Wages and wage elasticities for wine and table grapes in South Africa

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Abstract

A survey of 190 wine and table grape farmers in the Western Cape puts the average wage for farm labour at R928 per month in 2003 and R1123 per month in 2004. Output per worker has doubled since 1983. On farms with grape harvesters, labour is 30 per cent more productive (48 ton/worker) than on farms where wine grapes are picked by hand (37 ton/worker). At 9.75 tons per worker, table grapes are four times as labour-intensive as wine grapes. Resident men dominate the workforce on wine farms, while the resident female workforce is 20 per cent larger than the resident male workforce on table grape farms. Seasonal workers contribute a third of labour in table grapes, and brokers less than ten per cent in either case. In a single-equation short-run Hicksian demand function, wage, output, capital levels and mechanisation intensities are highly significant determinants of employment. Higher wages decrease employment and larger output increases employment. More mechanisation, measured by the number of tractors used to produce a ton of fruit, raises labour intensity too. Grape harvesters could not be shown to reduce jobs. The ten per cent rise in the minimum wage planned for March 2005 could reduce employment by 3.3 per cent in the wine industry and 5.9 per cent in the table grape industry, but it is more likely that the wage increase will be offset against fewer benefits. The average expected impact is about the same as for all agriculture and manufacturing as a whole.

1. Introduction

Agriculture is shedding labour the world over. Lately, new legislation governing farm labour may have increased the rate at which jobs are lost in South Africa (Newman *et al*, 1997; South African Human Rights Commission, 2003:62). Given the broad unemployment rate of close on 30 per cent (Klasen & Woolard, 1999), it is important to know the effect of the minimum wage on employment in every sector to which it applies.

In 1970, agriculture employed 31 per cent of the economically active population in South Africa. In 2002, only 6 per cent of the economically active remain in agriculture (Department of Agriculture, 2004). Employment levels

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have fallen steadily at 1.7 per cent per year since 1970. There is some evidence that the trend may have accelerated during the early 1990s. The Department of Labour (2001) reports that one in five farm workers lost their jobs between 1990 and 1996. In contrast, Western Cape farms shed almost no jobs between 1985 and 2002 in spite of real wages rising at 2.3 per cent per year over that period.

The minimum wage was introduced at two levels in March 2003, the higher of which was binding for wine farmers (Conradie, 2004). Minimum wage laws *per se* do not create unemployment, but when binding, the extent of disemployment depends on the elasticity of labour demand, which is industry specific. Jobs are lost when the real wage grows faster than productivity or where relative factor costs favour mechanisation. Some production processes, such as fruit picking, are inherently less likely to be mechanised. This could partly explain why the Western Cape has lost fewer jobs than the rest of the country. It also suggests that the demand for farm labour in the province is relatively inelastic and that a binding minimum wage may cause fewer job losses here than elsewhere.

Fallon and Lucas (1998:11) showed that wage elasticities for the non-farm sectors in South Africa range from extremely inelastic in tobacco (–0.06) and beverages (–0.18) to quite elastic in textiles (–0.98) and wearing apparel (–2.51). One of the few local estimates for agriculture places the wage elasticity for farm labour in KwaZulu-Natal on the elastic side at about –1.4 (Latt & Nieuwoudt, 1985). In the US corn belt, the demand for farm labour is inelastic (O'Donnell *et al*, 1999) while reported wage elasticities range from –0.32 in England and Wales to –0.79 in Scotland (Dickens *et al*, 1995). Errington *et al* (1997) confirm the inelastic demand for farm labour England and Wales with short-run elasticities of –0.12 and –0.20 and long-run elasticities of–0.43 and –0.53. In South Africa, the overall wage elasticity for agriculture is estimated to be –0.59 (Balcombe *et al,* 2000), which is not unlike the estimate of –0.55 found for manufacturing (Fedderke & Mariotti, 2002). But Fallon and Lucas's findings provide reasons to believe that within agriculture, estimates could vary dramatically from sector to sector.

The results presented here, are specific to the wine and table grape industries. Data come from a two-wave panel of 80 wine farmers surveyed in August 2003 and resurveyed in August 2004. In 2004, the survey was extended to include 40 table grape growers as well. Details of data collection and initial findings are discussed in Conradie (2004). The structure of the paper is simple: Section II briefly touches on the data, Section III presents the model specification and section IV discusses the econometric results. The paper closes with a summary of estimates wage elasticities and their policy implications.

