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The Consequences of Policy Uncertainty: Disconnects and Dilutions in the South African Real Effective Exchange Rate-Export Relationship

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Abstract

In recent years, the link between the real effective exchange rate (REER) and exports in South Africa has weakened. While exports still rise in response to REER depreciations, the REER-export elasticity is below historical estimates. The literature has put forward a number of possible explanations, from multi-national supply-chains to muted exchange rate pass-through. This research explores the role of policy uncertainty in reducing the responsiveness of exports to relative price changes. We construct a novel "news chatter" measure of policy uncertainty and examine how it, paired with other supply-side constraints, can improve our understanding of export performance. We find that increased policy uncertainty diminishes the responsiveness of exports to the REER and has short and long-run level effects on export performance. Finally, we show that a measure of competitiveness that adjusts for uncertainty and supply-side constraints greatly outperforms the REER in tracking exports performance.

1 Introduction

In the post-crisis period, several countries have experienced large depreciation episodes coupled with falling export volumes, marking a disconnect in the traditional relationship between the real effective exchange rate (REER) and export performance. This puzzle is most notably present in Japan.[1] From 2011 to 2014, the Japanese REER depreciated by almost 30 percent; over the same period its export volumes fell by 0.6 percent.[2]

Far more common than REER-export disconnects are dilutions of the REER-export relationship (IMF, 2015). Dilutions in the REER-export relationship occur when the relationship is still in line with theoretical expectations (i.e., rising exports when the REER depreciates), but exports are far less responsive than expected based on historical estimates. One prominent example, and the focus of this paper, is South Africa. From the end of 2011 to early 2014, South Africa's real effective exchange rate (REER) depreciated by 20.6 percent. Over the same period, export volumes rose by only 6.8 percent, suggesting a simple price elasticity of -.3 (see Figure 1). While a proportion of this sluggish responsiveness can be attributed to weak foreign demand, a demand side explanation does not provide a complete explanation. When we control for foreign demand in an autoregressive distributed lag framework, the price elasticity for this period falls to -.4, but is insignificant.[3] This stands in contrast to historical estimates that place South Africa's aggregate export elasticity within a range of -.6 to -6.0.[4] In 2015, export performance improved, however the low elasticity over the 2011-2014 period remains a puzzle.

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[1] Other countries with sizable depreciations and falling export volumes include: Cameroon; Cote d'Ivoire; Croatia; Dominica; Gambia; Ireland; Israel; Lesotho; Malawi; Romania; Togo; and Tunisia (based on authors' own calculations).

[2] Amiti, M., Itskhoki, O., & Konings, J. (2014).

[3] This approach was introduced by Peseran, Shin, and Smith (2001) and is described in Section 6.2. The sample period covers 2011 to 2014 and uses data at the quarterly frequency.

[4] See Edwards and Garlick (2008) for a summary of historical estimates and Anand, Perelli, and Zhang (2014) for a more recent summary. Also, there was a disconnect in the period prior to 2010; this earlier disconnect can be attributed to the commodity boom.

South Africa's Real Effective Exchange Rate-Export Dilution
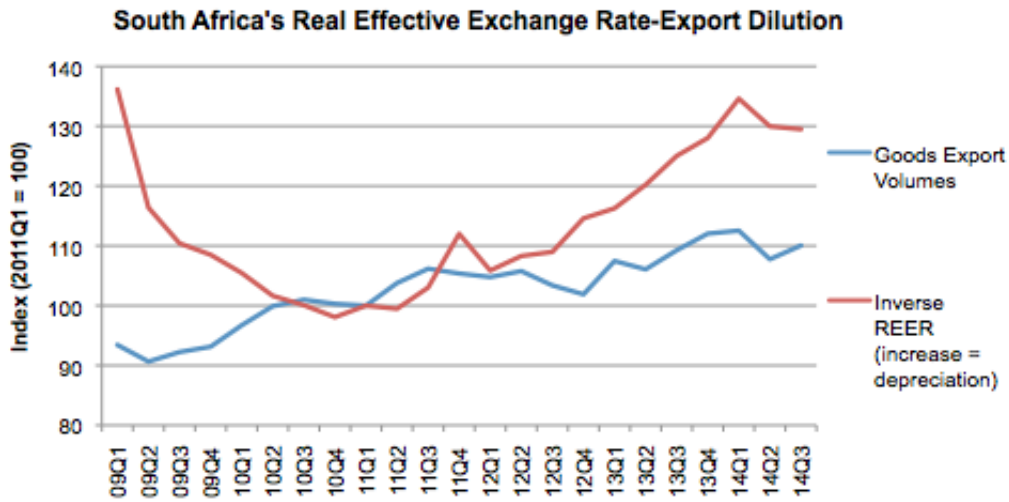
Sources: IMF IFS; Haver Analytics

Recent papers have promoted a number of alternative explanations for these more recent disconnects and dilutions–from increasingly multi-national supply-chains to muted exchange rate pass-through to export prices. This research puts forward an alternative explanation: high domestic policy uncertainty reduces the responsiveness of exports to relative price changes by increasing the real option value of firms adopting a "wait and see" approach when it comes to making large, exporting-related fixed cost investments. For example, uncertainty over how a firm's assets will be taxed might lead that firm to halt expansion or capital investment until that uncertainty is resolved, even in the face of high and rising demand for its products. As opposed to other forms of uncertainty shocks (e.g., natural disasters, terrorist attacks, and external shocks), policy uncertainty is unique in that it can be proactively managed, if not altogether avoided. Existing research on uncertainty makes the link between high uncertainty and poor investment, employment, and output; this research (to our knowledge) is the first to link uncertainty to declining export relative price responsiveness.

After constructing a novel "news chatter" measure of South African economic policy uncertainty, we find that increased policy uncertainty has diminished the responsiveness of exports to relative price changes. Moreover, increases in policy uncertainty are associated with both direct short and long-run effects on export performance. To date, the uncertainty explanation is robust to alternative explanations that center on credit constraints, supply-chains, and threshold/ boundary effects. Finally, we show that a measure of competitiveness that adjusts the REER for uncertainty outperforms the unadjusted REER in tracking exports in South Africa.

The paper proceeds as follows: section 2 discusses the recent alternative explanations for disconnects and dilutions; section 3 describes the channels between uncertainty and poor export performance/responsiveness;

section 4 details the construction of the measurement for South Africa's domestic policy uncertainty; section 5 presents the empirical approach and results; section 6 introduces an alternative measure of competitiveness and shows that it outperforms the REER in tracking exports over a 25 year period (including the more recent "puzzle" period); section 7 concludes.

2 Alternative Explanations for REER-Export Disconnects & Dilutions

The preponderance of dilutions and disconnects between REER movements and exports in the post-crisis period has generated several competing explanations. Using a rich firm-level French dataset, Berman, Martin, & Mayer (2012) find evidence of muted exchange rate pass-through to export prices. In response to depreciations, highly productive exporting firms opt to buffer their profits by increasing their mark-ups and engaging in pricing to market behavior, with the result of muting the response of export volumes to changes in relative prices.

Amiti, Itskhoki, & Konings (2014) and Ahmed, Appendino, & Ruta (2015) advance supply-chain explanations, noting that large exporters also tend to be large importers. While large depreciations mean that these firms' exports are becoming more price competitive, their imports are also getting more expensive, partially offsetting the impact of the depreciation. The former authors decompose the importance of this effect relative to the pricing to market effect and find that the two explanations contribute equally in explaining the incomplete pass-through and muted export volume response to depreciations.

The disconnect (i.e., depreciation and falling exports) tends to arise under crisis conditions. Chor & Manova (2012) point to the importance of credit constraints and tight lending conditions in explaining the decrease in export flows during crises. Using a sample largely comprised of European countries, economies with tighter credit conditions saw larger drops in exports, driven by sectors that are heavily reliant on external financing. Alessandria, Pratap and Yue (2013) find evidence to support this finding in emerging markets.

