Labor Demand in the Post-apartheid South African Wine Industry[1]

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Running title: **Labor demand in Post-apartheid SA Wine Farms**

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Abstract
In 2013 the minimum wage for farm workers in South Africa increased by an unprecedented 51%. This paper uses data on 77 Western Cape wine grape farms, for 2005-2015, to estimate the impacts on employment. Earlier post-apartheid labor market reforms increased minimum wages substantially, but renewed access to global markets increased demand and this protected jobs in the wine industry, however, by 2005 this growth had largely ceased. A long run wage elasticity of -0.38 was found for permanent workers, but for casuals the figure was -4.73, that is the 51% increase in the wage is expected to reduce casual employment by 240%. Thus, casual workers, who are the poorest and most vulnerable, lose both in terms of jobs and income, whereas permanent staff gain. Thus, the minimum wage changes are likely to increase the gap between privileged permanent staff and the casual workers as these bear all the adjustment costs. This result is not so surprising in view of the long-standing interdependence of farmers and their permanent workers in South African wine grape production. Thus, it is highly unlikely that minimum wage legislation will improve the welfare of workers.

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Keywords: Western Cape wine industry, wage elasticities, rural livelihoods

Supporting documents

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1. Introduction

Black laborers in South Africa were subject to an elaborate system of domination and control under apartheid (Wolpe, 1972) and collective action was illegal until the late 1970s (Adler and Webster, 1995). Yet even when industrial workers started to gain these basic rights, agricultural labor remained exempt and the living and working conditions of these workers only improved after 1994. Just prior to the end of apartheid, the government passed the Agricultural Labour Act (Act 14 of 1993) although this was generally regarded as an ineffectual piece of legislation. Since the election of the democratic government in 1994 five main pieces of labor legislation have been enacted, the most important of which is the Basic Conditions of Employment Act (Act 75 of 1997). Included in this Act was the requirement that all employment contracts had to be in writing and regulations regarding leave, etc. clearly stated. This Act also introduced a statutory minimum wage for agriculture, which was introduced in 2003.[2]

Evidence of the short run adjustment to these reforms is mixed and the long run outcomes are unknown, although it is clear that the interpretation of these reforms differed across the country. For example, in KwaZulu-Natal Province these labor reforms destroyed many permanent jobs mainly because farmers understood the Tenure Act to be a potential land grab (Newman et al., 1997; Sparrow et al., 2008). However, more generally, the effect of these reforms is poorly documented. Thus, the current discussions about the impact of a universal minimum wage for agriculture of ZAR3500 (US$250) per month are based on limited empirical evidence.

By modern standards, South Africa retains a unique farm labor market. Family farms are still the dominant form, but usually black staff do the work on the farm under the supervision and management of the white owners. Tied housing on the property means the workers live in close proximity to their employers and this has bound the two groups together in mutual obligations that go beyond the typical employment contract (Du Toit, 1993). Du Toit (1993; 320) described the paternalism on wine farms as a position of:

> " '*pa staan vir die werkers*': quite literally, 'occupying the place of the father', 'taking responsibility'. But even when it is not explicitly conceptualised in this way, this 'organic' interpretation saturates the discourse of farmers and farm workers alike. To start work on a farm is not merely to enter a business relationship, it is to become *deel van een familie* (part of one family), even *deel van die plaas* (part of the farm)."

One way in which farmers took responsibility for their staff was to supplement cash wages with a range of goods and services considered necessary for a decent life, which ranged from medical and day care and funeral benefits to free housing and electricity, water, garbage disposal, firewood and farm shops (Van der Merwe, 1976; Conradie, 2005b). Although widely criticised, this paternalistic relationship has been remarkably resistant to reform

[2] Also influential was the Security of Tenure Act (Act 62 of 1997), which formalized customary tenure rights on farms for resident farm workers. Other legislation includes the Labour Relations Act (Act 66 of 1995), the Employment Equity Act (No 55 of 1998) and the Skills Development Act (Act 97 of 1998).

(Ewert and du Toit, 2005). Some of these non-cash benefits were scraped when higher cash wages were imposed (Conradie, 2005b; Zvoutete, 2014), which left workers feeling isolated and discontented. However, despite this, more than half the hired farm laborers were in permanent employment as recently as 2007 (Statistics South Africa, 2010).

An interesting question to be addressed is whether this historic special relationship between farmers and workers insulate permanent employees from market forces when wages rise. Since the price of permanent labor has risen substantially over the past ten years, a model of labor demand can be used to examine the impact of reducing labor costs by increased mechanization and casualization. In neither case is it clear from the existing literature what the outcomes may be. Ewert and Hamman (1999) claimed that there was no evidence of large scale reduction of permanent labor in the second half of the 1990s, but Sunde and Kleinbooi (1999) and Du Toit and Ally (2003) recorded extensive casualization across all sectors of Western Cape agriculture. Furthermore, both Ewert and Hamman (1999) and Conradie (2005a) have provided evidence of the capacity to mechanize grape harvesting. However, apart from harvesting, the opportunities for mechanisation are limited and Conradie (2005a) found that employment initially adjusted slowly to rising statutory minimum wages.

No systematic employment records exist for the wine industry after 2004. KWV (1997) reported a workforce of 45,000 farm workers and by the early 2000s the industry claimed that it supported 345,000 workers plus dependents on wine farms (SAWIS, 2004). Assuming a figure of 3.5 dependents per worker, and two adult workers per household (Van der Merwe, 1976; Levy, 1977), this implies a workforce of 49,000 fulltime equivalent workers in 2003. This is reasonable and consistent as growth in the sector during the 1990s resulted in area planted of around 110,000 hectares by 2003, which accounts for 0.455 jobs per hectare. Thus, the impact of the minimum wage thereafter is unclear. One of the few surveys of wine farms in the Breede River Valley reported a decrease in labor demand from 0.42 to 0.37 fulltime equivalent jobs per hectare when the minimum wage came into effect (Conradie et al., 2006), while Sunde and Kleinbooi (1999) and Du Toit and Ally (2003), recorded extensive casualization across all sectors of Western Cape agriculture. This study attempts to shed more light on the employment situation in the industry.