2. Descriptive statistics

Selected descriptive statistics are given in Table 1. It is clear that wine grapes are different from table grapes in most respects. Wine farms are significantly larger in terms of output and fruit produced, although table grape operations employ more workers. Female farm workers and seasonal workers, of whom the majority are female, are more readily employed on table grape farms than on wine farms. On wine farms, regular men dominate (59% of the workforce), while table grape farms employ fewer regular men than regular women. Counter to popular belief (South African Human Rights Commission, 2003:43), women are employed in their own right on table grape farms, although not on wine farms. At 32 per cent, or 43.3 full-time labour equivalents, seasonal workers are an important part of the workforce on table grape farms. Seasonal workers are not important on wine farms. Labour provided by labour brokers comprises less than ten per cent of the workforce in both industries. The level of mechanisation, as measured by the number of tractors, is the same in both industries, but variable mechanisation cost, measured as the amount spent on fuel, is significantly higher on table grape farms than on wine farms.

Table 1: Selected sample descriptive statistics

Variable	Units	2003 wine	2004 wine	Table grape	Entire sample		
		Mean	Mean	Mean	Mean	Std dev	n
Output	ton	1393	1533	1036	1386	1120	188
wine grapes	% of crop	77	63	0.6	60	37	188
table grapes	% of crop	2	0.5	98	22	41	188
Unit cost	R/ton	1511	1676	6255	2515	2309	161
Employment	FTEs	33.7	34.8	118.6	52.1	80.8	190
resident men		19.2	19.5	29.6	21.5	17.0	190
wives of resident men		12.8	11.8	35.5	17.7	17.0	187
contract labour		2.9	2.8	11.8	4.6	21.0	188
seasonal workers		1.5	2.6	43.3	10.7	36.2	188
Average wage	R/month	928	1035	1227	1039	346	181
Labour productivity	ton/FTE	41.8	43.9	9.75	36.1	20.5	188
Tractors	number	5.9	6.0	6.8	6.2	4.3	188
Tractor productivity	ton/tractor	228	243	157	219	105	188
Grape harvesters	number	0.40	0.37	NA	0.41	0.47	151
Fuel	R1000	72	67	159	92	116	173
Fuel productivity	ton/R1000 fuel	21.5	21.9	9.6	19.1	10.4	171

From August 2003 to August 2004, the wine industry saw some permanent women replaced seasonal workers, but the changes were not statistically significant at the five per cent level. In some cases, the change is due to a reclassification of the same individuals. Wine farms use more permanent labour than other agriculture in the Western Cape. The 2002 Agricultural Census reports an average workforce of 29 workers per farm for the Western Cape, and sets the contribution of part-time and seasonal workers at 55 per cent (StatsSA, 2004).

The average wine farm in this sample produces 1140 tons of wine grapes and 340 tons of other fruit, consisting mostly of fruit for canning. It is large and expensive compared to the industry average. According to SAWIS (2004) the average wine farm produces only 278 tons of grapes, and more than 80 per cent of wine farmers produce less than 500 tons per year. The difference is mostly due to what one regards as a 'farm'. SAWIS counts producer numbers, or wine brands, while this survey counts operational units. In addition, wine making or fruit packing are included in the scope, and thus cost, of a farm, while VINPRO calculates unit cost of production from a list of grape growing activities. VINPRO estimates the average cost of production in this area to be about R760 per ton (Van Wyk, 2004). The average table grape farm produces 1008 tons of table grapes and 28 tons of other fruit, including wine grapes and citrus. Unit cost of production is R2515 per ton for the sample as a whole, but is significantly higher in the table grape industry (R6255/ton) than in the wine industry (± R1550/ton). This is not surprising given that table grapes are packaged on the farm while most wine grapes are processed centrally. Table grape cost thus includes the cost of packing, cooling and shipping while cellar costs are only included for a small number of wine farms. Even if one includes the estimated processing costs of roughly R900 per ton (SAWIS, 2004), table grapes are still significantly more expensive to produce than wine grapes.

The average wage on wine farms increased significantly from R925 per month in 2003 to R1035 per month in 2004. Table grape workers earn higher wages, on average R1227 per month in 2004. Average wage was calculated by dividing the total wage bill for the previous financial year by the number of workers employed in August of each year. According to the Census, the Western Cape's average wage was R662 per month for all farm labour and R1149 per month for permanent labour in 2002 (StatsSA, 2004). Recalculated for the observed ratio of permanent to casual staff, the 2002 provincial average is R1053 per month, which is 19 per cent higher than the wage recorded here.

Labour productivity, measured in tons of fruit produced per full-time labour equivalent, is four times higher on wine farms (± 43 ton/FTE) than on table grape farms (9.75 ton/FTE). Labour productivity on wine farms increased by five per cent in 2004. In 1983, the average product of labour in the study area (statistical region 8) was 20 tons per worker (StatsSA, 1987).

