Wage flexibility in a high unemployment regime: spatial heterogeneity and the size of local labour markets

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ABSTRACT

Whereas some previous microeconometric evidence suggests that wage setters in South Africa are highly responsive to external local labour market circumstances, this is not corroborated by macroeconomic studies. This question is interrogated again, with particular attention to methodological issues in wage curve estimation. The latter is a robust negative relationship between individuals' wages and local unemployment rates, found in most countries, except where bargaining is highly centralized. Adding time variation to the micro data allows controls for spatial heterogeneity to be introduced, leading to the conclusion that wages are really inflexible in the short-run. Rather, the trade-off between wages and local unemployment that previous work has found represents a long-run spatial pattern. This finding is robust to instrumentation for reverse causality and the measurement error that is associated with choosing incorrect labour market demarcations. Additionally, this paper disputes the notion that very small geographic regions are appropriate to define "local" labour markets. Specifically, former magisterial districts appear to be smaller than the functional regions for which wage setters take labour market information into account. District councils tend to offer the most appropriate definitions. This concurs with the fact that collective bargaining councils "galvanise" smaller areas into larger wage setting regions, encompassing multiple magisterial districts. The role of bargaining councils is further investigated, with wage curve elasticities tending to be significantly negative for wage setters that work in the small firm, non-unionised sector. This points to the fact that the short-run inflexibility that is found overall is driven by sub-samples of larger firms with high concentrations of unionised workers. This section of the labour market appears to be insulated from the pressures of high unemployment in the short run.

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1. Introduction

South Africa's economy consistently ranks among the lowest internationally when it comes to firms' discretion about wages that they pay their employees (World Economic Forum, 2014). Rigid labour laws and strong unions are regularly cited as constraints to employment creation, with wages growing faster than labour productivity (Fedderke, 2012; Klein, 2012; Banerjee et al., 2008). Despite high structural unemployment, wage demands have not moderated, even during downturns in economic activity. Collective bargaining agreements have also contributed to this situation, with substantial wage premia that limit job creation capacity, especially among smaller firms (Magruder, 2012). Legally, wages that are negotiated between groups of firms and unions can be extended to entire industries, even to firms with only non-unionized workers. As a result, many firms have little discretion with regards the wages that they pay, with wage setting far removed from an individual worker-firm match.

However, annual rankings of wage flexibility are based on subjective assessments obtained from selected commentators by the World Economic Forum, with little concrete evidence to support them. One piece of microeconometric research that measures flexibility in wage setting surprisingly concludes that South African workers behave similarly to those in the rest of the world: when local labour market conditions are slack, wage demands are apparently moderated, so that firms are able to offer lower wages in less favourable economic climates. Kingdon & Knight (2006a) estimate wage curves using cross section data, and conclude that the elasticity of individual wages with respect to local unemployment rates is close to -0.1, a widely cited figure that is established for most developed economies. This result is so consistent across studies that it has been termed an "empirical law of economics" by its originators (Blanchflower & Oswald, 2008). In high unemployment economies it is unlikely, however, that wages can drop sufficiently to clear labour surpluses. Wages may already be close to a lower bound to enable subsistence, so that downward adjustment is not possible, even if unemployment grows. Additionally, in other countries with high degrees of centralized bargaining, wages have been found to be insensitive to high local unemployment (Albaek et al., 2000; Daouli et al., 2013).

The results of Kingdon & Knight (2006a) therefore contrast with two commonly understood regularities about the South African labour market: that wages are sticky downward in response to the protection of workers' interests, and that when

unemployment is as high and structural as it is, wages are not a primary mechanism by which the labour market imbalance is corrected. The authors also express their surprise that despite multiple robustness checks, their results conform to those of international labour markets, rather than one that faces the rigidities that South Africa does.

This paper investigates whether wage flexibility is as high in South Africa as existing estimates have suggested, or whether it instead conforms to reports of rigidity in macroeconomic research (Fedderke, 2012; Klein, 2012). In testing this central hypothesis, both economic and methodological questions are answered. Primarily, the empirical strategy outlined below allows wage flexibility estimates to be separated into short-run and long-run effects. Microeconometric models *do* suggest that wages are inflexible in response to high local unemployment rates in South Africa in the short run, but not in the long run. Secondary objectives illustrate the importance of spatial heterogeneity, using correct labour market demarcations and accounting for reverse causality in obtaining these estimates, as briefly outlined in the next paragraphs.

The empirical strategy builds on previous literature to provide a concrete metric – wage curve elasticities – by which to evaluate whether wage setting does respond to labour market conditions, especially where they are severely slack. A first methodological objective is to highlight the importance of spatial heterogeneity in the estimation of wage curve elasticities. International evidence suggests that this is particularly important when centralized bargaining is pervasive (Albaek et al., 2000). Regional unemployment may have persistent components (as determined by institutions such as separate development and collective bargaining), which should be modelled with spatial fixed effects. This framework allows for the separation of short-run from long-run wage adjustments to local labour market conditions, a possibility not yet considered in the South African context. Previous estimates were unable to account for spatial heterogeneity effectively, due to the lack of time variation in survey data. Additional periods of Labour Force Survey (LFS) data allow for these estimates to be updated, fully accounting for spatial heterogeneity.

Secondly, this paper investigates the possible consequences of estimating wage curves with demarcations that do not naturally constitute functional local labour markets. Most authors assume that smaller regions better represent "local" labour market boundaries. However, it is possible, for instance when institutions such as bargaining

councils cover multiple small regions, that larger geographic areas naturally integrate into functional labour markets. Given the availability of various demarcations in the LFS data, this paper establishes the best approximation for "natural" labour markets in South African surveys. Importantly, wage flexibility can be vastly underestimated if regions that are either too small *or* too large are chosen to conduct estimation.

Finally, wage curve estimates usually address the problems of reverse causality and measurement error by instrumenting with time-lagged unemployment rates. Data limitations again have precluded this approach in previous studies for South Africa. However, this study shows that this instrument is weak when spatial heterogeneity plays a central role in estimation, and fixed effects remove common variation across time. As an alternative, the use of *spatial* lags are investigated, exploiting geographic variation in unemployment as an instrument.

Accounting for each of spatial heterogeneity, reverse causality and potentially incorrect labour market demarcations, estimates confirm that South African wage setters[3] are inflexible in their response to slack labour market conditions. These results suggest that the data limitations faced by Kingdon & Knight (2006a) led to conclusions that were at odds with what macroeconomic research has established. This contribution emphasizes the importance of addressing various methodological concerns in a high unemployment region with high degrees of spatial heterogeneity, and bridges the gap between existing microeconometric evidence and macroeconomic methodology (which by definition does not take local labour market definitions into account).

The paper is structured as follows. Section 2 briefly interrogates the literature that links local labour markets and spatial heterogeneity. Section 3 surveys the wage curve literature, with a specific focus on the conditions under which wage inflexibility is measured: both empirical elements (such as the statistically optimal radius by which to measure labour markets and spatial heterogeneity) and institutional rigidities are considered. Section 4 introduces the dataset and empirical strategy that have been adopted, while section 5 outlines a full set of results. Section 6 concludes.

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[3] The term "wage setter" as referred to throughout this paper is not limited to firms that command market power, but specifically includes workers and collective bargaining councils that possess bargaining power and can therefore influence wages from the demand side.

2. Spatial heterogeneity and local labour markets

Wage flexibility estimates require the identification of spatial units that constitute local labour markets. These geographic units are determined by various economic forces, notably the ability of labour and firms to move across regions in order to find the best opportunities. Hence, the review first focuses on how various spatial equilibria arise and/or persist, with specific reference to South Africa. Thereafter, the reach of local labour markets is explored in the light of labour market institutions that are regionally defined. Each of these sub-sections informs the discussion that follows.

2.1.   Spatial equilibrium

South Africa has a segmented labour market along multiple dimensions: barriers to entry into the informal sector raise unemployment (Kingdon & Knight, 2004), the apartheid migrant labour system separated individuals over space (Posel, 2010), as did segregation within cities and job reservation within firms (Mariotti, 2012). While some of these characterisations are to a degree specific to the current situation, labour markets are rarely homogenous across space within most countries (Moretti, 2011): in equilibrium, regions may have vastly different productivity levels, wages and capacity for employment creation. This contrasts with the product market, where the law of one price predicts that arbitrage will lead to equilibrium with fairly uniform product prices across space. Potentially equivalent equilibrating forces in the labour market come in the form of migration of workers towards regions offering high wages and where favourable conditions entail a high enough probability of finding a job to warrant a move. Similarly, firms may find it profitable to locate where wages are low and productivity is high, thereby creating employment in that location.

Nevertheless, wages and employment levels rarely reach a point of uniformity across regions, despite movements of people that should achieve this. For instance, the seminal contribution of Harris & Todaro (1970) postulates why urbanization in developing countries typically occurs despite high unemployment levels there. Their two-sector model suggests that the attractive high *expected* wages (adjusted for the distribution of employment probabilities) in urban areas pull individuals into economic hubs, despite a long queue of workers already pursuing the same ideal. The net benefits of migrating to urban regions with higher potential wages (but also a

greater risk of joblessness) outweigh a more secure, but lower wage in the subsistence rural sector.

On the labour demand side, firms in many cases do not relocate to regions where labour is cheap and relatively abundant (such as rural areas), but stay in highly productive regions. Economic hubs are therefore often centred on highly rewarded, productive inputs, rather than profiteering through finding locations with low input costs. Nominal wage differentials across regions in the United States are large and spatial patterns are persistent over the long-run; they correspond to similarly persistent patterns of labour productivity and innovation, which are in turn a function of agglomeration economies (Moretti, 2011). However, real wages (where local prices are accounted for, rather than national time variation) appear to have a more uniform spread, disincentivizing people to move to high income regions; the rigidity in this case is the high cost of living, particularly in terms of property.

The Rosen (1979) and Roback (1982) framework predicts that (in a scenario where labour is perfectly mobile) if a particular city experiences a productivity shock, this will reflect in both nominal wage and property price adjustments, so that real wages remain constant. Consequently, benefits of productivity shocks accrue in the form of capital rents, but none go to workers, and so real wages always equalize across regions. Moretti (2011) generalizes this model (through small elasticities of both labour and housing supply) to account for the case in which labour cannot move voluntarily. Such rigidities are relevant to economies such as South Africa, to the extent that apartheid regulations effectively limited housing and labour supply to blacks in regions that were designated for whites. In this country long-run wages (that do not adjust for local prices) are spatially diverse. As predicted by the model, even real wages could, however, differ by region in long-run equilibrium. In particular, productivity shocks in regions where housing supply is less elastic than in other regions, can benefit property owners as opposed to workers. Apartheid-era urban regions were productive but restricted, while homelands regions had fewer limitations on labour and residential supply to the black population group. Hence, this model predicts that in the pre-transition period, positive productivity shocks would accrue to land owners as opposed to workers. With the (relatively) free expansion of urban informal settlements in the post-apartheid period, this model supposes that shocks to productivity may benefit workers to a greater extent than was the case in the past.

By all expectations, South Africa should have experienced movements leading to a new spatial pattern that allowed workers to take advantage of freedom of movement. However, many spatial patterns from the past persist, with homelands remaining high unemployment regions – in contrast to both the Harris & Todaro (1970) and Moretti (2011) predictions. It is therefore likely that other rigidities (such as collective bargaining councils and barriers to entry into the informal sector) exist that raise the costs of job search in productive urban regions, so that even though internal migration has occurred, wages have not become spatially uniform in the post-apartheid period.

Given the particular restrictions mentioned above, South Africa offers an interesting case study of the existence of separate local labour markets. Labour demand has traditionally been concentrated near mines and in metropolitan regions of white apartheid South Africa, while the dominant location of (unskilled) labour supply was purposefully decentralized to homeland regions by the apartheid regime. The former were small pseudo-independent "states" that were created by the apartheid government, where apparent black self-determination was instated. Black South Africans were effectively only citizens of these "states" (which were not recognized by the international community), even though the only viable labour market opportunities were available in the designated white areas of South Africa. A migrant labour system developed, whereby blacks were only allowed to work in white South Africa with permits, and were only recognized as temporary residents. Families stayed behind in the homelands, while only employed blacks could realistically migrate to industrial centres. However, migrant workers remained primarily connected to their sending households, and likely returned home at selected intervals (Posel, 2010).

As a consequence, a spatially divided labour market resulted, with few viable opportunities in the homelands and unemployment rates that were approximately double those of other regions. As apartheid laws were repealed in the early 1990s (though free movement of workers from all race groups was allowed as early as 1986), it should be expected that the spatial duality of the labour market would diminish. Posel (2010) established that, while patterns of temporary migration to economic centres continued well into the post-apartheid era, a slow-moving shift towards permanent settlement in the receiving (industrialized) regions has started to emerge. Additionally, household income from remittances has started to decline, suggesting that a new spatial pattern could be emerging in post-apartheid South Africa.

However, despite large movements of people to areas of greater economic activity, complete adjustment across space has not been achieved, with high unemployment still concentrated in rural areas. One potential explanation for this slow change is the important role that social grants have played in rural households' incomes. These grants have provided a public safety net that have allowed unemployment to persist in some regions, potentially crowding out the reliance on private remittance transfers (Klasen & Woolard, 2009).

Importantly, these factors inform our understanding of long-run spatial equilibria. Kingdon & Knight (2006a) conclude that homeland regions tend to have concurrently high levels of unemployment and relatively high wages, while a negative relationship exists in other parts of the country – hence, spatial separation has created distinct labour markets over the long-run. After segregation policies have been abandoned, it may be possible to find more integrated labour markets in data that is more recent than that used by Kingdon & Knight (2006a). Has post-apartheid migration eliminated these differences over time? And is the negative relationship in non-homeland regions reflective of this long-run scenario or representative of short-run wage flexibility in the labour market? The rest of this paper differentiates between these two effects.