This paper examines the changes in employment, wages and mechanization in the Cape wine industry in the period 2005 to 2015, ten years after the first reforms were implemented. Labor demand functions are modelled with a systems generalised method of moments (GMM) dynamic panel estimator. The new wages elasticities improve on Conradie (2005) by quantifying the short and long run impact of rising wages, while long and short run output elasticities predict the employment effects of possible expansion. The remainder of the paper is structured as follows. The next section provides an overview of the South African wine industry, including the role of cooperatives in the sector. Section 3 describes the data and the specification of the estimating equation. Section 4 reports the results and discussion. The paper ends with brief conclusions and policy implications.

2. The Wine Industry in South Africa

The *Koöperatiewe Wijnbouwers Vereniging van Zuid-Afrika Bpkt* (KWV) was an industry body intended to create unity and serve the wine producers. KWV was founded in 1918 and was granted increasing legislative powers from the 1920s onwards. While the intention was to improve wine quality, the structure of the organisation made it counter-productive as it encouraged the production of large quantities of poor quality grapes. This was because votes were given to members regardless of their output and thus biased decisions in favor of the numerous small scale operators, who voted for the introduction of generous price floors. The huge surpluses that resulted were disposed of by exporting and distilling poorer quality wines into brandy, both activities where KWV had de facto monopolies. WHERE DID THESE LOW LEVEL EXPORTS GO DURING THIS PERIOD OF SANCTIONS?

Comment [B1]: Nick?

By the 1950s, increased mechanisation was introduced largely to adopt cold fermentation and small farms organised themselves into producer co-operatives, partly to enable equipment sharing arrangements. However, this resulted in the grape harvest being pooled, which was again detrimental to quality. The vast majority of the wine was sold in bulk, including to the KWV, with the remainder bottled, marketed and distributed under the co-operatives' own labels.

KWV suspended production quotas in 1992 as part of the deregulation in the agricultural sector (Kirsten et al, 2009) BECAUSE OF WHAT? and decision making was transferred to the grower co-operatives. Quality had to be upgraded rapidly as the main opportunities lay in exports- AGAIN TO WHERE, GIVEN SANCTIONS?. And co-operatives introduced processing fees and differentiated output prices by cultivar (Williams et al., 1998). For example, the price premium for noble red varieties over the price of bulk white varieties rose from 36% in 1995 to 650% in 2000, although this come down just as rapidly over the next five years due to domestic over production, as shown in Figure 1. While red wine prices were high, vineyards replaced their vines and area planted expanded rapidly, such that between 1995 and 2005 approximately 40% of the national vineyard was upgraded from bulk white to noble red cultivars. As expected, yields fell while quality increased and the premium this attracted made the necessary labor intensive crop control and canopy manipulation worthwhile. However, the changing political situation in South Africa was a concern and farmers wishing to insure against further labor reforms found increasing mechanization attractive while the high profits made it possible (Newman et al., 1997; Ewert and Hamman, 1999).

Comment [B2]: Was it in response to the Kassier commission?

Comment [B3]: Export opportunities arrived with the end of sanctions. When was this?

Figure 1

But by 2010 the price of Cabernet Sauvignon grapes fell to just 66% more than that of Chenin Blanc, which from 2007 had also also begun to fall in real terms. In the decade from 2005 to 2015 the area under grapes contracted and the unit cost of production rose slightly while yields increased at 1.4% per year. Farmers first abandoned canopy manipulation and later crop thinning to gain higher yields although at reduced quality. This *return to bulk* at the expense of quality maximised short run profitability, but the left the Western Cape wine industry in a less competitive global position.

A further labor issue for wine grape farms concerns the employment of women. The Rural Foundation, an NGO that supports economic development and training to rural communities, particularly women,[3] campaigned for gender equality in the sector, which meant fulltime positions for women. This was easily achieved in the deciduous fruit industry (Mayson, 1989; Kritzinger and Vorster, 1996) where the casual contract lasts for nine months of the year. But this is not the case in the wine industry where casual workers are only needed for three months of the year. Levy (1977) described the position of female labor as "permanent seasonal" workers, although some wine farmers felt obliged also to employ them during the off season so that their families could survive throughout the year. Despite the 27-hour per week restrictionIS THIS THE DEFINITON OF A SEASONAL? SURELY NOT FULL TIME imposed by the Basic Conditions of Employment Act (Act 75 of 1997), the system of being allowed to "work as you wish" during winter was still widely in use in the Breede River Valley in the early 2000s (Conradie, 2003). This clearly put farmers at risk of not complying with the Act. As farms expanded, the Extension of Security of Tenure Act (Act 62 of 1997), which was widely interpreted as the start of government condoned land grabs[4], resulted in more fulltime jobs for women, as having two fulltime workers per dwelling limited the exposure of the farm to the risk of land claims.

With farm women employed fulltime and the peak harvest period supplemented by machine picking, it was logical to outsource winter work to casual labor. This also shifted the administrative burden of the Basic Conditions of Employment Act (Act 75 of 1997) although Ewert and Du Toit (2005) described this as a growing divide between secure, relatively well paid permanent jobs and insecure, poorly paid casual work. Furthermore, on-farm relations became more strained as profitability in the wine industry fell causing old privileged relationship to make way for new formalized arrangements. In 2012, a strike by farm workers in the table grape industry over poor working conditions and outsourcing (Zvoutete, 2014) quickly spread to other parts of the province. This extended into informal rural settlements where protesters focussed as much on poor local service delivery as on declining working conditions in agriculture. Protesters' demands included a doubling of the minimum wage and the banning of employment brokers. This did succeed in raising the minimum wage in agriculture by 51%, but Zvoutete (2014) notes that it led to immediate retrenchments on some farms and a further reduction in services that were previously free and many were worse off.