Wine grapes are different from most other fruit insofar as they can be picked by machine, making capital and labour direct substitutes in this case. There is a claim that grape picking machines could reduce a wine farm's harvest labour requirement from a hundred workers to two workers (Simbi & Aliber, 2000). In this survey, 35 per cent of respondents already own a grape picking machine and another 20 per cent rent a quarter of a machine on average. The capacities of these machines vary widely and part-time use is difficult to estimate accurately. However, the average labour productivity on farms with a grape harvester is 29 per cent higher (48 ton/FTE) than on farms where a grape harvester is not used (37 ton/FTE). As more farms adopt grape harvesters, labour productivity will rise, employment will most likely fall and real wages might increase.

Tractors are the measure of mechanisation for which reliable data are easiest to collect. Fuel data, while more accurate (tractors can be idle), is more difficult to record accurately at the farm-level. The average farm has 6.2 tractors and spent R92 000 on fuel in the previous financial year. There is no statistical difference between the number of tractors on wine farms and table grape farms, but the average expenditure on fuel is significantly higher on table grape farms. Like labour productivity, tractor productivity is higher on wine farms (± 235 ton/tractor) than on table grape operations (157 ton/tractor). Fuel productivity is twice as high on wine farms as on table grape farms.

3. Model specification

Economic theory usually assumes that prices (wages) and quantity (employment levels) are endogenous in competitive markets, but in the presence of minimum wages this may not be the case. The choice of model critically depends on the presence of simultaneity. If there is simultaneity, 2SLS estimation is consistent and efficient while OLS is inconsistent. If on the other hand, there is no simultaneity, OLS is consistent and efficient while 2SLS is consistent but inefficient (Pindycke & Rubinfeld, 1998:353). Hausman's specification test[2] is used as a preliminary diagnostic before the models are discussed in more detail.

[2] *See Appendix 1 below.*

3.1 Determinants of labour demand

In the simple neoclassical model of profit maximisation, a firm produces output by choosing optimal combinations of capital and labour to maximise profits. The short-run cost function is a constrained version of profit maximisation in which capital and output levels are held constant.

$$C = C(w, K, y)$$

By Shephard's lemma, the conditional labour demand function is the partial derivative of the short-run cost function with respect to wage. The basic estimating equation is obtained by taking the natural logarithms:

$$ln(empl)_i = a_0 + a_1\, ln(wage)_i + a_2\, ln(output)_i + a_3\, ln(capital\ level)_i + u_i$$

where

empl	employment in full time labour equivalents
wage	average nominal wage calculated from previous year's wage bill and current full-time equivalent employment
output	size of the harvest in tons
u	stochastic error term

A higher wage is expected to reduce employment and higher output to increase employment. Given the double log specification, the coefficient on wage can be read off directly as a short-run Hicksian wage elasticity (Errington *et al*, 1997).

Capital level is proxied by expenditure on fuel and the presence of certain labour-saving equipment such as grape harvesters.

fuel	fuel expenditure in R1000
gh	number of grape picking machines used (owned and rented)

If one believes that capital and labour are substitutes in production, the *a priori* expectation on *fuel* is negative, but several authors have found that capital and labour are complements (Latt & Nieuwoudt, 1985; O'Donnell *et al*, 1999; Fedderke & Mariotti, 2002). This suggests that production on some farms (and firms more generally) is more intensive than on others; those farms that use more labour also use more machines. Nevertheless, the *a priori* expectation about the coefficient on *gh* is still negative since these machines directly save labour.

Picking up on the idea of intensity of production, the following capital productivity variable is defined:

tracton number of tractors ÷ output

Tracton measures the intensity of mechanisation independent of farm size. The expected sign is positive since firms that have high machine productivity will also have high labour productivity and *vice versa*.

Theoretically one expects unique labour demand functions for each of the products produced. A crop dummy allows one to separate table grapes from wine grapes. A positive coefficient would indicate that table grapes are more labour intensive than wine grapes.

cropd crop dummy, 1 = table grapes and 0 = wine grapes

Cash wages are not the only cost of employment. Farm workers in the study area receive extensive free benefits which are not accurately quantified. Benefits are expected to reduce employment since they increase the cost of employment. The provision of free electricity is used to proxy all benefits.

electricity 1 = free electricity provided, 0.5 = electricity subsidized,
0 = workers pay for electricity

Crop type and mechanical grape picking, as captured by grape harvesters, potentially affect wage elasticity. There is no *a priori* expectation regarding the sign of the interaction between *cropd* and *lnwage*. According to the Hicks-Marshall rules of elasticity (Hicks, 1932:242), demand should be more elastic where the wage bill contributes a larger portion of total costs (table grapes) and more elastic where the technology permits input substitution (wine grapes). The interaction between *gh* and *lnwage* is expected to have a negative coefficient, since the opportunity to substitute a machine for workers is greater on farms where grape harvesters are used.