Shirakawa & Shiono (2013) explore a threshold effect, or boundaries, explanation in the Japanese context, where exported goods are highly differentiated. At a lower bound, the market for a highly differentiated good is saturated so additional falls in relative price will not engender increased sales. At a higher bound, the non-substitutability of an intermediate product suggests that downstream customers will purchase it despite the increase in cost stemming from further appreciations. The authors argue that Japan was already below its lower bound in 2011, explaining why exports are were not responsive to the large depreciation.

The International Monetary Fund (2015) conducted a large cross-country study of dilutions, finding that boosts to exports from depreciations tend to be largest when countries have economic slack, normally functioning financial systems, and lower intermediate input trade–confirming many of the above results. Focusing on South Africa in particular, Anand, Perrelli, and Zhang (2014) use a firm-level dataset to examine what characteristics tend to dilute the relationship between the REER and exports. Their results reveal the central role of supply-side bottlenecks in reducing export price elasticity. They find that electricity constraints, low diversification, labor market rigidities, and sectoral concentration all contribute to lower relative price responsiveness for exporting firms.

While the above explanations are presented as alternatives, an uncertainty explanation can be framed as being embedded in several of these explanations. Higher borrowing costs in the credit constraint channel could result from increased uncertainty.[5] Out of bounds depreciations or appreciations could be considered by firms to be proxy evidence of uncertainty, as large fluctuations in the exchange rate might be caused by domestic policy uncertainty. Finally, the decision to engage in pricing to market behavior could be endogenously driven by uncertainty as firms try to shield their foreign customers (and market shares) from domestic policy uncertainty and its effects on costs and the exchange rate.

3   From Uncertainty to Exports: Channels

Under a highly uncertain policy environment and in the presence of fixed, irreversible costs, the real option value of delay rises (Dixit & Pindyck, 1994; Bernanke, 1983), hindering export responsiveness and performance. The primary channel for this effect is decreased and delayed investment, as firms adopt a "wait and see" approach. A large literature points to the presence of particularly large fixed costs for exporters relative to producers that sell to a purely domestic market. Such exporting-related fixed costs include export market entry costs (Roberts and Tybout, 1997); costs associated with hiring and firing (Bernanke, 1983; Bloom, 2009; Schaal, 2013); the cost of technology adoption (Bessen, 2002); traditional investment adjustment costs (Ramey & Shapiro, 2001); and the cost of expansion/upgrading of existing facilities to meet importers' demands and preferences. In this context, uncertainty has both direct and indirect effects on exports. The direct effect is a level effect—exports falling under high uncertainty. The indirect effect, and the focus of this paper, is a sensitivity effect—firms are less responsive to changes in demand, prices, and productivity under high uncertainty (Bloom, 2013).

Bloom (2009) constructs a model of firms facing uncertainty, non-convex labor adjustment costs, and non-convex capital adjustment costs. The model features a zone of inaction for investment and hiring, which

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[5]In particular, there is a large risk premia literature that makes the connection between uncertainty and increased borrowing costs (e.g., Arellano, Bai and Kehoe, 2010; Christiano, Motto and Rostagno, 2009; and Gilchrist, Sims and Zakrasjek, 2010).

increases in size as uncertainty increases. "Firms only hire and invest when business conditions are sufficiently good, and only fire and disinvest when they are sufficiently bad."[6] Once the uncertainty is resolved, correction should take place (with firms far from optimum undertaking large corrections and firms close to optimum undertaking small corrections). Since policy uncertainty is correlated with economic uncertainty, this results in pro-cyclical growth in productivity, a stylized fact of business cycles. Baker, Bloom, and Davis (2015) find that increased policy uncertainty leads to diminished investment, employment, and output across 12 major economies.

Handley & Limao (2012) consider the role of trade policy uncertainty in export outcomes. They build a dynamic trade model with heterogenous firms, uncertainty, and fixed costs where firms make entry and trade decisions. The model predicts that firms will limit investment and entry into new export markets under conditions of high policy uncertainty. They test this using Portugal's accession to the European Community in the late 1980s, finding that the reduction of trade policy uncertainty led to improvements in export performance along both the intensive and extensive margins.

Altogether, the theoretical and empirical results of the uncertainty literature suggest both a direct impact of uncertainty on export performance and an indirect effect via decreased relative price responsiveness under periods of high uncertainty due to firms' being in a "zone of inaction" state space. These effects should materialize along both the intensive and extensive margins. Finally, policy uncertainty is both an impulse and a propagation mechanism; that is, while uncertainty can certainly drive a decline in exports directly, it also can arise as a result of economic volatility where it takes on a propagation and amplification role (e.g., if, in response to an external shock, a policymakers disagree on how to best counter it).

4 Measuring South African Economic Policy Uncertainty

"Policy uncertainty has been advanced as one of the reasons for poor business confidence levels and the slow pace of private sector investment spending."

- Business Day, 2 April 2013

"Energy constraints, inadequate transport capacity and uncertainty in the regulatory environment have held back progress."

- South African Medium Term Budget Policy Statement, 2011

"The [mining] industry continued to be negatively affected by infrastructural constraints, policy

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[6]Bloom, 2009.

uncertainty, ongoing labour tension, lower commodity prices alongside rising operational costs, and the
fragile global recovery."

<div align="right">- South African Reserve Bank Quarterly Bulletin, March 2015</div>

Policy uncertainty is often mentioned as a key impediment to South African economic performance, above
and beyond traditional supply-side barriers like electricity provision, quality of ports, high concentration in
several sectors, skill mismatches, and labor market rigidities. However, examination of its impact is rare
because of the difficulty associated with accurately measuring it. Baker, et al. (2015) championed a recent
approach to measuring uncertainty via the use of "news chatter" in the press. Unlike more traditional
outcome measures of uncertainty in an economy (e.g., strike days or currency volatility), "news chatter"
uncertainty indices also pick up the threat or anticipation of volatility, whether or not it comes to fruition.
At the aggregate level, we constructed both economic policy and political uncertainty indices. At the sector-
level, we constructed industry-related indices. To construct the indices, we count the number of articles that
match a certain search algorithms (see below).

Since coverage of different sources varies overtime, the absolute counts are normalized using the number
of articles that include the term "today" within 10 words of "South Afric*", where * denotes a wildcard. All
indices are standardized to a range of [0,100].[7]

4.1 Search Algorithms & Construction

The following search algorithms were employed via the Dow Jones Factiva news aggregator:[8]

- **Aggregate Economic Uncertainty:** Articles that contain three mentions of words related to policy,
  economics, and uncertainty (i.e., one mention of each area) within 10 words of "South Afric*".

    - Policy: "Department of Energy", "Department of Labour", "Department of Trade and Industry",
      "Economic Development Department", "government", "interest rate", "National Treasury", "policy",
      "South African Reserve Bank", "spending", "tax", and "yield"
    - Economic: "econ*"
    - Uncertainty: "uncert*"

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[7]A similar method was employed by Redl (2015).

[8]Factiva covers 32,000 sources in 28 languages; over 760 African-based sources; over 450 continuously updated
newswires / 700 wires (e.g., Associated Press and Reuters); and press websites (e.g., allAfrica.com; Mail & Guardian
Online; etc.). Results can be filtered by language, source type/ source location, subject classification (inclusions &
exclusions), and company / industry classification.

- **Aggregate Political Uncertainty:** Articles that contain three mentions of words related to government, politics, and uncertainty (i.e., one mention of each area) within 10 words of "South Afric*".

  - Government: "ANC", "government", "National Assembly", "National Council of Provinces", "Parliament", "President", "protes*", [9]
  - Political: "political", "power", "shake up"
  - Uncertainty: "uncert*"

- **Sector-Specific Uncertainty:** Articles that contain four mentions of words related to the sector, policy, economy, and uncertainty (i.e., one mention of each area) within 10 words of "South Afric*".

  - Each of the following sectors: electricity/energy/load shedding, mining, manufacturing (manufactur*), agriculture (agricultur*)/farming, telecommunications, retail, finance
  - Policy: "government", "policy", "Parliament", "regulation", "spending", and "tax"
 - Economic: "econ*"
  - Uncertainty: "uncert*"

The measures for aggregate political uncertainty and selected sector-specific uncertainty are shown in Appendix I.