Comment [B4]: This caused confusion for farmers. The BCEA provided for fulltime and parttime work only , no seasonal contract. If >27 hrs per week, workers had to be given fulltime contracts. Farmers needed seasonal contracts of fulltime employment for a limited period (Levy's point)

To fit in with the silly new law farmers could

1. Scale back on their use of farm women to <27hrs/ week
2. Make women fulltime and grow into the larger permanent workforce. On farms with mostly grapes, mechanised picking and pruning could address seasonal peaks. On farms with a fruit / veg component, off-farm casual workers provide flexibility
3. This option I would rather not talk about, which was to give farm women fulltime contracts with a no work no pay clause which could be invoked unilaterally during the off-season, and hope for the best

3. Data and models

Sample and Data Sources

A balanced panel of 77 farms for eleven production seasons, from 2005 to 2015, was taken from a larger Vinpro[5] survey into which farmers self-select. No farm identifiers were

[3] See http://www.charitysa.co.za/lima-rural-development-foundation.html

[4] The Extension of the Security of Tenure Act (Act 62 of 1997) stipulates that workers with more than ten years of service can live on the farm for life. Ironically, this was the customary arrangement, but now farmers fear that they will be unable to get rid of workers who have left the farm or the dependents of retired workers.

[5] Vinpro is the wine industry producers' organization that provides support in terms of technical and economic advice and is a link with government at the local, provincial and national level. See www.vinpro.co.za

available, but the time series of this sample implies that these farms are amongst the most established in the sector. The South African Wine Industry Information System reports that the sample farms are three times the size of the industry average with 33% higher yields and with 20% lower costs than their peers (www.sawis.co.za). Although these farms received the same price for their grapes as other wine farms, their higher yields and lower costs suggest greater than average profitability. However, the employment effect of greater profitability is uncertain as while this provides a buffer against wage increases it also enables the purchase of large-scale labor saving machinery and other equipment.

At the beginning of the study period (2005) the typical farm in the Vinpro sample produced 908 tons of grapes on 79 hectares. One third of these were planted with red varieties. More than 80% of vineyards were drip irrigated and an estimated 86% were planted in rows appropriate for machine harvesting. The rest of the land is dry land bush vine cultivation and yields on this land was 6.6 tons per hectare compared to 16.2 tons per hectare for the trellised and irrigated vineyards. About 5% of the area planted was comprised of vines that were older than twenty years while only 12% were younger than five years. Over the next ten years the size of the typical vineyard in the sample expanded by 10% (see Table 1) and the size of the average crush by a third. However, the cultivar mix remained more or less the same, suggesting that many farmers neglected to maintain their vineyards, which accounts for the lower proportion of area planted with youngest vines. The last row of Table 1 shows that land per unit of labor rose by 0.83% per year between 2005 and 2015, which does not keep up with the 2.23% per year increase in the real wage recorded for the study farms in this period. Job losses were perhaps inevitable on these farms, so it is surprising that employment fell at only -0.09% per year. The overall level of employment of 0.48 full time equivalent workers per hectare remained unchanged on the farms in this sample during the period 2005 to 2015, and largely unchanged from the 0.45 jobs per hectare established before the minimum wage had had much effect (Conradie et al., 2006). The proportion of casual to total labor remained almost unchanged during the study period, at just over one third and is far lower than the 50% reported by Du Toit and Ally (2003).

The financial data were deflated to constant 2010 prices using the consumer price index from the Department of Agriculture and Fisheries' (2015) Abstract of Agricultural Statistics. The practice at Vinpro is that in cases where multiple crops are produced, overhead costs are allocated to individual enterprises according to area planted, turnover or physical output, whichever is most appropriate in each case. Since most grape sales are to co-operative wineries that pay out over multiple years, farm-level revenue figures are estimates. A farm-level weighted average wine price was computed by dividing the expected income from grapes by the total tons picked. The proxy for mechanisation is the percentage of grapes picked by machine and Table 1 also shows the potential for mechanical picking, which as noted above, is the proportion of vineyards with suitably spaced trellising systems.

Table 1

Wages and employment data are from the payroll. For permanent labor there is both the wage bill and the number of workers employed, so that the average permanent wage is simply one divided by the other. This identified a substantial wage premium for Stellenbosch district,

which is adjacent to the Cape Town metropolitan area and has better educated workers with a higher level of training. For casual workers only total remuneration is available. The number of fulltime equivalent casual jobs was calculated by dividing this wage bill by the statutory minimum wage. The only exception to this rule again was Stellenbosch where it was assumed that casual workers enjoy the same wage premium as permanent workers. This was 50% between 2005 and 2008 and 74% thereafter. A weighted average wage for all labor was computed by dividing the total payroll by the imputed overall employment for each farm. Descriptive statistics for all data used in the estimations are shown in Table 1.

The ten original districts in the sample were aggregated into four regions: The Breede River Valley, the Orange River Valley, Stellenbosch and the remainder of the sector, labelled West Coast. These regions each have a unique character. Stellenbosch represents quality wine. The West Coast contains most of the dryland vineyards and the Orange River has a hot, arid climate that is detrimental to wine quality but has access to adequate irrigation water. In the post-boom period, the Breede Valley region has a mild climate and good access to irrigation and accounts for most of the remaining industry growth.

Wage determination is led by the statutory minimum wage for agriculture. This was introduced in March 2003 and was stratified by level of economic activity until 2009. Like other rates set by collective bargaining, the agricultural minimum wage in South Africa barely kept up with inflation during the first ten years. For example, in 2005 a nominal rate of R4.03 per hour applied in outlying areas while richer districts closer to the urban edge were required to pay R4.87 per hour. In 2006 the wage rate increased to R4.54 and R5.10 per hour, respectively. For the first nine years of the period covered in this study the gap between casual and permanent wage rates in areas outside Stellenbosch was 28.6% and the size of the gap was inversely related to the level of casualization, even if corrected by the fewer hours worked by casual labor (correlation coefficient, $\rho = -0.61$, and probability, $p<0.000$). Table 1 shows that for a brief time during the late 2000s, rising energy costs appeared to accelerate casualization in the wine industry. For example, the global financial crisis increased fuel prices by 48% in 2008 and casual workers could be used instead of machine harvesting. Permanent employment reached its lowest level of just 25.3 jobs per farm in this sample in 2009 while the number of fulltime equivalent casual workers employed peaked at 17.2 in the same year. Then, in November 2012 farm workers across the Western Cape went on strike to demand a doubling of the minimum wage. A 51% nominal increase, from R7.71 to R11.66 per hour, was awarded from March 2013. The corresponding real increase of 42.5% is reflected in the 2014 data. Table 1 shows that the wage gap (the difference between the minimum wage and the permanent wage) in all areas was reduced to zero in 2014 and 2.27% in 2015, with the exception of Stellenbosch. Even though wages in Stellenbosch were historically higher, the wage gap also fell dramatically from 26% in 2013 to just 5% in 2014.