Finally, it is possible that the demand for certain kinds of labour is more elastic than for other kinds. To this end, four additional employment variables were defined:

men regular men with headcount = 1 FTE
women the wives of regular men with headcount adjusted for actual hours
seas mostly picking labour recruited by the farmer in FTE
broker labour provided by a third party in FTE

Insofar as resident men are the dominant source of labour, one expects the demand for their labour to be less elastic than for that of women who often have only casual status in the eyes of many farmers (Conradie, 2004). There is no obvious expectation with regards to the elasticity of seasonal and contract labour. If the farmer views casual labour as 'extra', the demand for its labour will be relatively elastic, but where farmers have replaced permanent staff with casual labour, demand should be no different.

4. Results and discussion

Labour demand on grape farms is generally inelastic. Results deteriorate in proportion to the share of a particular labour type in overall employment. Between 85 and 89 per cent of the variation in total employment (Table 3) is explained, while only about 80 per cent of the variation in the employment of permanent men (Table 4) could be explained. For the wives of regular men (Table 5), the overall fit drops to between 63 and 71 per cent, but in this model wage is no longer statistically significant at any reasonable level of confidence. In the models of the demand for seasonal workers (Table 6) about 64 per cent of the variation is explained, while the coefficient on wage is only significant at the 15 per cent level of confidence.

According to Table 3, wage, farm size, fuel expenditure and mechanisation intensity are highly significant determinants of overall employment. Coefficients have the expected signs. A higher wage reduces employment and larger farms employ more people. This study confirms the result that firms using more machines also use more labour, since both *lnfuel* and *tracton* carry positive signs. Surprisingly, grape harvesters could not be shown to reduce overall employment, but table grape farmers employ significantly larger workforces than wine farmers. The coefficient on the interaction term of *lnwage* and *cropd* in Model 3 is not statistically significant at five per cent, implying that at the five per cent level of confidence there is no statistical difference in the wage elasticities for the two industries. However, if one is willing to accept the p-value of 0.079 for the interaction term, the demand for labour in table grape production (-0.59) is almost twice as elastic as the demand for labour on wine farms (-0.33). In Models 3 and 4 the Ramsey RESET tests (Gujarati, 1995:465) fail to reject the null hypothesis that the models have no omitted variables, while Breusch-Pagan tests (Gujarati, 1995:379) fail to reject a constant variance hypothesis and White's tests (Gujarati, 1995:379) fail to reject a null hypothesis of homoskedasticity.

Table 3: Demand for all workers

Variable	Model 1	Model 2	Model 3	Model 4
Dependent variable	***ln(empl)***	***ln(empl)***	***ln(empl)***	***ln(empl)***
ln(wage)	-0.312** (-3.64)	-0.341** (-5.20)	-0.334** (-4.94)	-0.390** (-6.51)
ln(size)	0.556** (6.84)	0.563** (7.03)	0.570** (9.63)	0.611** (9.86)
ln(fuel)	0.423** (7.21)	0.419** (7.23)	0.339** (7.28)	0.328** (7.05)
ln(tracton)	0.274** (3.52)	0.276** (3.55)	0.281** (4.23)	0.289** (4.34)
cropd	dropped	dropped	2.820** (2.79)	1.036** (16.37)
cropd × *ln(wage)*	0.115** (3.18)	0.116** (3.20)	-0.255 (-1.77)	
gh	0.397 (0.41)	-0.110 (-1.73)		
gh × *ln(wage)*	-0.073 (-0.52)			
electricity	-0.213** (-4.15)	-0.212** (-4.15)	-0.187** (-3.88)	-0.193** (-4.00)
constant	1.502* (2.49)	1.676** (3.35)	1.679** (3.33)	2.067** (4.53)
n	135	135	171	171
adjusted R^2	0.85	0.85	0.89	0.89
Ramsey RESET	2.58	2.65	1.58	1.67
prob.	0.06	0.05	0.19	0.18
Breusch-Pagan	4.32	4.27	1.15	0.34
prob.	0.04	0.04	0.28	0.56
White	51.39	47.52	35.46	34.48
prob.	0.04	0.01	0.27	0.12
T-statistics in parentheses; * significant at 5%, ** significant at 1%				