2.2. Spatially defining local labour markets

Local labour markets can potentially be defined as the geographic regions or demographic groupings from which workers source information and which they take into account in their wage setting decisions. In particular this includes the labour market conditions experienced by other peers within individuals' race groups and locality. This definition is in line with the concept that Kingdon & Knight (2006b) used to test whether the non-searching employed were a part of the labour market. By way of wage curve estimates, they found that wage demands also factored in the stock of local discouraged workers, with large coefficients relating these variables (as opposed to only modelling the searching unemployed as surplus workers). Hence, they conclude, the non-searching are a part of the *de facto* labour market, even if official definitions do not acknowledge this.

The literature is, however, silent on what precisely defines "locality" of labour markets. If labour markets (in the wage curve tradition) were fairly homogenous over large regions, then wage setters would respond to unemployment rates in much the

same way in large parts of the country. However, in countries where unemployment is highly dispersed and where differences are large across regions (as well as time persistent), the local labour market should be narrowly defined and accounting for fixed effects will be important. As shown below, unemployment is geographically dispersed in South Africa, so that introducing fixed effects is an important consideration. In contrast, however, the more centralized bargaining is, the more homogenous labour markets are likely to be across large regions, so that fewer regions of analysis could be used.

Often, demarcations that are available in survey data dictate researchers' definition, and they also tend to assume that the smaller the region, the more "local" it is (Kingdon & Knight, 2006a). Similarly to Kingdon & Knight (2006b), it is possible to establish whether other regions or demographic groups should be included or excluded from a particular group of wage setters' "local" labour market, depending on whether their bargaining demands take those places' and groups' labour market conditions into account. The regional dimension takes on the form of an area of a certain geographic reach for which wage setters take labour market conditions into calculation when bargaining. If the labour market is truly national in reach (and spatially integrated), then the national unemployment rate would be of importance in influencing wage demands; if, however, it is of much smaller size (such as a district or city), then information from further afield would be disregarded in wage setting decisions.

Some studies do in fact establish that wages are more sensitive to national than sub-regional unemployment rates (Daouli et al., 2013). This is especially true where bargaining is centralized. In such contexts, bargaining extends the borders of what would otherwise be small local labour markets to include large areas, as wages are set across broader regions. Hence, slackness of the labour market in close proximity of workers does not influence wage setting decisions as much as they would had bargaining not been centralized, so that information from further afield is assimilated into what workers conceive of as the "local" labour market. This is confirmed theoretically and emprically in Nordic countries (Albaek et al., 2000), and has potentially important ramifications for the analysis of South Africa, given the large influence of bargaining arrangements there.

The wage curve literature provides a tool to investigate this research question, by considering how large regions must be for information on labour market conditions to

flow and influence wage setting decisions. By delimiting units of measurement to "local" labour markets (which, importantly, have no uniform definition in these studies), the research that has followed on from the seminal work of Blanchflower and Oswald (1994) has consistently found that wages respond downwards to higher local unemployment rates.

In wage curve estimation, individual level (indexed by i) monthly earnings are typically regressed on regional unemployment rates, following the initial approach of Blanchflower and Oswald (1994):

$$\log(earnings_{irt}) = \beta_0 + \beta_1 \log(local\ unempl\ rate\ _{rt}) + \gamma' x_{irt} + \mu_r + u_{irt} \ (1)$$

The time index (t) indicates that individual level panel data could be used to also account for individual fixed effects; however, in many cases data limitations entail that estimates are conducted with repeated cross sections, allowing researchers to control only for *regional* fixed effects, indexed by r. In cases where only single cross sections are available, fixed effects can only be introduced for regions with an area larger than those for which unemployment rates are calculated. As discussed below, this strategy may not remove all forms of unobserved spatial heterogeneity and lead to biased estimates.

Estimates of β_1 are most often around -0.1, reflecting the downward pressure on wages exerted by excess labour within a region. This typical elasticity suggests that, as the unemployment rate increases by 10 per cent, wages fall by 1 per cent in response to labour market slackness. Because this figure is found in such a wide range of countries, it has been termed an "empirical law of economics" (Blanchflower & Oswald, 2008). Many studies therefore use it as a benchmark to evaluate whether wages are flexible or not. It can also, however, serve as an indicator of the definition of "local", as will be elaborated on in section 3.2.2.

Labour markets may also be defined by actual daily flows of commuters (as opposed to temporary migration patterns across large distances). Individuals weigh up the potential wage benefits of distant jobs against the time and monetary costs of getting to these workplaces, optimising their decisions across space. Monetary costs include both daily transport expenditures and also the potential cost of relocating if individuals own homes far from their place of work. Simini et al (2012) adjust traditional gravity models and show that commuting patterns can be accurately predicted based on population sizes between start and end locations, but importantly

also the size of the population within a radius (centered at the starting location) equal to the distance between both locations. Each of these quantities reflect job availability in plausible alternative local labour markets in which individuals could conduct their job search at the same cost.

Recorded journeys to work have been used to optimally delineate "functional" labour market areas for South Africa (Nel et al., 2008). By this definition, points located within delineated economic regions are more connected with other places that are also found within these confines, rather than with points outside. Their analysis also shows that functional economic regions often do not correspond to current politically determined demarcations. The practical implication for researchers is that household surveys that are designed to measure regional labour market conditions do not necessarily capture local labour markets information correctly, as they are most often stratified by administrative rather than economically functional regions.

The empirical analysis in this study tests, first, whether previous definitions of local labour markets that have been used by researchers are appropriate in terms of reflecting the real geographical spaces within which labour market forces (supply, demand, market power, etc.) interact to determine discernable spatially-delineated wages. Once these definitions are clarified, the second objective is to establish whether wages in these 'local' labour markets (as now defined) are as flexible as the wage curve estimates of Kingdon & Knight (2006a) suggest.

3. Wage curves in high unemployment regions – the role of regional heterogeneity

In their recent entry in the Palgrave *Dictionary of Economics* on the wage curve as an "empirical law of economics", Blanchflower & Oswald (2008) express their surprise that the wage curve holds in a country with an unemployment rate as high as South Africa's. In fact, they argue that it is uncanny that the elasticity is just as high as cases measured in their original work on OECD countries (Blanchflower & Oswald, 1994). Their assertion is based on the evidence of Kingdon & Knight (2006a), who used the 1993 South African PSLSD data to estimate an elasticity of individual wages related to broad unemployment rates of survey clusters. The existing South African estimates are also remarkably close to -0.1, despite the high unemployment rate there.

In contrast, a comprehensive meta-analysis of the wage curve literature suggests that muted elasticities arise when unemployment is particularly high - though non-linearities in unemployment are rejected statistically for the collection of studies (Nijkamp & Poot, 2005). The intuition for this apparent contradiction derives from the poor potential for declining wages to clear particularly large labour surpluses (specifically if wages have to drop to below reservation or subsistence levels). Should unemployment be persistent and high in the long-run, it is possible that the wage flexibility implied by the wage curve does not conform to the "empirical law". Indeed, Fedderke's (2012) contribution starts off with the premise that "South African labor market conditions are unusual by international standards. High and persistent unemployment do not prevent real labor costs from rising." This emphasizes that not only do wages fail to *fall* in some high unemployment scenarios (as suggested by a non-linear wage curve), but in some circumstances they are even able to *rise.*

However, to fully reconcile the conflicting predictions on the nature of the relationship between wages and unemployment, it is necessary to separate short-run adjustments from long-run ones. It is apparent that in some settings, a short-run non-responsiveness of wages to unemployment exists concurrently with long-run trade-offs, such as in the Nordic countries (Albaek et al., 2000). Without making provision for this in microeconometric models, the two effects are likely to be co;founded. The rest of this paper therefore attempts to understand how empirical wage curves should ideally be estimated to characterise various modern developing country labour markets, especially those with high levels of bargaining, segmentation and unemployment. In particular, this paper turns to the role of (permanent) unobservable regional heterogeneity to account for long-run relationships. An additional goal is to establish optimal definitions of regions and labour markets for which the empirical law holds.

Two reasons could explain why the existing evidence for South Africa conforms to international results from low unemployment countries, while it contradicts expectations for a high unemployment economy. Firstly, the work of Kingdon & Knight (2006a) documents a point in time before the large and steady rise in post-apartheid unemployment took place (Burger & von Fintel, 2014), and before many of the labour laws that they cite for apparent inflexibility were revised to become more strict. Secondly, because they are limited to work with cross-section data, the effect that they capture cannot distinguish between transient changes in the labour market and long-run factors. The result is that the estimates potentially confound these two

effects and that (as in the case of Nordic countries), no short-run adjustments in wages exist, but that the negative relationship is an observance of a long-run phenomenon that manifests in the data. This is also the case in Greece where no transient wage flexibility is observed in relation to high unemployment, while a long-term trade-off exists (Daouli et al., 2013). The reasons in this case are similar, with high centralization of bargaining being linked to labour market inflexibility.

Kingdon & Knight (2006a) acknowledge potential difficulties by adding a quadratic in unemployment for the South African specification, so as to allow for a section on the unemployment-wage profile that is flatter than the rest of the curve. In most international contexts, significantly positive non-linearities are predicted only for sections of the wage curve that are not actually contained in data; the high South African unemployment rate, however, means that this potential phenomenon cannot be ignored.

Kingdon & Knight (2006a) further explore these issues by segmenting their models into high and low unemployment regions. Their analysis focuses on differences between previous "homeland" and "non-homeland" regions. An insignificantly positive wage curve relationship existed in homeland regions (with high unemployment and concurrently high wages after conditioning on relevant factors), while a strong negative wage curve holds in the rest of South Africa. Results such as these highlight the importance of accounting for regional heterogeneity where unemployment is not only high, but where it is widely dispersed along the spatial dimension. However, the finding of a negative wage curve relationship for non-homeland regions still stands in contrast to assertions that South Africa has an inflexible labour market.

Magruder (2012) investigates another feature of the South African labour market, that has a strong spatial dimension, and which provides clues to the distinction between long-run and short-run wage flexibility. Collective bargaining takes place in many industries, where dominant firms and unions set up wage agreements that often become applicable across entire regions. Under the provisions of the Labour Relations Act, the South African Minister of Labour has the discretion to extend a bargaining council agreement to an entire industry within a particular geographic jurisdiction, regardless of whether firms' workers are members of the unions that constitute the bargaining council. Consequently, districts in which wages are set via a bargaining council extension tend to witness lower employment creation. This especially affects

smaller firms, which tend to be in low concentration in South Africa compared to other countries.

Magruder (2012) uses district-level spatial discontinuities (where jumps are defined at the borders of regions that are covered by collective bargaining agreements) to identify what can indirectly be viewed as behaviour that is contrary to a wage curve in post-apartheid South Africa. This behaviour, however, operates through a specific channel: in the presence of a bargaining council, wages increase by 10-21% and employment drops by 8-13%. These wage premia effects are very close to other estimates using alternative identification strategies which show that, compared to only firm-level union negotiations, bargaining councils are important forces for raising wages (Bhorat et al., 2012).

Magruder (2012) emphasizes that not all of the unemployment in South Africa can be explained by a bargaining council effect, but he acknowledges the long-term structural nature of unemployment (Bhorat & Hodge, 1999). This distinction between the long and short run is important for understanding the results of his study, and to inform the interpretation of wage curve estimates. While he finds an implied positive relationship between employment losses and wage increases in similar data[4] to that of Kingdon & Knight (2006a), it is likely that this represents only a short run wage curve relationship (through the collective bargaining channel), because of the appropriate treatment of time-invariant spatial fixed effects in his models.

The introduction of fixed effects, however, raises multiple questions which have been addressed in the literature in various manners, often dictated by data availability. Firstly, what is the appropriate geographic definition of a "local" labour market, and is this the correct level at which to measure unemployment for wage curve purposes? Potential answers to this question have been discussed above. A related question is: which accompanying fixed effect should be used in a wage curve specification to account for unobserved spatial heterogeneity associated with labour market institutions (such as collective bargaining) and political configurations (such as the former homelands system)? Secondly, what is the empirical importance of accounting for fixed effects, and which type of data is required to support such an analysis?

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[4] He uses Labour Force Surveys, which were collected by Statistics South Africa in the first half of the 2000s decade. These shared a similar survey design with the 1993 PSLSD used by Kingdon & Knight (2006a). The essential difference is the luxury of the time element which Magruder (2012) enjoys in order to account for spatial heterogeneity effectively.

While the groundbreaking work (Blanchflower & Oswald, 1994) advocated the introduction of regional fixed effects in the standard wage curve specification, fixed effects had a small role to play compared to the results of Scandinavian researchers (Albaek et al., 2000). In some cases the introduction of regional fixed effects amplifies the elasticity (see for instance Papps (2001)), while in others they are muted (see for instance Baltagi, Blien, & Wolf (2000)). Blanchflower & Oswald (1994: 181) emphasized their inclusion to distinguish between long-run and short-run differences in the wage-unemployment relationship.

This can be shown as follows. Suppose that the population regression function contains regional fixed effects ($\mu_{r_j^*}$) and naturally functional local labour markets are defined by an unknown radius r^* as follows:

$$\log(earnings_{ir^*t}) = \beta_0 + \beta_1 \log(unemployment\ rate_{r^*t}) + \mu_{r^*} + u_{ir^*t} \ ...(2)$$

Without accounting for regional fixed effects, estimates of the short-run wage curve coefficients deviate from the population coefficient, depending on the relationship between the unemployment rate and the fixed effects:

$$plim\hat{\beta}_1 = \beta_1 + \frac{Cov[\log(unemployment\ rate_{r^*t}); \mu_{r^*}]}{Var[\log(unemployment\ rate_{r^*t})]} \ ...(3)$$

Given that $\beta_1 < 0$ and that the relationship between the unemployment rate and fixed effects is positive positive, $\hat{\beta}_1$ will be underestimated (or biased towards zero). Alternatively, if the long-run relationship (the correlation between unemployment and the regional fixed effects) is negative, $\hat{\beta}_1$ will be overestimated (or more negative than it should be).