4.2 The Constructed Measure

Aggregate Economic Policy Uncertainty

Economic policy uncertainty worsened during the transition to democracy, however economic policy uncertainty reached maximal levels in the late 2000s in response to external shocks, an energy crisis, and investment regulation uncertainty. While external pressures loomed large in 2008, domestic pressures were also present.

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[9]The ANC is included as it has been the party in power since the end of Apartheid.
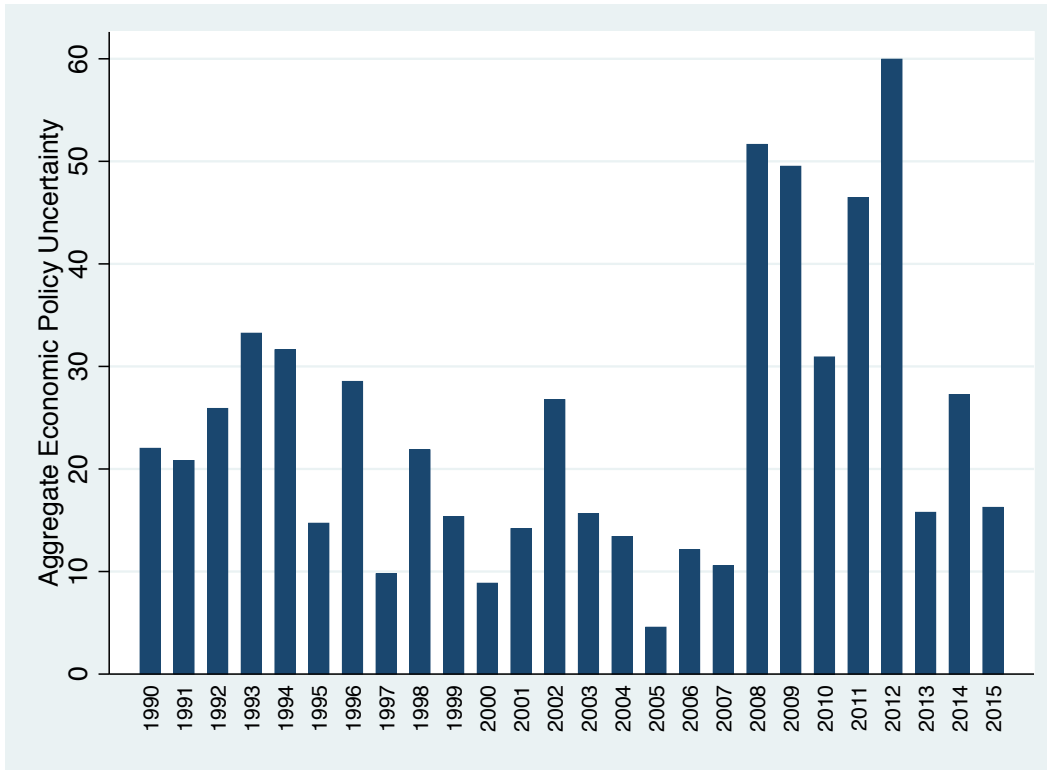
Note: Figure displays annual averages of the quarterly measure of uncertainty.

The ruling national party, the African National Congress, split into various factions in 2008 leading many to question whether South Africa would trend towards more populist policies (e.g., nationalization of the mines). Additionally, the national electricity grid nearly collapsed in early 2008 and the government was widely criticized for the electricity shortages. Uncertainty spiked in 2012 behind news that new power stations were far behind schedule, over budget, and double-digit rate hikes were likely to become the norm going forward. 2012 was also one of the most strike-heavy years in the post-Apartheid era—marked by the Marikana mining tragedy when police and 3,000 striking platinum miners violently clashed at the Lonmin Marikana mine, resulting in the death of 34 miners. The violence was coupled with increasing uncertainty as to how the government would regulate mining companies going forward with respect to ownership and investments.

4.3 What Does the Measure of Aggregate Economic Policy Uncertainty Pick Up?

All "news chatter" search algorithms produce imperfect proxies. However, the policy uncertainty measure appears to capture domestic policy disagreements and outages. Below are a few quotes from articles that are included in the count:

- "Revlon, the New York-based beauty products concern, said it was leaving because of 'the **uncertainty** in the **economic** and political situation in **South Africa** created by the **government**'s lack of progress in dismantling its system of apartheid and its failure to achieve racial equality."' - Chicago Sun Times, 5 December 1986

- "**South Africa**'s recovery from the 2008-09 recession has been lackluster, as it suffers the twin blows of low business confidence and policy **uncertainty** at home and the effects of Europe's woes."- Financial Times, 20 July 2012

- "The **South African government** is creating **uncertainties** in the country's mining industry by failing to take a definitive stance on **regulation**." - Wall Street Journal, 15 May 2015

All point to domestic economic policy uncertainty. However, the search algorithm also picks up articles that do not relate to domestic policy uncertainty:

- "South Africa's **economic** growth rate is higher than many predictions. Inflation and interest rates are within government targets. [...] There is one dark cloud, however: the oil price. [...] Back in January 2002 the oil price was below $20 a barrel. **Then US President George Bush started creating all sorts of uncertainty**. Result: the oil price started to run. Fortunately for **South Africa**, the rand started to strengthen at the same time." - AllAfrica.com, 8 November 2004

While imperfect, on the whole, the search algorithm does seem to pick more articles related to domestic economic policy uncertainty than not.[10] Still, given the broad scope of the policy uncertainty search algorithm, one might wonder whether the variable is just another measure of economic volatility. To examine this, we ran several checks.

First, we examine the classification of the articles by subject matter.[11] Of the top three subject classifications, two are related to political news, with the top subject being "Domestic Politics."[12] The second check is to explore the correlation between the uncertainty measure and professional forecasting standard deviations, as variation in professional forecasts is often viewed as a strong proxy for economic volatility.[13] While one would expect some correlation, given that policy uncertainty can arise in reaction to economic uncertainty and vice versa, a correlation near one would suggest that the measure is just picking up economic uncertainty. The correlation between uncertainty and forecasting variation is .28. The below figure shows South Africa's recessions, currency crises, and the policy uncertainty variable. As illustrated, spikes in policy uncertainty do not *always* coincide with economic turmoil—particularly in the more recent period.

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[10]This conclusion is currently based on an eye-ball audit of the articles. A human audit will be undertaken to get a more definitive answer on how many articles are relevant/non-relevant.

[11]Factiva, not the news organizations, classifies the articles by type (where more than one classification can be assigned to any given article).

[12]The top three subjects, in order of classifications, are "Domestic Politics," "Corporate/Industrial News," and "Political/General News."