The 51% wage rate increase had little effect on permanent employment during the first two years after 2013. In 74% of cases the same number of permanent workers was employed in 2014 as in 2013. In this sample, the loss of 25 permanent jobs was offset by 34 new permanent jobs so that the immediate effect of the increase in the statutory minimum wage was to create rather than destroy permanent positions. However, there was much more of an

impact on the casual workers. About 90% of farms reported a change in their level of casual employment in 2014 compared with 2013 and in 80% of cases they reported a decrease in casual labor. On average 6.5 fulltime equivalent casual jobs were lost per farm. Two farms each reported the loss of more than forty fulltime equivalent positions. With only 36.4 new casual jobs created the net loss was 340 full time equivalent casual positions. With the wage gap between permanent and casual workers now almost nothing future wage increases will affect permanent employment as well.

Variable Selection and Models

The labor economics literature contains fewer wage elasticity estimates than the policy importance of these warrants. This can be explained by the fact that employment and wages are typically endogenous and before dynamic panel estimation techniques were commonplace few studies have been able to present convincing instruments for either of these variables. Due to hiring and firing costs, employment levels do not adjust instantaneously to changes in factor prices, capital stock or environmental shocks (Hamermesh, 1993). Following the notation in Roodman (2009a) a linear model with one dynamic dependent variable can be specified to capture this phenomenon:

$$y_{it} = \alpha y_{it-1} + \boldsymbol{x}'_{it}\boldsymbol{\beta} + \varepsilon_{it} \qquad (1)$$

$$where\ \varepsilon_{it} = \mu_i + v_{it}$$

$$and\ E(\mu_i) = E(v_{it}) = E(\mu_i v_{it}) = 0$$

where y_{it} is the level of employment in farm i at period t, α is the rate of adjustment, y_{it-1} is the amount of labor used in the previous period, $\boldsymbol{x}_{it}$ is a vector of control variables including but not limited to input prices and stocks, in the manner of Petrick and Zier (2012) and ε_{it} is a two-part error that can be decomposed into a farm fixed effect μ_i and an orthogonal iid error, v_{it}.

Removing fixed effects with a first difference transform gives the foundation of the difference GMM model presented in Holtz-Eakin et al. (1988) and Arellano and Bond (1991).

$$\Delta y_{it} = \alpha \Delta y_{it-1} + \Delta \boldsymbol{x}'_{it}\boldsymbol{\beta} + \Delta v_{it} \qquad (2)$$

$$where\ \Delta y_{it} = y_{1t} - y_{it-1}$$

$$and\ \Delta y_{it-1} = y_{1t-1} - y_{it-2}\ \text{etc.}$$

Anderson and Hsiao (1981) suggest that the differenced lagged dependent variable, Δy_{it-1}, is mathematically still related to the differenced error term and is instrumented with the level y_{it-2} that is uncorrelated with Δv_{it}. In contrast, Arellano and Bond (1991) instrument y_{it-2} and other endogenous and predetermined regressors with longer lags, a process that has become known as GMM instrumenting. In this paper, the choice of the Blundell-Bond systems GMM estimator (Blundell and Bond, 1998), was motivated by the likelihood of a slow adjustment in farm employment (α close to 1) and a desire to retain an equation in levels. Operationally, the more efficient one-step version was used here. In response to the

suggestion by Roodman (2009a) that different sized instrument sets should be included to compare alternative specifications of the estimating equation these were done and evaluated using Arellano and Bond's AR(2) statistic, Hansen's J-test of over-identification of the instrument matrix. The significance of the coefficients of interest are reported in Table 2 along with other diagnostic tests.

Three versions of the basic model are fitted: overall employment (3a), which includes permanent and casual labor together, and permanent (3b) and casual (3c) labor separately. In addition to lagged employment, control variables included the wage and its lag, capital and its lag and output and its lag, following for example, Arellano and Bond (1991) and Micevska (2008). Simpler versions have omitted output (Blundell and Bond, 1998) or capital (Basu et al., 2005) and Petric and Zier (2012) expanded this specification to examine the effect of policy interventions. Output is proxied by the size of the vineyard,[6] while the wine price provides information on demand shocks. Regional dummy variables capture spatial heterogeneity and as suggested by Roodman (2009b) a series of time dummy variables is also included. The final estimating equations in first differences can be expressed:

$$\ln L_{it}^{o} = \alpha_{0i} + \alpha_1 \ln L_{it-1}^{o} + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{it-1} + \gamma_1 \ln W_{it} + \gamma_2 \ln W_{it-1} + \zeta_1 \ln C_{it} + \zeta_2 \ln C_{it-1} + \eta_1 \ln WP_{it} + \sum_{n=1}^{4} \vartheta_i R_i + \sum_{k=1}^{11} \kappa_k R_k + v_{it} \quad [3a]$$

$$\ln L_{it}^{p} = \alpha_{0i} + \alpha_1 \ln L_{it-1}^{p} + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{it-1} + \gamma_1 \ln W_{it} + \gamma_2 \ln W_{it-1} + \zeta_1 \ln C_{it} + \zeta_2 \ln C_{it-1} + \eta_1 \ln WP_{it} + \delta AW_{it} + \sum_{n=1}^{4} \vartheta_i R_i + \sum_{k=1}^{11} \kappa_k R_k + v_{it} \quad [3b]$$

$$\ln L_{it}^{c} = \alpha_{0i} + \alpha_1 \ln L_{it-1}^{c} + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{it-1} + \gamma_1 \ln W_{it} + \gamma_2 \ln W_{it-1} + \zeta_1 \ln C_{it} + \zeta_2 \ln C_{it-1} + \eta_1 \ln WP_{it} + \varphi RS_{it} + \sum_{n=1}^{4} \vartheta_i R_i + \sum_{k=1}^{11} \kappa_k R_k + v_{it} \quad [3c]$$