A positive *long-run* relationship is empirically verified in the United States (along with a negative transitory wage curve) (Blanchflower & Oswald, 1994), while a negative long-run relationship persists in the Nordic states (with a statistically insignificant transitory wage curve) (Albaek, et al., 2000). A long-run negative relationship in the latter case explains why unemployment elasticities are overstated when not accounting for fixed effects (though small numbers of regions in their analysis could be confounding this analysis).

Why, then do the Nordic results differ from the "empirical law", and are there lessons to be learnt for South Africa? Albaek et al. (2000) emphasize the role of centralized bargaining in driving these results. Under highly centralized bargaining regimes,

wages are likely to be unresponsive to higher *local* unemployment, as they are set at a more central regional level. In recent firm-level evidence for Germany, wage curve estimates are conducted separately for workers who negotiate at the firm level and workers that are covered by sector-wide bargaining agreements (Blien, et al., 2013). Wages are not at all responsive to local unemployment when workers benefit from sectoral agreements; however, unionized workers that negotiate only at the firm level do display wage curve behaviour. The implication is that, the further removed the negotiation is from the firm, the less flexible wages tend to become,since such agreements do not take local labour market conditions into sufficient account.

Given the provision for sectoral determination in South Africa, the high wage flexibility found by Kingdon & Knight (2006a) is surprising, and requires further investigation. It is likely that spatial heterogeneity has not been effectively accounted for. Some sectoral bargaining councils are centralized at the national level in South Africa, while others ecompass large districts. In each of these cases, bargaining is centralized to a level beyond the immediate firm or town, so that wages may also not be as responsive to "local" labour market conditions. The following section will follow up with a review of the literature, with the role of bargaining in generating results different from the "empirical law" in mind.

3.1.   A meta-analysis of wage curve studies and regional heterogeneity

Nijkamp & Poot's (2005) existing meta-analysis shows that including regional fixed effects in wage curve specifications reduces elasticities by an average of 0.035 percentage points, though this fall is not statistically significant across the specifications they survey. Accounting for long-run wage setting dynamics therefore does not detract from the wage curve as a transitory empirical law in most instances. However, most of the studies they survey are taken from developed country evidence, where unemployment is not abnormally high, and also not as dispersed across regions. They also do not explicitly explore the dimension of centralized bargaining in determining different long-run scenarios, as noted above. However, one of their examples specifically emphasizes the role of centralized bargaining in distinguishing between a long-run and a short-run wage curve (Albaek et al., 2000). The objective of this section is to highlight the main features of their meta-analysis, but to also study whether their conclusions on fixed effects can be potentially differentiated along the lines of the degree of centralized bargaining within an economy. Additionally, the number of "local" labour markets in each study is highlighted, in

order to understand whether researchers use small or large regions to find their effects, and by implication to learn about the size of local labour markets in wage curve studies.

Most studies utilise repeated cross sections, and present evidence of wage curves with and without regional fixed effects; in these studies it is possible to include fixed effects at the same level at which unemployment rates are calculated due to the time dimension that is present in the series of data. In a few cases a single cross section survey is used by necessity, and fixed effects are included for regions that are geographically larger than the level at which unemployment rates are calculated. This raises the question whether fixed effects for regions larger than those for which unemployment rates are estimated can effectively remove the long-run component of the wage setting relationship. Before exploring these dimensions in light of Nijkamp & Poot's (2005) overview, the context of South Africa is sketched.

Kingdon & Knight's (2006a) work is a case in point, where fixed effects potentially did not separate long-run from short-run wage curve effects. In the absence of multiple datasets with geographic variation, they resort to using one cross sectional survey. Consequently, they are not able to introduce regional fixed effects at the same level of aggregation as the unemployment rates that they measure. As a second best option, they include fixed effects for regions with larger geographic definition.[5] However, even within these larger regions, substantial heterogeneity exists in unemployment rates.

Despite some provinces clearly having higher unemployment rates on average, it is evident that the heterogeneity within these geographic units is non-negligible. Notably, unemployment is highly correlated with the apartheid homeland demarcations. Figure 1 shows that this is true even in the 2000-2004 period, some years after the homeland system was abandoned by the post-transition regime. Many provinces (as in Figure 3), display substantial variation in unemployment *within* their boundaries, with homeland sub-regions standing out as high unemployment areas. This contrast is particularly stark in the northernmost Limpopo province of South Africa. While this province is a high unemployment region as a totality (Figure 3), it also contains many magisterial districts with substantially lower levels of unemployment that are directly adjacent to high unemployment districts. As

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[5] They include provincial fixed effects (the demarcations are shown in Figure 3), while estimating unemployment rates for survey clusters.

discussed above, this persistent situation is potentially the product of social grants that have expanded more rapidly in homeland regions (Pienaar & von Fintel, 2014); unemployed individuals live in households with recipients of grants and remain isolated from main labour market centres (Klasen & Woolard, 2009). Alternatively, the costs of migration (such as transport and search costs) may be high. Aditionally, existing land rights would be forfeited if entire households decided to move from the homelands to enter the urban labour market.

Accounting for this level of heterogeneity is potentially important for wage curve analyses. It is firstly evident that a province potentially cannot constitute a "local labour market" purely by the differences in unemployment within these administrative regions. However, if wages setters disregard these differences and factor average unemployment rates within geographically dispersed social networks into wage bargaining, then a province or even a larger region could nevertheless be regarded as a local labour market. The alternatives should be investigated by conducting various wage curve analyses, which test the robustness of estimates with regard to the labour market demarcation chosen.

Figure 1 Broad magisterial district unemployment rates - 2000-2004

Source: Own calculations from LFS2000-2004. The unemployment rate is for the entire labour force within the region, calculated by the broad definition and pooled over the period.

Figure 2 Broad district council unemployment rates - 2000-2004

Source: Own calculations from LFS2000-2004. The unemployment rate is for the entire labour force within the region, calculated by the broad definition and pooled over the period.
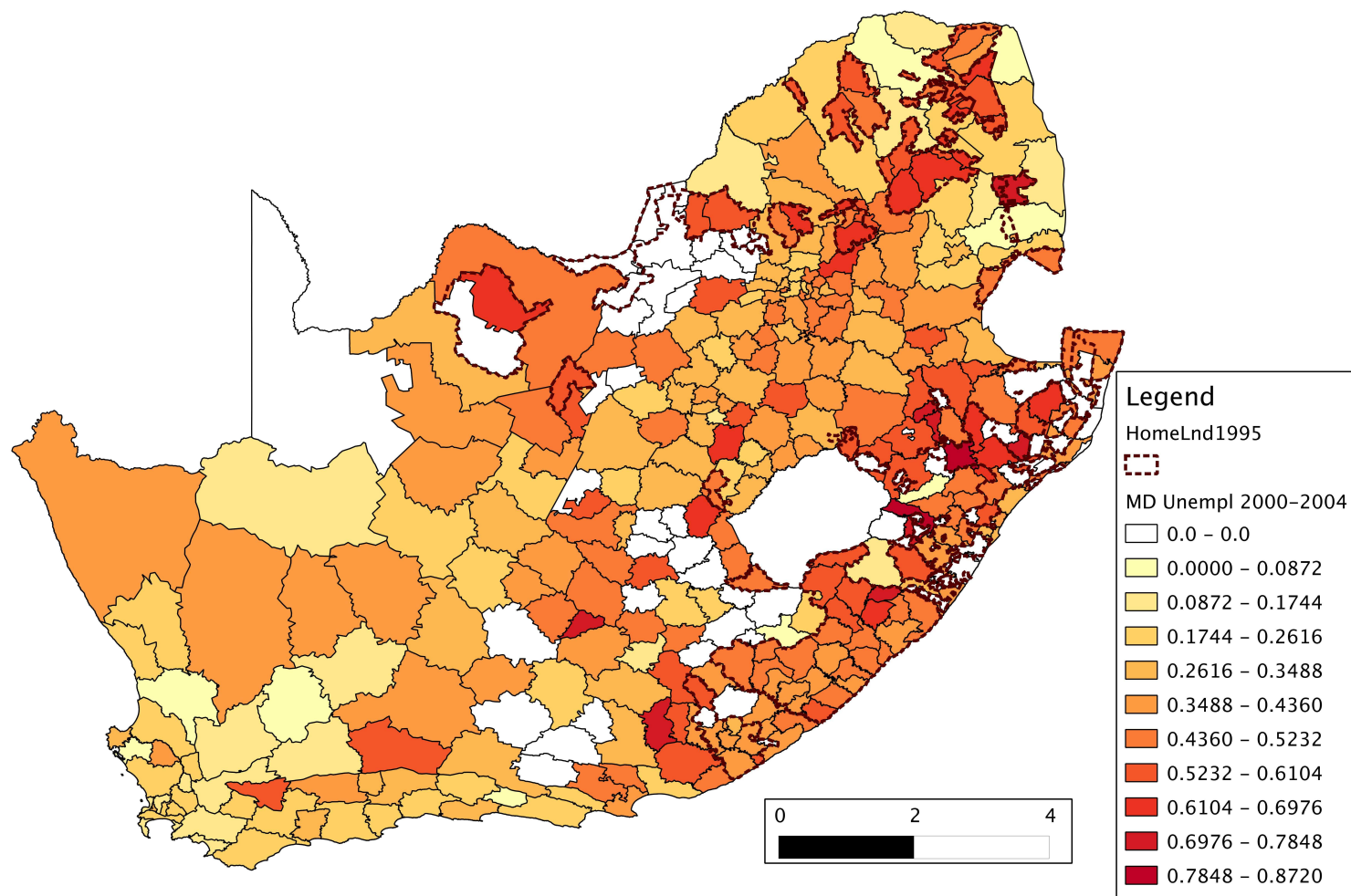
Figure 3 Broad provincial unemployment rates - 2000-2004