[13]The forecasting measure comes from Redl (2015) and is the simple average of a normalized index of the standard deviation of forecasts for growth, inflation, and the domestic interest rate.
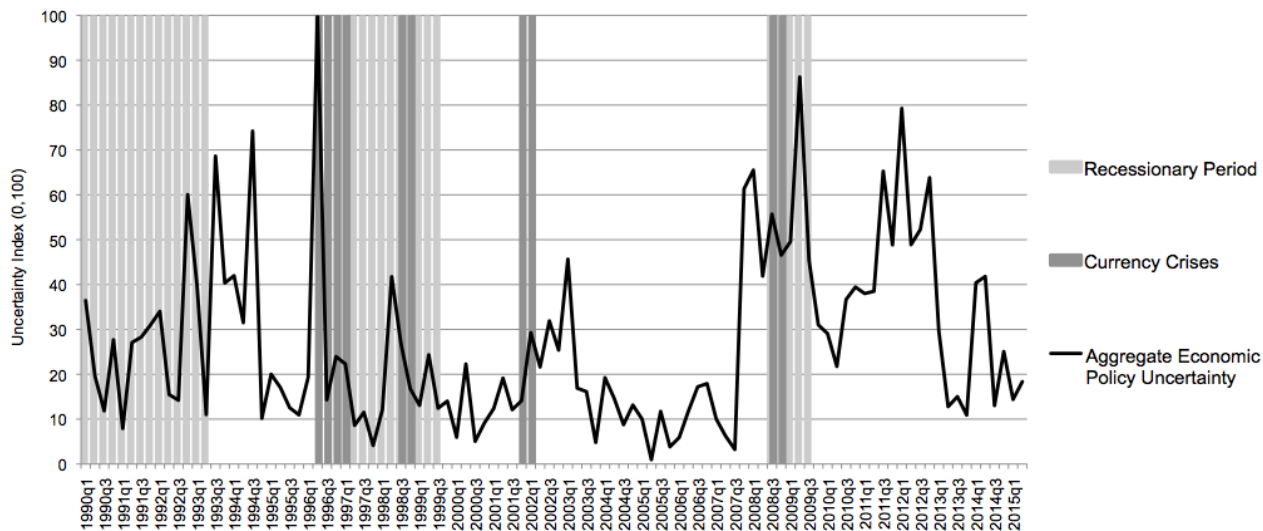
While these checks suggest that the measure picks up aspects of uncertainty beyond economic volatility, to accurately assess what the measure proxies, a human audit is the first-best approach (and will feature in forthcoming research). A human audit would also answer other open questions. For example, the set of search terms could be further refined to capture the way domestic policy uncertainty is covered in the local media. Additionally, it is possible that some of these articles reference declines in uncertainty, not rises in uncertainty. In Baker, et al.'s (2015) audit of the U.S. uncertainty measure, roughly 5 percent of audited stories were related to a resolution or decrease in policy uncertainty. However, South Africa went through a positive, uncertainty-reducing transition during the sample period suggesting that the number of "positive" uncertainty stories could be higher. For example, there was a considerable reduction in policy uncertainty during the second half of 1996 when then Minister of Finance, Trevor Manuel, released details on the government's new economic program, the Growth, Employment and Redistribution (GEAR) strategy.

5 The Role of Policy Uncertainty in Explaining the Dilution in the South African Real Effective Exchange Rate-Export Relationship

5.1 Methodology

Traditionally, the literature has specified aggregate export demand functions of the following form:

$$ln(export\ volumes)_t = \alpha + \beta_1 ln(relative\ prices)_t\ + \beta_2 ln(foreign\ demand)_t + \varepsilon_t$$

to estimate the long-run elasticities via OLS. However, this approach fails to account for short-term dynamics following shocks and the non-stationary nature of such data. Moreover, by using aggregate trade

data, such analyses suffer from aggregation bias. To address these concerns, this research employs a dynamic, pooled mean group (PMG) panel approach (Peseran, Shin, and Smith, 1999) over the period from 1995 to 2014 on ten sectors. This approach allows for the estimation of both short-run and long-run parameters (restricting the long-run parameters to be equal across sectors), while also being applicable to both stationary and non-stationary covariates. Such an approach also combats aggregation bias. Typically, the literature has addressed aggregation bias by disaggregating to the bilateral level. As Bahmani-Oskooee and Ardalani (2006) note, "[w]hen aggregate trade data are employed in import and export demand functions, significant price elasticity with one trading partner could be more than offset by an insignificant price elasticity with another trading partner, yielding an insignificant price elasticity." Moreover, Dekle, Jeong, and Ryoo (2006) show that ignoring heterogeneity biases export price elasticity estimates towards zero. For example, Narayan & Narayan (2010) and Anand, et al. (2014) find that the South Africa's export relative price elasticity is not statistically distinguishable from zero when using aggregate trade data. This paper combats this bias by allowing parameters to vary across sectors in the short-run.

The PMG estimator is more flexible than dynamic fixed effects models where all parameters are assumed to be the same in the cross-section, with the exception of intercepts. However, it is more restrictive than the mean group estimator which allows for all parameters to differ across sectors. Intuitively, the use of the PMG estimator in this context assumes that, in the long-run, all sectors will eventually respond to relative price and foreign demand changes, despite exhibiting different short-run dynamics and different speeds of returning to equilibrium relationships following shocks (where such differences are driven by fundamental differences across sectors). In order for the PMG estimator to be consistent, poolability must hold for the long-run estimates. When it does, PMG offers efficiency gains over a mean-group approach. To test for this, we run Hausman tests comparing the long-run coefficients from mean group estimations to the PMG results; poolability holds and therefore PMG is preferred to the mean group estimator. To implement PMG, we employ the following error correction specification:

$$\triangle ln\left(exports\right)_{it} = \alpha_i + \sum_{j=1}^{q} \beta_{ij} \triangle ln\left(exports\right)_{it-j} + \sum_{j=0}^{p} \acute{\eta}_{\mathbf{ij}} \triangle \mathbf{ln}\left(\mathbf{short-run\ determinants}\right)_{\mathbf{it-j}}$$

$$+\zeta_i \left(ln(exports)_{it-1} - \acute{\lambda}_{\mathbf{i}}\mathbf{ln}(\mathbf{long-run\ determinants})_{it-1}\right) + \varepsilon_{it}$$

Where i denotes sectors and t denotes years, with coverage of ten sectors over a time period of 1995 to 2013 or 2014 (depending on the determinants included), α_i are sector fixed effects, and ε_{it} is assumed to be

independently distributed across time and sectors.[14] The LR relationship can be expressed as:

$$ln\left(exports\right)_{it} = \theta_{\mathbf{i}}^{'}\mathbf{ln(long-run\ determinants)}_{it} + \vartheta_{it}$$

Where $\theta_{\mathbf{i}} = -\frac{\lambda_{\mathbf{i}}^{'}}{\zeta_{\mathbf{i}}}$ are the long-run coefficients and ϑ_{it} are stationary. ζ_i is the error correction term that picks up the speed of adjustment. As above-mentioned, under the PMG estimator, the long-run coefficients are assumed to be constant across sectors, so that $\theta_i = \theta \; \forall \; i$. The long-run parameters are computed via pooled maximum likelihood estimation. In the aggregated results below, the short-run estimates are the unweighted averages of the estimated parameters.

5.2   Data

The variables are constructed as follows:

- *Export volumes*: sector-specific South African export volumes from Quantec's Standardized Industry database; derived from Customs & Excise and SARB data and deflated using appropriate Stats SA price indices.

- *REER*: The IMF's International Financial Statistics real effective exchange rate, where increases are appreciations/ decreases in competitiveness.

- *Demand volumes*: sector-specific world import data from Comtrade, deflated using sector-specific U.S. import price indices where available and the overall U.S. import price index where unavailable.

- *High Exchange Rate Volatility:* a dummy for South African periods of high exchange rate volatility in 1996, 1998, 2001, and 2008; identified via a GARCH model by Duncan and Liu (2009).

- *Electricity Bind*: mean ratio of electricity consumption to electricity production interacted with sector-specific electricity intensity of usage. Production and consumption data sourced from Statistics South Africa via Haver Analytics. Electricity intensity data from Inglesi-Lotz and Blignaut (2011).

- *Aggregate Economic Policy Uncertainty*: authors' own calculations; see section 4. While sector-specific indices were constructed, we opt to use the aggregate measure since outlier articles can bias industry uncertainty measures in sectors that the media rarely cover.

- *Sector Labor Rigidities*: working days lost by sector by year; sourced from the ILO for years prior to 2008 and from various South African Department of Labour's Annual Industrial Action Reports thereafter. Unionization rates are from Statistics South Africa.

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[14]The number of lags of the export first differences and the determinant first-differences is limited to 1. A number of standard panel unit root tests (e.g., Harris-Tzavalis and Im-Pesaran-Shin) were run to check that the first differences are stationary, all with rejections of non-stationarity.

With the exception of demand, which is expected to have a positive relationship with exports, all other determinants are expected to lower exports.

5.3 Long-Run Results

Column (1) provides the baseline, long-run results.[15] If no controls are included for policy uncertainty or supply-side factors, the REER elasticity is insignificant despite having the expected sign. Increases in foreign demand are a strong, positive indicator of increases in export volumes, which is true across all specifications. In contrast, periods with high exchange rate volatility are associated with falls in exports across all specifications. Adding policy uncertainty in column (2) leads to a slight decrease in the REER elasticity, but it remains insignificant. Still, policy uncertainty enters significantly, pointing to a negative direct effect of uncertainty on exports. Moreover, the uncertainty coefficient is significant in the presence of the dummy for periods of high currency volatility (a proxy for currency crises). This suggests that uncertainty impacts exports, even when the economy is not in a economically volatile period.