where the dependent variables L_{it}^{o} , L_{it}^{p} *and* L_{it}^{c} are demand for overall, permanent and total labor, respectively, for farms *i* at time *t*. *Y* is area planted in hectares and *W* the annual wage in constant ZAR. *C* is the running cost of capital in constant ZAR, which is defined as the sum of fuel, electricity and insurance costs plus licence fees. Repairs and maintenance are excluded because these tend to be lumpy. *WP* is the farm-level wine price in constant ZAR per ton. All continuous variables are expressed in natural logarithms. R_i and R_k represent four regional and eleven production season/year dummy variables to capture fixed effects and seasonal differences and v_{it} is an uncorrelated error term. To link the two labor markets, (3b) and (3c) each include an exogenous variable to represent the other labor category. Finally, the model for permanent staff (3b) includes the statutory minimum wage AW_{it} and the model for casual labor (3c) includes the number of permanent workers employed RS_{it} .

The three models were estimated and care taken to prevent instrument proliferation.[7] Table 2 shows that for each dependent variable, four instrument specifications were tested. Apart from the usual F and t-tests several other diagnostics are needed to confirm adequate specification in dynamic panel models. Thus, Table 2 reports Hansen's test of the joint validity of the instrument set, for which the null hypothesis requires that the instrument

[6] Some authors use value of sales on the grounds that firm performance is determined by sales rather than production (Micevska, 2008). However, in this study physical output performed better than sales.

[7] The model was estimated in Stata 13 using xtabond2, with the *collapse* option.

matrix is overidentified. Roodman (2009a) suggests that p-values approaching 1 and below 0.10 should be viewed with suspicion. It is noted that first differenced variables are uncorrelated with the underlying variables for which they are instruments if AR(2) is stationary. Here, 0.05 is an appropriate cut off. The final diagnostic test involves ensuring that the coefficient of adjustment (γ_1), which is explained further below, falls within the range of estimates derived with OLS and a fixed effects panel model. For these data the ranges of (1-α) were from 0.096 for OLS to 0.481 for the panel, in the case of overall employment, 0.008 to 0.376 for permanent workers and 0.150 to 0.577 for casual workers. These test results are discussed in the next section.

Table 2

In partial adjustment models the coefficient γ_1 is the short-run wage elasticity and $(\gamma_1 + \gamma_2)/(1 - \alpha_1)$ the long run elasticity for a system in equilibrium (Basu et al., 2005; Babecký et al., 2012) and α_1 is the adjustment elasticity. The median lag length is $t^* = \log_\alpha 0.5$ (Hamermesh, 1993). Demand functions are well behaved if both long and short run wage elasticities are negative. Elasticities of less than unity implies that the total wage bill will increase if wages are increased. The elasticity of employment with respect to output is β_1 in the short run and $(\beta_1 + \beta_2)/(1 - \alpha_1)$ in the long run. Values of less than zero indicate decreased employment and less than unity means that employment will increase less than output. The expected sign on the operating cost of machinery is positive as capital and labor are normally substitutes. The wine price should also have a positive sign, as it shifts the demand curve for labor outwards. Since permanent and casual labor are substitutes, the expected sign on the statutory minimum wage is positive, while casual employment is expected to decrease with each additional permanent worker employed.

4. Results and Discussion

Wage elasticities by type of labor

Since we were interested in the relative wage responsiveness of each type of employment, separate models of overall, permanent and casual labor demand were fitted and the last two are more fully reported. Estimation was by iteration from the smallest to the larger GMM instrument matrix to avoid instrument proliferation, which is a serious concern when fitting dynamic panel models of employment (Roodman, 2009a). The most complex specifications treated employment, wages, output, capital cost and the wine price as endogenous and retained only the year and area dummy variables as exogenous instrumental variable (IV) style instruments. Specifications 5-8, reported in Table 2, also controlled for the level of the statutory minimum wage, which was always an IV-style instrument. Specifications 9-12, controlled for the level of permanent employment on the farm in addition to all the other variables, keeping permanent labor in the IV set. Table 2 reports the results of the diagnostic tests for all models.

Table 3 reports the estimation results of the four preferred demand specifications. There is one each for overall employment and casual labor and two for permanent labor. These results

are discussed together in the remainder of this section. Overall labor demand is best captured by specification 2 (from the list in Table 2), which assumes employment, wages and output to be endogenous. This model had 47 instruments and an F-stat = 144.28, see the lower part of Table 3. The p-value of 0.452 in Table 2 shows that the AR(2) process is stationary and combined with p = 0.256 on Hansen's test means the instrument set is jointly valid. Specification 2 was the only version of overall labor demand where over-identification is not rejected, making it the preferred specification. The fitted coefficient of adjustment ($1 - \alpha_{t-1}$ = 1 – 0.650 = 0.350) is within the range of 0.096 and 0.841 specified by OLS and the fixed effects model. The median lag length is 1.61 years, a far more rapid adjustment than typically reported for European family farms (Petrick and Zier 2012; Pietola and Myers, 2000; Stefano et al., 1992). The short run wage coefficient is negative as expected and although the coefficient on lagged wages is positive, the net effect is still negative ($\gamma_t + \gamma_{t-1}$ =-0.341 + 0.208 = -0.133). The short run output effect is positive and while its long run effect is negative, the overall effect is positive as expected. The lack of significance of the capital variable indicates that once machines are in place their use is not responsive to the wage or the fuel price. This irreversibility is a well-documented feature of farm machinery. The lack of significance of the wine price reflects the fact that the cooperative pooling system does not properly reward quality.

Table 3

Treating capital cost as endogenous as well as employment, wages and output produced a better fit for the demand for permanent labor than keeping it in the IV instrument set with the wine price, minimum wage, area planted and the year/season dummy variables. With 48 instruments this version of the demand for permanent labor has a value of p<0.18 on Hansen's test. Together p<0.328 on the AR(2) process, a coefficient of adjustment of $1 - \alpha_{t-1}$ = 1 – 0.799 = 0.201, an F-statistic significant at p<0.000 and point estimates on the important variables significant at p<0.05, this model is clearly a good representation of the demand for permanent labor on wine farms. As before the cost of mechanization and the wine price does not affect permanent employment directly.