Source: Own calculations from LFS2000-2004. The unemployment rate is for the entire labour force within the region, calculated by the broad definition and pooled over the period.
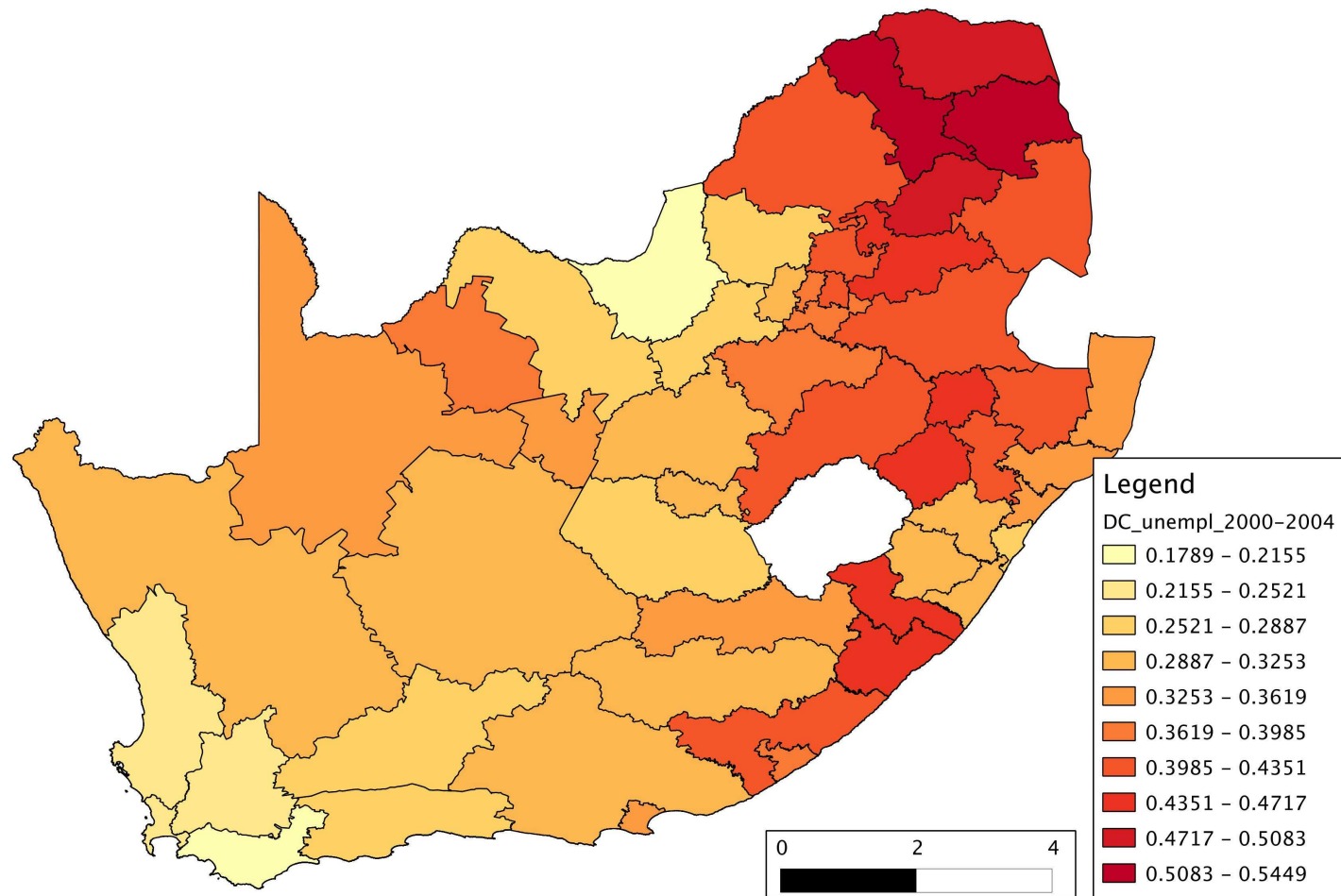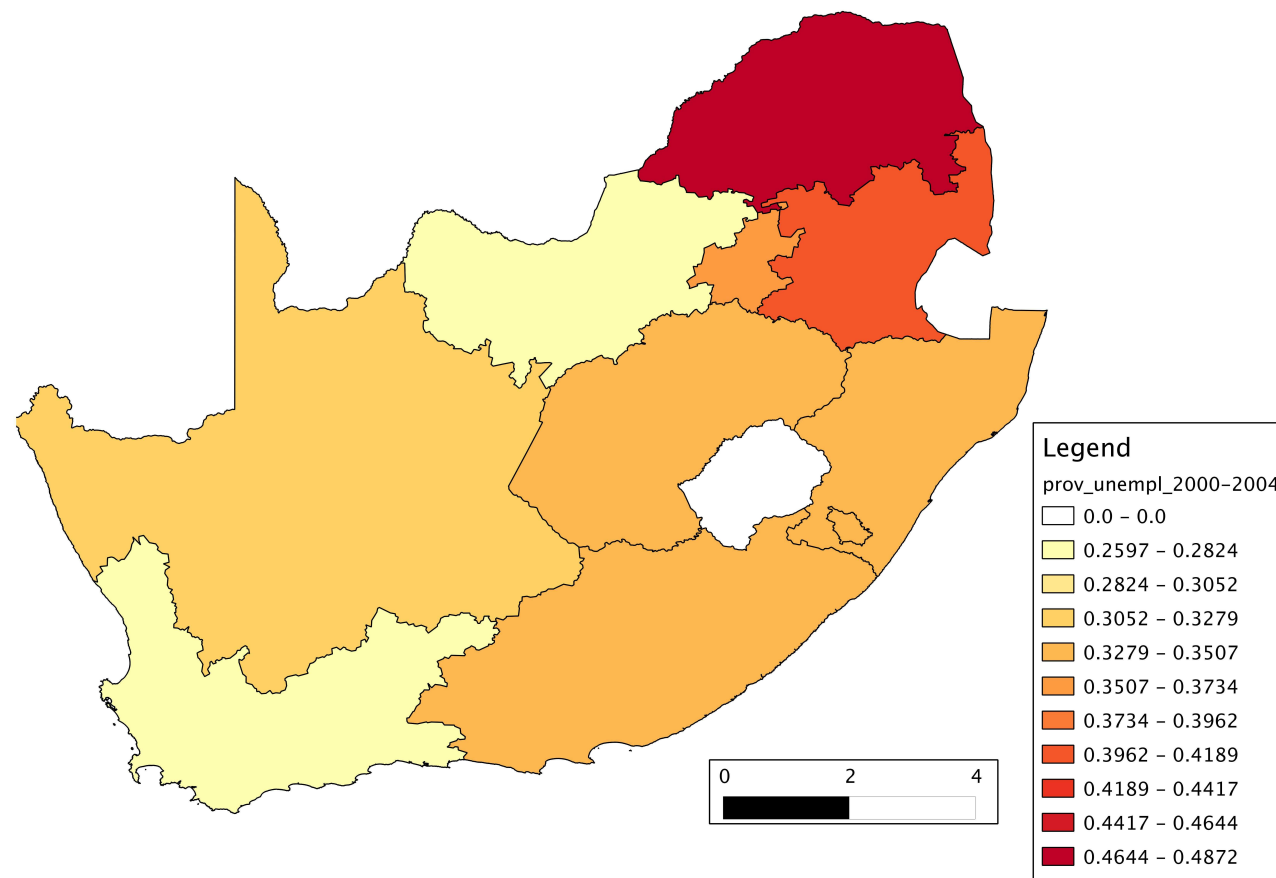
Furthermore, if it is true that labour markets are defined by areas smaller than a province, the heterogeneity *within* provinces will not be accounted for by introducing fixed effects representing provinces. Given that unemployment is of a long-term structural nature in South Africa, it is unlikely that incorrectly defined fixed effects can purge the wage curve relationship from this feature adequately.

Finally, Card (1995) highlights concerns that arise when degrees of freedom are limited by a small number of regions. To illustrate, should 9 provincial unemployment rates be used to model individual wages, the wage curve elasticity is not based on the number of individuals, but 9 multiplied by the number of surveys used. As a result, if the number of aggregate units is small, standard inference using aggregated data to explain individual level outcomes would be potentially misleading (Moulton, 1990). Using smaller regions would have the benefit of more units of observation to cover the map, which reduces problems for statistical inference. In this study, standard errors are clustered at the relevant geographic unit to account for this problem, as is done elsewhere in the wage curve literature (Sanz-de-Galdeano & Turunen, 2006)[6].

In their study, Kingdon & Knight (2006a) take account of the first and third concerns by estimating unemployment rates at the survey cluster level, which covers substantially smaller areas than provinces. However, their use of cross sectional data does not allow them to address the second concern, so that it is likely that sufficient long-term heterogeneity remains unabsorbed by fixed effects estimation. Other studies suffer the same limitations (Blanchflower & Oswald, 1990; Winter-Ebner, 1996). In each case, the introduction of fixed effects at a level of aggregation larger than the unemployment rate reduces wage curve elasticities, though does not render them insignificant (as is the case in other studies). However, the potential remains that the elasticity remains overstated. This possibility is discussed in more detail below.

While Nijkamp & Poot (2005) conclude that the introduction of fixed effects does not have an overall impact on the elasticities that they survey, some specific differences nevertheless emerge. As noted above, their overview does not pay much attention to the problem of using few (but large) regions to proxy for labour markets, and also does not consider the role that fixed effects can play when centralized bargaining is

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[6] Unemployment rates should ideally also be treated as generated regressors, with more conservative standard errors being implemented. While acknowledging this shortcoming, it is beyond the scope of this study to consider the effects of this potential problem on statistical inference.

high. The rest of this section provides some re-interpretation of their evidence, which also potentially explains why Kingdon & Knight (2006a) obtain results that are not expected for an economy such as South Africa. Table 1 draws together most of the estimates they review (bar for those from the book of Blanchflower & Oswald (1994)), but now explicitly focuses on study dimensions relevant to the current question, namely the number of regional unemployment rates, the number of regional fixed effects, and also the potential for centralized bargaining to dampen short-run wage fluctuations. The latter is achieved by comparing countries by measures of the degree of centralization of their collective bargaining systems (Iverson, 1998) and the prevalence of central bargaining (Driffill, 2006). The purpose of this attempt is to highlight under which circumstances various empirical strategies generate wage curves that should be scrutinised more carefully, and to give potential explanations for some of the deviations from the norm.

Starting with studies of countries that have lower levels of centralized bargaining, US and UK estimates are robustly in line with the wage curve, even when accounting for regional fixed effects. The exception is the repeated cross section estimate of Blanchflower & Oswald (1990), which becomes statistically insignificant when fixed effects are introduced. However, this exposes a problem of limited degrees of freedom rather than bias (Card, 1995), as only 11 regional unemployment rates were constructed. This questions the validity of statistical inference rather than economic factors that lead to the apparent inflexibility that is measured. The specifications of Wagner (1994) suffer the same problem, so that the insignificance after fixed effects are introduced can potentially not be attributed to the relatively high centralization of bargaining that prevails in Germany.

However, other estimates for (East and West) Germany are also rendered insignificant by *regional* fixed effects (Baltagi, Blien, & Wolf, 2000; Baltagi & Blien, 1998), despite defining larger numbers of regions. As a result, the potential role for a centralized bargaining channel re-emerges. Other estimates for Germany (Pannenberg & Schwarze, 1998; Buettner, 1999) remain significant but small after conditioning on regional dummies. For Germany (with relatively highly centralized bargaining institutions), the evidence could be consistent with the claims of Albaek, et al. (2000) that wage curve elasticities are either small or insignificant in the presence of strongly centralized bargaining.

However, antipodean studies (in regions with only slightly lower degrees of centralized bargaining than Germany) do not follow this pattern. Australian repeated cross sectional data (Kennedy & Borland, 2000) yields smaller (yet significant) estimates of the elasticity after introducing fixed effects, despite a small number of defined regions and moderate levels of centralized bargaining. In the case of New Zealand, the elasticity becomes more strongly negative (Papps, 2001). Belgian estimates (Janssens & Konings, 1998) follow a similar pattern to those from Australia, with similar limitations in terms of numbers of regions and within a similar bargaining environment.

Table 1 Summary of wage curve studies and their regional fixed effects

Author	Country	Period	Data type	Number of u% rates	FE Region	Impact of introducing regional FE	Centralization Index§	Score*	1980	1990	2000
Blanchflower & Oswald (1990)	Britain	1981	CS	65	9	Elasticity remains significantly negative	0.177	3+	70	40	30
Blanchflower & Oswald (1990)	Britain	1983-1987	Rep CS	11	11	Elasticity becomes insignificant	0.177	3+	70	40	30
Wagner (1994)	W Germany	1979;1985	Rep CS	10	10	Elasticity becomes insignificant	0.377	5--	80	80	90
Wagner (1994)	W Germany	1984-1990	Rep CS	9	9	Elasticity becomes insignificant	0.377	5--	80	80	90
Bratsberg & Turunen (1996)	USA	1979-1993	Panel	1376	1376	Elasticity becomes smaller, but remains significant	0.071	2	26	18	14
Winter-Ebmer (1996)	Austria	1983	CS	99 regions x 31occupation	9	Elasticity becomes smaller, but remains significant	0.431	6	95	95	95
Partridge & Rickman (1997)	USA	1972-1991	State panel	48	48	Elasticity is positive, but becomes smaller	0.071	2	26	18	14
Baltagi & Blien (1998)	Germany	1981-1990	Panel	142	142	Not significant for all workers, except when instrument added	0.377	5--	80	80	90
Janssens & Konings (1998)	Belgium	1985-1992	Indiv Panel	11	11	Remains negatively significiant	0.321	4	90	90	90
Pannenberg & Schwarze (1998)	E Germany	1992-1994	Indiv Panel	35	35	Elasticity negatively significant with regional FE, but not with individual FE					
Buettner (1999)	W Germany	1992	Reg Panel	325	325	Small but negatively significant	0.377	5--	80	80	90
Albaek et al (2000)	Nordic Countries	1989-1993	Rep CS	8 to 19	8 to 19	Large region u% insignificant with same FE; limited effect for district level	0.459 to	5- to 5	70 to 90	70 to 90	70 to 90
Baltagi et al (2000)	E Germany	1993-1998	Rep CS	114	114	Fixed effects knock significance, instruments bring it back					
Kennedy & Borland (2000)	Australia	1982-1995	Rep CS	7	7	Elasticity becomes smaller, but remains significant		4	80	80	80
Papps (2001)	N Zealand	1986-1996	Rep CS	60	30	Elasticity becomes stronger		4	60	60	25
Blanchflower (2001)	Eastern Europe	1991-1997	Rep CS	6 to 42	6 to 42	Elasiticty becomes smaller: significant in most estimates; sometimes insignificant					

Source: Own summary of studies included in meta-analysis of Nijkamp & Poot (2005). CS = Cross Section. Centralization index from §Iverson (1998); centralization score & collective bargaining coverage indicators from *Driffill (2006).

Turning to highly centralized bargaining regions, Albaek, et al. (2000) attribute their insignificant elasticities (after introducing regional fixed effects) to the centralized bargaining systems that operate in the Nordic countries. However, small degrees of freedom could just as likely be playing a role in this case, other than the reasons that they offer. Their choice of few but large regions may, however, be justified on the grounds that "local labour markets" could be potentially larger where central bargaining prevails. Furthermore, Austrian estimates (Winter-Ebner, 1996) – with a sufficient number of regions (though a small number of fixed effects) – remain statistically significant once controlling for region. This is true despite it being at the extreme of the centralized bargaining spectrum; however, the lack of additional cross sections entails that higher level regional fixed effects were not likely to mop up the full degree of heterogeneity that was present in the data. This is similar to the case of South Africa.

Overall, then, evidence that centralized bargaining represents the mechanism through which insignificant or small short-run estimates arise, does carry some credibility, and is potentially masked by the existing meta-analysis' inclusion of many studies with low to moderate degrees of centralized bargaining, and in some instances low effective statistical degrees of freedom (Nijkamp & Poot, 2005). The evidence on the number of local labour markets and fixed effects is also not unambiguous from this meta-analysis. However, understanding levels of heterogeneity within these regions (perhaps also along the lines of bargaining councils, *inter alia*) is a potential route to uncovering why definitions of regions are as important for wage curve analysis as their presence in the literature suggests. This paper will not repeat a meta-analysis taking these specific factors into account, but will attempt to illustrate these features using a series of repeated South African cross sections. In this context, collective bargaining plays an important role in the wage setting mechanism (Bhorat et al., 2012; Magruder, 2012). As a result, short-run wage flexibility could be limited, while a long-run trade-off may nevertheless emerge. Spatial heterogeneity is therefore a potentially important component of the analysis.

3.2.   Regional/spatial heterogeneity and wage curve bias

This section proceeds to investigate theoretically how the wage curve specification can be distorted by inappropriately accounting for spatial heterogeneity, and furthermore considers the impact of measuring unemployment at the incorrect spatial

level. In each case, the potential bias for estimates is considered in order to establish the most credible way to estimate the relationship using South African data.

