoretical channels through which the exchange rate impacts on employment and reviews the existing literature on the impact of exchange rates on employment. Section 3 provides an exposition of a partial equilibrium model of the labour market, based on Campa and Goldberg (2001) and Chen and Dao (2011), which captures the various channels of exchange rate movements on sector-specific labour demand. Section 4 presents a discussion of the dataset, with further details provided in the Appendix. The remainder of the paper, sections 5 and 6 describes the results from the empirical estimation, while the final section presents some policy recommendations and concludes.

## 2. EXCHANGE RATES AND EMPLOYMENT

There are five main channels, explained below, through which exchange rates impact on employment, however, the relative importance and sign of these effects and the overall impact on employment can only be ascertained by empirical analysis.

### 2.1 Development Channel

In the case where the rate of capital accumulation in a sector has is positively related to profitability, and that profitability is also positively related to the real exchange rate, then a competitive real exchange rate that is aligned with an appropriately specified outward-orientated industrial strategy can create an employment generating growth process (Ngandu, 2008). In this scenario a higher real exchange rate (depreciation) will lead to faster growth of the traded sector and consequently faster growth rate of employment. In effect, Frankel and Ros (2006) describe such a competitive real exchange rate as an industrial policy tool designed to distort relative prices in favour of the tradable goods sector. This is supported by Woo (2004), where a depreciation of a country's currency is synonymous to a uniform tariff on imports, while simultaneously acting as a subsidy on exports.

### 2.2 Macroeconomic Channel

Since the 1930s and 1940s, Keynesian demand theory has acknowledged the relationship between the real exchange rate and employment. In a scenario where there exists involuntary unemployment, Keynesians argue that a depreciation of the exchange rate will

improve the cost competitiveness of domestic industries exports. The logic is intuitive, higher demand, output, income and employment are the results of a boost in net exports brought about by a depreciated real exchange rate.[4] Moreover, a depreciation of the currency is expected to directly improve the trade balance through the process of expenditure switching. Where imports is substituted in favour of domestically produced goods, while observing an increase in exports[5].

In addition to the direct effect on the demand of tradable goods, there is also the multiplier effect and supply side effect. The resultant increase in exports, output and income is expected to positive influence on the non-tradable good sector. Leading to an increase in aggregate demand and ultimately, domestic production and formal employment. As employment rises, unemployment rate will fall due to the wage differential between the two sectors narrowing (Frenkel and Ros, 2006). From a supply side perspective, the higher demand for formal employment reduces the supply of labour to the informal sector[6], leading also to a narrowing of the wage differential and a fall in the unemployment rate.

## 2.3 Factor Intensity Channel

The first industry specific channel operates through changes in relative prices of intermediate goods and capital in relation to labour. In the event of a depreciation, the increase in prices of imported intermediates and capital goods will drive producers to away from imported machinery and towards domestic labour.[7] Thus, having a direct impact (an increase) on total employment in the tradable sector. Theoretically, a sustained depreciation over the medium and long-term will result in significant impacts on employment as suggested by Frankel and Ross (2006). In dealing with the impact on employment due to changes in relative prices, Goldberg (2004) found that compared to transitory changes, permanent changes in the real exchange rate will have a greater impact on employment.

## 2.4 Market Structure and Labour Market Regulations

In a theoretical framework, market structure and the regulatory environment can also determine the extent of employment and output responses to an exchange rate shock. Competitive markets or industries will be more responsive to changes in exchange rate, while imperfect or monopolistic markets[8] will experience much smaller changes. In the context of South Africa, financial and business services and wholesale and retail trade can be categorised as competitive markets, while utilities, transportation and construction are potentially imperfect or monopolistic markets. From a domestic market perspective, the current structure can wield a significant influence regarding an exchange rate change on prices, with more protected markets (i.e. Electricity or Transportation) having smaller changes in price as compare to more competitive markets (i.e. Financial Services). As for labour regulations, high labour regulations make it extremely difficult and costly to hire and fire workers. Thus, any change in the real exchange rate will not have a substantial impact on employment. Instead firms are forced to absorb the exchange rate impact on prices through other means such as changes in profits (Ngundu, 2008).

## 2.5 External Orientation Channel

External Orientation as defined by Campa and Goldberg (1997) refers to the importance of the international economy to a sector or industry. Since there doesn't exist a single measure

[4] See Frankel and Ros (2006) for full analytical description of the macroeconomic channel.
[5] It must be noted that in the short-term, the balance of trade could worsen before improving, resulting in a "J-curve" scenario. See Bahmani-Oskooee (1985) and Rose and Yellen (1989).
[6] It is assumed that wages in the informal sector are always lower than that of the formal sector.
[7] This will obviously depend on the relative substitution of factor inputs of a given sector.
[8] These firms are often characterised by product differentiation and market power.

of industry external orientation which adequately captures the extent of importance of the international economy for any given industry, differing sub-transmission channels are needed. These include an industry's external orientation through exports, the use of imported inputs and import competition.

i) Export

Industries with greater export orientation are generally more labour sensitive to exchange rate movements than industries that mainly produce for the domestic market. This is largely the result of stimuli to revenues experienced when firms have greater external orientation, increasing with currency depreciations and decreasing with an appreciation (Ngundu, 2008; Campa and Goldberg, 2001).

ii) Imported Inputs

Similar to the export orientation channel, firms that depend on foreign inputs tend to be more affected by changes in the currency than ones that mainly rely on domestic inputs. For firms that rely on imported inputs, a real appreciation leads to a lowering of the price of inputs, resulting in output expansions and increases in labour demand, while the opposite is true for a real depreciation. In this case, the sensitivity of labour demand to exchange rate changes depends on the structure of production and product demand which is linked to the factor intensity channel. As stated in Ngundu (2008), it is the relative price of capital to labour that determines the level of factor substitution which leads to subsequent changes on labour demand. In other words, it is the proportion of a firm's imported inputs to its total outputs that determine employment variability. The higher the proportion, the greater employment will vary to any changes in the exchange rate.

iii) Import Competition

Foreign competition in domestic markets can be an important indirect determinant of the employment exchange rate elasticity. In the case of an exchange rate depreciation (appreciation), domestic consumption of an industries or firms product will increase (decrease) due to the relative price of foreign substitutes.

## 3. RESULTS FROM THE LITERATURE

It has been widely recognised that there has been a limited amount of research on the relationship between employment and exchange rates, with the majority of the previous studies being confined on developed economics such as OECD countries (Chen and Dao, 2011; Kim, 2005). However, there has recently been a growth in the literature focused on developing or emerging economies such as China and Latin America[9]. The emergence of new studies in developing countries has resulted in a very different set of empirical results. As Kim (2005) argues, country and industry characteristics in developing countries are very different from developed countries. As a result of such heterogeneity, the effects of exchange rate fluctuation on employment in the OECD countries can be very different from countries such as South Africa or China. These heterogeneities include market structure and market power; regulation of international trade through tariffs; regulation of the labour market and openness to the world market.

[9] See Hua (2007) and Chen and Dao (2011) for analysis on China and Camargo (1999); Damill and Frenkel (2003) and Frankel and Ros (2004) for Latin America.

Most of the earlier studies on exchange rate and employment have focused on the US, with authors such as Branson and Love (1986, 1987, 1988a) and Campa and Goldberg (1997, 2001) providing the anchor for much of the literature. The main focus in the 1980s studies was the impact of a real dollar appreciation, from 1981 to 1985, on manufacturing output and employment. Using a computable general equilibrium (CGE) model that distinguishes three sectors: exportables, import-competing and non-traded goods, Branson and Love (1988a) found exchange rates had significant effects on US manufacturing employment with about 1 million US jobs lost as a result to the real dollar appreciation.[10] Branson and Love also found evidence showing that the impact of exchange rates on employment was sector-specific, with employment in durable goods sectors responding negatively to the dollar appreciation. This result was seen as consistent with their earlier work[11] that found non-production employment to be less sensitive to exchange rate movements relative to production employment.

Following from Branson and Love, Campa and Goldberg (2001) continued the analysis of the exchange rate employment linkage in US manufacturing industries. Using a simple dynamic model of labour market equilibrium they found that an exchange rate depreciation resulted in an increase in employment, where - on average - a 10 percent permanent dollar depreciation will resulted in an increase in total employment by about 0.1 percent. As mentioned above, the effect of an exchange rate movement on employment will depend on a range of variables.[12]

Other researchers that have studied the exchange rate employment relation in developed countries include Alexandre et al (2010), who in a panel analysis of 23 OECD countries, found that for low technology and open sectors, the employment exchange rate elasticity is positive and significant[13]. This is similar to the findings by Burgess and Knetter (1998), who found that employment growth, in 5 of the G-7 countries, was impaired by a real appreciation of the home currency, with only Germany and Japan showing no effect. This apparent negative relationship recently found in cross-country analysis between exchange rate appreciation and employment growth is supported by country specific case studies such as Brunello (1990), Gourinchas (1999) and Kim (2005) who found exchange rate appreciations to have a negative impact on sectoral employment in Japan, France and South Korea respectively.

The recent emergence of studies in developing and emerging markets has provided a new dynamic on the exchange rate employment relationship. While earlier studies were focused on deindustrialisation and the impact of exchange rate movements on manufacturing employment, recent studies - on developing countries - have shifted the analysis towards the issue of price adjustments and industry characteristics that result from movements in the exchange rate. The origins of this work lie in Campa and Goldberg (1997), where facing possible exchange rate fluctuations; a firms external orientation, proportion of imported

[10] Each of the three sectors had a model of demand and supply. The demand model was assumed to be sensitive to the relative price of home and foreign goods, with the nominal exchange rate influencing relative prices. Under these assumptions, a depreciation of the domestic currency would increase the relative prices of foreign to home goods, shifting demand towards home markets and away from foreign goods, leading to increases in output and employment. From the supply side, their model assumes that each sectors output depends on its relative price to the nominal wage, decreasing supply as the real product wage rises (Branson and Love, 1988a).