Comment [B5]: Jenny

This is where we begin to talk about the two options that produce the two elasticity options for regular staff

Reassigning the wine price from IV to a GMM instrument increased the number of instruments from 48 to 58 in specification 8. Despite the larger instrument set, this model passed Hansen's test with p<0.202 and the AR(2) test with p<0.391. The F-statistic of F = 4276.32 pointed to joint significance and the coefficient estimates on the variables of interest remain robust. The coefficient of adjustment ($1 - \alpha_{t-1}$ = 1 – 0.772= 0.228) is only marginally larger than before and still within the acceptable range. The short run wage coefficient of -0.30 in Table 3 is negative as expected, and larger in magnitude than the coefficient on the lagged wage (0.1397), so that the long run wage elasticity is still negative as expected. Likewise, the positive short run area coefficient is large enough to keep the lagged output coefficient (0.3116 - 0.1849 = 0.1267) from producing a negative output elasticity. As before neither the wine price nor the cost of mechanization materially affected the employment-wage relationship for this category of labor.

Comment [B6]: Option 2 for regular labour

Both estimates of the coefficient of adjustment for permanent labor are smaller than the coefficient of adjustment for overall employment. Instead of just 1.61 years to get halfway to

the new steady state, it takes the permanent workforce between 2.68 and 3.09 to adjust to shocks, a rate of adjustment similar to that reported for European family farms (Petrick and Zier, 2012; Stefano et al., 1992). Since casual labor can be easily substituted for permanent labor, it is normally expected that overall employment will have a lower coefficient of adjustment than any of the individual employment categories. The finding here that the size of the overall labor force adjusts more quickly than permanent employment must mean that casual employment adjusts quickly, which is evidence of the special relationship between these workers and their employers described by Du Toit (1993) and of the deepening of the divide between insiders and outsiders in the wine industry caused by post-apartheid labor market regulation (Ewert and Du Toit, 2005).

As expected the quantity of casual labor demanded on wine farms is shown to adjust more rapidly than the employment of permanent labor. In specification 12 the coefficient of adjustment ($1 - \alpha_{t-1} = 1 - 0.662 = 0.338$) is 50-70% higher that estimated for permanent labor and within the range of 0.150-0.577 determined by OLS and the fixed effects model. Specification 12 easily passed the other diagnostic tests too with values of $p<0.421$ and $p<0.599$ on Hansen's J and the AR(2) tests. The short run wage elasticity of -5.615 is dramatically larger than the corresponding elasticities reported for permanent or overall labor demand. Despite the lack of spatial variation in the statutory minimum wage this coefficient is significant at $p<0.05$. The long run component of the employment response to a wage change is also positive, but smaller than the short run effect so that the net effect ($\gamma_t + \gamma_{t-1} = -5.615+ 4.017 = -1.598$) is negative as expected. It too is significant at $p<0.05$. The second component of the output elasticity is less precisely fitted in model 12 than in specifications 7 and 8 but is nonetheless retained in the elasticity calculation to enable a direct comparison to the other estimates. Unlike in the other models there is evidence of capital-labor substitution shown by the positive and significant coefficient on machinery cost. This means that should wine or energy prices rise, there will not be an effect on employment.

The elasticity results reported in Table 4 are explained above and the short run numbers are just the coefficients on the wage, see Table 3. The long run results are the figures reported in the previous paragraph for $\gamma_t + \gamma_{t-1,}$ divided by the adjustment elasticities. The overall wage elasticity of -0.34 in the short run confirms earlier results for the wine industry (Conradie, 2005a). The slightly larger figure of -0.38 for the long run suggests that most of the employment changes are apparent immediately after a wage increase. While some people may get exercised by the potential to increase the total wage bill by further wage increases, policy makers must recognise that people who lose jobs as a result of rising wages will find it difficult to find other work in the current employment climate.

Table 4

In KwaZulu-Natal the massive casualization of agricultural jobs following labor market reform pushed up the long run wage elasticity for permanent labor from -0.23 in the period 1960 to 1990 to -1.34 in the period 1991 to 2005 (Sparrow et al., 2008). In the wine industry there was not the same urgency to reduce permanent workers, as the less than unitary long run wage elasticities for this category of worker illustrate. But the less than unitary long run

area elasticities of 0.56 and 0.80 show that these secure and well paid positions will be created at a slower pace than before as the wine industry continues to expand. The emphasis is now predominantly on casual employment where wage elasticities are -5.62 in the short run and -4.73 in the long run, pointing to much greater vulnerability for these workers if wages rise. A sensible future wage policy can still salvage the employment situation as the overall output elasticity of 0.98 in the long run indicates that so far the farms in this sample have opted for casualization over mechanization. However, policy makers must appreciate that every time the statutory minimum wage is increased the government is gambling with jobs and the livelihoods of poor people. Therefore, the proposed further 44.6% increase implied by a universal statutory minimum wage of ZAR 3,500 (US $250) is not a good idea that has very serious negative implication and should be resisted.

Conclusions

This paper applied a dynamic panel estimation model to farm-level wage and employment data for 77 farms in the Western Cape Province of South Africa from 2005 to 2015 to estimate wage and output elasticities for the wine industry. The results show that even the 51% wage increase in 2013 may have had only a limited impact on full time employment, as the long run elasticity of labor with respect to wages is only -0.58 to -0.70. An elasticity of way below unity means that the fall in employment is heavily outweighed by the rise in wages of those still employed and the total remuneration of permanent staff will rise. But, while the remaining workers gain, this is no consolation to those who do lose their jobs and they will suffer severe difficulty in finding work due to high levels of rural unemployment. However, the main finding emphases that this comes at a heavy cost to casual workers and this is the group that bear almost all the losses. For casual workers the long run wage elasticity of -4.73 means that the 51% wage increase must be expected to result in a 240% decrease in jobs. Thus, it is the poorest and most vulnerable who suffer as a result of a policy intended to help them.