As before, suppose that the true wage curve is represented by:

$$\log(earnings_{ir^*t}) = \beta_0 + \beta_1 \log(unemployment\ rate_{r^*t}) + \gamma' x_{ir^*t} + e_{ir^*t} \ ...(4)$$

where $e_{ir^*t} = \mu_{r^*} + \lambda_t + u_{ir^*t}$, i and t index individuals and time respectively, and r^* indexes a set of geographic reference regions. The latter are true (but unknown) functional local labour markets, for which individuals take the full set of information into account in their wage demands. The size and number of these regions within a country depends on how spatially polarized the labour market is, but may also be influenced by social network connections that bridge regions with very different labour market conditions. Should labour market circumstances be fairly homogenous across space, and workers able to migrate freely into another region or industry, the functional regions may be fairly large. In the South African case, these regions have the potential for being smaller than in other countries, owing to the spatial segregation introduced by the homeland system. While labour market movement between these regions has been liberalised after apartheid, the spatial patterns along very small regional lines still persist (as is evident in Figure 1). However, even collective bargaining and temporary migration (Posel, 2010) can extend the labour market to encompass regions that are spatially far apart. This could occur through the working of social networks, which are found to be very important for job search and hiring in South Africa (Hofmeyr, 2010; Schoer et al., 2014).

Should equation (4) be estimated without adding any regional fixed effects, the standard result holds that coefficients of interest may be biased and inconsistent if any of the covariates are correlated with the unobserved heterogeneity that is absorbed into the error term (Wooldridge, 2010). As highlighted by equation (3), bias depends on the long-run relationship between wages and unemployment.

3.2.1. *Fixed effects for non-functional regions*

Suppose, however, that a lacking time dimension in the data disallows fixed effects to be added at the same level of spatial aggregation at which the unemployment rate is calculated. Where spatial differences are important, it may be preferable to account for heterogeneity at a geographic level that is typically larger than the functional labour market, a strategy followed by Kingdon & Knight (2006a). Suppose that it is

still possible to calculate unemployment rates for true local labour markets, but that fixed effects for larger regions and industries are included as follows:

$$\log(earnings_{ir^*t}) = \tilde{\beta}_0 + \tilde{\beta}_1 \log(unemployment_{r^*t}) + \tilde{\gamma}' x_{ir^*t} + \tilde{e}_{irt} \ \dots(5)$$

where $\tilde{e}_{irt} = \mu_r + \lambda_t + \tilde{u}_{irt}$ and $\mu_r = \frac{1}{n_{r^*\subset r}}\sum_{r^*\subset r}\alpha_{r^*}\mu_{r^*}$ is now a weighted "average" of the fixed effects of all of the true unknown sub-regions (with radius r^*) of which the larger region (with radius r) is comprised, with the functional region specific deviations (ξ_{r^*}) from this average being absorbed into $\tilde{u}_{irt} = u_{ir^*t} + \xi_{r^*}$.

Hence, $\mu_{r^*} = \mu_r + \xi_{r^*}$ so that

$$plim\ \tilde{\beta}_1 = \beta_1 + \frac{Cov[\log(unemployment_{r^*t}); \xi_{r^*}]}{Var[\log(unemployment_{r^*t})]}$$

where

$$Cov[log(unemployment_{r^*t}); \xi_{r^*}]$$

$$= Cov[log(unemp_{r^*t}); \mu_{r^*}] - \frac{1}{n_{r^*\subset r_j}}\sum_{r^*\subset r_j}\alpha_{r^*}\ Cov[log(unemp_{r^*t}); \mu_{r^*}] \ \dots(7)$$

Given that this sub-optimal fixed effect does not "mop up" all of the unobserved heterogeneity in a true but unobserved labour market, bias emerges, as in (6). The first term of equation (7) determines the inconsistency that would arise if no fixed effects were included in the specification, as highlighted in (3). The second term in (7) represents the potential reduction in this bias that results from at least including the rougher fixed effects. However, suppose that large degrees of spatial heterogeneity exists within the larger district (r) than in each of its component districts (r^*), so that one district (say) with a large population (large α_{r^*}) is a high unemployment-high wage district (in the Harris-Todaro (1970) sense), while other districts have (say) close to zero correlations between unemployment and the long-run wage fixed effect. The consequence of this would be a large between district correlation (large first term), and a small sum of within district correlations (small second term), so that the overall correlation between unemployment and the unobservable heterogeneity is not eliminated by the rougher fixed effect. Essentially this suggests that if area fixed effects attempt to account for large levels of heterogeneity across sub-regions, it stays likely that estimates will remain biased and inconsistent if this heterogeneity *within* the larger regions is substantial. Should μ_r account for much of the variation in μ_{r^*} as opposed to ξ_{r^*} this strategy will result in minimal bias.

3.2.2. Optimal labour market size for wage curve analysis

Since most studies in the wage curve literature are silent on what should be the size of the "functional" labour market, and no clear prescriptions exist at which level unemployment rates should be calculated, other potential (unnoticed) problems may arise. Wagner (1994) and Kingdon & Knight (2006a), for instance, recommend that unemployment rates should be measured at lower levels of aggregation to reflect "local" labour markets. This, however, assumes that other factors such as centralized wage setting and demographic networks across large distances do not galvanize small regions into larger definitions of "locality". Presumably, most applied work relies on the information of regions that is available in survey data, which is often dictated by the sampling design, or political and administrative divisions. Kingdon & Knight (2006a) state this explicitly, noting that their choice of locality was data-driven and not based on institutional knowledge. Where local labour markets naturally fill these boundaries (such as where minimum wages and bargaining are defined regionally), this is unproblematic.

However, extending the analysis above, it may be that unemployment rates that are calculated for regions that are larger than functional local labour markets, could compromise the estimation of the elasticity if labour markets are truly small[7]. Suppose now that unemployment is calculated for a larger region (with radius r) than is optimal and used to estimate (8) below. Unemployment is now assumed to be measured with error $(\omega_{(r^*\subset r)t})$ that is multiplicative with the unemployment rate of the unknown functional labour market region (r^*):

$$\log(earnings_{irt}) = \hat{\beta}_0 + \hat{\beta}_1 \log(unemployment_{rt}) + \hat{\gamma}'x_{irt} + \hat{e}_{irt}$$

$$= \hat{\beta}_0 + \hat{\beta}_1 \log\big(unemployment_{(r^*\subset r)t}\omega_{(r^*\subset r)t}\big) + \hat{\gamma}'x_{irt} + \hat{e}_{irt}$$

$$= \hat{\beta}_0 + \hat{\beta}_1 \log\big(unemployment_{(r^*\subset r)t}\big) + \hat{\gamma}'x_{irt} + \hat{v}_{irt} \ (8)$$

where $\hat{v}_{irt} = \frac{1}{n_{(r^*\subset r)}}\sum_{(r^*\subset r)} \alpha_{r^*}\mu_{r^*} + \xi_{r^*} + \lambda_t + \hat{\beta}_1\log(\omega_{(r^*\subset r)t}) + u_{irt}$ so that

$$plim \ \hat{\beta}_1 = \beta_1 \frac{Var[\log(unempl_{rt})]}{Var[\log(unempl_{rt})]+Var[\log(\omega_{(r^*\subset r)t})]} + \frac{Cov[\log(unempl_{r^*t});\xi_{r^*}]}{Var[\log(unempl_{r^*t})]} \ (9)$$

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[7] While this discussion focuses on regions that are defined as too large, the results transfer to a situation where regions may be too small compared to a truly functional region, which also induces measurement error.

This specification now yields a composite error term with two additional components that can be potentially correlated with unemployment. The second term in equation (9) is associated with the incorrect specification of fixed effects, while the first is of interest with regards to sub-optimal labour market size. Under classical measurement error assumptions, the inappropriate size of the labour market will reduce the absolute value of wage curve estimates. This will be true when labour markets are defined as either too small *or* too large, compared to the true functional region. As $Var[\log(\omega_{(r \subset r^*)t})] \rightarrow 0$, or as measurement error (due to incorrect demarcations) becomes equally dispersed across space, the bias is removed. As a result, the maximum wage curve estimates (in absolute value) will be obtained using labour market definitions that also represent functional economic regions in reality. Any demarcation smaller or larger in area will yield a muted wage curve elasticity (provided that wage setters do respond to local labour market conditions). A statistical criteria for defining "functional local integration" is therefore a region type for which wage curve elasticities are largest. .

Each of these measurement concerns can be addressed by respectively introducing appropriate fixed effects in order to isolate the transitory wage curve effect, and by defining locality according to geographic regions that are known to operate as separate labour markets. However, knowledge about functional local labour market size is not necessarily available, as acknowledged by Kingdon & Knight (2006a). Alternatively, one could instrument to account for this type of measurement error. Apart from inappropriate reach, choosing local labour market demarcations that are too small may also lead to attenuation bias related to the sampling frame: if surveys are stratified to be representative of geographic regions that are larger than chosen areas, unemployment rates may be constructed with too few observations to reflect the population of that place. A trade-off exists in calculating representative unemployment rates for fewer, larger regions, and having greater cross sectional variation achieved by calculating more unemployment rates for smaller regions. Instrumentation is therefore vital to account for all types of measurement error.

While instrumental variables (IV) are commonly used in the wage curve literature, the purpose is never explicitly related to measurement error. Rather, researchers instrument to account for possible bi-directional causality that introduces additional bias to estimates. Kingdon & Knight (2006a) argue that wages that are bargained beyond market-clearing levels induce higher unemployment, a proposition that others

have also suggested to be true for South Africa (Fedderke, 2012). Consequently, estimates of wave curve elasticities will be biased toward zero. Kingdon & Knight (2006a) illustrate this by their use of cluster-level indicators as instruments.

The standard IV approach followed in this literature assumes that local unemployment rates are predetermined, so that time lags thereof are used as instruments for current values (Baltagi et al., 2012). In the absence of a time dimension in the data, Kingdon & Knight (2006a) did not follow this route. While fixed effects reduced wage curves estimates to insignificance in Turkey, adding lagged instruments brings them back in line with the normal benchmark of -0.1 (Baltagi et al., 2012). This confirms the direction of bias resulting from reverse causality. However, IV results ignore the measurement error issues discussed here. If, for instance, the same incorrect labour market demarcation is used in *all* periods, measurement errors will surely be correlated over time, rendering the IV endogenous and estimates inconsistent. Additionally, if a large component of unemployment rates is time persistent, adding fixed effects will strip substantial variation from both the current and lag periods. The results in a weak instrument. Each of these factors calls for alternative instrumentation strategies. This paper explores the use of two other instruments[8].

Firstly, a spatial discontinuity is exploited: unemployment rates jump at former apartheid homeland borders. They increase, the further they are from the border *within* homelands, while they decrease with distance *outside* the homelands. However, this instrument is time-invariant and correlated with labour market demarcations, so that it is not compatible with fixed effects estimation. Secondly, spatial lags of unemployment rates are used as instruments. Magisterial district unemployment rates are weighted within a pre-determined radius (of 200km) from the centroid of the district[9]. Weights are represented by the inverse of the distance between the centroid of one magisterial district from the centroid of another. In so doing, information that is spatially distant is given less weight in the composite unemployment rates, under the assumption that variables have greater influence on each other, the closer the geographic proximity (Arbia, 2006). Magruder (2012) instruments for bargaining council status in a magisterial district with the status in a

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[8] A third approach was also followed unsuccessfully, and is not shown in the text. Rainfall deviations from a long-run trend, as collected by Matsuura & Willmot (2012) are potentially correlated with labour market conditions in developing countries. However, given the diminishing role of agriculture in the economy, it is no surprise that this was a weak instrument, regardless of specification.

[9] Robustness checks use other radii. However, the instrument is weak at other intervals.

larger district council, similarly to this approach. However, if the local labour market is in actual fact larger than the boundaries of the magisterial district, wages will be directly influenced by unemployment rates further afield, so that this may potentially result in an endogenous instrument. These eventualities are discussed where necessary.

4.   Data and approach

To explore these potential problems with wage curve estimates, we turn to the context of Kingdon & Knight (2006a), who find a wage curve for South Africa using cross sectional data in 1993. While they are able to estimate unemployment rates for fairly small geographical regions – survey clusters, which are smaller than magisterial districts (as in Figure 1) – their use of a cross section survey prevents them from controlling for fixed effects at that same spatial level. They therefore estimate approximately 360 cluster level unemployment rates and include only 9 provincial fixed effects.

The current study updates the evidence of Kingdon & Knight (2006a) by employing a series of cross sections from South Africa's Labour Force Surveys, enumerated twice yearly in March and September by Statistics South Africa. The period spans September 2000 to March 2004, and is able to capture short-run changes in earnings and unemployment. These particular rounds have been chosen because they allow for the identification of individuals' place of residence by various classifications (the smallest being magisterial districts as in Figure 1, then larger district councils as in Figure 2 and finally provinces as in Figure 3).[10] The various demarcations allow for potential local labour markets of various sizes to be differentiated, as well as multiple levels of regional heterogeneity. Furthermore, this period is known for consistent measurement of labour market status and earnings over time (Burger & Yu, 2006). While this time was marked by robust economic growth, unemployment continued to rise concurrently. It is therefore of interest to know whether wages moderated in response to growing unemployment – or whether they tracked positive economic

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[10] Magisterial districts are administrative boundaries that were adhered to in the apartheid era. However, many post-apartheid sampling frames used these small units, and data in various years can be linked at this geographic level. District councils are new administrative boundaries that were introduced in the post-apartheid era for the purposes of local government: they oversee smaller local municipalities. These 55 regions are larger than the magisterial districts, and are mostly comprised of a number of former magisterial districts. South Africa has a second tier of governance, divided into 9 provinces since 1994. Other rounds of the LFS cannot be linked to magisterial districts or other small regions, without additional information. Later datasets, such as the National Income Dynamics Study, enable precise location of households if secure data is retrieved. At the time of writing, this option was not yet available.

growth more closely. Furthermore, the empirical analysis seeks to understand whether the existence of high long-run unemployment influences the wage setting relationship.