According to Table 4, the demand for regular men is similar to the demand for total labour. Higher wages significantly reduce the number of permanent men employed and larger farms employ more regular men than smaller farms. Higher fuel spending and more intensive use of machines are associated with more employment. Again table grape farms employ more workers than wine grape operations, but this time the crop dummy and the *cropd-lnwage* interaction term are not significant at the five per cent level. To argue that the demand for regular men is more elastic on table grape farms (-0.44) than on wine grape farms (-0.20), one needs to accept a p-value of 0.146 on the interaction term. This is usually not done, but given the small number of table grape growers in the current sample, the data definitely suggest that demand for regular men in the two industries could be very different from each other. Benefits do not seem to affect the number of regular men employed and grape harvesters could not be shown to reduce employment. In Models 8 and 9 the Ramsey RESET test fails to reject the null hypothesis that the models have no omitted variables, while Breusch-Pagan tests fail to reject a constant variance hypothesis and White's test fail to reject a null hypothesis of homoskedasticity.

Table 4: Demand for all permanent men

Variable	Model 5	Model 6	Model 7	Model 8	Model 9
Dependent variable	***ln(men)***	***ln(men)***	***ln(men)***	***ln(men)***	***ln(men)***
ln(wage)	-0.150 (-1.65)	-0.147 (-1.62)	-0.209** (-3.02)	-0.205** (-2.69)	-0.258** (-3.82)
ln(size)	0.610** (7.08)	0.591** (7.06)	0.609** (7.40)	0.612** (8.82)	0.624** (9.02)
ln(fuel)	0.296** (4.77)	0.305** (4.98)	0.296** (4.87)	0.224** (4.27)	0.213** (4.09)
ln(tracton)	0.232** (2.81)	0.219** (2.69)	0.223** (2.74)	0.248** (3.31)	0.255** (3.41)
cropd	dropped	dropped	dropped	2.105	0.445**
cropd × ln(wage)	0.073 (1.91)	0.075 (1.95)	0.075 (1.95)	-0.237 (-1.46)	
gh	1.114 (1.08)	1.086 (1.05)			
gh × ln(wage)	-0.181 (-1.21)	-0.176 (-1.18)	-0.019 (-1.95)		
electricity	-0.051 (-0.93)				
constant	-0.354 (-0.56)	-0.378 (-0.59)	-0.012 (-0.02)	0.308 (0.54)	0.667 (1.30)
n adjusted R^2	135 0.82	135 0.82	135 0.82	171 0.79	171 0.79
Ramsey RESET prob. Breusch-Pagan prob. White prob.	7.06 0.0002 8.55 0.004 67.75 0.0007	7.03 0.0002 8.58 0.0034 61.47 0.0002	7.29 0.0002 8.67 0.0032 43.48 0.0027	2.48 0.06 0.61 0.43 33.99 0.07	2.46 0.06 0.41 0.52 23.62 0.21
T-statistics in parentheses; * significant at 5%, ** significant at 1%					

Models of the demand for the labour supplied by the wives of regular men are presented in Table 5. While these models provide a reasonable fit, with significant coefficients on *lnsize*, *lnfuel* and *lntracton*, the coefficient on *lnwage* is not statistically different from zero at any reasonable level of significance for Models 10 to 13. Grape harvesters and the free benefits could not be shown to reduce the number of women employed, but the average table grape operation employs about four and a half more permanent women than the average wine farm. The Ramsey RESET tests on Models 12 and 13 fail to reject the null hypothesis of no omitted variables and the results of the Breusch-Pagan and White tests indicate the absence of heteroskedasticity. Given that all variables in Model 13 are significant at the five per cent level, there is no reason to drop any of them, but since the majority of permanent women in the sample are employed on table grape farms, the *lnwage-cropd* interaction term prevents the wage elasticity from being estimated accurately. In Model 14 the interaction term is dropped, producing a statistically significant coefficient on *lnwage* of -0.195, which is similar to the wage elasticity estimated for their husbands. The result of Ramsey's RESET test fails to reject the null hypothesis of no omitted variables and the results of the Breusch-Pagan and White tests again indicate the absence of heteroskedasticity for Model 14.