The underlying problem that cannot be directly addressed by this paper is the move to increased mechanisation. Further increases in the statutory minimum wage for agriculture could result in capital-biased technical change that will reduce employment and job security in the long run. Further wage increases can also have a negative impact on wine value since viticulture practices such as canopy manipulation and crop control are labor intensive and hard to mechanise. Neglecting these tasks further as a means of reducing labor costs will be detrimental to wine quality. Therefore the industry is at risk of returning to bulk wine production rather than export quality output. Thus, the 2013 increase in the statutory minimum wage has resulted in farmers choosing to produce poorer quality wines, which undermines the viability of the industry in the long run. Policy makers should recognise that the future of the industry and its workforce are bound up with decisions made now about wine quality. Loss of market share to competitors like Australia, New Zealand and South America would mean a difficult future. Greater research and development and a more

generous extension budget combined with less political uncertainty would help to secure the future of this industry, which is a major contributer to GDP in the Western Cape Province.

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Table 1: Descriptive statistics, 77 farms for the period 2005 – 2015 (Means with standard deviations below)

													Growth % per year		
	Units	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	All yrs	2005-12	Δ 2013/4
Vineyard size	ha	101	101	103	104	104	105	107	108	109	111	111	0.74	0.74	2.21
		82	84	86	87	86	85	88	92	96	100	101			
Wine price	R/ton*	3543	3090	2986	2616	2702	2775	2693	2621	2570	2423	2489	-2.30	-3.01	-5.70
		1843	1498	1434	1269	1329	1310	1170	1143	1128	872	1006			
Yield	ton/ha	13.1	14.7	14.6	15.5	15.6	14.9	14.6	16.3	17.2	17.8	16.9	2.53	1.73	3.54
		7.2	8.6	7.5	7.9	7.1	9.2	7.4	8.5	9.3	8.2	8.5			
Machine ready	%	84	84	85	85	85	85	86	86	87	87	87	0.30	0.33	-
		29	29	28	28	29	28	28	28	28	28	28			
Machine picked	%					37	40	41	42	45	47	51	2.15	1.67	3.50
						39	40	40	41	40	40	40			
Minimum wage	R/year	13144	13734	14181	12990	13115	14198	14443	14283	14789	21072	21360	4.14	1.00	42.49
		1236	1225	786	324										
Permanent wage	R/year	16936	17193	18562	17004	17213	18138	18672	18312	19288	21038	21845	2.20	1.00	9.07
		8846	9107	9356	8614	10375	11812	12562	13036	13508	14531	11392			
Permanent workers	Employees	26.4	26.9	26.1	25.5	25.3	26.0	26.6	26.7	27.2	27.3	26.9	-0.72	0.52	0.43
		17.7	17.8	16.6	16.8	16.9	18.8	20.8	20.2	22.2	22.2	21.9			
Casual fulltime equiv.	Employees	15.3	14.2	14.7	16.0	17.2	16.7	16.9	17.0	17.5	13.1	13.5	-0.19	-0.65	-25.25
		24.8	22.3	24.7	25.3	27.2	26.9	28.1	28.7	27.8	20.9	19.1			
Total employment	Employees	41.7	41.0	40.8	41.6	42.5	42.7	43.5	43.6	44.6	40.3	40.4	-0.09	0.43	-9.62
		34.3	32.2	33.9	34.2	35.8	35.7	39.0	39.4	40.3	34.8	33.4			
Labor intensity	Ha/worker	2.5	2.6	2.7	2.6	2.6	2.6	2.7	2.7	2.7	3.0	2.9	0.83	0.31	10.64
		1.0	1.2	1.1	1.0	0.9	1.0	1.1	1.2	1.2	1.3	1.3			

*The wages and financial figures are all in constant 2010 Rand

Table 2: Results of diagnostic tests to select preferred specifications (in bold). All models fitted with systems GMM.

Model	Variables listed as GMM instruments	Cross sections Number	Instruments Number	Hansen's J test p-values	AR(2) process p-values	Wage coefficients p-values	Output coefficients p-values
			Overall labor demand				
1	Lagged employment, wage	77	37	0.104	0.559	0.000	0.061
						0.015	0.403
2	**Lagged employment, wage, area**	**77**	**47**	**0.256**	**0.452**	**0.000**	**0.005**
						0.011	**0.364**
3	Lagged employment, wage, area, capital cost	77	57	0.108	0.923	0.000	0.002
						0.013	0.100
4	Lagged employment, wage, area, capital cost, wine price	77	67	0.071	0.876	0.000	0.003
						0.008	0.111
			Demand for permanent workers				
5	Lagged employment, wage	77	38	0.010	0.234	0.000	0.853
						0.178	0.754
6	Lagged employment, wage, area	77	48	0.054	0.322	0.000	0.016
						0.026	0.24
7	**Lagged employment, wage, area, capital cost**	**77**	**58**	**0.180**	**0.328**	**0.000**	**0.001**
						0.014	**0.038**
8	**Lagged employment, wage, area, capital cost, wine price**	**77**	**68**	**0.202**	**0.391**	**0.000**	**0.001**
						0.038	**0.011**
			Demand for casual labor				
9	Lagged employment	74	28	0.152	0.755	0.316	0.484
						0.336	0.619
10	Lagged employment, area	74	38	0.472	0.556	0.374	0.940
						0.372	0.724
11	Lagged employment, wage, area, capital cost	74	48	0.483	0.694	0.084	0.394
						0.104	0.933
12	**Lagged employment, wage, area, capital cost, wine price**	**74**	**58**	**0.421**	**0.599**	**0.018**	**0.211**
						0.021	**0.816**

Table 3: Determinants of labor demand for a sample Western Cape wine farms, 2005-2015