Unemployment rates are based on the broad definition, following the recommendation of Kingdon & Knight (2006b). Discouraged workers are classified as part of the labour market through their similarities to the searching unemployed and also because wage setters appear to take the stock of discouraged workers into account when framing their decisions. Individual monthly log earnings are used with a log-log specification, so that the coefficient of interest represents an elasticity. Standard Mincerian controls are included, as well as region-level covariates, in much the same way that Kingdon & Knight (2006a) did.

Initially, specifications probe the question whether wage setters are more likely to respond to unemployment rates of small regions within which they live or operate their business operations (magisterial districts), or whether they take information from larger areas into account. Should the latter be true, it suggests that labour markets are not as small as magisterial districts, and that mechanisms that centralize wage setting (such as bargaining and networks) are at play. In each of these specifications, the role of spatial heterogeneity is tested, to understand whether the high levels of wage flexibility previously recorded for South Africa is transitory or long-term. Instrumental variables account for using potentially inappropriate labour market demarcations and other measurement errors, as well as reverse causality. Results are differentiated by race and gender, in order to establish whether demographic groups have specific responses to (geographically) local labour markets in their wage demands[11]. If labour markets are still segmented by race (as was the case under the apartheid dispensation), then it can be expected that blacks respond to overall labour market conditions most acutely, as they also make up the majority of the population (both the employed and unemployed). Other groups, in contrast, may not factor overall labour market conditions into their wage setting agreements if they do not fall within the network of the majority of the population. Additional

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[11] Race and gender are obvious classifications, as they distinguish very separate groups within the labour market. However, as Baltagi et al. (2012) show for Turkey, skills, age and education may present appropriate categorizations. Younger, less educated workers there are more responsive to high unemployment, likely due to their limited bargaining power. Kingdon & Knight (2006a) also present separate estimates for the black sub-population, as well as various demographic groups. While each of these heterogeneous effects is potentially very real in the South African context, the separation of effects by sub-group is limited to two additional cases in appendices. Appendix A considers differences by union membership and firm size.

analysis in Appendix A also reports separate elasticities by individuals' unionization status, as well as the size of the firm that they work in, in order to understand the role that collective bargaining plays in wage flexibility[12].

A priori expectations suggest that functional local labour markets may be defined at the district council level (and in some cases magisterial districts), for the simple reason that bargaining councils are defined by these boundaries, and have been effectively used in the identification strategy of labour market effects elsewhere (Magruder, 2012).

The core focus of this research is therefore two-fold. Firstly, the goal is to separate long-run from short-run estimates of wage flexibility, while also establishing whether bargaining arrangements have any role to play in their size. Secondly, important econometric considerations are highlighted in order to find credible estimates of wage flexibility: spatial heterogeneity, the delineation of functional labour markets to minimise measurement error, as well as instrumentation for reverse causality are emphasised.

5. Results

Table 2 highlights various racial groups' wage setting responses to local unemployment rates of the entire population in their region (where locality is defined at three levels: magisterial districts, district councils and provinces). These results emphasise two important econometric considerations: firstly, that the size of the region at which unemployment is measured matters for conclusions on the extent of wage flexibility; secondly, that accounting for unobserved time-invariant spatial heterogeneity influences the sign and statistical significance of wage curve estimates in the South African context. A third, behavioural feature also becomes apparent, in that racial groups are not equally sensitive to overall labour market conditions within a relevant region. In addition, the role of reverse causality and measurement error is investigated with instrumental variables' estimates later in Table 3, in order to test the econometric robustness of conclusions.

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[12] Bargaining councils are not measured directly as is done by Bhorat et al. (2012). Only union status is contained in the data. Given the larger role for sectoral agreements in wage determination in South Africa than for unions directly, this proxy for collective bargaining is poor.

Table 2 OLS wage curve estimates with various regional unemployment rates and fixed effects specifications, by race and gender

Dependent variable: *log(monthly earnings)* OLS	1	2	3	4	5	6	7	8	9
Unemployment region	Magisterial district (x354)				District council (x55)			Province (x9)	
Wage curve elasticity — Coefficient on *log(broad unemployment rate)* by group — Black male	-0.076* (0.040)	-0.082** (0.033)	-0.074** (0.032)	-0.004 (0.029)	-0.148 (0.095)	-0.114* (0.063)	-0.041 (0.069)	0.089 (0.166)	0.173 (0.152)
Black female	-0.067 (0.041)	-0.075** (0.038)	-0.067** (0.034)	-0.028 (0.038)	-0.104 (0.098)	-0.086 (0.092)	-0.027 (0.097)	0.014 (0.145)	0.106 (0.137)
Coloured male	0.029 (0.043)	0.081* (0.042)	0.071** (0.035)	0.062* (0.033)	-0.141** (0.068)	0.013 (0.072)	0.071 (0.076)	0.174* (0.083)	0.348* (0.181)
Coloured female	0.014 (0.059)	0.061 (0.060)	0.051 (0.051)	0.043 (0.048)	-0.188** (0.093)	-0.037 (0.090)	0.021 (0.090)	0.067 (0.113)	0.243 (0.206)
Indian male	0.101 (0.075)	0.075 (0.062)	0.071 (0.062)	-0.025 (0.073)	0.172 (0.138)	0.140 (0.135)	0.207 (0.149)	-0.103 (0.166)	0.010 (0.176)
Indian female	0.103 (0.073)	0.076 (0.059)	0.069 (0.053)	-0.038 (0.053)	0.115 (0.236)	0.069 (0.213)	0.137 (0.215)	-0.172 (0.285)	-0.067 (0.312)
White male	0.106** (0.048)	0.128*** (0.041)	0.128*** (0.039)	0.146*** (0.039)	0.078 (0.078)	0.159** (0.070)	0.218*** (0.078)	0.264 (0.146)	0.423** (0.153)
White female	0.128*** (0.039)	0.160*** (0.035)	0.155*** (0.036)	0.169*** (0.038)	0.114 (0.070)	0.212*** (0.065)	0.271*** (0.076)	0.326** (0.130)	0.489** (0.193)
Age	0.107*** (0.003)	0.107*** (0.003)	0.106*** (0.003)	0.104*** (0.003)	0.108*** (0.005)	0.108*** (0.005)	0.107*** (0.005)	0.110*** (0.007)	0.110*** (0.007)
Age^2	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Education	-0.030*** (0.004)	-0.029*** (0.004)	-0.030*** (0.004)	-0.030*** (0.004)	-0.025*** (0.006)	-0.025*** (0.005)	-0.026*** (0.005)	-0.019* (0.009)	-0.020* (0.009)
Education^2	0.011*** (0.000)	0.010*** (0.000)	0.011*** (0.000)	0.011*** (0.000)	0.011*** (0.000)	0.010*** (0.000)	0.011*** (0.000)	0.010*** (0.001)	0.010*** (0.001)
Period FE & Race x Gender FE & Region	Y	Y	Y	Y	Y	Y	Y	Y	Y
Province FE	N	Y	N	N	N	Y	N	N	Y
DC FE	N	N	Y	N	N	N	Y	N	N
MD FE	N	N	N	Y	N	N	N	N	N
Constant	3.581***	3.424***	3.447***	3.656***	3.059***	2.488***	2.800***	4.939**	1.527**
R-squared	0.538	0.543	0.547	0.556	0.535	0.539	0.542	0.529	0.53
N	186353	186353	186353	186353	186731	186731	186731	186731	186731

NOTES: * p<0.1, ** p<0.05, *** p<0.01. Own calculations from LFS 2000b to 2004a. Monthly earnings measured at individual level and deflated by national CPI. Unempl measured by broad definition, at geographic level indicated in headings. Additional controls for *regional education composition, regional occupation composition, regional sector composition*. Standard errors, clustered at geographic level at which unemployment is measured, in parentheses.

5.1. Local labour market size

Column 1 of table 2 shows estimates of the responsiveness of individual wages to overall broad unemployment rates within magisterial districts, with separate elasticities estimated by race and gender. No geographic fixed effects are included. Since magisterial districts are the smallest geographic units observed in labour market data, it is also the smallest possible labour market definition that can be delineated by this study. While Figure 1 highlights that, broadly speaking, adjacent magisterial districts have similar unemployment rates, in some cases aggregating to larger geographic regions would potentially introduce measurement error of the kind that is analysed in equation (9) above.

Results for the black population group are discussed first. Kingdon & Knight (2006a), whilst not including appropriate spatial fixed effects, found a wage curve for the population as a whole, with a slightly weaker estimate for the black sub-population[13]. Newer data used in this study delivers a similar result, with an elasticity of -0.076 for black males. This estimate is statistically different from zero at the 10 per cent level of significance, and is reasonably close to the standard magnitude of -0.1 found in the international literature. The elasticity for black females is only slightly smaller, but statistically insignificant. However, both genders have elasticities that are not statistically different from -0.1, while this proposition is rejected for all other demographic groups. Hence, the focus of the discussion remains on the black sub-population, and differences noticeable for other groups are highlighted below, where relevant.

Moving to column 5, where unemployment is estimated at the district council level (but no fixed effects are accounted for), the wage curve estimates are about twice the magnitude in absolute value compared to when magisterial districts unemployment rates are used. However, estimates are also less precise. While the coefficients are not statistically different from zero at conventional significance levels, they are also not statistically distinguishable from -0.1. In sum, moving to the district council level has raised wage curve estimates, but also raised standard errors. Because wage curve magnitudes are more negative when using district council unemployment rates,

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[13] In results not shown, the specification of choice does not render a wage curve for the population as a whole, with or without spatial fixed effects. This is also reflected in the lack of wage curve behaviour for the other population groups.

predictions from equation (9) suggest that this demarcation is a more appropriate labour market definition than magisterial districts for the black population group.

In column 8, where provincial unemployment rates are used in estimation (without any fixed effects), the estimated wage curve coefficients for the black population group turns positive regardless of gender. Importantly, moving to this larger regional demarcation also results in a shift away from a large negative baseline coefficient that is obtained using smaller geographic demarcations. This may be explained by measurement error that is introduced by choosing a labour market definition that is too large in geographic reach. It appears that, when unemployment rates are calculated for geographically large regions (but where sub-regions display large levels of heterogeneity within these borders), coefficient sizes move away from the the usual magnitude of of -0.1 towards zero, as equation (9) predicts[14].

Given that the largest negative value is obtained for estimates using district council unemployment rates, this appears to be the most optimal labour market definition that can possibly be discerned in the data[15]. Both smaller and larger labour market demarcations yield less negative estimates; one possible reason is that measurement error from using other labour market demarcations is present. However, estimates using magisterial districts also yield wage curve behaviour for the black population group. Elasticities are smaller, yet more efficiently estimated. As a result, both demarcations could potentially be considered as "local" labour markets from an empirical perspective. However, as discussed below, Table 3 illustrates that instrumental variables estimation raises magisterial district elasticities to similar levels as district council elasticities. Hence, measurement error problems can potentially be solved using instruments, despite "wrong" definitions of local labour markets. While magisterial district unemployment rates do give us good answers, district councils meet the criteria of equation 9 best.

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[14] Equation (9) predicts that the coefficient would tend to zero and not necessarily switch to a positive value, so that factors other than labour market definition are also at play here. Nevertheless, these estimates indicate that provinces do not define labour markets well for the black population group.

[15] The premise of this argument is that the "empirical law" of wage curves (Blanchflower & Oswald, 2008) is true within the research context, and that any estimates that approach this benchmark model a situation that most closely reflects the real data generating process. This is the idea that underlies the work of Kingdon & Knight (2006b) in motivating that discouraged workers should be classified as unemployed in South Africa. Only after an appropriate regional unemployment definition is established in this manner is the notion of a short-run wage curve dispelled for South Africa below. This result holds, regardless of demarcations used, so that solving other econometric problems to some extent makes the definition of the local labour market demarcation less influential for final conclusions.

This appears to suggest that wages of black workers are more likely to respond to unemployment rates of small regions within which they live (magisterial districts and district councils), rather than responding to information from larger areas such as the provinces. However, further analysis of the spatial dimension of labour markets is required before a conclusion can be drawn. Similar observations hold for coloured males and females, while no wage curve is evident for Indians and whites.

5.2.   The importance of taking account of spatial heterogeneity

Turning to the second concern, the importance of spatial heterogeneity is clearly illustrated in the South African context. The goal is to net out long-run effects, so that wage curves only reflect short-run behaviour. For each of the specifications, unobserved spatial heterogeneity is accounted for, starting with fixed effects for provinces, and progressing to those for smaller regions (district councils and magisterial districts).

Column 2 in table 2 is akin to the estimation of Kingdon & Knight (2006a), where *magisterial* district unemployment rates are used with *provincial* fixed effects. Notably, relative to the estimate in column 1, the point estimate of -0.082 in column 2 for black males is hardly different, though it is more efficiently estimated. Therefore, the results in column 2, though using similar methods, align quite closely with the estimates for 1993 by Kingdon & Knight (2006a), where a wage curve elasticity of -0.072 is found for black South Africans.

However, given the concerns highlighted in equations (6) and (7), it is desirable to account for fixed effects of geographically smaller regions. Column 3 does so by using district council fixed effects, raising the number of fixed effects from 9 to 55. Again, the coefficient estimates are not substantially influenced. At this juncture one might want to conclude that black South African wage setters are highly responsive to local unemployment rates; furthermore one might want to conclude that the findings from meta-analyses (Nijkamp & Poot, 2005) that fixed effects do not alter conclusions, apply in this country also.