Table 5: Demand for labour supplied by the wives of regular men

Variable	Model 10	Model 11	Model 12	Model 13	Model 14
Dependent variable	*ln(women)*	*ln(women)*	*ln(women)*	*ln(women)*	*ln(women)*
ln(wage)	-0.035 (-0.24)	-0.035 (-0.24)	-0.093 (-0.85)	-0.078 (-0.71)	-0.195* (-2.00)
ln(size)	0.461** (3.49)	0.461** (3.49)	0.511** (5.21)	0.491** (5.02)	0.517** (5.26)
ln(fuel)	0.414** (4.31)	0.414** (4.31)	0.285** (3.85)	0.294** (3.99)	0.272** (3.68)
ln(tracton)	0.251 (1.96)	0.251* (1.96)	0.290** (2.74)	0.284** (2.67)	0.298** (2.78)
cropd	dropped	dropped	4.175** (2.63)	4.438** (2.79)	0.944** (9.62)
cropd × ln(wage)	0.129* (2.22)	0.129* (2.22)	-0.468* (-2.06)	-0.500* (-2.20)	
gh	1.14 (0.72)				
gh × ln(wage)	-0.189 (-0.82)	-0.024 (-1.61)			
electricity	-0.213* (-2.02)	-0.167* (-2.02)	-0.124 (-1.62)		
constant	-0.793 (-0.80)	-0.393 (-0.48)	-0.101 (-0.13)	-0.212 (-0.26)	0.573 (0.78)
n	130	130	166	166	166
adjusted R^2	0.63	0.63	0.71	0.71	0.71
Ramsey RESET	2.60	2.51	0.38	0.31	0.23
prob.	0.06	0.06	0.77	0.82	0.87
Breusch-Pagan	0.53	0.57	0.03	0.16	0.03
prob.	0.47	0.45	0.86	0.69	0.86
White	37.86	24.83	19.92	15.38	13.98
prob.	0.34	0.64	0.94	0.88	0.78

T-statistics in parentheses; * significant at 5%, ** significant at 1%

The demand for seasonal labour in Table 6 is determined by the same variables as the demand for permanent labour, but a smaller sample size generally produces fewer significant coefficients. As expected, table grape farms employ significantly more seasonal workers than wine grapes, but in Model 19 *lnsize, lntracton* and *lnfuel* are not significant at the five per cent level. In Model 20, both *lnsize* and *lntracton* become significant at one per cent or better if *lnfuel* is dropped. The Ramsey RESET test does not reject the null hypothesis of no omitted variables and for Model 20. Neither Model 19 nor Model 20 has a heteroskedasticity problem. The provision of benefits and the use of grape harvesters do not affect the demand for seasonal workers. The wage elasticities in Models 19 and 20 are only significant at 12 and 11 per cent respectively, but they are almost double the wage elasticity for regular men.

Table 6: Demand for seasonal workers

Variable	Model 15	Model 16	Model 17	Model 18	Model 19	Model 20
Depend variable	*ln(seas)*	*ln(seas)*	*ln(seas)*	*ln(seas)*	*ln(seas)*	*ln(seas)*
ln(wage)	-0.300 (-0.49)	-0.247 (-0.50)	-0.305 (-0.73)	-0.502 (-1.61)	-0.491 (-1.58)	-0.485 (-1.61)
ln(size)	1.195* (2.17)	1.185* (2.20)	0.674* (2.33)	0.711* (2.51)	0.685* (2.42)	0.942** (5.67)
ln(fuel)	-0.206 (-0.45)	-0.199 (-0.44)	0.257 (1.14)	0.236 (1.07)	0.245 (1.10)	
ln(tracton)	1.529* (2.50)	1.528* (2.53)	0.593 (1.74)	0.614 (1.81)	0.628 (1.85)	0.832** (2.87)
cropd	dropped	dropped	5.352 (1.22)	2.233** (7.47)	2.234** (7.72)	2.467** (9.89)
cropd×ln(wage)	0.120 (0.71)	0.119 (0.71)	-0.450 (-0.71)			
gh	-1.124 (-0.16)	-0.038 (-0.08)				
gh × ln(wage)	0.159 (0.15)					
electricity	-0.394 (-1.03)	-0.391 (-1.04)	-0.256 (-0.99)	-0.276 (-1.08)		
constant	3.878 (0.88)	3.545 (0.94)	0.562 (0.19)	1.845 (0.78)	1.861 (0.78)	2.073 (0.91)
n	51	51	86	86	86	88
adjusted R^2	0.14	0.16	0.64	0.64	0.64	0.65
Ramsey RESET	0.87	0.93	1.31	1.20	1.49	1.39
prob.	0.46	0.43	0.28	0.31	0.22	0.25
Breusch-Pagan	0.38	0.38	3.89	3.59	3.83	3.64
prob.	0.54	0.54	0.05	0.06	0.05	0.06
White	42.27	31.33	34.91	34.95	21.37	12.29
prob.	0.19	0.30	0.29	0.19	0.32	0.50
T-statistics in parentheses; * significant at 5%, ** significant at 1%						

