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UNIVERSIDAD ADOLFO IBÁÑEZ

# A Bad Year? Climate Variability and the Wine Industry in Chile

*International Workshop on General Equilibrium  
Modeling, Universidad Adolfo Ibañez  
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# Introduction

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Viticulture is highly dependent upon climatic conditions

Quality mainly determined by weather:

- ✓ Australia (Webb et al., 2008); Mosel Valley, Germany (Ashenfelter and Storchmann, 2010); Bordeaux, France (Ashenfelter, 2010)

Implications for wine prices and vineyard profitability:

- ✓ Oczkowski (2016, 1994); Ashenfelter (2010); Steiner (2004); Schamel and Anderson (2003)

# What makes a “good year”?

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Weather conditions as a good predictor of a “good year” – quality and prices of the mature wines of a vintage (Ashenfelter, 2010)

Chardonnay (Casablanca) - ideal conditions - variation between low and high temperatures (10 °C - 25 °C).

Cold climate of the Pacific Ocean, brings acidic marks and citrus notes.

# Temporary *versus* permanent climate shocks

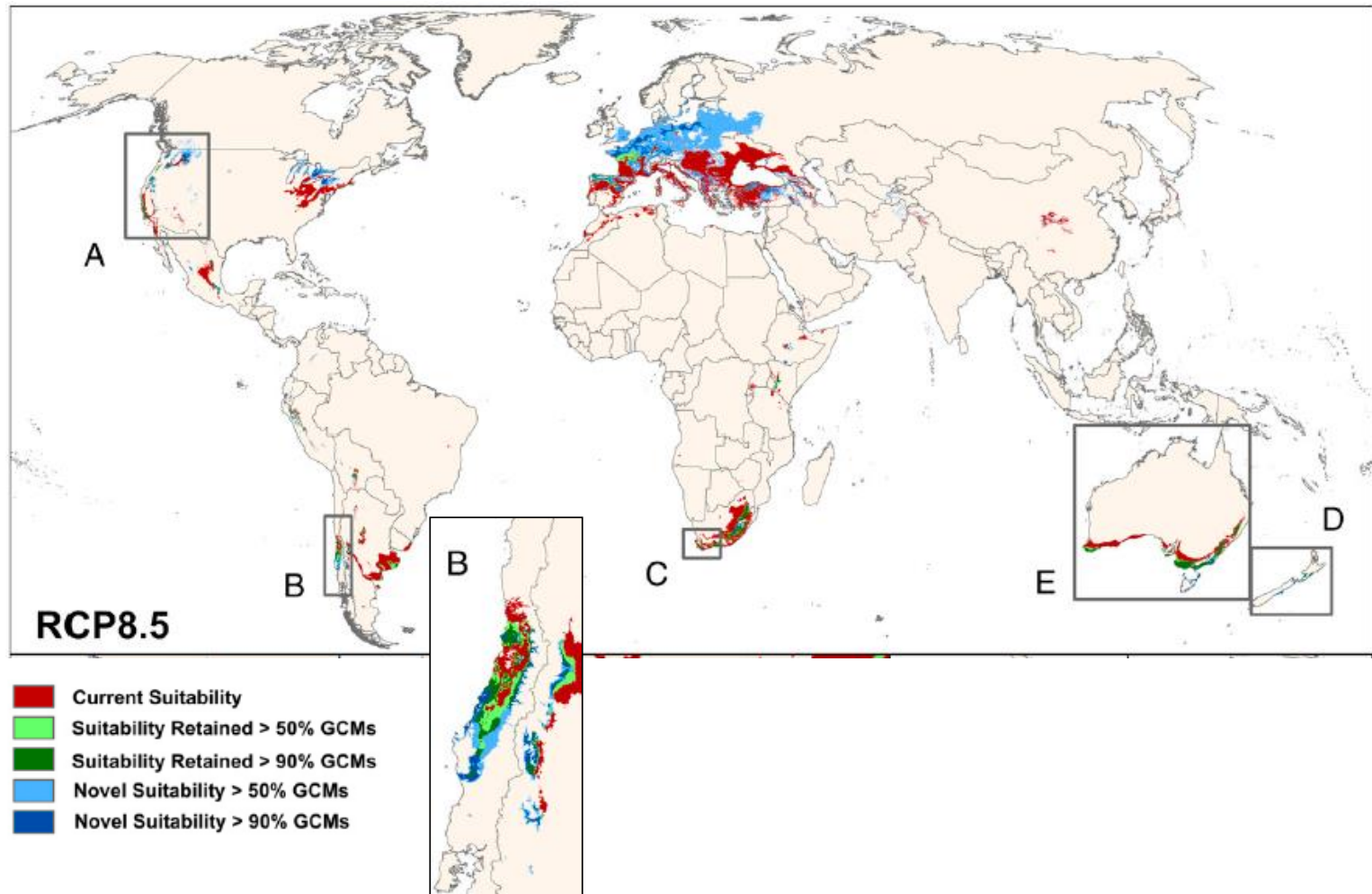
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Climate change: growing season warming trends, increasing water stress, and increasing frequency and intensity of extreme climatic events

Climate change and wine:

- ✓ Uneven geographic impacts (Jones et al., 2005; Hannah et al., 2013)
- ✓ Effects on quantity (yields) and quality (Van Leeuwen and Darriet, 2016)
- ✓ Economic implications (Ashenfelter and Storchmann, 2016)