However – and this is the key point – the multiple time periods in the data allow for the inclusion of *magisterial district* fixed effects that match the spatial level of the unemployment rates. In column 4 the coefficient for the black population becomes statistically insignificant, and is now also distinguishable from -0.1 at the 1% level. This estimate suggests that, once appropriate controls for spatial heterogeneity are

included, black South Africans do not exhibit short-run wage curve behaviour (i.e. wage sensitivity to unemployment rates in the relevant labour market). The the negative relationship found in results *without* the inclusion of fixed effects in column 1 represents the *combination* of short-run and long-run wage curves. When fixed effects *are* specified (in order to net out long-run relationships), wages do not respond to slack local labour market conditions. Hence, results without fixed effects are dominated by a *long-run* trade-off between wages and local unemployment rates that does not manifest in the short-run. In the light of equation (6), 'finer' fixed effects reduce the inconsistency that rougher fixed effects cannot. In fact, these estimates concur with the assertions that wages are inflexible in the short-run and that high unemployment rates do not influence how wage demands are formed (Fedderke, 2012).

Rather, one might argue, it may be that collective bargaining and unionization lead to simultaneously higher wages and unemployment and an inflexible labour market in the short run. Magruder (2012) emphasises that these institutions explain only short-run rigidities. Structural (or long-run) labour market outcomes are, instead, driven by long-run shifts in factor demands (Bhorat and Hodge, 1999). The permanent effects of labour market institutions on employment and wages are not studied here, though the results in Figure 4 (that are discussed below) suggest that high unemployment regions do eventually offer lower wages in the long-run, despite the presence of bargaining arrangements. Results in Appendix A further explore the proposition that bargaining is influential for short-run rigidity. They show that the zero effect that is observed here is not necessarily applicable to all categories of workers. In particular, the overall zero effect is primarily due to the dominant behaviour of union members in larger firms. Non-unionized workers do appear to be responsive to local labour market conditions, though they are less sensitive to local unemployment when they work in large firms. (Collective bargaining agreements are extended to such workers, and thereby contributes to wage inflexibility.)

A similar exercise is repeated for unemployment rates estimated for larger regions. Column 6 introduces provincial fixed effects when unemployment is estimated at the district council level, with inconsequential changes in the wage curve magnitude. However, once district council fixed effects are introduced in column 7, the estimate collapses to a magnitude that is statistically indistinguishable from zero. Notwithstanding, the coefficient is ten times the size of estimates using magisterial district unemployment rates with appropriate fixed effects.

Provincial fixed effects - when estimating unemployment rates for the same region type (in column 9) - do not alter magnitudes substantially, but this is from a baseline estimate in column 8 that was already positive.

In sum, spatially finer fixed effects tend to reduce the bias in wage curve estimates in South Africa, and provincial unemployment rates are inadequate at capturing local labour market conditions. All specifications indicate that a short-run wage curve is unlikely for all races and genders, though this average effect masks some segmentation: non-unionised workers and those working in smaller firms are more likely to adjust wages in response to high local unemployment rates.

Up to this point, only wage curve estimates for the black population group were reported. This is because this group constitutes a majority of the population and also dominates the overall unemployment rate used in these estimates. Other groups are not as responsive in their wage setting to the overall unemployment rate within their regions. Regardless of specification, estimates for the white population group are positive and statistically significant in most instances. They are, however, always statistically distinguishable from -0.1. These results suggest that white individuals constitute a distinct labour market, and that they potentially temper their wages only when unemployment is high within their *own* ethno-demographic network. Investigation of this type of segmentation is relegated to future work.

5.3. Measurement error and reverse causality

The fixed effect analysis does not account for measurement error explicitly, nor for reverse causality. To attend to these, table 3 presents instrumental variables' estimates, with and without spatial fixed effects[16]. Results without fixed effects are discussed first, in order to understand only the role of measurement error and reverse causality. Specification 10 follows the standard in the literature, by using the time-lagged log of the unemployment rate as an instrument for contemporaneous local unemployment. Instruments are strong, with a first stage F statistic of 183.81, and with the Hausmann test concluding that results differ significantly from the OLS estimates. As is standard, instrumentation increases the absolute value of the wage curve elasticity, indicating higher wage flexibility (Baltagi et al., 2012; Kingdon &

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[16] Instead of a two-stage least squares (2SLS) estimator, a control function approach is followed. In the first stage unemployment model, no differentiation by race and gender is introduced. The second stage contains a residual from the first, but allows the instrumented variable to be interacted with demographic classifications. While standard errors should be adjusted to be more conservative, this is not implemented here (Imbens & Wooldridge, 2007).

Knight, 2006a). While it is possible that reverse causality is eliminated, it is also likely that measurement error associated with incorrectly chosen demarcations is accounted for. For instance: the estimates for black males and females in specification 10 in Table 3 (using instrumented magisterial district unemployment rates without fixed effects) are very close to comparable estimates in specification 5 in table 2 (using district council unemployment rates without instruments or fixed effects). Recall that the results in table 2 established that district councils are (according to statistical criteria) the most informative labour market demarcation, while smaller magisterial districts are slightly less optimal. Hence, it is possible that the instrumentation strategy serves as a correction for using a labour market demarcation that is too small (magisterial district level), yielding estimates that would have arisen had a more natural labour market definition been chosen (i.e. district council level).

Using the homeland border discontinuity as an instrument yields even larger estimates, with wage curve behaviour now emerging for all race and gender groups (specification 11). The spatially lagged unemployment instrument provides a comparable specification in column 12. Similar identification strategies, using district councils as unemployment regions, also yield large wage curve elasticities in columns 15 and 16. Geographic instruments therefore appear to be a potentially fruitful alternative to time lags.

Results from instrumental variables' estimates show greater wage flexibility than with OLS. This clearly illustrates that measurement error and reverse causality could be highly detrimental in wage-curve estimation in South Africa if not dealt with properly, resulting in downward-biased results. However, the instruments have not removed all forms of endogeneity – compare how section 5.2. illustrates the importance of spatial heterogeneity for estimates. For instance, contemporaneous and lagged unemployment rates both contain a common time persistent, structural component. Should this be correlated in any way with wage fixed effects, IV estimates remain inconsistent. It is likely that long-run wages are related to long-run unemployment, so that corrections for spatial heterogeneity are required in IV estimates of this kind also.

Specifications 13, 14, 18 and 19 use instruments *and* introduce appropriate fixed effects for magisterial districts and district councils respectively. Time and spatial lags are used as instruments, though the homeland border discontinuity is discarded

due to its time-invariance and perfect collinearity with spatial fixed effects. For both demarcations, time lags yield large negative (but statistically insignificant) wage curve estimates. The instruments are, however, particularly weak, with first stage F statistics below 1. As a result, these large, inefficient estimates are biased and inconsistent. Given that the first and second stages are stripped of the time-persistent component of unemployment by the introduction of fixed effects, the correlation between the transient components in consecutive periods is poor. While other studies successfully use this instrumentation strategy with fixed effects (Baltagi et al., 2012), it is not useful when local unemployment is structural and permanent in nature, with little of the variation occurring across *time*.

Alternatively, specification 14 uses the *spatial* lag as an instrumental variable for local unemployment. Variation across space remains intact after fixed effects remove individual means over time. Instruments are now strong, with a first stage F statistic of 22.99. The Hausmann test reveals that introducing instruments to the fixed effects specification has, however, *not* changed estimates compared to specification 4, so that wages remain inflexible in the short run. Elasticities are either statistically insignificant or positively significant for the various demographic groups. The same estimate using district council unemployment rates again yields large and insignificant elasticities, though the instrument is again weak.

In all cases when instruments are weak, elasticities are overstated; whenever they are strong, elasticities are closer to zero once fixed effects are introduced. While the potential exists that the spatial lag is nevertheless endogenous to wages [17], specification 14 is the best estimate that attempts to solve for each of spatial heterogeneity, reverse causality and measurement error. Even without instrumentation, spatial fixed effects reduce the wage curve elasticity to zero. The implication of these estimates is that wages are not responsive to local unemployment in South Africa in the short run, concurring with the sentiments of Fedderke (2012), but rejecting earlier evidence by Kingdon & Knight (2006a) on econometric grounds.

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[17] If wage setters actually take larger regions' unemployment rates into account when bargaining, the instrument will be correlated with wages *directly*, rather than indirectly through own-district unemployment. As a result, the exclusion restriction may be violated.

Table 3 Instrumental Variables wage curve estimates with various regional unemployment rates and fixed effects specifications, by race and gender

Dep var: *log(monthly earn)*		10	11	12	13	14	15	16	17	18	19
Unemployment region		Magisterial district (x354)					District council (x55)				
Instrumental variable		Time lag	Border	Spatial	Time lag	Spatial	Time lag	Border	Spatial	Time lag	Spatial
	Black male	-0.141**	-0.329***	-0.320**	-0.828	0.027	-0.294**	-0.496***	-0.046	-0.230	-0.809
		(0.063)	(0.093)	(0.141)	(3.344)	(0.089)	(0.120)	(0.163)	(0.349)	(1.142)	(2.541)
	Black female	-0.144**	-0.324***	-0.316**	-0.859	0.003	-0.263**	-0.445***	-0.002	-0.226	-0.795
		(0.057)	(0.088)	(0.134)	(3.347)	(0.090)	(0.108)	(0.165)	(0.315)	(1.145)	(2.529)
	Coloured male	-0.036	-0.236***	-0.258*	-0.759	0.073	-0.328***	-0.384***	-0.038	-0.141	-0.697
		(0.063)	(0.083)	(0.132)	(3.344)	(0.081)	(0.096)	(0.134)	(0.335)	(1.168)	(2.539)
	Coloured female	-0.060	-0.274***	-0.294**	-0.784	0.035	-0.371***	-0.422***	-0.084	-0.192	-0.746
		(0.078)	(0.085)	(0.136)	(3.346)	(0.081)	(0.121)	(0.144)	(0.350)	(1.158)	(2.553)
	Indian male	0.024	-0.142*	-0.131	-0.859	0.009	0.056	-0.124	0.274	0.043	-0.560
		(0.091)	(0.083)	(0.155)	(3.352)	(0.104)	(0.190)	(0.136)	(0.332)	(1.182)	(2.535)
	Indian female	0.022	-0.143*	-0.131	-0.880	-0.005	-0.082	-0.179	0.219	-0.107	-0.630
		(0.090)	(0.081)	(0.150)	(3.355)	(0.093)	(0.240)	(0.229)	(0.356)	(1.197)	(2.546)
	White male	0.067	-0.107	-0.135	-0.657	0.179**	-0.020	-0.163	0.177	0.065	-0.550
		(0.071)	(0.103)	(0.137)	(3.354)	(0.090)	(0.094)	(0.151)	(0.335)	(1.151)	(2.534)
	White female	0.052	-0.077	-0.107	-0.668	0.212**	-0.048	-0.100	0.213	0.061	-0.497
		(0.051)	(0.095)	(0.135)	(3.345)	(0.092)	(0.088)	(0.146)	(0.333)	(1.160)	(2.556)
Period FE		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Race x Gender FE		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Other Controls		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
DC FE (x55)		N	N	N	N	N	N	N	N	Y	Y
MD FE (x354)		N	N	N	Y	Y	N	N	N	N	N
Constant		3.471***	2.576***	2.588***	2.394	3.693***	2.243**	1.566	3.598*	2.466	0.528
R-squared		0.542	0.547	0.546	0.561	0.563	0.541	0.544	0.535	0.547	0.542
N		161843	173362	172618	161843	172618	162389	173740	186731	162389	186731
p-value of Hausmann test		0.063*	0.001***	0.049**	0.805	0.731	0.057*	0.048**	0.749	0.866	0.768
F statistic of first stage		183.81	30.908	47.31	0.044	22.99	47.532	27.713	14.139	0.031	0.005

The leftmost vertical labels read: "Wage curve elasticity", "Coefficient on", "log(broad unemployment rate)".

NOTES: * $p<0.1$, ** $p<0.05$, *** $p<0.01$. Own calculations from LFS 2000b to 2004a. Monthly individual earnings deflated by national CPI. Broad Unempl measured at geographic level indicated in headings. Additional controls: *Age, Age², Educ, Educ², region educ composition, region occup composition, region sector composition.* Standard errors, clustered at geographic level, in parentheses. Control functions do not adjust standard errors in 2nd stage. Border IV measures straight line between regional centroid and closest former apartheid homeland border, with a discontinuity at the border. Spatial lag IV represents the spatially weighted unemployment rate within a radius of 200km of regional centroid. Time lag IV represents previous period's unemployment rate within same region.

5.4. Long-run flexibility

It is frequently argued that South Africa's unemployment problem is structural, so that long-run factors are salient in its analysis (Bhorat & Hodge, 1999). As noted above, accounting for fixed effects separates the long-run from the short-run wage curve: the high wage flexibility recorded by Kingdon & Knight (2006a) may confound a true zero short-run effect with a long-run trade-off between wages and unemployment, in much the same manner as in Nordic countries (Albaek et al., 2000). This section investigates the possibility that the labour market does adjust over the long-run, as noted above for other countries.

Figure 4 plots the wage fixed effects from various specifications against magisterial district unemployment rates[18].
a) Specification 4 from Table 2 (with no instruments, indicated as "No IV") yields fixed effects that are negatively related to local unemployment rates.
b) Similarly, specification 14 from Table 3 (with spatially lagged instruments: "Spatial lag IV") yields a negative long-run relationship.

In both of cases (a) and (b), a zero effect was found for short-run wage curve estimates.
c) In contrast, specification 10 from Table 3 ("Time lag IV") yields an insignificantly negative (but biased) short-run elasticity, but with a positive relationship in the long-run shown in the figure.