[11] Branson and Love (1988b)

[12] The effect of an exchange rate movement on employment will depend on export orientation;, import competition; reliance on imported inputs; an industries competitive structure; composition of the labour force; the characteristics of the production process, etc. See Campa and Goldberg (1997) for an in-depth discussion.

[13] A 1% depreciation in the domestic currency induces a 0.61% increase in employment.

inputs to total inputs and the degree of import competition is seen to influence its price, employment and output decisions.

Aligning the emergence of the new wave of studies was the development of both better data and econometric techniques. Panel econometric techniques have since been extensively used within the literature. While single time-series or cross-section estimates tend to measure different things; the former measuring long-run effects, and the latter short-run effects, panel econometrics is provides an opportunity to blend together both long-run and short-run effects.[14] Moreover, Ngundu (2008) states that panel techniques are able to combine "inter-individual" differences with "intra-individual" dynamics amongst sectors, helping to capture and identify the behavioural complexities in an industry.

Research on the impact of exchange rate changes on employment in developing countries have generally focused on three geographical areas, Eastern and Central Europe, Latin America and China. Research on the Eastern European region include Filiztekin (2005), who in a study of Turkey concluded that - due to the high dependency of Turkish manufacturing industries on foreign inputs – a net depreciation would have a negative impact on both employment and wages. Using firm specific data for Hungary, Koren (2001) finds that a depreciation of the domestic currency leads to an adverse effect on employment though the cost channel but also a positive effect from the demand channel. However, the overall net effect of exchange rate on employment is ambiguous.

Given the differences between country and industry characteristics, the rationale behind research on the exchange rate employment relation for Latin American has been primarily driven by the persistently high unemployment rates even during periods of low inflation and economic growth. Frenkel and Ros (2006) assessed the relationship between the real exchange rate and employment in four Latin American countries, finding on average that a 10 percent appreciation (depreciation) of the real exchange rate is associated with a 5.6 percent increase (fall) in the unemployment rate two years later. This result is consistent with earlier Latin America studies by Camargo (1999), Damill et al (2002) and Ros (2004) where an appreciation of the home currency induces contractions in formal industrial employment. It would seem that real exchange rate appreciations had a significant effect on the persistently high unemployment rates of the 1990's in Latin America.

In recent years, the international community has been intensifying pressure on the Chinese government to appreciate its currency. This has led to a need to understand the relationship between a real exchange rate appreciation and employment. While there remain few studies on the impact of the real exchange rate on Chinese employment, authors such as Hua (2007) have found evidence of employment losses in the manufacturing sector following a real appreciation of the Chinese Yuan. In a recent paper, Chen and Dao (2011) found that contrary to theoretical predictions, employment in both the tradable and non-tradable sector contracted following a real appreciation.

As research becomes more focused on the developing world there is a new emphasis on the analysis of price adjustments and industry characteristics. There also appears to be a general consensus that real exchange rate depreciation (appreciation) results in an increase (decrease) in tradable employment. Moreover, as discussed, past research – owing to data limitations – has focused primarily on the manufacturing sector and its reactions to exchange rate movements, with little or no analysis of the non-tradable sector. While increasing attention is now directed to emerging markets, the striking aspect is the limited amount of research in Sub-Saharan Africa. The only research on the exchange rate employment relation in South Africa is that of Ngundu (2008), who using a CGE model, found that while

[14] See Lee, Pesaran and Smith (1998) and Hsiao (2007) for full discussions of the advantages and challenges of using panel data.

an appreciation has a negative impact on manufacturing employment, the net effect on employment is positive.

Following from these contributions, this paper estimates a labour market equilibrium model for South Africa, assessing the price adjustments and industry characteristics of both the tradable and non-tradable sectors. Campa and Goldberg (1997) argued that external orientation, proportion of imported inputs and the degree of import penetration are vital in explaining the role exchange rate has on employment and this paper aims to investigate this further. Furthermore, while Ngundu (2008) used a CGE model, it is commonly recognised that the importance and sign of the multiple effects through which exchange rates impact employment can only be determined through econometrics. As a result, this paper proceeds to using dynamic panel techniques with industry and sector fixed effects to determine the exchange rate employment relation.

## 4. MODELLING EXCHANGE RATE AND EMPLOYMENT

For empirical analysis the model developed by Campa and Goldberg (2001) and Chen and Dao (2011) is used, whereby the focus is on the effect of exchange rate changes on labour demand in different sectors, distinguishing the different adjustments of tradable compared to non-tradable sectors. As noted above, the real exchange rate affects both revenues and costs of each sector. Tradable sectors that have a high export orientation will suffer from a real appreciation as the price adjustment of higher product prices will lead to a downward shift in demand, causing a loss of competitiveness in both the foreign and domestic markets and thus drops in output and employment. On the other hand, import intensive tradable sectors will benefit due to lower marginal costs. Moreover, competition on end products from aboard will increase due to cheaper imports, thus potentially reducing final demand, output and employment in domestic sectors.

With this in mind, the overall net effect of a currency appreciation in the on tradable sector employment is ambiguous and depends on the relative strength of the three effects. As for the non-tradable sectors, the import competition effect can be considered is miniscule or non-existent. Therefore, through the imported inputs channel, a real appreciation is expected to unambiguously increase output and employment in non-tradable sectors. Due to the complexity of defining and measuring import competition as well as its potential miniscule effect, the model will only consider the effects of export orientation and the share of imported inputs on employment.

The starting point of the model is to consider a representative firm in either the tradable or non-tradable sector which maximises profits by choosing the optimal quantity of inputs and outputs. The assumptions within the model include perfectly competitive producers, labour as a homogenous input into production and levels of capital and foreign inputs which are able to fully adjust in the short-run with no additional costs.

The profit function of a producer is given by:

$$\max_{q^j L^j K^j Z^{*j}} \pi^j = p^j(Y, Y^*, e)q^j - w^j L^j - rK^j - \frac{s^*}{s} Z^{*j} \quad (1)$$

$$where\ j = T\ for\ tradable\ sector\ and\ N\ for\ non-tradable\ sector$$
$$q^j = output\ in\ sector\ j\ \&\ e\ is\ the\ real\ exchange\ rate$$

subject to a Cobb-Douglas production structure:

$$q^j = Q^j\left(L^j, K^j, Z^{*j}\right) = (L^j)^{\alpha}(K^j)^{\beta}(Z^{*j})^{1-\alpha-\beta} \quad (2)$$

where the average output price faced by the producer of both sectors is $p^j(Y, Y^*, e)$ is subject to an upward shift with an increase in domestic ($Y$), or foreign ($Y^*$) income, and with a real depreciation. Capital (K) and labour (L) are used as inputs along with imported foreign inputs ($Z^*$). The factor costs in each sector are given by the wage $w^j$, the real interest rate $r$ and the imported input price $\frac{s^*}{e}$.

Solving for the equations (1) and (2) provide FOCs which in term can be linearlised to create labour demand and supply functions, which in-turn is used to created employment and wage equations for the two sectors. Since the derivation's follow closely from that of Chen and Dao (2011), the full derivation can be found there.

The following set of equations show employment and wages yields for the tradable and non-tradable sectors:

$$L_t^T = c_0^T + c_1^T Y_t + c_2^T Y_t^* + \left[\boldsymbol{c_{3,1}^T}|\eta^e| + \boldsymbol{c_{3,2}^T}(1-\alpha-\beta)\right]e_t + c_4^T r_t + c_5^T s_t^* + c_6^T H_t^T \quad (3)$$

$$w_t^T = d_0^T + d_1^T Y_t + d_2^T Y_t^* + \left[\boldsymbol{d_{3,1}^T}|\eta^e| + \boldsymbol{d_{3,2}^T}(1-\alpha-\beta)\right]e_t + d_4^T r_t + d_5^T s_t^* + d_6^T H_t^T \quad (4)$$

$$L_t^N = c_0^N + c_1^N Y_t + \boldsymbol{c_2^N}(1-\alpha-\beta)e_t + c_3^N r_t + c_4^N s_t^* + c_5^N H_t^N \quad (5)$$

$$w_t^N = d_0^N + d_1^N Y_t + \boldsymbol{d_2^N}(1-\alpha-\beta)e_t + d_3^N r_t + d_4^N s_t^* + d_5^N H_t^N \quad (6)$$

where the coefficients of interest that measures the impact of the exchange rate are $c_{3,1}^T, d_{3,1}^T < 0$; $c_{3,2}^T, d_{3,2}^T > 0$ and $c_2^N, d_2^N > 0$. Employment and wage equations for the tradable and non-tradable sectors are mostly identical, except that by earlier definition, demand for non-tradable goods only depends on domestic income. Therefore, the real exchange rate only affects non-tradable labour demand through the second channel of imported inputs. Equations (3) to (6) provide the basis for the empirical analysis. Campa and Goldberg (2001) suggest that the higher the export share of a tradable sector, the greater the price elasticity with respect to exchange rates ($|\eta^e|$) since a larger share of the sectors demand will face foreign competition. The coefficients $c_{3,1}^T$ and $d_{3,1}^T$ will capture this effect. On the other hand, the larger the imported input share, the larger the variable $(1-\alpha-\beta)$ and the stronger the positive (negative) employment effect resulting from a real appreciation (depreciation) since producers' marginal costs are reduced. The effects from the imported input channel will be captured by the coefficients $c_{3,2}^T$, $d_{3,2}^T$ and $c_2^N, d_2^N$.

## 5. DATA DESCRIPTION

In the context of South Africa, empirical work on employment is often fraught with difficulties due to poor data quality and availability. This has resulted in the majority of employment research being focused on cross-sectional analysis rather than using either time-series or panel data analysis. While studies have attempted to construct longer series by combining supply side data such as October Household Survey (OHS) with the Labour Force Survey (LFS) or the LFS with the Quarterly Labour Force Survey (QLFS), the problems of different sample design, sampling, weights and employment totals has left much to be desired upon.