5. Wage elasticities and their policy implications

The estimated wage elasticities are summarised in Table 7. The demand for contract labour could not be estimated with a single equation model for the current sample. There are various reasons why this is the case. Firstly, labour brokers contribute a small share of total labour so that there is simply not enough data available at this point. In addition, labour brokers probably operate in a market where employment and wage are determined simultaneously. Furthermore, estimating the full-time equivalent labour provided by labour brokers require strong assumptions since farmers do not normally record the hours or days worked by contract labour. While the wives of regular men contribute a larger share of overall labour, especially on table grape farms, collecting data on their employment was similarly challenging. Even regular women rarely work full-time, again requiring a whole range of assumptions to convert a body count into full-time equivalent employment. Finally, it is possible that not all employers view women in the same way. Some may actually employ women on charity principles rather than straightforward productivity grounds explaining why the relationship between employment and wage is noisier than for the other types of labour. The small number of observations for seasonal labour similarly hampered the estimation of industry specific wage elasticities.

Table 7: Wage elasticities by farm and labour type

	Wine grapes	Table grapes
All employment	-0.33	-0.59
Regular men	-0.21	-0.44
Wives of regular men	-0.20	-0.20
Seasonal workers	-0.49	-0.49
Contract labour	not estimated	not estimated

The demand for labour on grape farms is inelastic. For overall labour demand, the wage elasticity in table grapes is similar to Balcombe *et al*'s (2000) estimate for agriculture as a whole, while the estimate for wine grapes is much lower. The industry differential is to be expected, since labour is a bigger cost item on table grape than on wine grape farms. For men, the industry differential is similar, but due to noisy data no industry differential could be established for women and seasonal workers.

The most surprising result is that the wage elasticity for women on wine farms is of a similar magnitude as the wage elasticity for men. Many farmers consider the wives of regular men as casual labour only to be employed when "there is work", usually during the harvest season. But almost in the same breath these farmers also talk of the need for both husband and wife to work in order to get by, and of wanting to keep money on the farm rather than pay it out to contract workers. Tied housing thus provides job security in an environment of rising real farm wages. As expected, the demand for seasonal workers is more elastic than the demand for regular workers.

The proposed ten per cent wage increase scheduled for March 2005 will cause very few additional job losses, despite the current low inflation environment which causes most of the nominal increase to register as a real increase. First, the estimates in Table 7 are low. Even in the table grape industry, a ten per cent real wage increase would reduce employment only by six per cent at most. Second, farm workers still receive a significant portion of their wages in kind, and as long as employers are able to offset some of the cash wage against fewer benefits, the effective wage increase will be lower that the statutory increase. Seasonal workers will be more at risk than permanent staff, since they receive fewer benefits that can be offset against higher wages.

From labour's point of view, low wage elasticities are good news since it means that labour stands to benefit from higher minimum wages without facing proportional disemployment, at least in the short-run. In the wine and table grape industries, more people could be lifted out of poverty at a given minimum wage than would have been the case had the demand for labour been more elastic.

To date, experience with the minimum wage has been in a positive product price environment for the wine industry. When product prices rise, employers find it relatively easy to meet statutory increases. If wine prices fall by 15 per cent, as it could this season, the increase in the minimum wage planned for March 2005, might meet with more resistance than have been observed so far. The strong Rand puts similar pressure on table grape farmers.

Finally, demand for labour is derived from the demand for the product and is a function of production technology. These wage elasticity estimates for wine and table grapes are probably similar to those that apply in other tree fruit industries, but could be dramatically different from the wage elasticities that apply in field crops or livestock production. Given the importance of accurate estimates of wage elasticity in the process of setting minimum wage policy, it is essential to extend this kind of analysis to the other important agricultural industries before any further interventions are made.

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Appendix 1

Hausman's test of endogeneity

The literature describes slightly different versions of Hausman's specification test. Consider the following structural demand and supply equations for a labour market:

Demand: $e_i = \alpha_0 + \alpha_1 w_i + \alpha_2 y_i + \alpha_3 c_i + u_{1i}$ [1]

Supply: $e_i = \alpha_4 + \alpha_5 w_i + \alpha_6 s_i + u_{2i}$ [2]

The demand-side model is fairly standard: Employment (e_i) is a function of the wage (w_i), output (y_i) and capital (c_i) and a stochastic error term (u_{1i}). Labour supplied (e_i) is modelled as a function of wage (w_i), the level of benefits provided (s_i) and a stochastic error term (u_{2i}), rather than the usual alternative wage since the alternative wage would not vary across farms in the same district.