Dependent Variable: Change in ln(Export Volumes)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Real Effective Exchange Rate	-0.157	-0.206	-0.426**	-0.548**	-0.506**	-2.683**	-3.061**
	(0.161)	(0.166)	(0.203)	(0.257)	(0.227)	(1.103)	(1.429)
Foreign Demand	0.840***	0.854***	0.837***	0.827***	0.921***	0.858***	1.019***
	(0.0478)	(0.0543)	(0.0507)	(0.0678)	(0.0470)	(0.0613)	(0.0882)
High Exchange Rate Volatility	-0.128***	-0.137***	-0.142***	-0.204***	-0.0833*	-0.157**	-.172**
	(0.0483)	(0.0523)	(0.0507)	(0.0702)	(0.0484)	(0.0631)	(0.0698)
Aggregate Economic Policy Uncertainty		-0.0577*		-0.0794*	-0.0662**	-3.361**	-4.873***
		(0.0336)		(0.0438)	(0.0265)	(1.643)	(2.232)
Electricity Bind				-2.290	-1.388	-3.612***	-2.634
				(1.579)	(1.964)	(1.230)	(1.728)
Labor Disputes					0.0156		
					(0.0114)		
Real Effective Exchange Rate x Aggregate Economic Policy Uncertainty						0.768**	1.047**
						(0.360)	(0.488)
N	190	190	190	190	180	190	190

Standard errors in parentheses; * $p < .10$, ** $p < .05$, *** $p < .01$

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[15] The Hausman test statistic is 1.99 and insignificant, indicating that the pooled-mean group estimator is favored over the mean group estimator for this sample.

If electricity constraints are added, as in column (3), the REER elasticity now falls to -.43 and is significant at the 5 percent level, suggesting that omitted variable bias was resulting in its underestimation. While large in magnitude, the electricity constraint coefficient is noisy. This is likely due to measurement error; the measure proxies binds as periods when consumption approaches production levels. However, this measure does not pick up actual blackouts and also does not account for the fact that South Africa has imported electricity during high demand periods in recent years.[16]

When both uncertainty and electricity constraints are included (column (4)), the REER elasticity falls to -.55, in line with historical estimates of South Africa's export relative price elasticity. The inclusion of labor rigidities increases the REER elasticity slightly and it also enters insignificantly. This was unexpected given that South Africa ranks 5th in the world for the average rate of days not worked per 1000 workers.[17] Moreover, the transition to democracy featured a rapid increase in the number of unionized workers (all government and state-owned enterprises were unionized). It could be that, prior to the 2012 Marikana mine violence, strikes typically did not hinder exports as they were relatively non-violent and resolved in an expedient manner due to the close relationship between government and labor. Another reason for its insignificance is that the uncertainty measure picks up some of the impacts of labor strife (this is also the case for electricity constraints).

With confirmation of the direct effect of uncertainty on exports, column (6) explores the presence of an indirect, sensitivity effect of uncertainty on price responsiveness. The interaction term shows that with higher uncertainty, REER responsiveness falls. When uncertainty is one standard deviation below the mean, the implied REER elasticity is -.92; at the mean, the REER elasticity is -.41. When uncertainty is one standard deviation above the mean, the REER elasticity is .10, with a reversal in its expected sign and a small magnitude. We obtain similar results when dropping the electricity constraint (see column (7)).

Finally, to test the stability of the results, we interacted a period dummy (for subsequent periods from 2004–the midpoint of the sample–onwards) with economic policy uncertainty to assess whether uncertainty has had a larger impact due to the increases in its magnitude in the period after 2007. There is scant evidence of a period effect, with the exception of the 2010 to 2014 dilution "puzzle" period.[18] During this period, economic uncertainty had a larger negative role on exports relative to the 1995-2010 period. This suggests evidence of a threshold effect; that is, fluctuations in policy uncertainty are less impactful when uncertainty is at a lower magnitude.

Together, the results presented above support the theoretical literature that points to dual roles for

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[16]The volume of imported electricity increased by almost 20 percent from 2013 to 2014. Source: StatsSA/ http://www.statssa.gov.za/?p=4045

[17]Bhorat, H., & Tseng, D. (2014).

[18]Results available upon request from the the authors.

policy uncertainty–a direct effect and a sensitivity effect as firms become less sensitive to relative price changes during high uncertainty periods.

5.4 Short-run Results

While not of central interest, there is important heterogeneity in parameters across sectors in the short-run. The below results, which correspond to column (4) in the long-run results above, show the average short-run parameters across the 10 sectors and a few of the sectors' results shown as examples.

Selected Short-run Coefficients	Average	Mining	Chemicals, Rubber, Plastics, and Glass	Motor Vehicles and other Transport Equipment
Speed of Adjustment	-0.268***	0.036	-0.348***	-0.207***
Real Effective Exchange Rate	-0.428***	0.114	-1.023***	-0.363*
Foreign Demand	0.326**	0.027	0.455*	0.928***
Aggregate Economic Policy Uncertainty	-0.040***	-0.023	-0.048*	-0.065**

$^{*}p < .10, ^{**}p < .05, ^{***}p < .01$

The average speed of adjustment term indicates that sectors take ˜3.7 years to adjust back to long-run equilibrium relationships following disequilibrating shocks (or a 27 percent adjustment per annum). Manufacturing sectors tend to adjust faster than commodity-producing sectors; mining's speed of adjustment term is near zero. In fact, the mining sector shows very little responsiveness to relative prices, foreign demand, or policy uncertainty in the short-run. This may reflect a number of factors including the industry's non-competitive market structure and long lead times on fulfilling orders. The lack of mining relative price responsiveness can also be explained by the high incidence of dollar pricing in commodities. In the short-run, the chemicals/rubber/plastics/glass industry is far more responsive to relative price changes than the transport vehicles industry; the opposite is true of demand. The reasons for these disparities may relate to differences in the composition of importers across industries or myriad other fundamental factors. Regardless of the reasons for their differences, the variability makes it clear how important allowing for short-run heterogeneity is. The short-run elasticities for electricity constraints and labor disputes (when included) are insignificant and not shown.

5.5 Uncertainty vs. Competing Explanations

This section examines whether the importance of uncertainty, both directly and via the sensitivity effect, is is robust to the inclusion of controls for alternative channels.

5.5.1 Credit Frictions

The credit friction channel argues that increases in borrowing costs and a tight lending environment during times of crisis tends to lower exports, particularly in sectors that are heavily reliant on external financing. To examine this channel, we use Chor & Manova's (2012) sector external finance dependence measure interacted with South African interbank rates as a sector-specific external financing constraint measure. The external financing dependence measure, which proxies sectors' total requirement for external financing, is based on US firm data. The authors used it in a cross-country context, arguing that the financing choices of US firms reflect "an optimal choice over external financing and asset structure."[19] To examine whether these effects are amplified during economically vulnerable periods, we include an interaction term for high exchange rate volatility periods in the specifications.

Below are the long-run results. While the signs of the coefficients on the external financing constraint are negative as expected, they are insignificant. The direct and indirect relationships between the REER and uncertainty hold.

Dependent Variable: Change in ln(Export Volumes)	(1)	(2)
Real Effective Exchange Rate	-0.487**	-1.521***
	(0.228)	(0.565)
Aggregate Economic Policy Uncertainty	-0.0584*	-2.040**
	(0.0353)	(0.845)
REER x Policy Uncertainty		0.440**
		(0.186)
External Financing Constraint	-0.0317	-0.0466
	(0.0321)	(0.0363)
External Financing Constraint x High Exchange Rate Volatility	-0.000380	0.0120
	(0.0113)	(0.0156)
N	190	190

Standard errors in parentheses/ * $p < .10$, ** $p < .05$, *** $p < .01$

Note: Full model (not shown) includes electricity bind, high exchange rate volatility, and demand parameters.