The most trustworthy estimates (accounting all forms of endogeneity with fixed effects and instruments that are strong as in case (b)) therefore point to zero short-run wage flexibility, but a long-run trade-off (flexibility) between wages and regional unemployment. Parametric estimates of the long-run elasticity (which are not shown) depicted in Figure 4 are remarkably close to -0.1.

Biased estimates (as in case (c)) usually show that a short-run wage curve exists, but this occurs together with a long-run spatial scenario that would agree with migration models in the Harris & Todaro (1970) tradition. Kingdon & Knight (2006a) therefore produce results that confound the short-run inflexibility of wages with a long-run scenario that may reflect migration to regions with relatively high wages and low unemployment. The latter explanation, however, requires further investigation, as alternative structural arguments may be equally true.

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[18] This demarcation is used because all instruments were weak when using district councils.
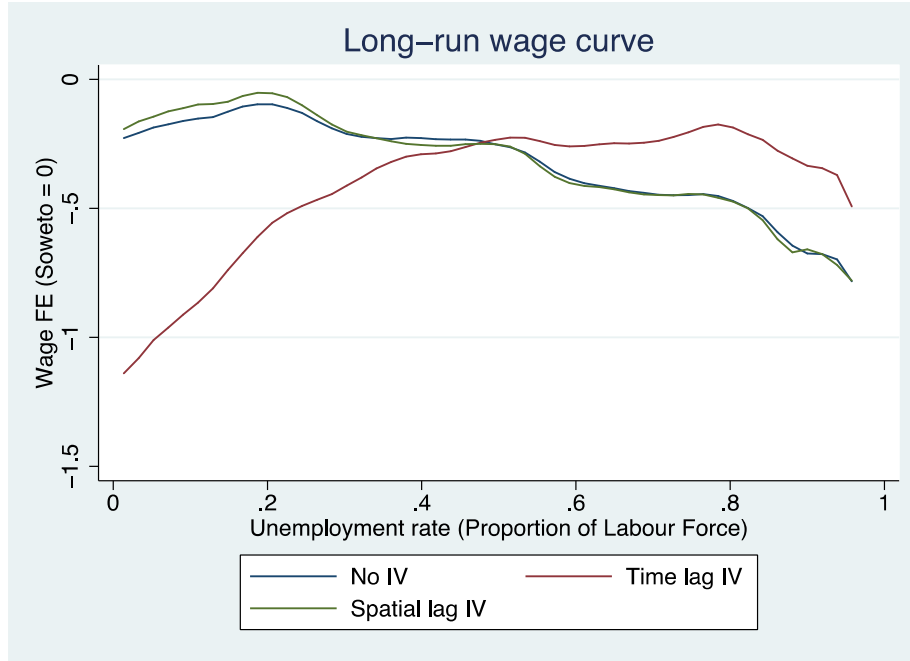
Figure 4 Relationship between wage fixed effects and broad local unemployment rates

NOTES: Own calculations from Labour Force Survey 2000b to 2004a. "No IV" uses fixed effects from specification 4 in Table 1; "Time lag IV" uses fixed effects from specification 10 in Table 3; "Spatial lag IV" uses fixed effects from specification 12 in Table 3. Unemployment is measured by the broad definition, for the whole population, at the magisterial district level

6. Conclusion

While many studies suggest that South Africa has a rigid labour market together with inflexibility in wage determination, some microeconometric research has concluded the opposite (Kingdon & Knight, 2006a). This paper has highlighted the influence of correctly defining "local" labour markets, accounting for spatial heterogeneity and using context-appropriate instrumental variables in order to correctly conclude on wage flexibility across various time horizons. Addressing each of these three methodological aspects removes bias of a different variant, yielding baseline estimates that point to inflexible wages in response to local labour market conditions in the short run. Rather, the trade-off between wages and local unemployment that is found by previous work represents a long-run scenario. Estimates that do not separate long-run from short-run scenarios confound two time horizons, reflecting only the former. This central contribution of this paper produces a new, improved understanding of previous evidence.

The leverage of methodological adjustments on conclusions is briefly summarised. Firstly, this paper has shown that in the short-run wages are not very responsive to local labour market conditions, once appropriate spatial fixed effects net out long-run

effects. This concurs with time series evidence which suggests that, on average[19], South African wage setting appears to be rigid downwards in the short-run (in relation to productivity), but not in the long-run (Klein, 2012).

Secondly, it appears that the best local labour market definition in survey data is the district council. Two potential reasons can be offered for this finding. Smaller magisterial districts may not be adequately sampled in household surveys and mismeasured unemployment rates therefore lead to attenuated wage curve estimates. However, instrumental variables' estimation successfully alleviates this problem. A more plausible explanation is that district councils are more appropriate because collective bargaining agreements often cover regions that are larger than magisterial districts, but smaller than entire provinces. These institutions therefore determine the functional reach of "local" labour markets.

Thirdly, the standard approach of using time lagged instrumental variables is not appropriate in a country where local unemployment is persistent. The lack of short-run variation in unemployment yields weak instruments once long-run effects are netted out. This study demonstrates, and proposes, the use of *spatially*-lagged variables to identify the wage curve in the context of persistence.

Heterogeneous results suggest that the overall zero short-run effect is due to the dominant behaviour of unionized workers, particularly those that work in larger firms. This matches the notion that collective bargaining agreements extend negotiations to entire regions and industries, limiting the adjustment of wages when labour market conditions are slack. In particular, respondents working in small firms exhibit short-run responses to local unemployment. Non-unionized workers as a whole are more flexible in wage setting.

South Africa does not follow the typical developing country pattern due to the high unemployment rate (Fields, 2011) and because the long-run scenario is not characterised by high wage-high unemployment urban regions (Harris & Todaro, 1970). Nor does it strictly comply with the international norm of short-run wage flexibility in response to slack labour market conditions (Blanchflower & Oswald, 2008); this is mainly due to centralized bargaining institutions, as is also the case in Nordic countries (Albaek et al., 2000).

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[19] However, the evidence discussed below suggests heterogeneity in estimates, with greater flexibility arising when bargaining agreements are weaker.

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Appendix A

Short-run inflexibility by industrial structure

Given the evidence of Magruder (2012), the concurrence of missing small formal sector firms, high wages and lower employment can be explained by collective bargaining, as also postulated by Rankin & Stijn (2013). This estimation context further investigates this wage inflexibility, by splitting the sample to understand whether rigidities can be traced to a bargaining channel.

Kingdon & Knight (2006a), for instance, find that the group of union members in South Africa does not exhibit wage curve behaviour, while non-union members do. Blien et al. (2011) show that workers in Western Germany who bargain at a more centralized level, beyond their firm, are less flexible in their wage setting than those that bargain only at the firm level. These arguments are consistent with findings that countries with more centralized bargaining do not have wage curves (Albaek et al., 2000; Daouli et al., 2013).

Table A1 estimates separate wage curve elasticities by workers' unionisation status and by their firm size. Fixed effects estimates, using district council unemployment rates[20], are shown with 95% confidence intervals.

Considering the elasticities for union members and non-unionized workers (without conditioning on firm size) the results of previous studies are confirmed (Kingdon & Knight, 2006a; Blien et al., 2011). Union members are insensitive to local unemployment rates, with positive or statistically insignificant elasticities. These workers tend to raise wage demands despite high local unemployment. The dividend of economic growth over the period of analysis accrued to higher wages of the employed rather than higher levels of employment creation. Results for this group most closely resemble those of the population as a whole, so that wage inflexibility in the South African labour market is associated with union members. Point estimates for non-unionized workers are negative, except for Indian males and white females. While some elasticities are insignificant, their 95% confidence intervals include values well below the international norm of -0.1. Institutional bargaining therefore tends to reduce workers' sensitivity to local labour market conditions.

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[20] This demarcation is chosen, because section 2 shows it to be the most optimal. Instrumentation is avoided here, as instruments are weak at the district council level.

Non-unionized workers may still benefit from bargaining through the extension of wages negotiated by industry bargaining councils and large unions. Because it is not possible to identify whether a worker is subject to a collective bargaining agreement in the data, the effects of this institution are discussed indirectly. Since large unions and large companies usually bargain collectively (Magruder, 2012), the combination of union membership and working in a large firm proxies for this classification. Regardless of union membership, individuals that work in small firms of 1 to 4 employees are sensitive to high local unemployment rates, exhibiting wage curve behaviour (except for unionized Indian males and non-unionized white females). For females, and white and Indian males the point estimates are positive, though their confidence intervals mostly include large negative values. As individuals tend to work in slightly larger firms (5-49 employees), workers' responsiveness to unemployment generally becomes smaller (though some exceptions exist). This is indicative of the prevalence of collective bargaining in these sections of industry. Even the non-unionized display lower sensitivity to regional unemployment rates as they work in larger firms, despite elasticities being muted in all firm size segments. Hence, wage determination is not identical across small firm and large firm sectors, with collective bargaining in the large firm sector diminishing wage flexibility. Furthermore, the influence of collective bargaining in the large firm sector also spills over to members who are not a part of a union, as these agreements are extended to entire industries. These results show that non-union members benefit from collective agreements, while unionized workers additionally gain from firm level negotiations, as illustrated by Bhorat et al. (2012). However, workers in the very largest firms do not display these same patterns, so that the result is not robust.

The sensitivity of small firm workers to local labour market conditions suggests that they are less likely to be covered by collective bargaining agreements, or that compliance in paying collectively negotiated wages is low. The inclusion of the informal sector in these results may explain why bargaining effects do not extend wage inflexibility to small firms, as it does in slightly larger firms. Informal firms are less likely to comply with collective bargaining agreements.

High downward wage flexibility in the small firm sector would also provide a mechanism to at least partially clear the labour market, so that this sector would be a net job creator. However, this contrasts with the conclusions of Magruder (2012), who suggests that small firms' job creation capacity is dimished by the extension of collective bargaining agreements to entire industries. His analysis considers industries that are not typically active in the informal sector. Consequently, the results can be reconciled by the potential that wage curve behaviour amongst small firms is likely to be representative of informal sector workers who

do not benefit from bargaining agreements. This does not, however, provide insight into why the informal sector does not create more jobs in South Africa, despite flexible wages when unemployment is high.

Table A.1 Wage curve elasticities by union and firm size status

Union	Union members				Non-unionized workers			
Firm size	1-4	5-49	50 plus	All	1-4	5-49	50 plus	All
Black male	-0.062	0.000	-0.020	0.185	-0.135	0.020	-0.047	-0.098
	(-0.285 ; 0.160)	(-0.132 ; 0.131)	(-0.149 ; 0.110)	(0.026 ; 0.344)	(-0.275 ; 0.004)	(-0.110 ; 0.149)	(-0.226 ; 0.131)	(-0.211 ; 0.014)
Black female	0.166	0.101	-0.257	-0.033	-0.171	-0.141	-0.365	-0.167
	(-0.136 ; 0.467)	(-0.055 ; 0.256)	(-0.432 ; -0.083)	(-0.204 ; 0.139)	(-0.295 ; -0.047)	(-0.335 ; 0.053)	(-0.547 ; -0.183)	(-0.297 ; -0.038)
Coloured male	-0.146	-0.063	0.029	0.311	-0.158	0.109	0.252	-0.023
	(-0.462 ; 0.170)	(-0.277 ; 0.151)	(-0.100 ; 0.158)	(0.162 ; 0.460)	(-0.343 ; 0.027)	(-0.031 ; 0.250)	(0.115 ; 0.389)	(-0.133 ; 0.088)
Coloured female	0.071	0.129	0.048	0.279	-0.215	0.188	0.163	-0.033
	(-0.271 ; 0.413)	(-0.025 ; 0.282)	(-0.142 ; 0.239)	(0.124 ; 0.434)	(-0.416 ; -0.014)	(-0.001 ; 0.376)	(0.023 ; 0.302)	(-0.156 ; 0.090)
Indian male	0.992	0.200	0.179	0.668	0.308	0.110	-0.048	0.029
	(0.510 ; 1.474)	(-0.285 ; 0.686)	(-0.258 ; 0.616)	(0.365 ; 0.972)	(-0.258 ; 0.875)	(-0.393 ; 0.612)	(-0.604 ; 0.508)	(-0.286 ; 0.343)
Indian female	0.728	0.537	-0.146	0.555	0.345	0.090	-0.476	-0.049
	(-2.116 ; 3.572)	(0.158 ; 0.915)	(-0.726 ; 0.433)	(0.227 ; 0.883)	(-0.337 ; 1.028)	(-0.365 ; 0.546)	(-1.027 ; 0.075)	(-0.437 ; 0.338)
White male	0.244	0.093	-0.102	0.641	0.178	0.157	0.068	-0.011
	(-0.084 ; 0.573)	(-0.086 ; 0.272)	(-0.287 ; 0.082)	(0.411 ; 0.870)	(-0.110 ; 0.465)	(-0.035 ; 0.349)	(-0.157 ; 0.293)	(-0.150 ; 0.127)
White female	0.579	-0.011	-0.177	0.667	0.226	0.377	0.001	0.074
	(-0.090 ; 1.248)	(-0.402 ; 0.379)	(-0.384 ; 0.030)	(0.464 ; 0.870)	(0.063 ; 0.389)	(0.114 ; 0.640)	(-0.210 ; 0.212)	(-0.090 ; 0.238)

NOTES: 95% Confidence intervals in parentheses. Own calculations from LFS Sept 2000 to LFS March 2004. Drawn from a similar specification to table 2, specification 4, but with race-firm size-union-log(unemployment) interactions added, on which these results are based. Monthly earnings measured at the individual level and deflated by a national CPI. Unemployment measured at the magisterial district level (354 in the data) according to the broad definition. Additional controls for *education and its square, age and its square, magisterial district education composition, magisterial district occupation composition, magisterial district sector composition, magisterial district union density, magisterial district firm size concentration*. Standard errors are clustered at the geographic level at which unemployment is measured.