	Specification 2: Overall demand		Specification 7: Permanent labor		Specification 8: Permanent labor		Specification 12: Casual labor	
	Coefficient	Robust SE	Coefficient	Robust SE	Coefficient	Robust SE	Coefficient	Robust SE
$Ln(employment)_{it-1}$	0.6503***	0.0742	0.7991***	0.0597	0.7722***	0.0493	0.6622***	0.1437
$ln(wage)_{it}$	-0.3408***	0.0639	-0.2792***	0.0462	-0.3000***	0.0501	-5.6150**	2.3138
$ln(wage)_{it-1}$	0.2079**	0.0796	0.1628**	0.0647	0.1397**	0.0661	4.0173**	1.7011
$ln(vineyard\ area)_{it}$	0.4263**	0.1472	0.3107***	0.0921	0.3116***	0.0887	0.5862	0.4649
$ln(vineyard\ area)_{it-1}$	-0.0834	0.0914	-0.1497**	0.0710	-0.1849**	0.0708	-0.0713	0.3050
$ln(machine\ cost)_{it}$	0.1877	0.1174	0.0893	0.0606	0.0529	0.0559	0.7100**	0.3419
$ln(machine\ cost)_{it-1}$	-0.1954	0.1394	-0.0009	0.0448	-0.0307	0.0448	0.0886	0.2336
$ln(wine\ price)_{it}$	0.0901	0.0566	-0.0492	0.1106	-0.1090	0.0728	0.0703	0.2980
$ln(casual\ wage)_{it}$			-0.0147	0.1803	0.2730	0.2303		
$ln(regular\ workers)_{it}$							-0.6031*	0.3499
Breede Dummy	-0.0031	0.0747	0.4763	1.8315	-0.4154	1.8856	-1.8783**	0.8310
Orange Dummy	0.2995**	0.1460	0.6177	1.8317	-0.5494	1.9247	0.0000	(omitted)
Stellenbosch Dummy	0.0000	(omitted)	0.4989	1.9110	-0.4648	1.9670	-0.8381	0.9015
West Coast Dummy	-0.0534	0.0584	0.3980	1.8192	-0.4853	1.8745	-1.7778*	0.9913
Yr2005 Dummy	0.0000	(omitted)	0.0000	(omitted)	0.0000	(omitted)	0.0000	(omitted)
Yr2006 Dummy	-0.0147	0.0622	0.0505	0.0944	0.1423	0.1132	6.8318	10.0281
Yr2007 Dummy	-0.0133	0.0495	0.0257	0.0850	0.1168	0.1067	6.8881	10.0404
Yr2008 Dummy	-0.0075	0.0499	-0.0463	0.0994	0.0675	0.1238	6.3109	9.8891
Yr2009 Dummy	0.0144	0.0463	-0.0100	0.0888	0.0932	0.1135	6.9368	9.9793
Yr2010 Dummy	0.0199	0.0403	0.0018	0.0798	0.0861	0.1002	7.0672	10.0636
Yr2011 Dummy	-0.0101	0.0447	0.0009	0.0681	0.0857	0.0895	6.7384	10.0530
Yr2012 Dummy	-0.0137	0.0320	-0.0124	0.0705	0.0844	0.0943	6.4687	10.0161
Yr2013 Dummy	0.0382*	0.0220	-0.0080	0.0617	0.0838	0.0840	6.7929	10.0723
Yr2014 Dummy	0.0000	(omitted)	0.0069	0.0193	0.0000	(omitted)	8.3097	10.5257
Yr2015 Dummy	0.0538**	0.0260	0.0000	(omitted)	-0.0044	0.0185	7.2596	10.4730
Constant	0.3851	1.1489	0.0000	(omitted)	0.0000	(omitted)	0.0000	(omitted)
Observations	770		770		770		664	
Groups	77		77		77		74	
Instruments	47		58		68		58	
F-stat	144.28		6479.40		4276.32		84.16	
AR(2) p-value	0.452		0.328		0.391		0.599	
Hansen's p-value	0.256		0.180		0.202		0.421	
Adjustment range	0.096-0.481		0.008-0.376		0.008-0.376		0.150-0.577	

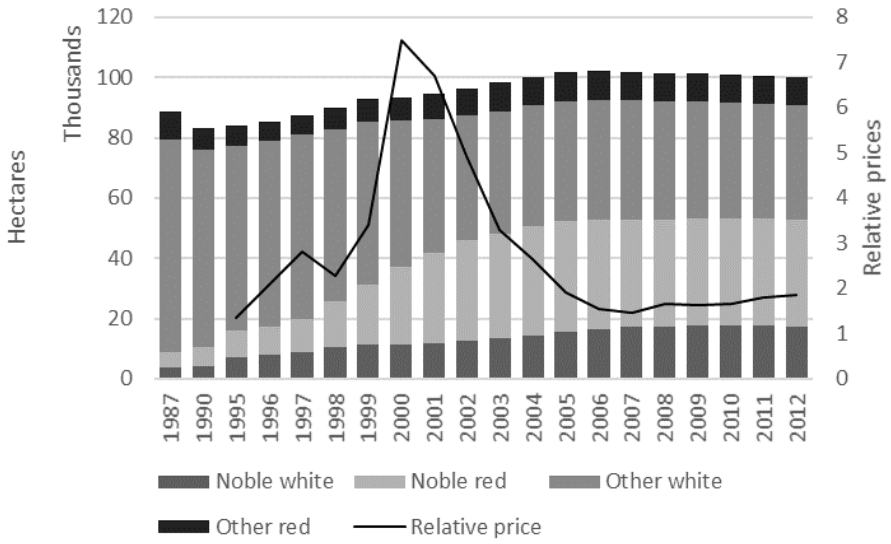
Note that the lagged dependent and wage variables varies across specifications depending on the class of labour examined. Models in first differences *** $p \leq 0.001$, ** $p \leq 0.05$, * $p \leq 0.10$

Table 4: Wage and output elasticities of overall, permanent and casual labor, 2005-2015

	Wage elasticity		Output elasticity	
	Short run	Long run	Short run	Long run
	γ_1	$(\gamma_1 + \gamma_2)/(1 - \alpha_1)$		
All labor	-0.34	-0.38	0.43	0.98 †
Permanent jobs specification 7	-0.28	-0.58	0.31	0.80
specification 8	-0.30	-0.70	0.31	0.56
Casual jobs	-5.62	-4.73	0.59	1.52 †

† Only significant at lower levels of confidence

Figure 1: Size and composition of the South African national vineyard with relative prices of Cabernet sauvignon to dry white wine



Source (www.sawis.co.za)