As discussed, the credit channel could embed an uncertainty explanation (i.e. uncertainty leads to increases in borrowing costs, which then leads to a reduction in responsiveness). Thus, policy uncertainty may be absorbing the relevant variation associated with a credit channel. However, even when policy

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[19]Chor & Manova, 2012.

uncertainty is not included in the specification, the coefficients on the credit channel variables are still insignificant. It may be the case that credit access is not binding constraint for South African exporters; however this would make the experience of South African exporters an outlier relative to the experience of exporters in emerging and developed markets alike. This channel deserves more attention in future research.

5.5.2 The increasing importance of global supply/value-chains

Increasingly multinational supply-chains moderate the zero-sum nature of depreciations. In South Africa, the domestic value added share of gross exports fell from 86.8 to 80.5 percent from 1995 to 2011, suggesting an increasing role for imported intermediates trade.[20] To examine this channel, we use the OECD's Trade in Value Added measure of foreign value added share of gross exports by sector. It is expected that the relative price responsiveness of exports will fall as import content of exports rises. [21]

Below are the selected long-run results. Column (1) offers support for the support for supply-chain/value-added literature. For import content one standard deviation below the mean, the REER elasticity is -1.39; at the mean level of import content, the REER elasticity is -.24. For import content one standard deviation above the mean, the REER elasticity is positive and .92. For highly integrated sectors, a REER appreciation's positive effects (from lower imported intermediate input costs) appear to offset the negative effects of the appreciation.

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[20] OECD Trade in Value Added (TiVA) dataset.

[21] For missing data within 1995 to 2011 period, we linearly interpolated the missing values; after 2011, we linearly extrapolated using average growth over the period from 2007 to 2011.

Change in ln(Export Volumes)	(1)	(2)
Real Effective Exchange Rate	-10.82***	-3.362***
	(2.727)	(1.256)
Aggregate Economic Policy Uncertainty	-0.0969**	-4.512**
	(0.0494)	(1.788)
Import Content in Exports	-15.68***	0.204
	(4.170)	(0.159)
REER x Import Content in Exports	3.514***	
	(0.924)	
REER x Policy Uncertainty		0.977**
		(0.392)
N	190	190

Standard errors in parentheses
* $p < .10$, ** $p < .05$, *** $p < .01$

Note: Full model (not shown) includes electricity bind, high exchange rate volatility, and demand parameters.

The coefficient on policy uncertainty in column (1) remains significant and falls relative to other specifications. Finally, in column (2) the sensitivity effect of uncertainty on exports survives inclusion of the supply-chain control (which is insignificant).

5.5.3 Threshold Effects

There is no evidence of threshold effects in exports' REER elasticity. To check for this, we used both 90/10 and 75/25 percentiles and examined whether there were different coefficients for high bounds, low bounds, and dual bounds. The lack of boundary effects can be attributed to several explanations. For example, given the large proportion of commodity exports in South Africa, its exports are less differentiated than Japanese exports. Also, it may be that there is less expectation of a consistent range for the REER in developing market contexts.

6 Alternative Measure of Export Competitiveness

The results of the previous section reveal the importance of electricity constraints and policy uncertainty (directly and indirectly via decreased price responsiveness) in tracking exports. In this section, we use

these findings to construct alternatives to the REER as measure of export competitiveness that adjust for uncertainty and electricity constraints.

6.1 Measures of Export Competitiveness

Four new measures are created. The first is a weighted index, where the weights, θ_i, are constructed from the coefficients from column (6), under section 5.3, normalized by the REER coefficient θ_0.

$$New\ Index\ of\ Competitiveness =$$

$$ln\left[REER^{\theta_0} \times Uncertainty^{\theta_1} \times (REER \times Uncertainty)^{\theta_2} \times Electricity\ constraint^{\theta_3}\right]$$

The second index is an unweighted aggregate where each component is given equal weight (all $\theta_i = 1$). A third index drops the electricity constraint component, where the weights are based on a PMG specification without electricity constraints. The fourth index drops policy uncertainty; again, the weights for this index are based on a PMG specification that excludes policy uncertainty. A comparison of the weighted index and the standard REER show the large impact of the adjustments (see below figure).

While the two measures sometimes track each other (especially in the period prior to 2001), the correlation between the two measures is only .23 over the period from Q1 1990 to Q4 2014. During the recent puzzle period (marked by the red box), the REER shows a consistent and persistent improvement in export competitiveness in the past five years. However, the new weighted index shows that, while there was an increase in competitiveness in 2013, both 2012 and 2014 saw decreases in competitiveness.

6.2 Methodology

To compare the relative indices' ability to track exports, we employ an autoregressive distributed lag (ARDL) cointegration approach paired with error correction bounds testing developed by Banerjee, et al. (1998) and

extended by Peseran, Shin, and Smith's (2001) (hereafter, PSS).[22] The approach uses aggregate time-series data, leaving it open to aggregation bias. This makes the likelihood of getting significant results less likely than in the panel setting since the elasticities will be biased towards zero. Additionally, the choice to use aggregate trade data (unlike in Section 5, where sector-level data are used) is motivated by policymakers – in computing export price elasticities, which are then used to assess the extent of currency misalignment, aggregate trade volumes are used by international financial institutions and governments alike. The following ARDL specification is used:

$$\triangle ln\left(exports\right)_t = \alpha + \sum_{i=1}^{m} \beta_i \triangle ln(exports)_{t-i} + \sum_{j=0}^{n} \gamma_j \triangle ln(external\ demand)_{t-j}$$

$$+ \sum_{k=0}^{o} \iota_k \triangle ln(Competitiveness\ Measure)_{t-k}$$

$$+ \lambda_1 ln(exports)_{t-1} + \lambda_2 ln(external\ demand)_{t-1} + \lambda_3 ln(Competitiveness\ Measure)_{t-1} + \varepsilon_t$$

If no long-run relationship exists, then $\lambda_1 = \lambda_2 = \lambda_3 = 0$ in the above unrestricted error correction model. The distribution of the F-test for this hypothesis is nonstandard; bounds are provided by Peseran, et al. (2001) for large samples and by Narayan and Narayan (2004) for smaller samples. If the F-stat falls outside two bounds, one can determine if the variables are cointegrated (below a lower bound indicates no cointegration; above an upper bound indicates definite cointegration; within the bounds is an inconclusive result). Once cointegration is confirmed, the correct ECM is chosen based on a BIC test and the short and long-run elasticities can be computed. Higher frequency, quarterly data is available at the aggregate level for a longer period (1990 onwards). Data for the REER come from the IMF's IFS; foreign demand is proxied by OECD real GDP[23]; and aggregate export volumes are from the South African Reserve Bank.

6.3 Results

All the models show evidence of cointegration; the F-stats are above the 1 percent upper bound. There is stronger evidence of cointegration for the new measures of competitiveness, particularly for the weighted and uncertainty-adjusted measures. The weighted index also outperforms the other measures in tracking quarterly export volumes over the sample period; a 10 percent decrease in competitiveness is associated with a 5.7 percent increase in export volumes. The elasticities for the other measures are not statistically

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[22]This approach outperforms the more widely used JJ maximum likelihood test for cointegration, which is not robust with small sample sizes. Moreover, PSS is applicable irrespective of whether the included time-series are of varying degrees and types of stationarity.

[23]Level data available up to 2013Q4. We used OECD quarterly real GDP growth rates from OECD to complete the series.

distinguishable from zero, although the index with no electricity bind (i.e. the uncertainty-adjusted REER) comes close to being marginally significant.

Measure of Competitiveness	Estimated Long-Run Elasticity	PSS Bounds Test F Statistic
Real Effective Exchange Rate	-.07	6.42***
Weighted New Index	-.57**	19.10***
Unweighted New Index	-.00	17.70***
No Electricity Bind	-.39	18.10***
No Uncertainty	-.14	6.92***

Granger causality tests of the same models (i.e., exports, a competitiveness measure, and foreign demand) support these findings. The weighted index granger causes exports, while the REER does not. Exports do not granger cause either measure. The results of this section indicate that the REER is an insufficient measure of competitiveness for tracking exports in South Africa. Policy uncertainty and electricity constraints greatly improve a competitiveness measure's ability to track exports.