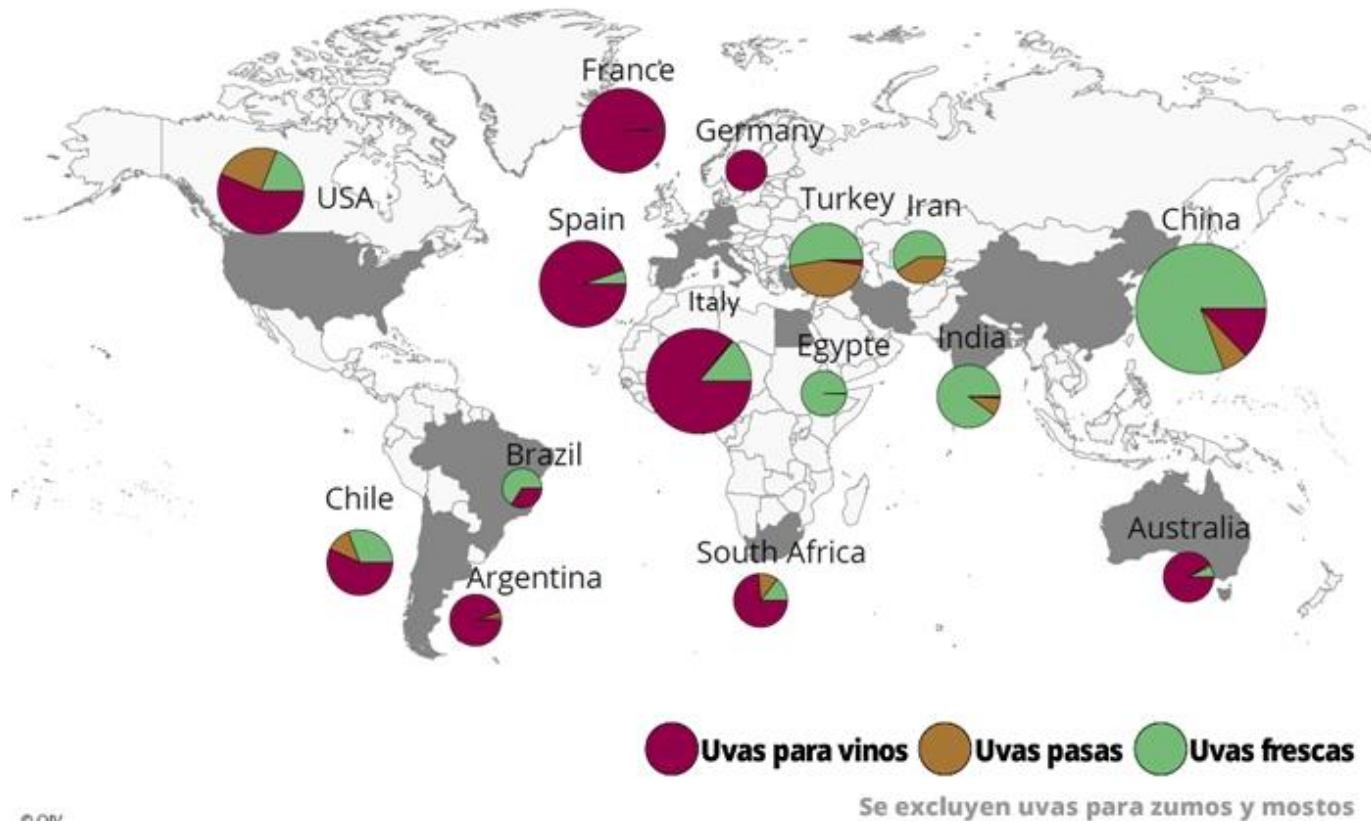
# Climate change and the wine industry



Source: Hannah et al. (2013)

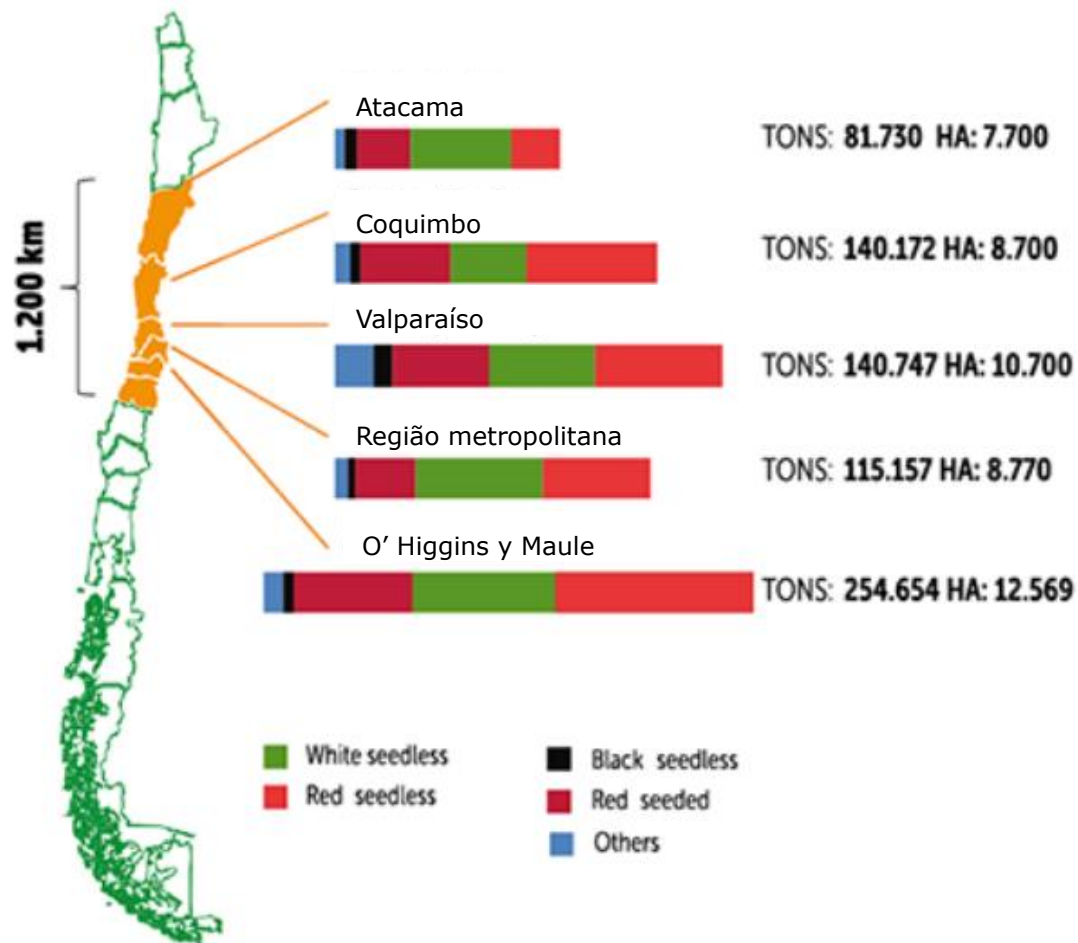
# Grape production

## MAYORES PRODUCTORES DE UVA DEL MUNDO



Source: <http://www.oiv.int/>

# Grape-growing regions in Chile



Source: <http://www.oiv.int/>



# Viticulture, wine industry and weather in Chile

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**Wine**

## Global wine production expected to fall by 5% due to 'climatic events'

South America, particularly Argentina and Chile, likely to see biggest decline, which may concern fans of wines such as malbec

Stephanie Kirchgaessner in Rome

@skirchy Email

Thu 20 Oct 2016 17.20 BST

2,702 250

This article is over 2 years old



▲ A worker harvests grapes in South Africa where production is set to fall by 19%. Photograph: Mike Hutchings/Reuters

Global wine production is expected to fall by 5% in 2016 because of “climatic events” causing steep drops in production in most of the southern hemisphere, particularly Chile and [Argentina](#).

Source: <https://www.theguardian.com/lifeandstyle/2016/oct/20/global-wine-production-falls-2016-climatic-events>



# Viticulture, wine industry and weather in Chile

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Wine production (2015):

- ✓ Rainfall reduced volume and quality of the grapes
- ✓ Climatic conditions generated a low acidity wine, low alcohol and soft structure, which is not the traditional characteristic of a Chilean wine

Table grape production (2015):

- ✓ Weather conditions have affected grape production

**Grape production (2015-2016): - 10.6%**

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Source: GAIN Report (USDA): "Climatic Conditions Lower Chilean Fruit Production Volumes", 2015

## Vintage ratings – Chile: Reds (all regions)

Vintage	Score	Description
2016	87	Untimely rains in key regions such as Colchagua, Maipo and Casablanca cut yields and led to less concentrated flavors, particularly for reds
2015	92	A warm growing season and good harvest weather delivered powerful Cabernet Sauvignons and crisp, fruity Pinot Noirs; average quality for whites
2014	89	Spring frost cut crop; good quality fruit harvested; crisp reds, savory whites
2013	90	Cool vintage, delivering fresh, well-structured wines with good balance in terms of concentration and flavor
2012	91	Warm summer weather resulted in an early harvest, with clean, disease-free fruit and yields 15 percent above average; late-ripening Carmenère performed well

Source: <https://www.winespectator.com/>

# Vintage ratings and wine prices

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Effects of weather on quality ratings from wine guides (Cardebat et al. 2014; Ramirez, 2008)

Experts reviews may influence demand (Friberg and Grönqvist, 2012)

Schamel and Anderson (2003) estimate hedonic price functions for premium wine from Australia and New Zealand, differentiating implicit prices for **sensory quality ratings** over the vintages:

- ✓ The parameters for vintage rating are all significant and fairly constant over time; **the price premium is 3.1% on average** and varies between 2.3% and 4.1% for a one-point increase in the vintage rating for the 1992-2000 vintages