In light of these data problems, the alternative approach is the usage of demand side or firm side data supplied by Quantec Research. However, the dataset is not without its drawbacks

since the South African Standardised Industry Database (SASID) only captures formal non-agricultural sector employment and thus not a representative of the entire economy. With this in mind, the employment and output data used for empirical analysis is from the demand side and collected from Statistics South African and Quantec Research. The real and nominal effective exchange rate, Treasury bill rate and other control variables (i.e. relative oil price, inflation, world demand etc.) are taken from Statistics South Africa and the IMF's International Financial Statistics (IFS).

The SASID database – complied by Quantec Research – is based on a combination of the two databases; namely the Survey of Employment and Earnings (SEE) and the Quarterly Employment Survey (QES). The SEE was introduced in 1998 and took place on a quarterly basis that estimated employment figures based on a sample of 10 000 private and public enterprises in the formal non-agricultural business sector. However, the drawback of the survey was that it did not collect information from various industries[15] (Burger and Yu, 2012). As a result, Stats South Africa, in collaboration with the South African Revenue Services (SARS), the Department of Trade and Industry (DTI) and Labour, re-engineered the register of businesses in 2002, expanding the sample to 25 000 private and public formal non-agricultural industries that covers all previously excluded non-agricultural industries. This re-engineered database would be introduced as the QES which was introduced in 2005 as the replacement of the SEE.

Since the SASID data is based on a number of sources[16], the dataset was able to be extended back to 1970 rather than simply 1998 as provided by the SEE. Furthermore, by using the agglomeration of the different sources, Quantec was able to use the current QES sampling framework – considered as the most correct – to work backwards and re-estimate the employment series. Thus, generating a smoother data series that is absent of the large breaks previously experienced when combining the SEE and QES databases. While this isn't the most ideal scenario, such is the difficulty of obtaining reliable and long employment series that we can consider this as the best, if not, only choice for panel series estimations.

The SASID provides annual employment and output data covering a total of eight sectors and forty-five industries, and together with the real effective exchange rate – from the IFS – forms the empirical estimation on the exchange rate employment relation between the period 1975 and 2009. In conjunction with the eight identified sectors, the SASID also disaggregates output and employment into industries and skills. This, as suggested by Campa and Goldberg (2001) provides an ideal opportunity for understanding South Africa's exchange rate employment dynamic by considering further disaggregation's such as skills and industry characteristics.

South Africa's real effective exchange rate (REER) is obtained from the IFS and is measured as an index[17] that describes the relative value of a currency against a weighted average of other currencies. This means that an increase in the REER refers to a real appreciation of the Rand relative to the other currencies. Figure 1 in the appendix graphs the index of the REER from 1975 to 2012. During the 38 year period, the striking feature is the substantial real appreciation and depreciation experienced between the 1979 and 1986. This was followed by a long-term trend of relatively mild depreciation and stabilisation. However, in the midst of the long-term stabilisation are two important periods of concern. Firstly, following the

[15] These industries include the following (Altman 2008:128): agriculture, hunting, forestry and fishing; restaurants and other eating and drinking places, boarding houses, caravan parks and guest farms; storage, water and air transport; telecommunication services; financial institutions other than banking institutions and insurance companies; real estate and business services; educational services; medical, dental and other health services; welfare organizations; religious organizations; and recreational and cultural services.
[16] These include the Department of Labour. South African Reserve Bank (SARB), SARS, National Treasury and Statistics South Africa.
[17] The base year for the REER index is 2005 (2005=100).

Asian and Mexican crisis of 97-98, the REER fluctuated substantially: first depreciating by over 40 percent and then appreciating by 44 percent. The second period of fluctuation is during the recent financial crisis where once again the REER firstly depreciated and was followed by an appreciation.

Sectoral output from the SASID is measured as the gross value added at 2005 constant prices with seasonal adjustments. The real interest rate is constructed by subtracting inflation from the Treasury bill rate, both obtained from Statistics South Africa and measures the factor cost of capital. Additional control variables in order to account for demand and price effects include U.S GDP and the price of food and oil. US GDP is taken from the World Bank's World Development Indicators (WDI) and is recorded in constant 2000 US dollars[18]. Imported crude oil price, is measured in US dollar per barrel, is used as a proxy for oil price, which is used as a measures of imported input price and is obtained from the U.S Energy Information Administration. Due to data limitations this paper uses population as a proxy for labour force. This method has generally been considered acceptable within the macroeconomic growth literature. Table 1 below provides summary statistics of the overall dataset.

**Table 1: Variable Description and Summary Statistics**

| Variable Name | Variable Description | Mean | Std. Dev. |
|---|---|---|---|
| Annual | | | |
| Employment | Annual Employment in South Africa by SASID | 830879 | 546655 |
| REER | Real Effective Exchange Rate (index 2005=100) | 114.64 | 23.69 |
| r | Real Interest Rate (T-Bill - Inflation) | 0.40 | 4.90 |
| oil | Oil Price in $ per Barrel | 24.95 | 18.17 |
| RGDP | Gross Value Added at 2005 Constant Prices (Rm) | 239862 | 207573 |
| US GDP | US GDP in as Index (2005=100) | 64.21 | 24.07 |
| Population | South African Population (000's) | 36519 | 8567 |

Source: Own Calculations, 2013. Statistics SA, Quantec Research and IMF.

## 6. ESTIMATION METHODS

In undertaking the empirical analysis of exchange rate and employment in South Africa, a major problem has been poor data quality, availability and exogenous variation. However, the combination of the SASID and IMF databases has provided reliable longitudinal data, which has led to the improvement of leverage and data quality. Moreover, developments in panel data techniques have helped overcome limited exogenous variation within the data. As longer time series data becomes available in macroeconomics, panel data methods such as fixed effects, random effects, mean group estimators and dynamic specifications have become increasingly popular.

The recent increase in panel data usage have introduced a number of issues such as unobserved time-varying heterogeneity induced by common shocks that influence all units differently (Coakley, Fuertes and Smith 2004). This is particularly important in macroeconomics where long run data are becoming available for many countries or economic sectors, each of which may be subject to global shocks that may affect sectors differently. Such heterogeneity will introduce correlation between errors of different units, rendering conventional estimators inconsistent if the global shocks are correlated with the regressors. In the case of South Africa, global shocks will have substantial effects on the different industries which could lead to spurious results. To address this issue, a method as

[18] GDP figures have also been deflated using Purchasing Power Parity (PPP).

suggested in Coakley, Fuertes and Smith (2004) is to use fixed effects in a dynamic panel environment.

In the panel time-series literature where both *N* and *T* are large, the proposed solution to cross-section dependence is to introduce period dummies or fixed effects. However, as the data available in this paper is not "wide" enough to use large-*N* and large-*T* methods a dynamic model is specified and fixed effects is used. While the one-way fixed effects estimator (within estimator) allows the intercept to differ over sectors or industries, in taking deviations from group means, it ignores all the information in the between group cross-section relation. As a result, a two-way fixed effects estimator that allows for both time and sector or industry effects is seen to be more suitable for empirical work.

A general two-way fixed effect estimator in a dynamic model is of the form:

$$y_{j,t} = \alpha_j + \rho_t + \beta x_{j,t} + \lambda y_{j,t-1} + u_{j,t} \tag{7}$$

where because of the inclusion of a lagged dependent variable there exists bias, which biases the OLS estimator $\beta$ (coefficient of $x_{j,t}$) downwards. As identified earlier, there is further heterogeneity bias when the parameters differ over groups[19] (Pesaran and Smith, 1995). Unlike the lagged dependent variable bias, the resultant heterogeneity bias, biases the estimates of $\lambda$ upwards[20]. Interestingly this tends to not be an issue since in the long-run, the overall biases are seen to offset each other because the estimates of $\beta$ (downwards) and $\lambda$ (upwards) work in opposite directions[21]. Following from equation (3) and (6) and using a general first-order dynamic panel model[22], the estimated equation can be written as:

$$\Delta lnL_{i,t} = \alpha_i^0 + \lambda_i^1 lnL_{i,t-1} + \alpha_i^2 \Delta lne_t + \alpha_i^3 lne_{t-1} + \sum_{j=1}^{5} \beta^j \Delta lnZ_{j,i,t} + \sum_{j=1}^{5} \gamma^j lnZ_{j,i,t-1} + \eta_t + \mu_i + \upsilon_{i,t}$$

$$i = 1,2,\dots,N\,; t = 1,2,\dots,T \tag{8}$$

where the dependent variable is $L_{i,t}$, measuring sectoral employment, $L_{i,t-1}$ is the lagged level variable of sectoral employment, $e_t$ is the REER and $e_{t-1}$ is the lagged REER. The control variables, $Z_1$ is sectoral output or GDP, $Z_2$ represents world demand (world GDP), $Z_3$ is the price of oil, $Z_4$ is the real interest rate and $Z_5$ is South African population. The empirical model has all variables in log form, with $\Delta$ representing the change in the independent and dependent variables, while following from dynamic panel form, all control variables are also included as a lagged level form. The variables $\eta_t$ and $\mu_i$ represent sector or industry and time fixed effects, while $\upsilon_{i,t}$ is the error term. Interpretation of the employment coefficients can be divided into short and long-run effects. For the short run, the coefficient is simply $\alpha$, however, for the long-run – in dynamic form - the coefficient is interpreted as $\alpha/(1-\lambda)$.

[19] This biases arises because the error term in the fixed effects equation is correlated with the regressors.

$$u_{j,t} = e_{j,t} + (\beta_j - \beta)x_{j,t} + (\lambda_j - \lambda)y_{j,t-1}$$

[20] In the standard case where $x_{j,t}$ is positively serially correlated.

[21] Similar to Phillips and Moon (1999,2000), in the case where *T* is large, another method (random coefficient model) used to avoid this bias is by estimating each equation individually and then taking a weighted or unweighted average of the individual estimates. See Swamy (1970) for more details.