7   Next Steps & Concluding Thoughts

This research bridges the economic policy uncertainty and REER-exports disconnect-dilution literature by examining the impact of policy uncertainty on exports' relative price responsiveness. We find that aggregate policy uncertainty is associated with lower export performance in both the short and long-run, directly and indirectly (via decreased relative price responsiveness). In the absence of policy uncertainty and other supply-side constraints, South African exports would be far more responsive to relative price changes. The policy uncertainty channel is robust to several alternative explanations for the REER-export relationship's dilution. Finally, the real effective exchange rate (REER) is an insufficient measure for tracking overall export performance. A measure that appropriately adjusts for uncertainty and electricity contstraints greatly outperforms the REER in tracking exports.

There are several future directions for research. Conducting a human audit of the uncertainty variable will help uncover what types of policy uncertainty are driving the results. Second, because uncertainty is both an impulse and propagation mechanism, it is difficult to establish causality. Examination of large uncertainty shocks in an event-study framework may help advance a causal explanation (e.g., use of the December 2016 changes in the South African Minister of Finance). Bernanke, et al. (1997) also suggest

structural VAR methods that adjust for feedback mechanisms. In terms of alternative explanations, the exchange rate pass-through explanation still needs to be explored. Extension of the work to other countries, especially other dilution/disconnect countries, would help assert the generalizability of the work. There are also further refinements that can be made to the competitiveness measure. For example, instead of just accounting for South African policy uncertainty, the policy uncertainty of its trading partners can also be adjusted for. Finally, much of the theory within the uncertainty literature focuses on firms' choices, making firm-level approaches more theory-consistent. Forthcoming work from Hlatshwayo (2016), uses firm-level data to help uncover what attributes drive decreased REER responsiveness under high uncertainty across several European countries.

Appendix I: Political Uncertainty and Sector-Level Uncertainty Examples

Aggregate Political Uncertainty

Aggregate political uncertainty was high around the transition period and, more recently, during the 2008 ANC Mbeki/Zuma factional split.
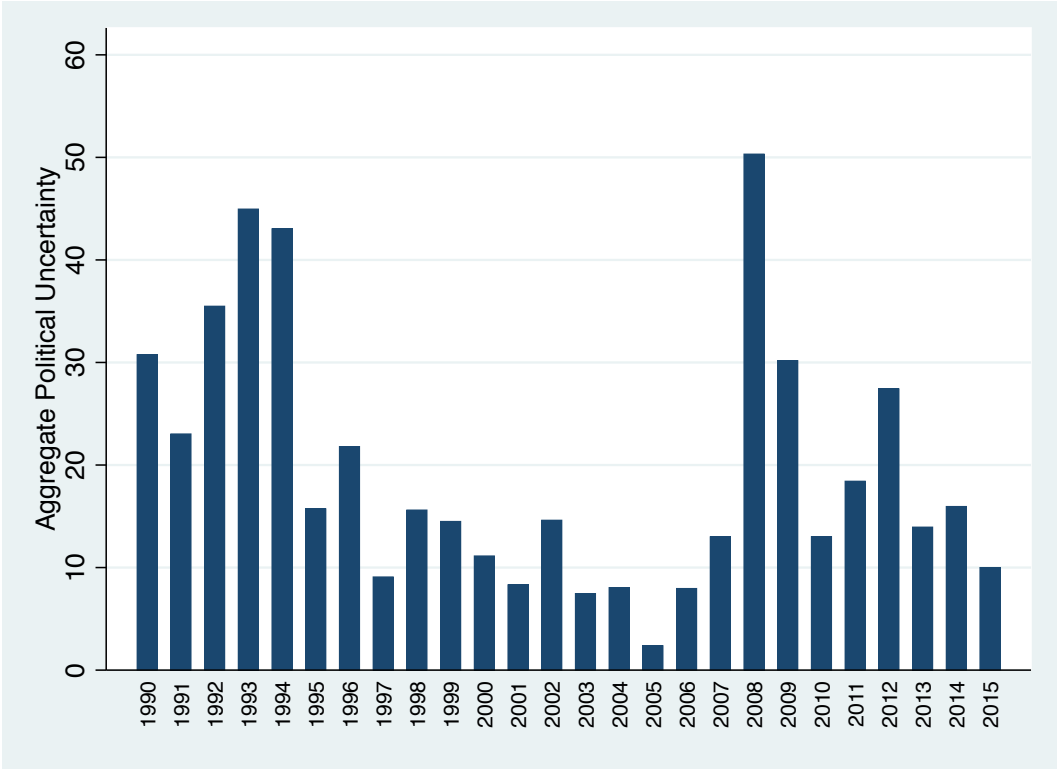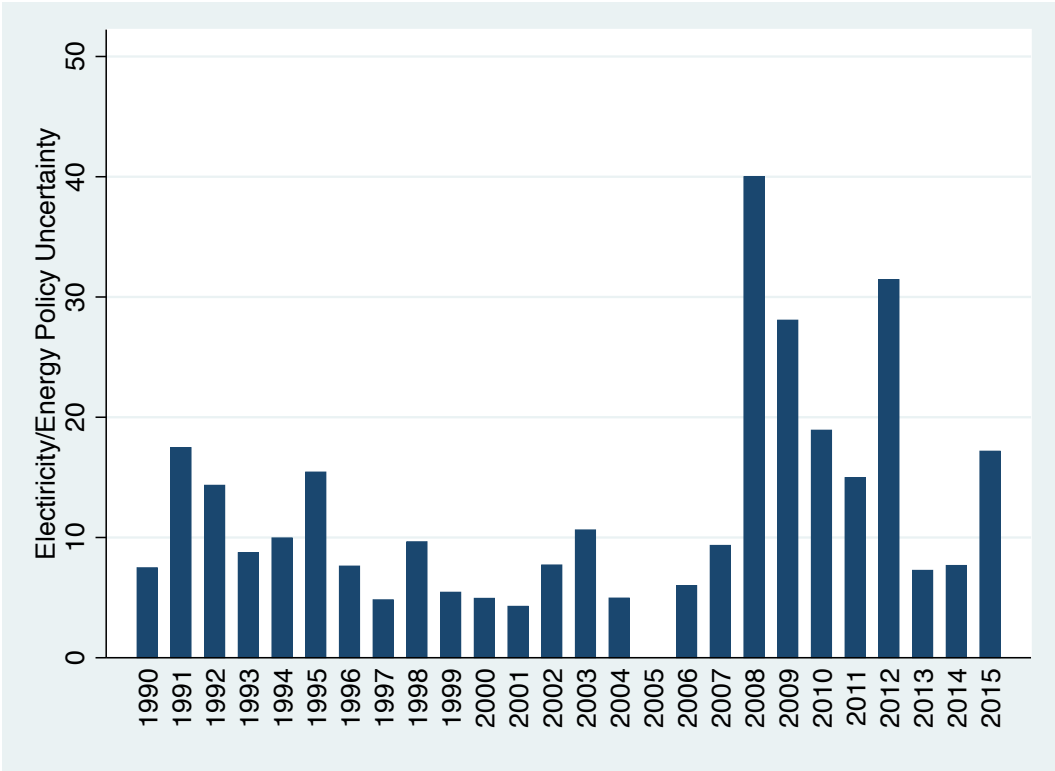

Note: Figure displays annual averages of the quarterly measure of uncertainty.

The correlation between this and the policy uncertainty measure is .75. When using the political uncertainty variable in the export empirical analysis, we find it to be insignificant.

**Sector Example I: Electricity/ Energy Sector**

Electricity/energy policy uncertainty spikes at exactly the time that the South African national grid all but collapsed (late January 2008). Uncertainty has remained high since then. It spiked again in 2012 behind news that the new power stations were far behind schedule, over budget, and double-digit rate hikes were to become the norm going forward.

Note: Figure displays annual averages of the quarterly measure of uncertainty.