# Industries and commodities in the CGE model

- 111 industries:
    - 12 industries - Agriculture and fishing
    - 6 industries – Mining
    - 45 industries – Manufacturing
    - 6 industries – Public Utilities
    - 42 industries – Services
  - 179 commodities
    - 26 commodities- Agriculture and fishing
    - 10 commodities – Mining
    - 82 commodities – Manufacturing
    - 6 commodities - Public Utilities
    - 55 commodities - Services
- 3 - Cultivo de uva
- 30 - Elaboración de piscos y licores  
31 - Elaboración de vinos
- 7 - Uva vinífera y pisquera  
8 - Uva de mesa
- 59 - Piscos y otros licores  
60 - Vinos

# Grape and wine sectors in Chile

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## Grape growing sector

- ✓ Value added = 451 CLP billions (0.33% of total)

## Wine making sector

- ✓ Value added = 402 CLP billions (0.30% of total)

## Commodity output:

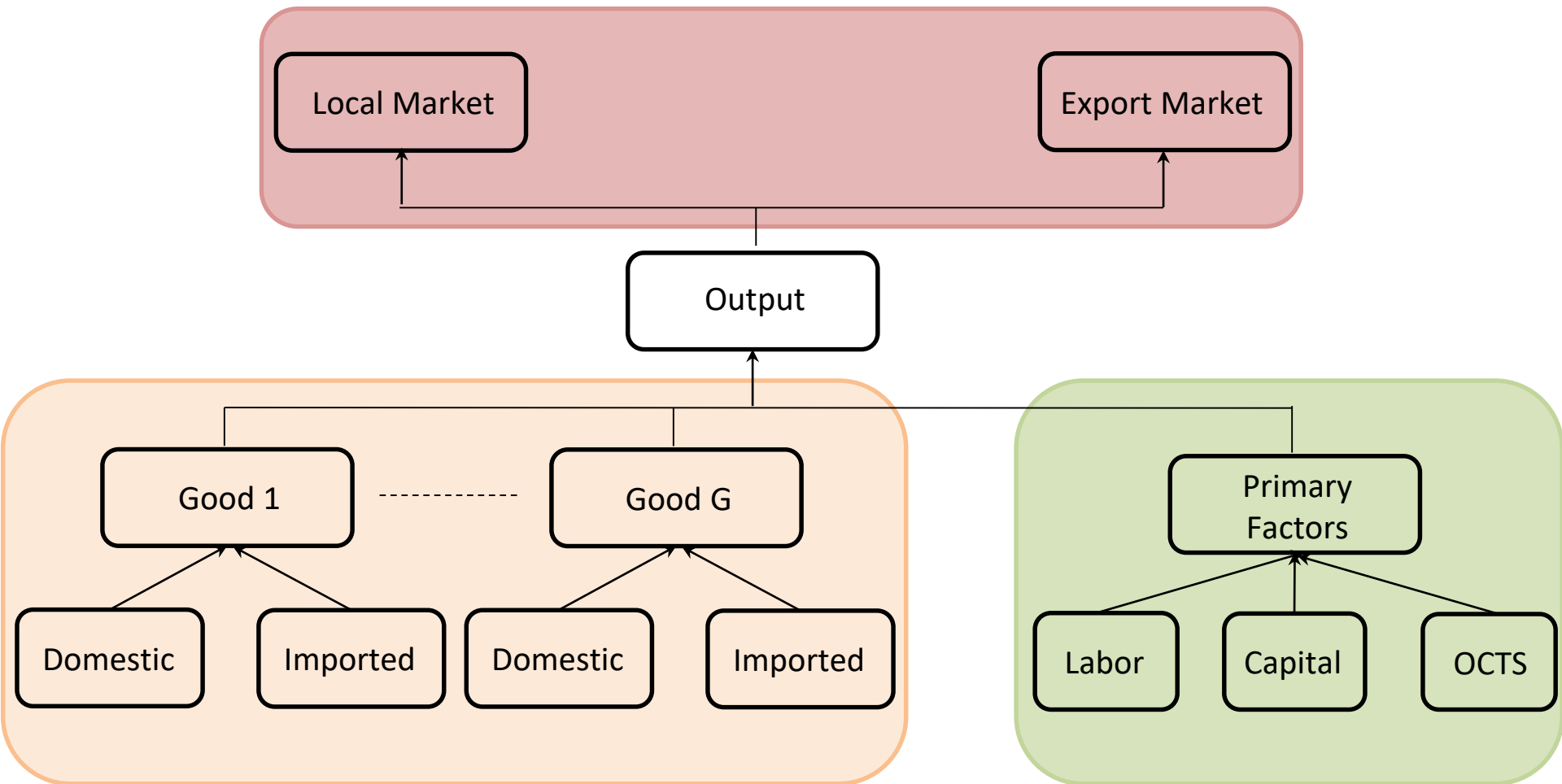
- ✓ Wine grape = 235 CLP billions (0.09% of total)
- ✓ Table grape = 582 CLP billions (0.22% of total)
- ✓ Piscos = 166 CLP billions (0.06% of total)
- ✓ Wine = 1277 CLP billions (0.48% of total)

# Main exports, Chile (2014)

#	Commodity	Label	CLP billions	Share
1	Cobre	30 Cobre	21305	45.98%
2	Salmon y trucha refrigerados o congelados	43 SamonConge	2429	5.24%
3	Celulosa	71 Celulosa	1642	3.54%
4	Otros bienes y servicios	179 OtrosBienes	1390	3.00%
5	Servicios de transporte marítimo	141 TransMaritim	1074	2.32%
<b>6</b>	<b>Vinos</b>	<b>60 Vinos</b>	<b>1063</b>	<b>2.30%</b>
7	Conservas de frutas y vegetales	46 ConservasFru	926	2.00%
8	Madera aserrada, cepillada y astillada	68 MaderaAserra	918	1.98%
9	Otros productos químicos básicos	84 OtroQuimBasi	831	1.79%
10	Oxido de molibdeno	83 OxidoMolibde	633	1.37%
11	Hierro	32 Hierro	622	1.34%
12	Servicios comerciales a cambio de una retribución o por contrata	133 CormercialCa	622	1.34%
13	Oro	33 Oro	575	1.24%
14	Servicios de alquiler sin operarios	167 SerAlquiler	500	1.08%
15	Servicios de transporte aéreo de pasajeros	143 TransAeroPas	487	1.05%
16	Tableros y madera prensada	69 Tableros	487	1.05%
<b>17</b>	<b>Uva de mesa</b>	<b>8 UvaMesa</b>	<b>481</b>	<b>1.04%</b>
18	Abonos y plaguicidas	82 Abonos	479	1.03%
19	Productos básicos de metales no ferrosos	100 BasicoNoFerr	469	1.01%
20	Conservas de pescados y mariscos	45 ConservasPes	400	0.86%