[22] The derivation from equation (7), which is in general form, to equation (8) is through first differencing.

## 7. EMPIRICAL ANALYSIS

Unit root tests are performed using Im-Pesaran-Shin (2003) and Levin-Lin-Chu methods are reported in Table 2 shows that, as expected, real gross value added or GDP are unit root. Moreover, both the Im *et al.* (2003) and Levin-Lin-Chu tests find annual real effective exchange rate to be stationary while mixed results were seen in annual employment. More importantly, however, the two panel unit root tests show that all the annual variables of interest are stationary in first differences at the 1 percent significant level. In other words, all the variables involved in the annual estimations have a deterministic trend where exogenous shocks have transitory effects on the variables of interest.

**Table 2: Panel Unit Root Tests**

| | Im *et al.* (2003) | | Levin-Lin-Chu (2002) | |
|---|---|---|---|---|
| **Variables** | **Test Statistic** | **p-value** | **Test Statistic** | **P-value** |
| **Annual** | | | | |
| Employment | -2.0481 | 0.1183 | -3.0623 | 0.0011*** |
| REER | -2.4629 | 0.0010*** | -6.1061 | 0.0000*** |
| RGDP | 0.2697 | 1.0000 | 3.9392 | 1.0000 |
| ∆Employment | -4.4681 | 0.0000*** | -4.4193 | 0.0000*** |
| ∆REER | -2.4024 | 0.0024*** | -6.6761 | 0.0000*** |
| ∆RGDP | -4.9588 | 0.0000*** | -4.7441 | 0.0000*** |

Notes: Significance levels: *** p<0.01, ** p<0.05, * p<0.1

### 7.1 Panel Regressions by Sector and Industry

The first set of panel regressions considers the role of exchange rates and other variables in influencing employment growth across eight major sectors, using annual data between the periods 1975 to 2009. In addition to the panel regression across the full sample of sectors, this paper compares sector responses in tradable versus non-tradable sector groups. The second set of regressions provides the same assessment as before but further disaggregation of the overall sample is provided using a combination of annual data and two and three-digit industry codes. Finally, the full sample is stratified by industry and skill levels. While industry-specific regressions are ultimately the most ideal, they individually offer too few observations to fully stand on their own merits, thus the need to use panel regressions.

Table 3 provides the estimated results from equation (14). All the regressions in Table 3 use the SASID database, which has 8 sectors (formal employment) and covers the period from 1975 to 2009. All dynamic panel regression equations include sector fixed effects and a linear time trend.

**Table 3: Cross-Sector Panel Regression for Employment Growth: 1975-2009**

| | (1) 1975-2009 All Sectors ∆Employment | (2) 1975-2009 Tradable ∆Employment | (3) 1975-2009 Non-Tradable ∆Employment |
|---|---|---|---|
| **∆REER** | **-0.0353** | **-0.0874**** | **-0.0164** |
| | (0.0285) | (0.0435) | (0.0347) |
| ∆South Africa RGRP | 0.168*** | 0.160** | 0.134* |
| | (0.0513) | (0.0721) | (0.0688) |
| ∆Oil Price | 0.0391*** | 0.0709*** | 0.0287* |
| | (0.0130) | (0.0205) | (0.0158) |
| ∆SA Population | -1.058 | 1.909 | -2.207 |
| | (1.608) | (2.472) | (1.987) |
| ∆US RGDP | 0.517** | 1.050*** | 0.361 |
| | (0.231) | (0.363) | (0.280) |
| ∆Real Interest Rate | -0.000597 | -0.00102 | -0.000453 |
| | (0.000953) | (0.00146) | (0.00116) |
| Lagged Sectoral Employment | -0.00967 | -0.0336 | -0.0119 |
| | (0.00868) | (0.0447) | (0.00965) |
| **Lagged REER** | **-0.0166** | **-0.160**** | **0.0344** |
| | (0.0400) | (0.0605) | (0.0487) |
| Lagged South Africa RGRP | -0.0365** | -0.0167 | -0.0433** |
| | (0.0154) | (0.0372) | (0.0200) |
| Lagged Oil Price | 0.0535*** | 0.0880*** | 0.0430** |
| | (0.0148) | (0.0228) | (0.0180) |
| Lagged SA Population | 0.438* | 0.697* | 0.384 |
| | (0.239) | (0.388) | (0.291) |
| Lagged US RGDP | -0.0234 | -0.224 | 0.0567 |
| | (0.210) | (0.346) | (0.255) |
| Lagged Real Interest Rate | -0.00238** | -0.00369** | -0.00204* |
| | (0.000969) | (0.00147) | (0.00118) |
| Trend | -0.00960 | -0.0106 | -0.0103 |
| | (0.00988) | (0.0168) | (0.0120) |
| Constant | 15.11 | 15.70 | 16.71 |
| | (17.17) | (29.24) | (20.83) |
| Observations | 272 | 68 | 204 |
| Number of Sectors | 8 | 2 | 6 |
| R-squared | 0.302 | 0.622 | 0.271 |

Notes: Dependent variable: Growth rate of employment
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3, Column 1 presents the estimation results for the aggregate economy, showing a generally well defined econometric model with the expected signs on the majority of the control variables. As with dynamic panels, the regression is divided into two parts. Firstly all

the relevant explanatory variables are included as changes, which can be considered to represent the short-run effects on employment. Secondly, together with the lagged dependent variable, all the explanatory variables are included in lagged level form, which measures the long-run effects.

The coefficient estimates for an increase in domestic real value added *(∆South Africa RGDP*), a representative of domestic demand, is a positive and significant effect on employment growth. The estimates suggest that for the aggregate economy, a one percent increase in real value added, increases employment growth by roughly 0.17 percent. It is interesting that changes in domestic population and real interest rate seem to have no impact on annual employment growth. As expected, lagged sectoral employment has a negative effect on employment growth[23], but this is insignificant. Lagged domestic value added affects employment growth in a similar way to lagged sectoral employment, whereby, the higher the previous period's value added the lower the subsequent period's growth rate. Since the growth rate of domestic real value added has a positive and significant impact on employment growth, then the lower the growth rate of real value added, the lower the growth rate of employment.

Although the change in real interest rate had no impact on employment growth, real interest rate of the previous period does have a negative and significant effect on employment. A potential interpretation of the variable "real interest rate" is that an increase in the real interest rate is seen as a contractionary monetary policy which increases the return on capital investments. Thus, while changes in real interest rates have no immediate impact on employment,[24] over time, firms and markets adjust and employment in the long-run is estimated to decline following a hike in the real interest rate.[25]

Interestingly, while there is an abundance of research on the effects of oil price volatility or shock on employment, research into oil price changes on employment is very limited with its effect generally considered ambiguous (Hoel, 1981). In the case of the overall sample, an increase in the oil price - in both the short and long-run - has a significant positive effect on employment. While this may initially seem counter-intuitive, thorough analysis of the literature reveals the non-consensus that currently exists. Furthermore, it is often the case that researchers differentiate between oil price changes and oil price fluctuations or shocks. Indeed, research by the likes of Davis and Haltiwanger (2001) and Papapetrou (2001) suggest that oil price shocks or fluctuations are seen to have a negative effect on both production and employment. However, others such as Lilien (1982), Hamilton (1988) and Keane and Prasad (1996) find that the long-run effect of an oil price increase on aggregate employment is actually positive and significant, while it is negative and significant in the short-run. In the context of this paper and the economic model used, the trade-off between oil price – measured as a proxy for foreign input prices – and labour is just as probable as the traditional capital-labour trade-off. In the case of this three factor economy, labour and oil price can be considered as substitutes in the factors of production. With this in mind, the positive and significant coefficient for the oil price variable, seen in Table 3, is not surprising. The positive oil price[26] effects on employment can be explained by oil and labour being net substitutes in production and when oil price increases, wages decline and the labour supply shifts rightward, thus increasing employment[27].

[23] Similar to the theory of conditional convergence, where in this case, the higher the previous periods employment level the lower the following periods growth rate.
[24] Labour contracts and regulations in South Africa prevent the immediate hiring and firing of workers.
[25] For an counter-argument where higher interest rates is seen to benefit investment, output and employment see the Austrian School of Economics.
[26] It must further be noted that the variable oil price used within this papers empirical estimation represents oil price change rather than shocks or fluctuations.
[27] For detail description of the dynamics and mechanism behind this process see Pindyck and Rotemberg (1983) and Keane and Prasad (1996).

The most important variables within the regression estimations are the two real effective exchange rate (REER) variables. The change in the real effective exchange rate *(∆REER)* measures the short-run relationship between exchange and employment growth, while the lagged level term *(Lagged REER)* measures the long-run relationship. In Table 3, Column 1 the estimated coefficients for the two REER variables (short and long-run) are negative and insignificant. This implies that in the short-run and long-run, an appreciation in the real exchange rate has no impact on employment growth. While this result is interesting, it is not unexpected since, as explained earlier, the impact of exchange rate changes on employment can be disaggregated into tradable and non-tradable sectors, each having theoretically opposite effects on employment. The overall effect is then determined empirically through a combination of the tradable and non-tradable sectors, which can hide considerable heterogeneity and a disaggregation of the overall sample into different sectors will provide a more conclusive analysis. Thus, the REER's impact on the tradable and non-tradable sector employment is estimated and shown in Table 3, Column 2 and 3.

In assessing Table 3, Column 2, the limitation has to be the limited degrees of freedom within the regression. Due to the way the sectoral data is set up, there are only two industries, mining and manufacturing, within the tradable sector which combined provides 68 observations. The estimation results show a similarly well-defined empirical model with the real effective exchange rate having significant negative effects on employment growth in the short and long-run for the tradable sector. A one percent appreciation of the real effective exchange rate will decrease employment growth by almost 0.09 percent in the short-run and 0.16 percent in the long-run. This result follows theoretical predictions that tradable sectors suffer from a real appreciation through a loss of competitiveness both in foreign and domestic markets which shifts the demand curve of their products downward. The results of the *REER* variables for non-tradable sector (Table 3, Column 3) are very different to that of the tradable sector, both employment variables are insignificantly different from zero.