Sector Example II: Mining Sector

The mining sector's uncertainty index spikes during 2012, when South African police shot at 3,000 striking platinum miners at the Lonmin Marikana mine; 34 miners were killed. The strike accompanied several other large labor disputes in the mining sector that same year, in what was the amongst the most protest-heavy years since the end of apartheid.
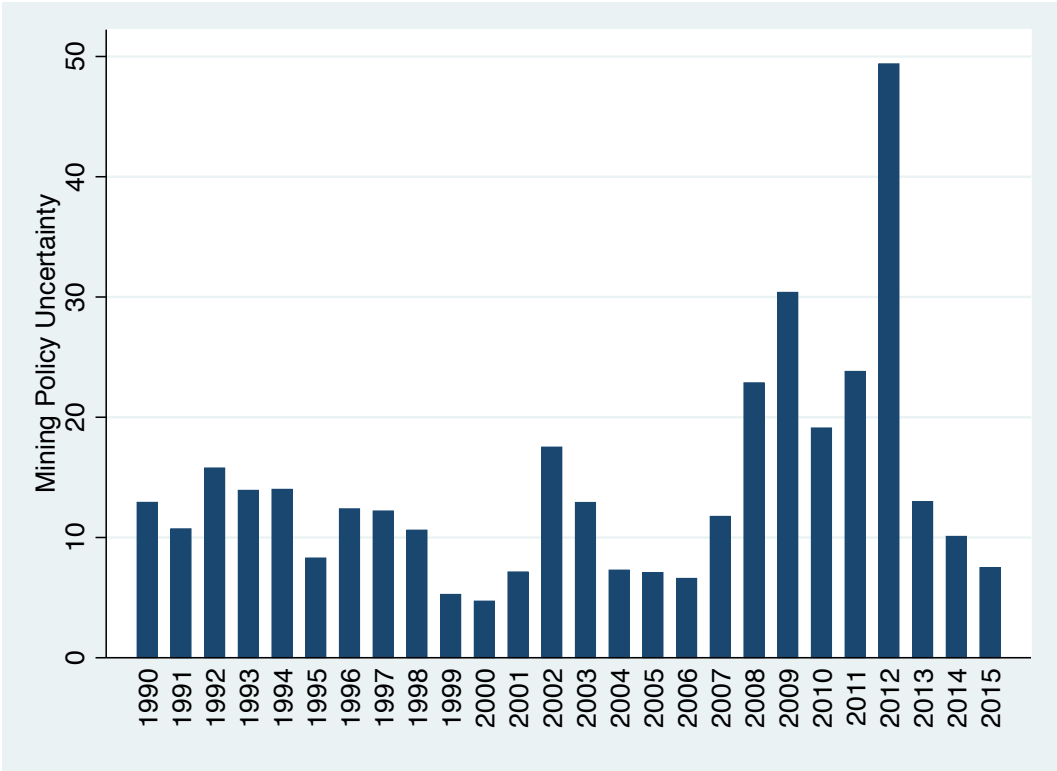
Note: Figure displays annual averages of the quarterly measure of uncertainty.

References

[1] Ahmed, S., Appendino, M. A., & Ruta, M. (2015). Depreciations without exports? global value chains and the exchange rate elasticity of exports. Global Value Chains and the Exchange Rate Elasticity of Exports (August 11, 2015). World Bank Policy Research Working Paper, (7390).

[2] Alessandria, G., Pratap, S., & Yue, V. Z. (2013). Export dynamics in large devaluations. Working paper.

[3] Amiti, M., Itskhoki, O., & Konings, J. (2014, July 7). Why Hasn't the Yen Depreciation Spurred Japanese Exports? Liberty Street Economics. Retrieved from http://libertystreeteconomics.newyorkfed.org/2014/07/why-hasnt-the-yen-depreciation-spurred-japanese-exports.html#.Vh8JELRVikp

[4] Anand, R., Perrelli, R., & Zhang, B. (2014). South Africa's Export Performance. Any Role for Structural Factors? In South Africa: Selected Issues Paper. http://www.imf.org/external/pubs/ft/scr/2014/cr14339.pdf

[5] Arellano, C., Bai, Y., & Kehoe, P. (2010). "Financial markets and fluctuations in Uncertainty", Federal Reserve Bank of Minnesota Research Department Staff Report.

[6] Bahmani-Oskooee, M., & Ardalani, Z. (2006). Exchange rate sensitivity of US trade flows: evidence from industry data. Southern Economic Journal, 542-559.

[7] Baker, S. R., Bloom, N., & Davis, S. J. (2015). Measuring economic policy uncertainty. NBER Working Paper.

[8] Banerjee, A., Dolado, J., & Mestre, R. (1998). Error-correction mechanism tests for cointegration in a single-equation framework. Journal of time series analysis, 19(3), 267-283.

[9] Berman, N., Martin, P., & Mayer, T. (2012). How do different exporters react to exchange rate changes?. The Quarterly Journal of Economics, 127(1), 437-492.

[10] Bernanke, B. (1983). Irreversibility, uncertainty, and cyclical investment. The Quarterly Journal of Economics 98(1), pp. 85–106.

[11] Bessen, J. (2002). Technology adoption costs and productivity growth: The transition to information technology. Review of Economic Dynamics, 5(2), 443-469.

[12] Bhorat, H., & Tseng, D. (2014, April 2). South Africa's Strike Data Revisited. In Brookings: Africa in Focus. Retrieved from http://www.brookings.edu/blogs/africa-in-focus/posts/2014/03/31-south-africa-strikes-bhorat

[13] Bloom, N. (2009). The impact of uncertainty shocks. Econometrica, 77(3), 623-685.

[14] ——— (2013). Fluctuations in uncertainty (No. w19714). National Bureau of Economic Research.

[15] Chor, D., & Manova, K. (2012). Off the cliff and back? Credit conditions and international trade during the global financial crisis. Journal of International Economics, 87(1), 117-133.

[16] Dekle, R., Jeong, H., & Ryoo, H. (2009). A Re-Examination of the Exchange Rate Disconnect Puzzle: Evidence from Firm Level Data. University of Southern California mimeo.

[17] Dixit, A. K., & Pindyck, R. S. (1994). Investment under uncertainty. Princeton university press.

[18] Duncan, A. S., & Liu, G. (2009). Modelling South African currency crises as structural changes in the volatility of the rand. South African Journal of Economics, 77(3), 363-379.

[19] Edwards, L., & Garlick, R. (2008). Trade flows and the exchange rate in South Africa. University Library of Munich, Germany. Unpublished.

[20] Handley, K., & Limao, N. (2012). Trade and investment under policy uncertainty: theory and firm evidence (No. w17790). National Bureau of Economic Research.

[21] Hlatshwayo, S. (2016). Policy Uncertainty & Export Performance: Evidence from Europe. Working paper.

[22] International Monetary Fund. (2015). World Economic Outlook: Adjusting to Lower Commodity Prices. Chapter 3. Exchange Rates and Trade Flows: Disconnected?

[23] Inglesi-Lotz, R., & Blignaut, J. N. (2011). South Africa's electricity consumption: A sectoral decomposition analysis. Applied Energy, 88(12), 4779-4784.

[24] Narayan, S., & Narayan, P. K. (2004). Determinants of demand for Fiji's exports: an empirical investigation. The Developing Economies, 42(1), 95-112.

[25] ——— (2010). Estimating import and export demand elasticities for Mauritius and South Africa. Australian economic papers, 49(3), 241-252.

[26] Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. Journal of the American Statistical Association, 94(446), 621-634.

[27] ——— (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326.

[28] Ramey, V. & Shapiro, M. (2001). "Displaced Capital: A Study of Aerospace Plant Closings," Journal of Political Economy, vol. 109(5), pp. 958-992.

[29] Redl, C. (2015). Macroeconomic Uncertainty in South Africa. EconRSA Working Paper. (No. 509).

[30] Roberts, M. J., & Tybout, J. R. (1997). The decision to export in Colombia: an empirical model of entry with sunk costs. The American Economic Review, 545-564.

[31] Schaal, E. "Uncertainty, productivity and unemployment in the great recession", NYU mimeo.