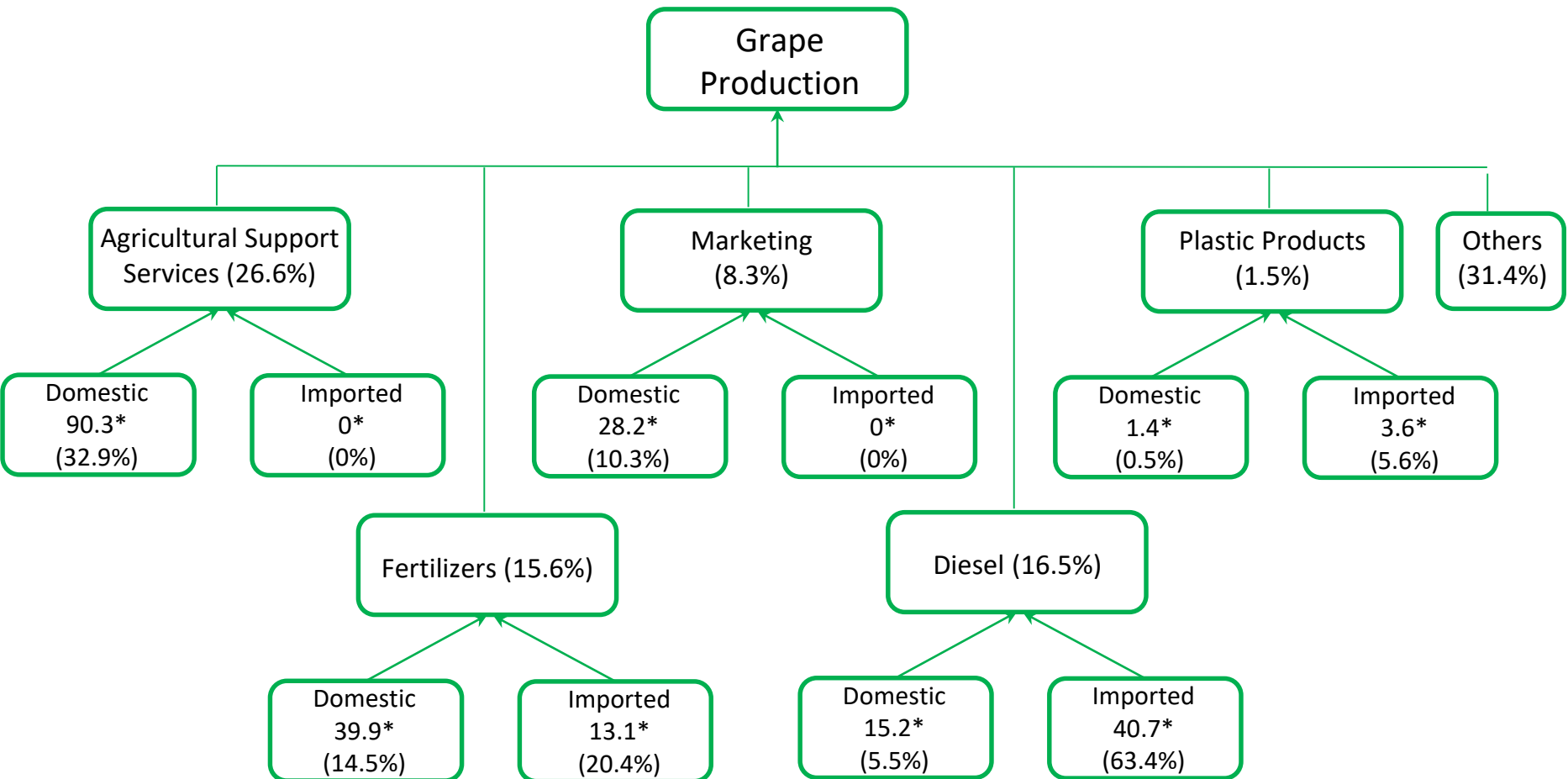
Source: MIP 2014, Chile Central Bank

# General structure of production



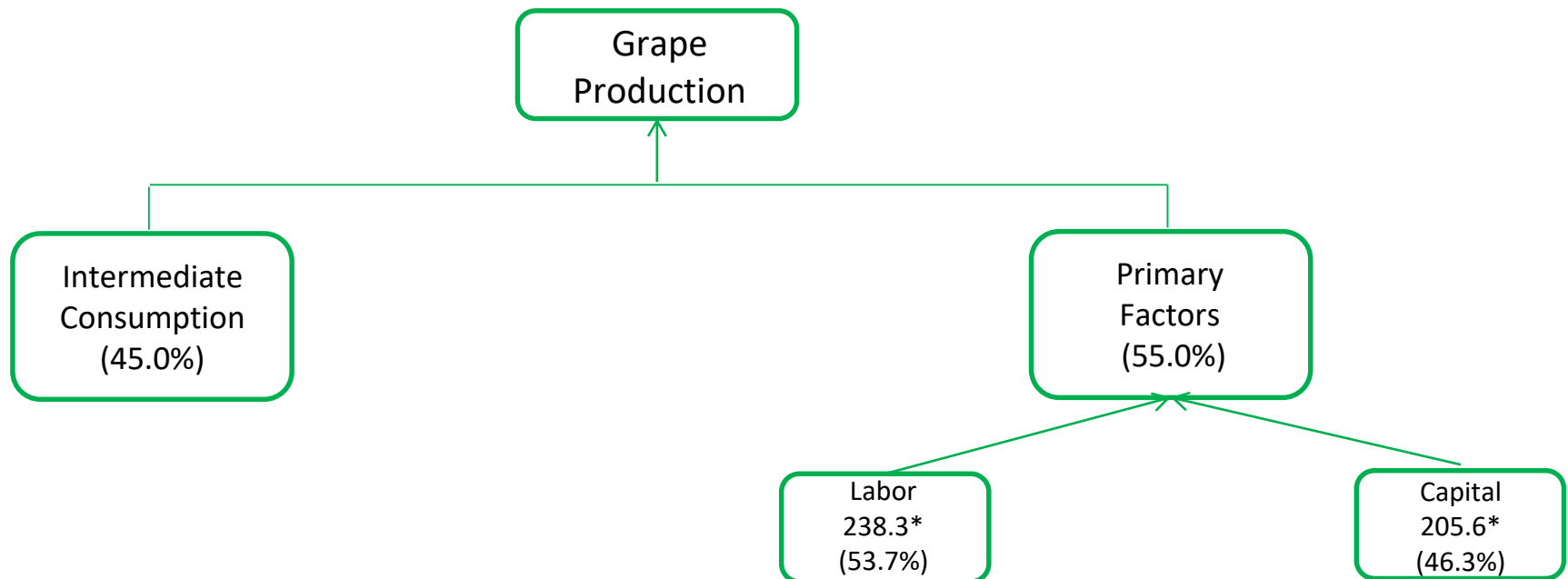


# Grape production – intermediate inputs demand



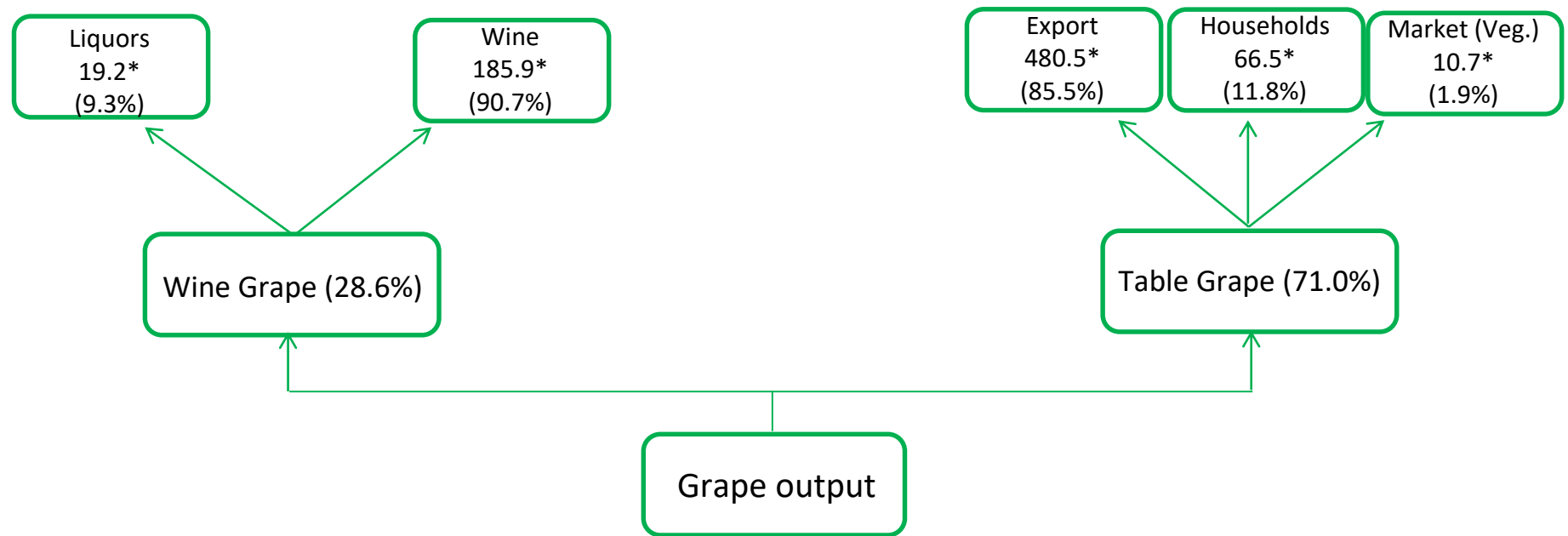
\*CLP billions

# Grape production – primary factors demand



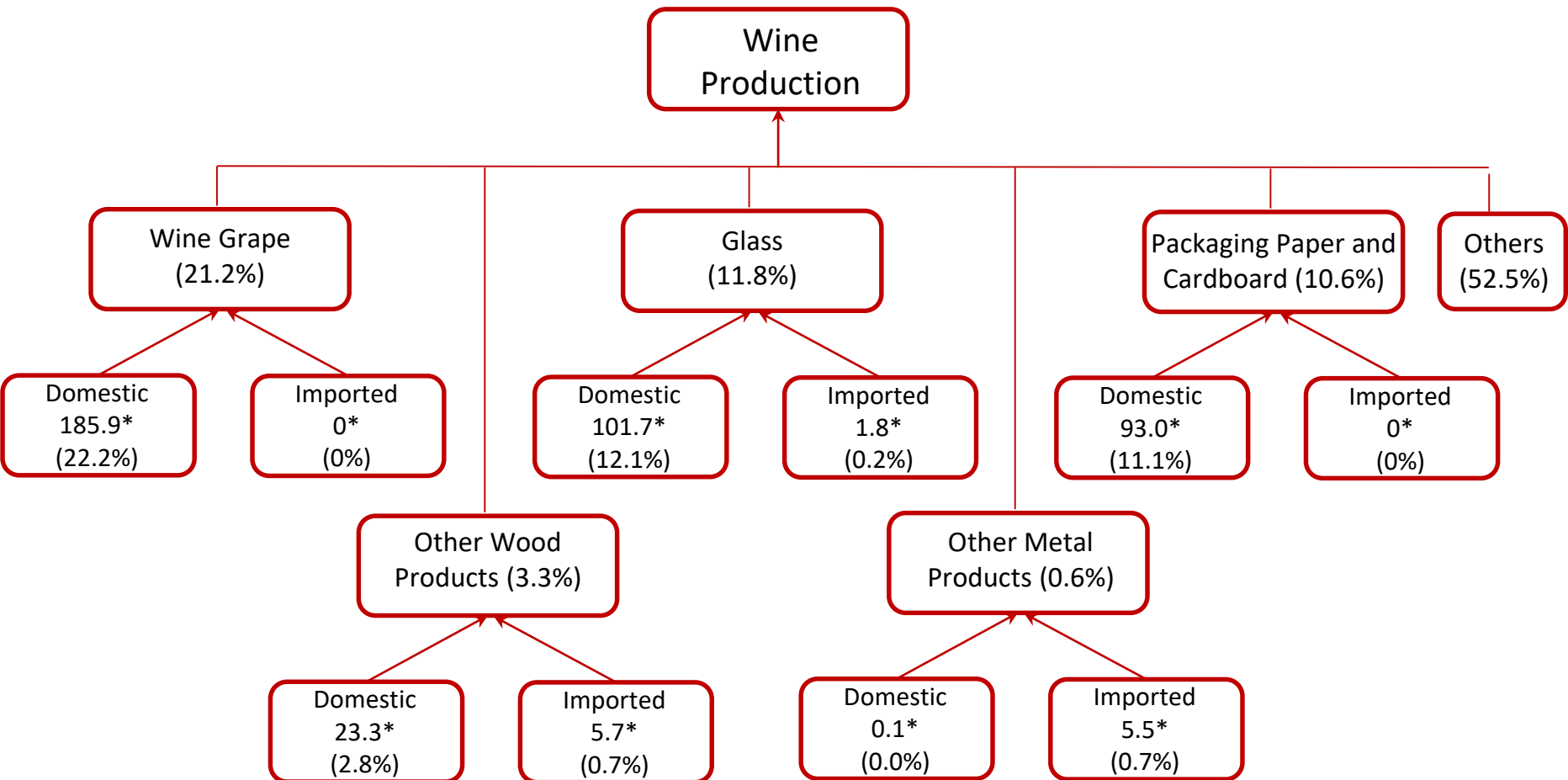