Estimation of the overall employment effects – short and long-run - (Table 3, Column 1) shows that the negative and significant employment effect on the tradable sector was counteracted by the insignificant negative and positive effects in the non-tradable sector and thus providing insignificant estimations for the aggregate economy. In the long-run, for the non-tradable sector, a one percent appreciation in the real exchange rate will lead to a 0.03 percent increase in non-tradable employment growth. While the short-run effect of an exchange rate appreciation is insignificant on non-tradable employment, the negative sign is counter to theoretical predictions. However, historical research in the literature does not disaggregate the exchange rate changes into short and long-run effects on employment and thus provide an unreliable source of comparison.

Due to the lack historical literature, this paper provides an alternative hypothesis to the sign of the *REER* coefficient estimated in the non-tradable sector. The mechanics behind the J-curve effect experienced on the balance of payment as a result of an exchange rate depreciation could very well have a similar impact on non-tradable sector employment. While overall employment in the non-tradable sector theoretically increases from an exchange rate appreciation, the dynamics within the short and long-run work in opposite directions through substitution and income effects. In the short-run, an appreciation results in foreign goods and services becoming relatively cheaper than domestic goods and services and hence a substitute away from both domestic tradable and non-tradable output. Furthermore, the contraction in the tradable sector ensures a negative effect on the demand for intermediate inputs supplied by the non-tradable sector[28]. Overall, in the short-run, the combined

[28] This channel can be defined as structural interdependence that can lead to spill over effects across sectors. i.e. the co-movement or employment changes in the tradable and non-tradable sector as a response to changes in the exchange rate.

substitution and demand effect has a negative impact on non-tradable output and employment.

However, the adjustment process also needs to incorporate the income effect, which for the non-tradable sector is positive for both output and employment. In the long-run, the increased income (cheaper imported inputs) for those in the non-tradable sector will lead to increases in output and hence employment. Chen and Dao (2011) explains that a real appreciation also tends to lead to a higher relative price of non-tradable goods (i.e. higher internal exchange rate), which reallocates labour and other factors to the non-tradable sector and hence boosts non-tradable sector employment. Overall, a combination of higher demand from increased income and the reallocation of labour and other factors to the non-tradable sector can result in a positive long-run employment effect in response to a real exchange rate appreciation.

It must be noted that while this paper believes that the proposed short-run employment effect to an exchange rate appreciation is negative, the overall and long-run impact must be determined empirically since it is subject to the level of interdependence across the two sectors. In the case that the interdependence is low, the overall and long-run effect will be positive, whereas a high interdependence could result in a negative employment impact. This theoretical assertion is supported in the sign of the *REER* coefficients seen in Table 3, Column 3. The insignificance of the two *REER* variables can be further interpreted as currency appreciation having no impact on non-tradable employment creation. The insignificance of the positive long-run effect on non-tradable employment could potentially be explained by the high interdependence between sectors. In order to examine the degree of interdependence between sectors, a brief assessment of the South African input-output tables will follow the empirical analysis section.

Having estimated the full sample, tradable and non-tradable sectors using annual sectoral data, this paper now attempts the same analysis but disaggregating the data into two and three digit industry codes and skill levels. The following estimations serve not only as a comparison to the theoretical predictions but also a robustness check on Table's 3's estimation results.

Table 4 disaggregates overall and sectoral employment into two and three-digit industry codes which increases the observations of the overall sample, tradable and non-tradable sectors to 1530, 1054 and 476 respectively. As stated in the estimation method section, by accompanying longer time periods with greater sample sizes, the estimation results decrease in biasness and complies better with both time-series and cross-sectional properties. The empirical estimations can be considered as satisfying the asymptotic properties for panel data since both N and T are considered large and tending to infinity. This then, provides a more accurate reflection of the exchange rate employment relationship. Moreover, for robustness a check, an extra pricing variable is in the form of an international food price index is included in the regression. This variable works in conjunction with the oil price and fits into the theoretical model as *s,* and along with oil prices, measures the imported input price. Since the new estimation results are consistent with Tables 3, the following Tables will only show the results of the real effective exchange rate variables.

Disaggregation into three-digit industry codes provides the estimations in Table 4, where for the overall sample an appreciation of the real effective exchange rate has a negative and significant short and long-run effect on employment growth. As expected this result also holds for tradable industries as shown in Table 4, Column 2. Unsurprisingly, the estimated coefficients for the tradable industries are larger than that of the overall sample; supporting the viewpoint that an appreciation of the Rand has a ubiquitous negative impact on tradable sector job creation. A one percent real appreciation in the Rand leads to employment growth decreasing by roughly 0.04 percent in the short-run and 0.07 percent in the long-run.

Considering the non-tradable industries, the estimation results shown in Table 4, Column 3 are consistent with previous estimates. An appreciation of the real effective exchange rate has a negative and insignificant impact on short-run employment growth but a positive and insignificant long-run effect.

**Table 4: Cross-Industry Panel Regression for Employment Growth: 1975-2009**

| | (1) 1975-2009 All Industries ∆Employment | (2) 1975-2009 Tradable ∆Employment | (3) 1975-2009 Non-Tradable ∆Employment |
|---|---|---|---|
| **∆REER** | **-0.0393**** | **-0.0398*** | **-0.0341** |
| | (0.0174) | (-0.0217) | (0.0276) |
| **Lagged REER** | **-0.0494**** | **-0.0699**** | **0.0051** |
| | (0.0248) | (0.0311) | (0.0397) |
| Time Trend | Yes | Yes | Yes |
| Food Index | Yes | Yes | Yes |
| Observations | 1,530 | 1,054 | 476 |
| Number of Industries | 45 | 31 | 14 |
| R-squared | 0.171 | 0.204 | 0.136 |

Notes: Dependent variable: Growth rate of employment
Other control variables are identical to Tables 3&4
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Comparison of estimation results between Tables 3 and 4 suggest that while an appreciation of the Rand has no effect on overall employment growth in the short and long-run using sectoral data, disaggregating the estimates into industries shows a different result. Using data that satisfies the large N and large T criteria, an appreciation of the real effective exchange rate has a negative and significant short and long-run effect on aggregate employment growth, while a similar, but larger effect can be found in the tradable sector. Interestingly, estimation results in Table 3 and 4 both suggest that employment in the non-tradable sector is not significantly affected by an appreciation of the Rand. Although the estimation results shown above provides compelling evidence to the potentially negative impact of an exchange rate appreciation on overall and tradable sector employment growth, the data obtained from Quantec offers further disaggregation opportunities in the form of highly skill, skilled and low-skilled employment.

### 7.2 Annual Panel Regressions by Industry and Skill Level

Campa and Goldberg (2001) identified the importance of the skill level of the labour force and its impact on the exchange rate employment relation. They found that industries with higher proportion of college-educated workers in their labour force also have lower employment elasticities to exchange rates. While Campa and Goldberg (2001) use education as a measurement of skill level, this paper uses employment by occupation.

Overall employment is broken down into nine major occupations[29], as defined by the South African Standard Classification of Occupations (SASCO) which fit into four major skill categories. The classification of major occupations and its related skill levels can be found in Table A1 in the Appendix.

Following from ISCO-88, the four skill levels can then be used as a formal measure of education and work experience. Skill level one is defined as someone with primary or no education and is classified as a low or unskilled worker. Skill levels two and three relate to secondary education and post-secondary education, which leads to an award not equal to a university degree, and can be classified as skilled workers. Finally, skill level four is equivalent to a university or post-graduate university degree and can be considered as a highly skilled employee. The breakdown of the four skill levels can now be used to evaluate whether industry characteristics, such as differences in the level of skills, has an impact on the exchange rate employment relation.

As stated, the impact of exchange rate changes on employment could have a different effect on workers with differing skill levels. To investigate this, the overall sample is divided into highly skill, skilled and low or unskilled workers.

Table 5 below provides empirical estimates across industries for highly skilled employees between the period 1975 and 2009. The regression in Table 5 is identical to that of Table 4 with the exception of only considering highly skilled employees. Estimations of the overall highly skilled sample suggest that an appreciation of the real exchange rate has a negative and significant impact on employment, with larger coefficients than that found in earlier estimations. An appreciation of the real effective exchange rate by one percent is predicted to decrease short-run employment growth by almost 0.06 percent and long-run employment by 0.09 percent. Interestingly, the R-squared is a lot higher for the highly skilled group as compared to the other two skill groups (see Tables 6 and 7).

Disaggregating the overall sample into tradable and non-tradable sectors reveals a similar outcome as before. As expected an appreciation of the Rand has an adverse effect on highly skilled tradable employment in both the short and long-run (Table 5, Column 2). The coefficients of the REER variables in Table 5 suggest that a one percent appreciation in the Rand will lead to a 0.06 percent decline in highly skilled employment growth in the tradable sector in the short-run and 0.11 percent decline in the long-run. Considering the non-tradable sector, the results in Table 5, Column 3 show highly skilled non-tradable employment to be unaffected by an exchange rate appreciation. While the coefficients for the two REER variables are insignificant, the negative sign does suggest further evidence of the interdependence between sectors; with the negative output and employment impacts on the tradable sector having a damaging spillover effect into the non-tradable sector. As explained above, the sign of the non-tradable *Lagged REER* variable is indicative of the degree of sectoral interdependence. As is the case with Table 5, Column 3, the negative long-run coefficient of the REER variable suggests that for the highly skilled workforce there is potential evidence of high interdependence between the tradable and non-tradable sectors.

[29] For international comparability the SASCO was developed using the same conceptual basis to that of the United Nations' International Standard Classification of Occupations (ISCO-88).