The reduced form system of the structural equations above is:

Wage: $w_i = \pi_0 + \pi_1 y_i + \pi_2 c_i + \pi_3 s_i + v_{1i}$ [3]

Employment $e_i = \pi_4 + \pi_5 y_i + \pi_6 c_i + \pi_7 s_i + v_{2i}$ [4]

In order to pick the right model to estimate labour demand, the question is if w_i is correlated with u_{1i} in equation [1] or not. Hausman's null hypothesis is no simultaneity, in other words that w_i is uncorrelated with u_{1i}. If this hypothesis holds, OLS is consistent and efficient. Both Gujarati (1995:670) and Pindyck and Rubinfeld (1998:353) first regress *wage* on the exogenous variables and a range of instruments, that is, estimating [3]:

$$\hat{w}_i = \hat{\pi}_0 + \hat{\pi}_1 y_i + \hat{\pi}_2 c_i + \hat{\pi}_3 s_i \quad [5]$$

such that

$$w_i = \hat{w}_i + \hat{v}_{1i} \quad [6]$$

and then substitutes [6] into [1]:

$$e_i = \alpha_0 + \alpha_1(\hat{w}_i + \hat{v}_{1i}) + \alpha_2 y_i + \alpha_3 c_i + u_{1i} \quad [7]$$

Gujarati (1995:670) estimates [7] directly, regressing *employment* on exogenous variables, the *fitted wage* and the *fitted residual* from the wage regression. According to Gujarati, Hausman's null hypothesis requires a statistically insignificant coefficient on the fitted residual variable in [7].

Pindycke and Rubinfeld (1998: 353) agree with the substitution in [7], but substitute [6] in again to be able to regress *employment* on *wage* (not *wage-hat*).

$$\begin{aligned} e_i &= \alpha_0 + \alpha_1 \hat{w}_i + \alpha_1 \hat{v}_{1i} + \alpha_2 y_i + \alpha_3 c_i + u_{1i} \\ &= \alpha_0 + \alpha_1 \left(w_i - \hat{v}_{1i} \right) + \alpha_1 \hat{v}_{1i} + \alpha_2 y_i + \alpha_3 c_i + u_{1i} \\ &= \alpha_0 + \alpha_1 w_i + \left(\alpha_1 - \alpha_1 \right) \hat{v}_{1i} + \alpha_2 y_i + \alpha_3 c_i + u_{1i} \end{aligned} \quad [8]$$

It is clear from [8] that the coefficient on the *fitted residual* should be zero if wage is exogenous to employment. Table 2 reports the results of Hausman's specification test for the Pindyck and Rubinfeld version of the test. The t-tests on the fitted residuals fail to reject the assumption of independence between wage and employment in four out of five cases. Further analysis thus proceeds with OLS, except for brokers for which single equation estimation is not appropriate and 2SLS estimation does not produce significant results.

Table 2: Results of Hausman's specification test

Dep variable	*lnwage*	*lnsize*	*lnfuel*	*lntracton*	*cropd*	*electricity*	*womeneq*	*funben*	*fitted res*	*c*	*adj.* R^2
ln(wage)		-0.037 (-0.46)	0.090 (1.42)	-0.048 (-0.56)	0.217** (2.71)	-0.037 (-0.60)	-0.254 (-1.63)	-0.066 (-1.17)		6.74** (22.19)	0.08
ln(empl)	-1.01** (-2.81)	0.572** (9.00)	0.361** (7.19)	0.280** (3.94)	1.21** (12.11)				0.677 (1.86)	6.27** (2.66)	0.89
ln(men)	-0.304 (-0.78)	0.633** (9.16)	0.207** (3.79)	0.304** (3.94)	0.432** (3.97)				0.077 (0.20)	1.22 (0.48)	0.78
ln(women)	0.015 (0.03)	0.523** (5.24)	0.262** (3.33)	0.309** (2.77)	0.898** (5.72)				-0.216 (-0.38)	-0.798 (-0.22)	0.70
ln(seas)	-1.015 (-0.51)	0.651* (2.21)	0.286 (1.12)	0.589 (1.66)	2.373** (4.72)				0.567 (0.28)	5.315 (0.40)	0.63
ln(broker)	3.83* (2.31)	0.445 (1.43)	-0.309 (-1.24)	0.494 (1.44)	-0.885 (-1.87)				-4.27* (-2.56)	-28.1* (-2.58)	0.03
T-statistics in parentheses; * significant at 5%, ** significant at 1%											