\*CLP billions

# Destination of grape production



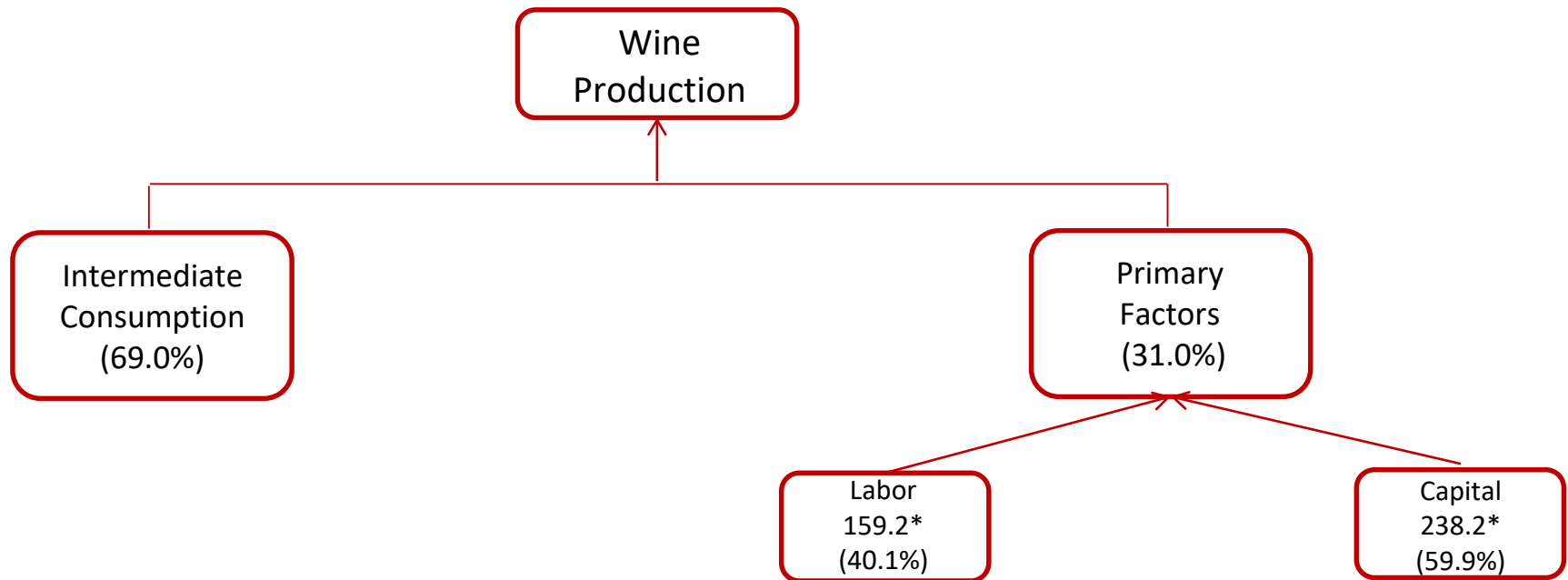
\*CLP billions

# Wine production – intermediate inputs demand



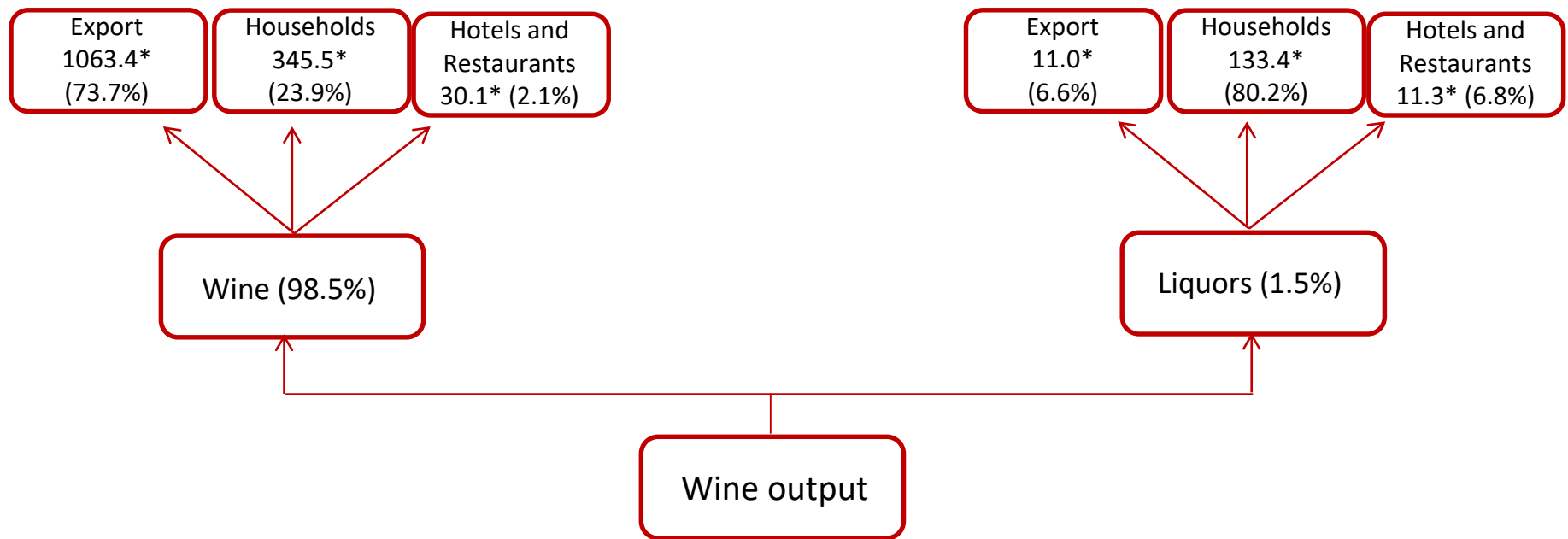
\*CLP billions

# Wine production – primary factors demand



\*CLP billions

# Destination of wine production

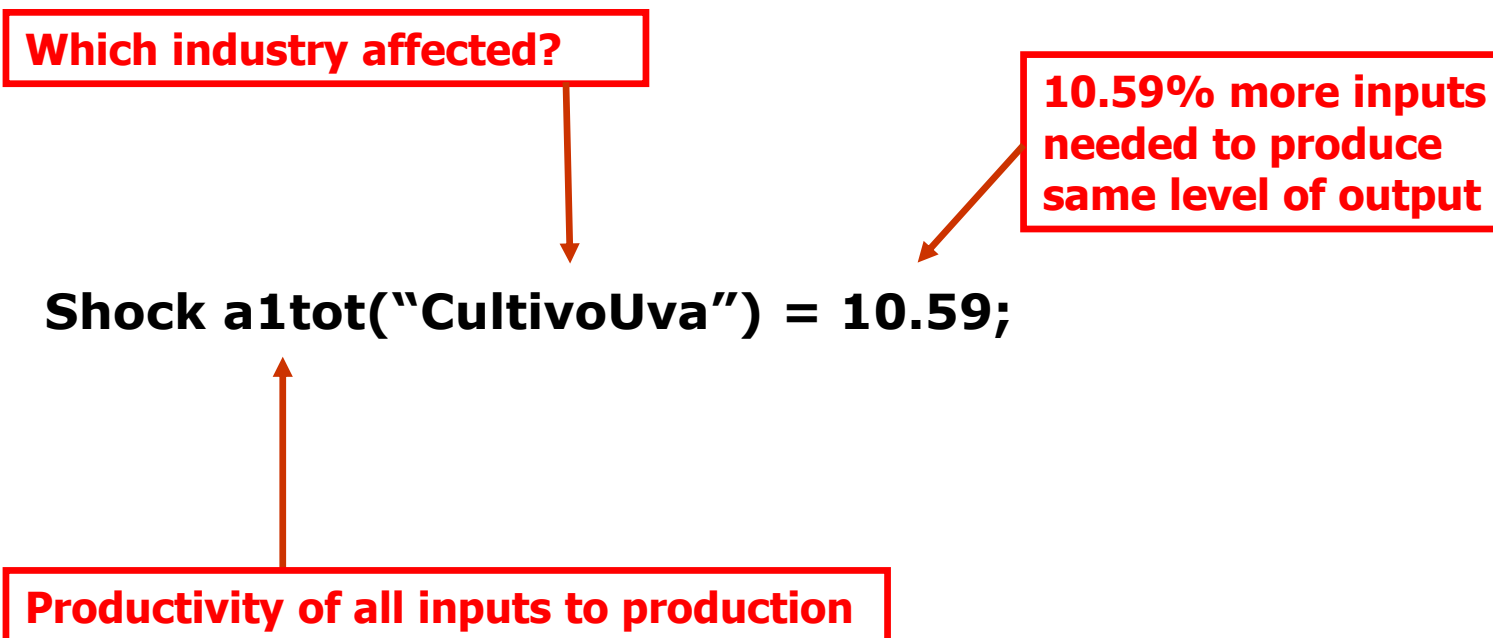


\*CLP billions

What if productivity in the grape sector decreased due to a temporary climate shock?

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***How do we implement grape output decline?***





# What if the climate shock also affected the quality of Chilean wine?

*How do we implement quality decrease?*

Which exported good affected?