**Table 5: Cross-Industry Panel Regression for Highly Skilled Employment Growth: 1975-2009**

| | (1) 1975-2009 All Industries ∆Employment | (2) 1975-2009 Tradable ∆Employment | (3) 1975-2009 Non-Tradable ∆Employment |
|---|---|---|---|
| **∆REER** | **-0.0591*** ** | **-0.0602** ** | **-0.0544** |
| | (0.0193) | (0.0235) | (0.0336) |
| **Lagged REER** | **-0.0861*** ** | **-0.1084*** ** | **-0.0311** |
| | (0.0276) | (0.0336) | (0.0483) |
| Time Trend | Yes | Yes | Yes |
| Food Index | Yes | Yes | Yes |
| Observations | 1,530 | 1,054 | 476 |
| Number of Industries | 45 | 31 | 14 |
| R-squared | 0.244 | 0.267 | 0.231 |

Notes: Dependent variable: Growth rate of employment
Other control variables are identical to Tables 3&4
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Moving to consider the impact of skilled workers, Table 6 shows the results for skilled employment in overall, tradable and non-tradable industries. The results suggest that an appreciation of the real effective exchange rate has a negative and significant short and long-run effect on overall skilled employment. Interestingly, the coefficients of the two REER variables (Table 6, Column 1) is smaller than that of the highly skilled workers suggesting that, unlike Campa and Goldberg's (2001) finding, higher skills does not lead to lower employment exchange rate elasticities. For aggregate skilled employment, a one percent appreciation of the real effective exchange rate is estimated to decrease short-run and long-run employment growth by 0.04 and 0.06 percent respectively. While it must be noted that how one measures skill levels matter, since the variable college education was unavailable, the next best alternative or proxy would be skills by occupation. Investigating the tradable sector (Table 6, Column 2) shows that an appreciation of the real exchange rate only has a negative and significant long-run effect on skilled employment, while the short-run effect, although negative, is not statistically significant. The estimation results for the non-tradable sector (Table 6, Column 3) were consistent with the highly skilled group, with insignificant negative short and long-run effects of an exchange rate appreciation on employment[30]. There are two important results found in Table 6. Firstly, the estimations provide further support for the presence of heavy interdependence between sectors. Secondly, together with Table 5, there is a potential of an opposite finding to that of Campa and Goldberg (2001), whereby an exchange rate appreciation is observed to have a smaller negative effect on lower skilled employment as compared to highly skilled employment.

[30] Although the short-run REER coefficient is significant at the 10 percent level, for this paper, it is not considered a sufficient criteria

**Table 6: Cross-Industry Panel Regression for Skilled Employment Growth: 1975-2009**

| | (1) 1975-2009 All Industries ∆Employment | (2) 1975-2009 Tradable ∆Employment | (3) 1975-2009 Non-Tradable ∆Employment |
|---|---|---|---|
| **∆REER** | **-0.0419**** | **-0.0327** | **-0.0588*** |
| | (0.0189) | (0.0223) | (0.0345) |
| **Lagged REER** | **-0.0551**** | **-0.0615**** | **-0.0341** |
| | (0.0271) | (0.0316) | (0.0496) |
| Time Trend | Yes | Yes | Yes |
| Food Index | Yes | Yes | Yes |
| Observations | 1,530 | 1,054 | 476 |
| Number of Industries | 45 | 31 | 14 |
| R-squared | 0.181 | 0.241 | 0.124 |

Notes: Dependent variable: Growth rate of employment
Other control variables are identical to Tables 3&4
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To further consider whether skill levels play a role in exchange rate changes on employment, cross-industry regressions are run for low or unskilled workers between the period 1975 and 2009. The results shown in Table 7, Column 1 suggest that for the low or unskilled workers a real exchange rate appreciation has no significant effect on aggregate employment. Moreover, the coefficients are the smallest as compared to the highly skilled and skilled regression coefficients. Breaking the sample down into tradable and non-tradable sectors (Table 7, Column 1 and 2) shows a result similar to that of Table 6. The negative employment effect, on the tradable sector, from a real exchange rate appreciation is only statistically significant at the ten percent significance level in the short-run and five percent in the long-run. A comparison of the *REER* coefficients between the skilled and unskilled tradable workers show that, surprisingly, the unskilled workers have roughly equal, if not, greater employment exchange rate elasticity than the skilled workers. Moving to consider the non-tradable sector, Table 7, Column 3 reports a negative and insignificant short-run coefficient for REER, while in the long-run, the REER variable is positive and insignificant.

**Table 7: Cross-Industry Panel Regression for Low and Unskilled Employment Growth: 1975-2009**

| | (1) 1975-2009 All Industries ∆Employment | (2) 1975-2009 Tradable ∆Employment | (3) 1975-2009 Non-Tradable ∆Employment |
|---|---|---|---|
| **∆REER** | **-0.0348*** | **-0.0385*** | **-0.0249** |
| | (0.0179) | (0.0225) | (0.0286) |
| **Lagged REER** | **-0.0397** | **-0.0659**** | **0.0244** |
| | (0.0257) | (0.0322) | (0.0411) |
| Time Trend | Yes | Yes | Yes |
| Food Index | Yes | Yes | Yes |
| Observations | 1,530 | 1,054 | 476 |
| Number of Industries | 45 | 31 | 14 |
| R-squared | 0.148 | 0.171 | 0.139 |

Notes: Dependent variable: Growth rate of employment
Other control variables are identical to Tables 3&4
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In trying to assess the robustness of the empirical estimations, Tables 5, 6 and 7 were subjected to different specifications of variables. An additional imported input price was added in the form of an international food index, while different measures of foreign GDP[31] and interest rate[32] were considered. Overall, the estimation results from the different specifications were consistent with all earlier estimates of the aggregate, tradable and non-tradable sectors, industries and skill levels. Thus, suggesting that the empirical estimations on the employment exchange rate relation are robust across different specifications and disaggregation.

Having analysed the role skill levels of the labour force play in the exchange rate employment relation, the evidence shown in Tables 5, 6 and 7 does not support Campa and Goldberg's (2001) assertion that higher skilled industries have lower employment elasticities to exchange rates. Instead, the estimation results in this paper provides support towards the hypothesis - opposite to Campa and Goldberg (2001) - that for South Africa, lower skilled workers are estimated to have lower elasticities of total employment to exchange rate changes. The correlation between this specific industry characteristic and exchange rates suggest issues such as skill levels of the labour force might result in quite different mechanisms for the adjustment of labour markets in response to exchange rate changes. In the case for South Africa, workers with higher skill levels are more exposed to subsequent changes in exchange rates as compared to lower skilled workers and vice-versa.
This result may seem highly counter-intuitive for a skill constrained economy like South Africa, since theoretically, the real effective exchange rate employment elasticity should be low for workers with high skills. The argument follows from the fact that industries or sectors

[31] The U.S GDP was used as an alternative measure of World GDP. We were unable to use GDP of EU countries since the data series only starts from 1996. While we acknowledge that the best approach to measuring foreign income in this paper is to create an income index on South Africa's major trading partners, however, due to data limitations this was not possible.
[32] The different interest rates considered include the Treasury Bill rate and the discount rate.

that are skilled constrained would be reluctant to dismiss skilled workers during downturns in output due to exchange rate changes. Furthermore, as Campa and Goldberg (2001) explain, skill intensive industries have relatively higher costs of hiring and firing workers which would decrease the employment exchange rate elasticity for high skilled workers. However, it has also been commonly established that industries with high skill intensity tend to be more export orientated and thus have higher employment exchange rate elasticities (Campa and Goldberg, 2001). Another factor to consider is the above mentioned interdependence between sectors or industries and how that might impact the employment exchange rate relation. In the case where an industry exhibits high export orientation and interdependence, the effect on the exchange rate employment elasticity could be larger than the role of higher costs to hiring and firing and considerations of skill constraints. With this in mind, the result found here could indeed be plausible and different to that of Campa and Goldberg (2001).

Moreover, two other issues to consider that is specific to South Africa's case is that of exchange rate pass-through and the strength of labour unions in low skilled employment. In terms of exchange rate pass through, it has been suggested that the impact of exchange rates passes through the greatest onto high skilled tradable employees. An example of this can be seen during recent financial crisis whereby high skilled workers that had similar jobs in the tradable and non-tradable sector were affected differently. In the case of two accountants working in the tradable (mining) and non-tradable (services) industry, the accountant directly employed by the mining company, due to exchange rate pass-through, is substantially more at risk than the non-tradable employee. The fact that tradable sectors are more exposed to exchange rate changes is no secret and exchange rates passing through to affect tradable sector employment more than non-tradable is also understandable.

In conjunction to the issue of exchange rate pass through is that of labour inflexibility and labour union power in South Africa. It has been found that tradable sectors (Mining and Manufacturing) are significantly more unionised than non-tradable sectors, with unionisation mostly based in low skill jobs (DPRU, 2013). Thus, the extent to which high skilled workers in the tradable sector is substantially more exposed to exchange rate changes is entirely plausible. Union strength in South Africa has resulted in a scenario that is opposite to Campa and Goldberg's (2001) assertion that high skilled industries have high hiring and firing costs. For South Africa, it is the low skilled industries – particularly the tradable sector - that has the highest hiring and firing costs. Increases in foreign input costs from an exchange rate appreciation is absorbed directly by the firm and does not pass to low skilled employees through the process of job losses. In a case unique to South Africa, high skilled workers –especially in the tradable sector - can be seen as having higher employment exchange rate elasticities than an equivalent low skilled worker.

The ideal approach to find which effect plays a larger role in the determination of the employment exchange rate elasticity for different skill levels is through empirical analysis using data from the input-output tables. However, due to data limitations, the only available input-output table for South Africa is in 2009 and thus eliminating the possibility of running any regression analysis. As a result, while not ideal, this paper believes that the next best alternative is to use the input-output tables as a snapshot in time for the year 2009 to assess the degree of external orientation and intersectoral dependence for the tradable and non-tradable sectors. This will help shed some light on earlier explanations made on the empirical results shown through Tables 3 to 7.