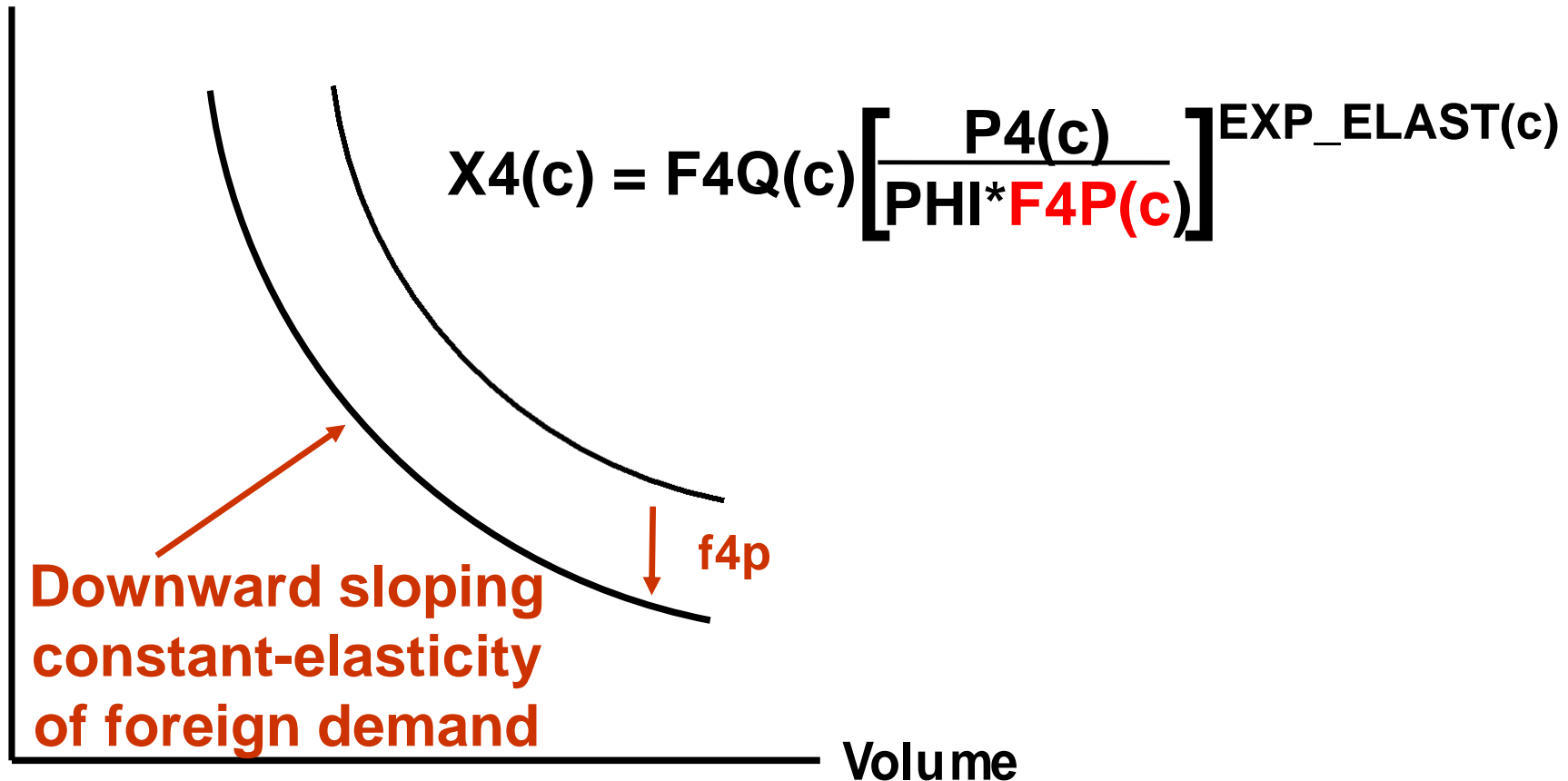
14.16% price decrease associated with the same level of foreign demand for Chilean wine

**Shock  $f4p(\text{"Vinos"}, \text{"DOM"}) = -14.16;$**

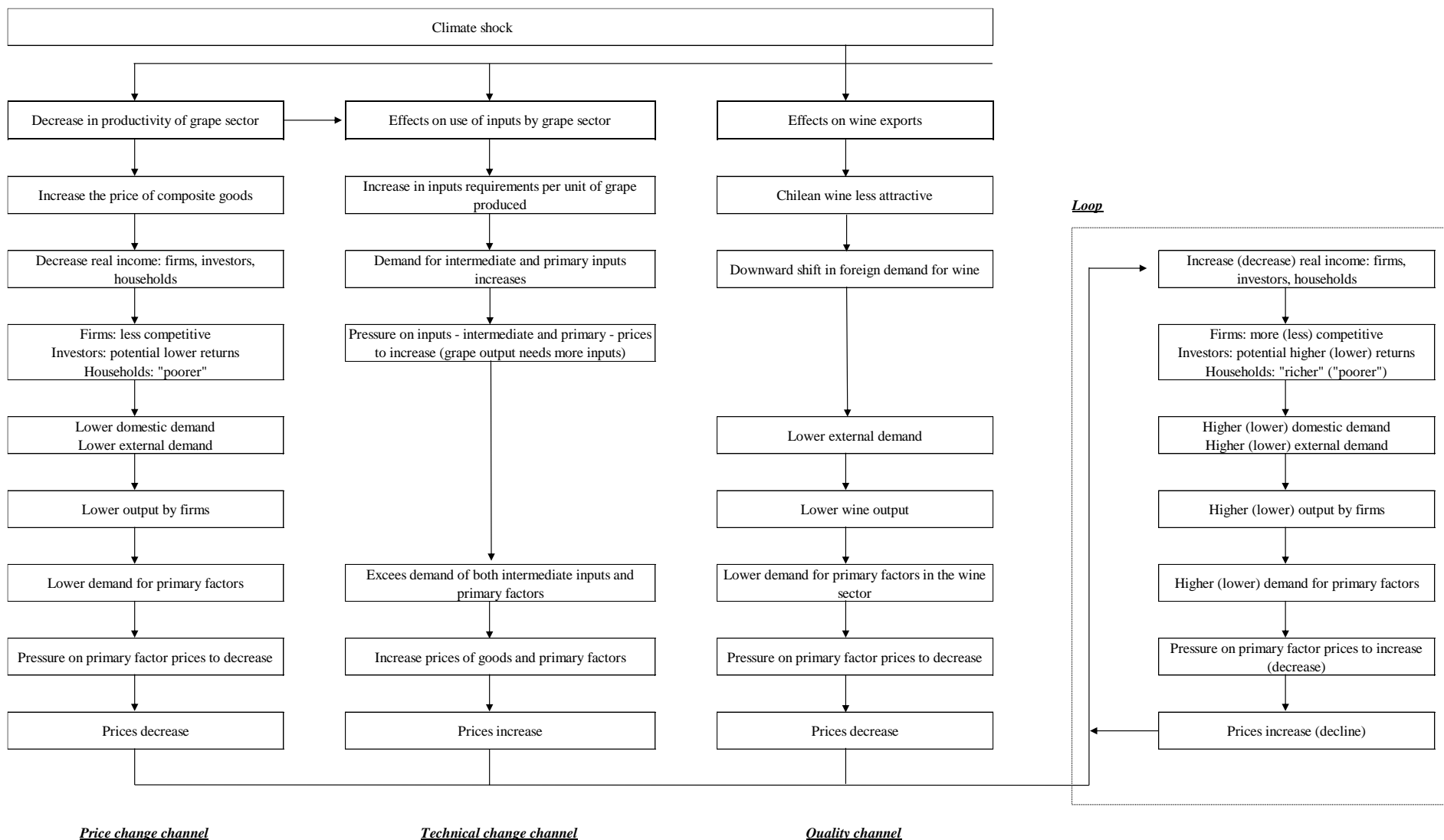
Price (upward) shift in export demand schedule  
– negative shock represents a downward shift