### 7.3 External Orientation and Intersectoral Dependence using Input-Output Tables

To assess the degree of external orientation and intersectoral dependence, Tables 8 and 9 provide industry-by-industry input-output tables in South Africa for 2009. The input-output table is a theoretical framework that focuses on the relationship between industries and their production and use of products. The figures in Table 8 suggest that for all eight industries,

there is evidence of high interdependence across industries. The mining industry is considered the most interdependent industry with 98 percent of production being consumed by other industries, while manufacturing is the least interdependent with 51 percent of production being consumed by other industries.

**Table 8: Industry-by-Industry Input-Output Table for South Africa, 2009**

| | Mining | Manuf. | Utilities | Const. | W & R Trade | Transport | Fin Services | CSPS |
|---|---|---|---|---|---|---|---|---|
| **Mining** | 2.1% | 81.3% | 10.2% | 2.8% | 0.0% | 0.6% | 0.0% | 2.9% |
| **Manufacturing** | 5.6% | 48.9% | 0.8% | 11.0% | 8.2% | 7.6% | 4.9% | 13.0% |
| **Utilities** | 12.2% | 32.1% | 21.4% | 0.9% | 7.3% | 3.6% | 14.3% | 8.2% |
| **Construction** | 4.6% | 18.2% | 0.6% | 28.2% | 1.9% | 21.7% | 16.6% | 8.2% |
| **W & R Trade** | 3.6% | 36.3% | 0.8% | 9.1% | 8.9% | 14.1% | 17.0% | 10.3% |
| **Transport** | 13.0% | 22.0% | 0.9% | 4.0% | 15.3% | 11.5% | 11.1% | 22.2% |
| **Fin Services** | 2.7% | 11.0% | 1.2% | 5.3% | 15.1% | 7.5% | 35.5% | 21.8% |
| **CSPS** | 2.6% | 34.0% | 0.1% | 1.2% | 1.2% | 7.6% | 14.5% | 38.7% |
| **Total** | 5.2% | 36.6% | 2.2% | 7.0% | 8.8% | 8.1% | 14.3% | 17.7% |

Source: Statistics South Africa: National Accounts, Draft input-output table for South Africa, 2009.
Notes: 1. The input-output table forms a matrix that lists consuming industries as columns and supplying industries as rows.
2. Mining and Manufacturing industries are classified as the tradable sector while the remaining six industries are considered the non-tradable sector.

Aggregation of the industries into tradable and non-tradable sectors (Table 9) shows that the tradable sector (mining and manufacturing industries) is far more intersectoral dependent as compared to the non-tradable[33] sector. Of total domestic sectoral consumption produced by the tradable sector, 40 percent is consumed by the non-tradable, while only 29 percent of non-tradable production is consumed within the tradable sector. Interestingly, this result is not uncommon due to the nature of the goods and services produced within the two sectors. Within the input-output intersectoral literature there is substantial evidence supporting asymmetrical dependence. Park and Chan (1989), in a cross-country analysis, found that non-tradable sectors tend to depend on the manufacturing or tradable sector as a source of inputs to a far greater extent than vice-versa.

**Table 9: Sectoral Input-Output Table for South Africa, 2009**

| | Tradable | Non-Tradable | Total |
|---|---|---|---|
| **Tradable** | 60.0% | 40.0% | 100% |
| **Non-Tradable** | 28.6% | 71.4% | 100% |
| **Total** | 41.8% | 58.2% | 100% |

Source: Statistics South Africa: National Accounts, Draft input-output table for South Africa, 2009.
Notes: Mining and Manufacturing industries are classified as the tradable sector while the remaining six industries are considered the non-tradable sector.

In the case for South Africa, the high dependence of tradable inputs by the non-tradable sector (40 percent) is a clear indication of the importance a strong tradable sector has on the non-tradable sector. The combination of evidence provided in Table 8 and 9 and the regression estimates (Tables 3 to 7) strongly support the earlier finding that a high degree of asymmetrical interdependence between sectors is present in the South African economy. Furthermore, evidence in Tables 8 and 9 suggests that following a real exchange rate

[33] Utilities, Construction, Wholesale and Retail Trade, Transport, Business and Financial Services and Community, Social and Personal Services.

appreciation, the negative spillover effect from intersectoral dependence (decline in output and employment in the tradable sector) has the potential to offset the positive price and income effects in the non-tradable sector, leading to no significant changes in non-tradable sector employment, positive or negative. This, indeed, was the finding for the non-tradable sector in Tables 3 to 7. Employment was not significantly affected by a real effective exchange rate appreciation. Tying the estimations in Table 3 to 7 with input-output tables provides clear support for the hypothesis of high interdependence between industries and sectors. It would seem that the earlier empirical results were justified and robust to assessment using the input-output tables.

Having analysed the issue of interdependence between sectors this paper now moves to consider the possible impact of sectoral external orientation and the implications it has on the exchange rate employment relationship based skill intensity (shown in Tables 5 to 7). Tables 10 and 11 provide industry and sectoral input-output figures calculated for external orientation respectively. Unsurprisingly, Table 10 shows that in 2009, the industry with the highest export orientation was mining - where almost 60 percent to total consumption is exported - followed by manufacturing and wholesale and retail trade. Moreover, as expected, non-tradable sectors such as utilities, construction, business and financial services and CSPS have little to no export orientation. As before, while the disaggregated figures provide a wealth of interesting analysis, for the purposes of this paper, the aggregation of the industries into tradable and non-tradable sectors is needed.

**Table 10: Industry-by-Industry Input-Output Table with External Orientation, Household and Government Consumption for South Africa, 2009**

| | Domestic Industry Consumption | Exports | Imports | HH Consumption | Government | Capital Formation |
|---|---|---|---|---|---|---|
| **Mining** | 63.5% | 58.9% | -22.8% | 0.4% | 0.0% | 0.0% |
| **Manufacturing** | 64.4% | 19.0% | -35.0% | 33.7% | 0.0% | 17.9% |
| **Utilities** | 70.7% | 0.6% | -0.9% | 29.6% | 0.0% | 0.0% |
| **Construction** | 18.0% | 0.1% | -0.2% | 0.7% | 0.0% | 81.3% |
| **W & R Trade** | 51.1% | 19.9% | -5.3% | 28.2% | 0.0% | 6.1% |
| **Transport** | 73.7% | 13.2% | -14.3% | 26.4% | 0.0% | 1.0% |
| **Fin Services** | 66.6% | 1.9% | -2.0% | 31.1% | 0.0% | 2.5% |
| **CSPS** | 29.9% | 2.0% | -1.0% | 21.9% | 47.2% | 0.0% |
| **Total** | 54.2% | 13.3% | -13.9% | 25.4% | 10.5% | 10.6% |

Source: Statistics South Africa: National Accounts, Draft input-output table for South Africa, 2009.
Notes: 1. Domestic industry consumption is the aggregate use of all eight non-agricultural industries.
2. HH Consumption represents industrial output incurred by the household while government represents final consumption expenditure incurred by general government.
3. Capital formation is equal to gross fixed capital formation.
4. Mining and Manufacturing industries are classified as the tradable sector while the remaining six industries are considered the non-tradable sector.

By aggregating the industry input-output tables into sectoral input-output tables, the figures shown below provide strong substantiation to higher export orientation for the tradable sector (26.8 percent) as compared to the non-tradable sector (5.8 percent).

**Table 11: Sectoral Input-Output Table with External Orientation, Household and Government Consumption for South Africa, 2009**

| | Domestic Industry Consumption | Exports | Imports | HH Consumption | Govern-ment | Capital Formation |
|---|---|---|---|---|---|---|
| **Tradable** | 64.2% | 26.8% | -32.7% | 27.2% | 0.0% | 14.4% |
| **Non-Tradable** | 48.7% | 5.8% | -3.5% | 24.3% | 16.2% | 8.4% |
| **Total** | 54.2% | 13.3% | -13.9% | 25.5% | 10.5% | 10.6% |

Source: Statistics South Africa: National Accounts, Draft input-output table for South Africa, 2009.

Notes: 1. HH Consumption represents industrial output incurred by the household while government represents final consumption expenditure incurred by general government.
2. Capital formation is equal to gross fixed capital formation.
3. Mining and Manufacturing industries are classified as the tradable sector while the remaining six industries are considered the non-tradable sector.

Having found that in the event of a real exchange rate appreciation, tradable sector workers[34] with higher skills are more likely to lose their jobs as compared to lower skilled workers (Table 5, 6 and 7); the combination of high intersectoral dependence and high external orientation for the tradable sector (shown in Table 10 and 11) suggests this to be highly plausible. Although skill-intensive industries have higher hiring and firing costs which often leads to relatively lower employment-exchange rate elasticities; in the case of South Africa, this is potentially outweighed by high interdependence between sectors and high export orientation. While this result is opposite to that found by Campa and Goldberg (2001) for the U.S, as explained, this is possible and acceptable. Moreover, due to country heterogeneity comparisons between the U.S and South Africa are never ideal and shouldn't be considered.

Although one can continue to argue that for a country such as South Africa, where skill shortages are the norm, higher employment exchange rate elasticities for skill intensive industries do not make sense. It must be reminded that the majority of skilled employmet reside within the non-tradable industries and these industries have already exhibited a high degree of employment rigidity[35] when it comes to exchange rate changes. It is only in the tradable sector that employment was seen to decline following an appreciation of the Rand, and this effect was larger for those with high skill intensities.

Overall, this paper believes that the empirical results, back up by robustness checks through the use of different specifications and input-output tables, are not unbelievable and could represent the nature of the employment exchange rate relation between the periods 1975 to 2009.

## 8. CONCLUSION

Exchange rate changes are indeed important in the influence it has, especially when it leads to a significant impact on changes in sectoral employment and output. While there is a large literature on the effects of exchange rate on employment, past research has mainly focused on developed countries such as USA and developing countries in Asia and South America. This paper has shown the existence of a number of channels through which exchange rate can impact employment. However, the relative sign and significance of these effects are

[34] The non-tradable sector was not considered since the regression estimates in Tables 3 to 7 showed employment changes following an exchange rate appreciation to be statistically insignificant (i.e for effect on employment). Furthermore, it has already been shown that due to high interdependence between sectors such results are probable.

[35] As shown in the insignificant changes in employment following an exchange rate appreciation, see Tables 3 to 7 for full regression results.

subject of empirical analysis. Furthermore, while a variety of channels do exist, the ability to reliably and consistently estimate the economic effects of an exchange rate change on employment through a well-defined theoretical framework is near impossible. As a result, this paper takes the approach of estimating the employment exchange rate relationship through the two largest theoretical channels; namely, export orientation and the proportion of imported inputs.

This paper contributes to the existing literature by developing and analysing the exchange rate employment relation in a developing economy such as South Africa. Using the modelling framework suggested by Chen and Dao (2011) and Campa and Goldberg (2001) and a balanced panel dataset of sectoral and industry data for the period 1975 to 2009, this paper estimates the short and long-run impact of an exchange rate appreciation on sectoral employment.

The estimated results show that a real appreciation in the South African economy has a strong negative employment effect in the tradable sector and surprisingly, no effect on the non-tradable sector. This finding is partially surprising as theory predicts that a real appreciation of the real effective exchange rates should lead to an expansion of the non-tradable sector and a contraction in the tradable sector. While a contraction was experienced in the tradable sector, the expected gain in the non-tradable sector was not found. The results are confirmed when sectoral data was disaggregated into two and three-digit industry codes. Although aggregate employment using sectoral data was not affected by a real appreciation, disaggregation into industries shows a strong negative aggregate employment impact. Further disaggregation of industry data into skill variations supports the papers initial findings, where a real exchange rate appreciation has a significant negative effect on aggregate and tradable highly skilled and skilled employment but no impact low skilled aggregate and tradable sector employment. Interestingly, throughout the disaggregation of the three different skill levels, exchange rate had no significant effect on non-tradable employment. Moreover, the results based on skills disaggregation are robust to the inclusion of other variables and different specifications. These results can be further seen as not being aligned to past theoretical predictions since Campa and Goldberg (2001) believe skilled workers to have lower employment exchange rate elasticities, a result found to be the opposite in this paper.

Yet, the results found here are not without grounds. Theoretical predictions have all been formulated on developed country analysis, with little effort linking theory and econometrics to the developing world. Thus, expecting econometric results from developing countries to fit established theoretical predictions for the developed world is ambitious to say the least. Furthermore, there are other considerations (intersectoral dependence and external orientation) in the theoretical framework that needs to be taken into account when assessing the likelihood and accurateness of the empirical results.

Using input-output tables for 2009, the issues of intersectoral dependence and external orientation are found to have substantial influence on the effect an exchange rate change will have on employment. The descriptive analysis showed evidence of high sectoral dependence between the tradable and non-tradable sectors which supports the hypothesis of a negative spillover effect moving from the tradable sector towards the non-tradable sector. And, thus the no employment impact in the non-tradable sector following an exchange rate appreciation can be considered potentially plausible. Further considerations into the result, where higher skilled workers in the tradable sector had larger employment exchange rate elasticities (more exposed to subsequent changes in exchange rates) can be explained by high interdependence between sectors and high skill intensive industries being more external orientated. The input-output tables, detailed at the sectoral and industry level show that indeed, the tradable sector does show a large amount of both intersectoral dependence and external orientation. This suggests the plausibility that export orientation

and sectoral interdependence can out-weight the high hiring and firing costs within skilled employment has have an overall larger employment exchange rate elasticity for the higher skilled workers.

The results in this paper have important implications for labour market adjustments in South Africa following a revaluation of the Rand in future. If a revaluation of the Rand leads to a real appreciation, and this, in turn, to an employment contraction in the tradable sector and no movement in the non-tradable sector, then it will likely be followed by a decrease in domestic demand, which would subsequently lead to decreases in output. Conversely, however, if the revaluation of the Rand leads to a real depreciation, then the outcome could well be an increase in aggregate and tradable employment, demand and output. In the context of the South Africa's currently economic policy of boosting growth and employment, the findings in the paper suggest that a real depreciation could prove extremely beneficial in achieving these policy goals. Yet, one should not ignore the issues of inflation. Therefore, a real depreciation should be accompanied by appropriate monetary policy measures that support increases in demand but also keep inflation in check. On the other hand, any real appreciation must be met with macroeconomic policies that support domestic demand and that enhance productivity of non-tradable sectors of the economy in order to separate the demand swings experienced in the tradable sector. Furthermore, the high intersectoral dependence points to a need of structural reform to decouple think link between sectors which, in the form of a real appreciation, is preventing the non-tradable sector to fully experiences the expected employment, demand and output gains.

While the focus of this paper has been on exchange rate changes on sectoral employment, the findings here do not preclude the role exchange rate volatility will play on employment or other channels (not empirically evaluated within this paper) exchange rate employment channels such as import competition, factor intensity or market structure and labour regulations. Another issue that this paper has eluded to mention is the problem of endogeneity. The difficulty in finding an instrumental variable for real effective exchange rate has plagued the literature, and while this is clearly an important issue, we feel it does not substantially dilute the importance of the work done within this paper. Moreover, we feel that the issue of endogeneity should be tackled in a paper that solely focuses on the issue of identification. Overall, we believe that this literature is only in its infancy and that finding other ways and data to shed light on the different transmission channels of the exchange rate employment relation as well as finding or creating suitable instrumental variables for the real effective exchange rate are just a few of the promising avenues of future work available to researchers worldwide.

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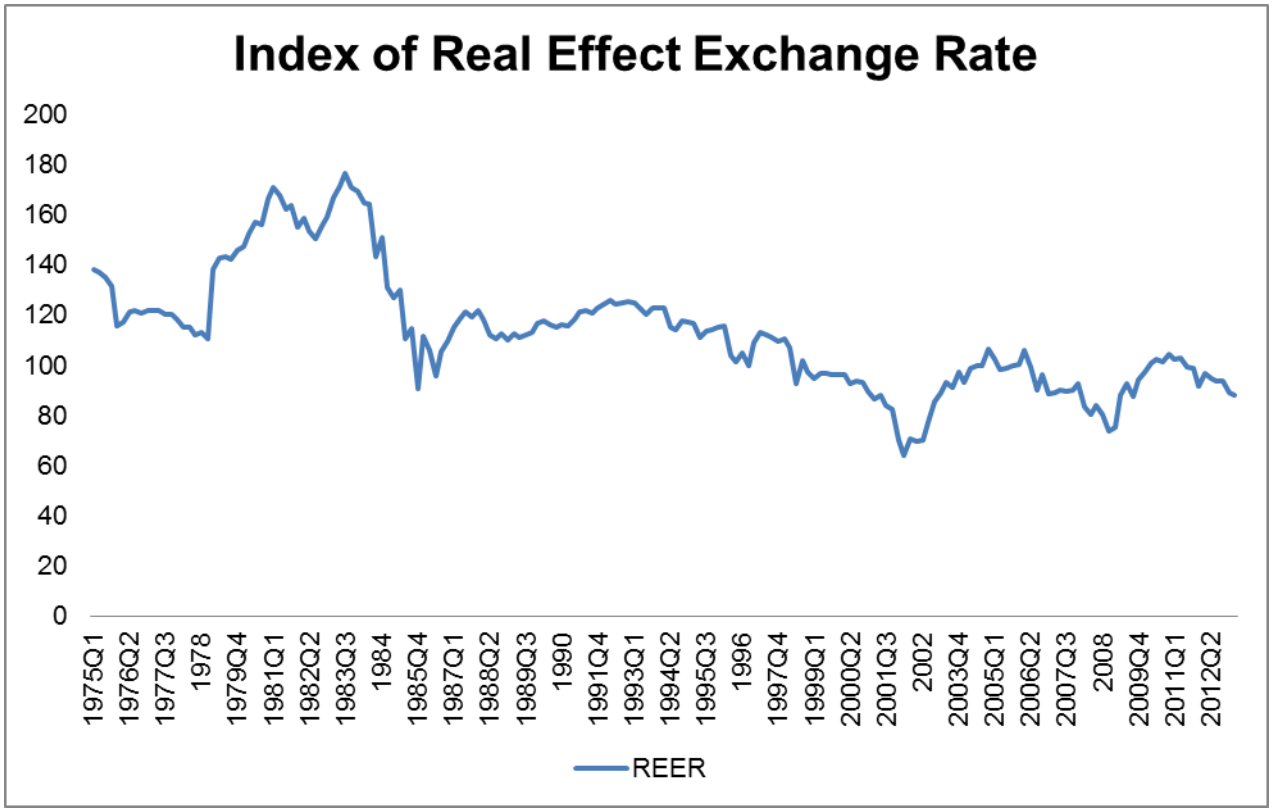
## APPENDIX

### Figure A1: Index of South African REER from 1975 to 2012




Source: International Financial Statistics, International Monetary Fund

### Table A1: Major Occupation and Skill Levels by SASCO

| | Major group | Skill level |
|---|---|---|
| 1. | Legislators, senior officials and managers | 4 |
| 2. | Professionals | 4 |
| 3. | Technicians and associate professionals | 3 |
| 4. | Clerks | 2 |
| 5. | Service workers and shop and market sales workers | 2 |
| 6. | Skilled agricultural and fishery workers | 2 |
| 7. | Craft and related trades workers | 2 |
| 8. | Plant and machinery operators and assemblers | 2 |
| 9. | Elementary occupations | 1 |

Source: Statistics South Africa: South African Standard Classification of Occupations (2001)

Development Policy Research Unit
University of Cape Town
Private Bag
Rondebosch 7701
Cape Town
South Africa

Tel: +27 21 650 5705
Fax: +27 21 650 5711

www.dpru.uct.ac.za