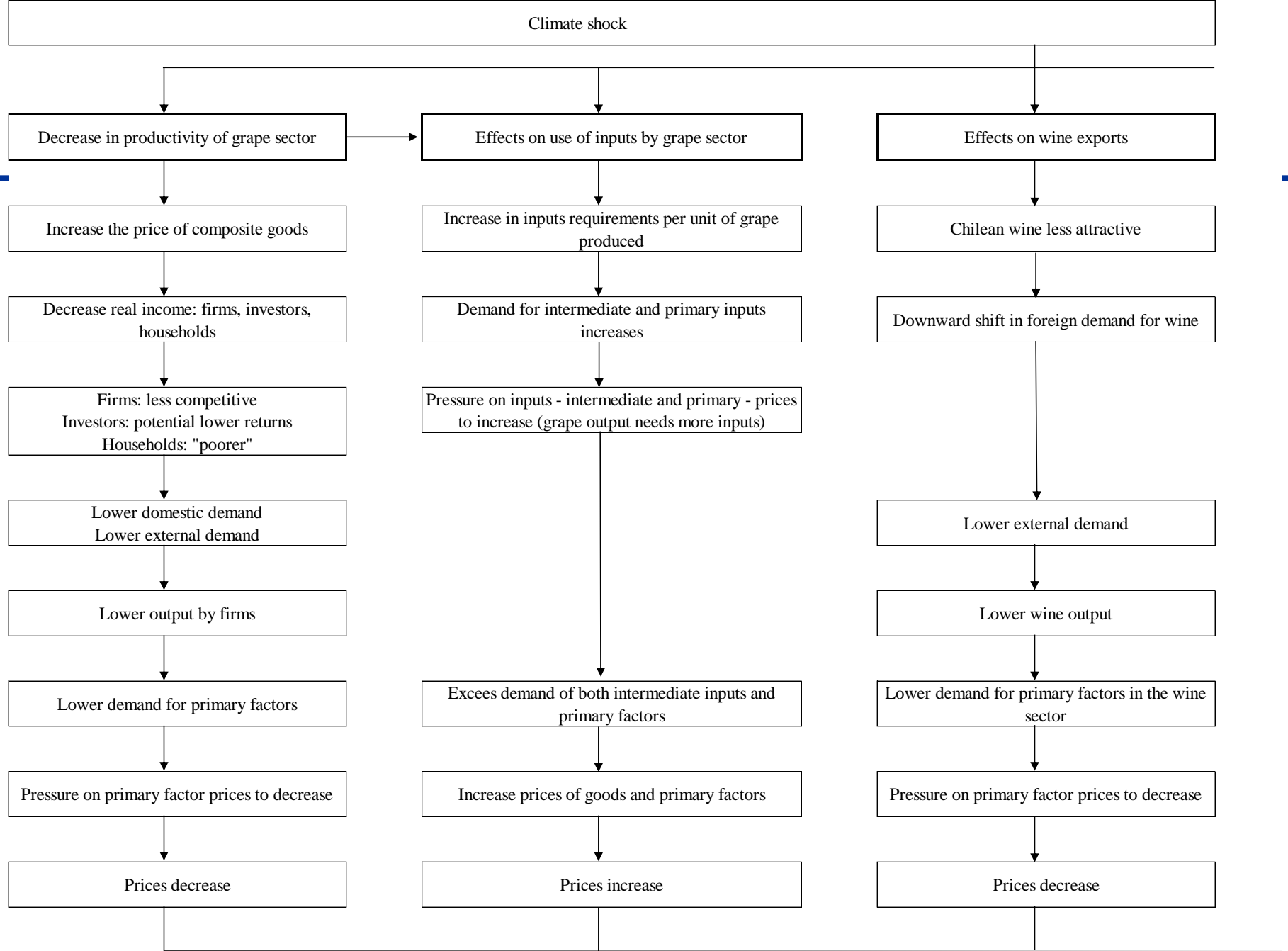
# Individual export demand

Export Price



# Causal relations underlying the simulation results



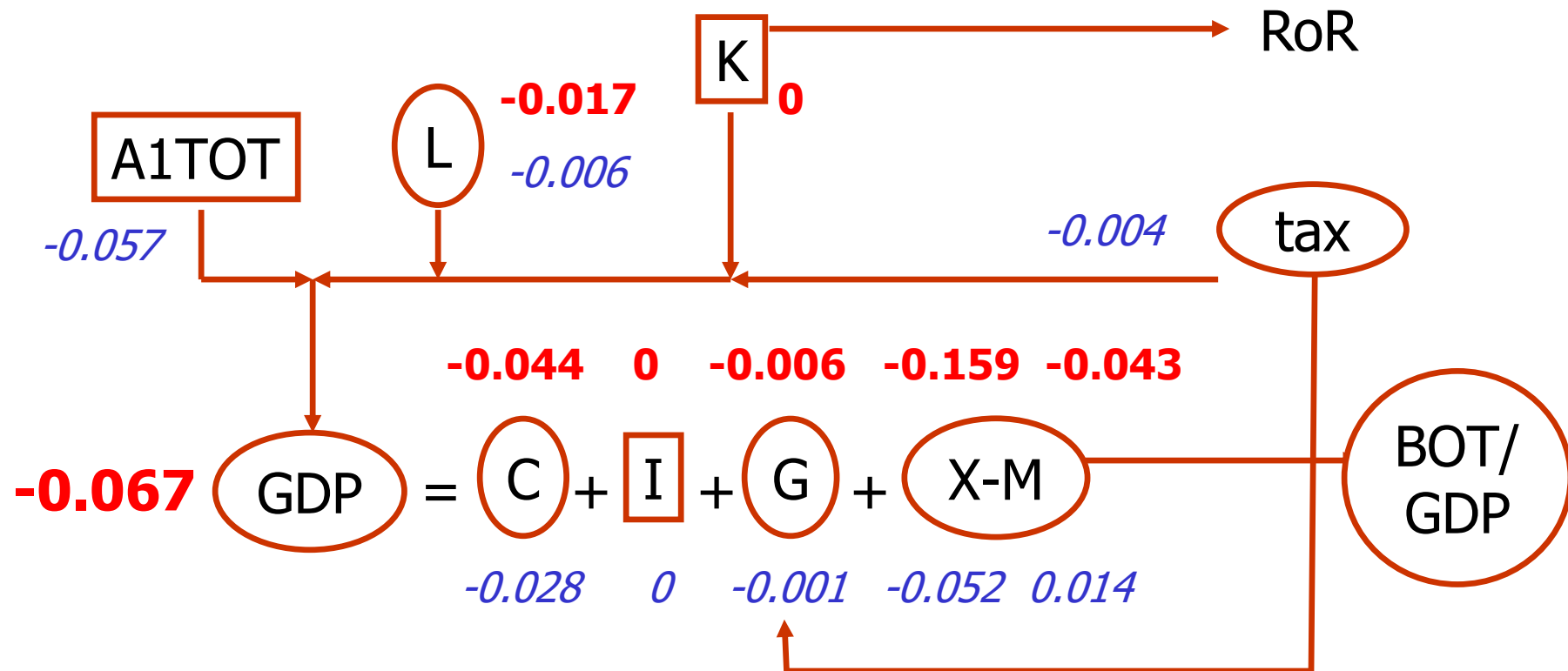


Price change channel

Technical change channel

Quality channel

# Macroeconomic effects (temporary shock)



Endogenous

Exogenous

**Percent Change**  
*Contribution to %GDP*

# Macro results (in % change)

	<i>Total</i>	<i>Subtotal</i>	
		<i>Quantity</i>	<i>Quality</i>
<i>Real GDP from expenditure side</i>	<b>-0.067</b>	-0.031	-0.036
Aggregate real investment expenditure	0.000	0.000	0.000
Real household consumption	-0.028	0.027	-0.055
Export volume	-0.052	-0.035	-0.017
Aggregate real government demands	-0.001	0.001	-0.001
Import volume	0.014	-0.024	0.037
 <i>Real GDP from income side</i>	 <b>-0.067</b>	 -0.031	 -0.036
Use of capital	0.000	0.000	0.000
Use of labor	-0.006	0.021	-0.028
Indirect taxes	-0.004	0.004	-0.009
Technical change	-0.057	-0.057	0.000

# Impacts on selected commodities (in % change)

	<i>Household consumption</i>			<i>Exports</i>			<i>Output</i>		
	<i>Total</i>	<i>Productivity</i>	<i>Vintage</i>	<i>Total</i>	<i>Productivity</i>	<i>Vintage</i>	<i>Total</i>	<i>Productivity</i>	<i>Vintage</i>
7 UvaVinifera	<b>0.000</b>	0.000	0.000	<b>0.000</b>	0.000	0.000	<b>-3.194</b>	-0.751	-2.443
8 UvaMesa	<b>-4.932</b>	-4.717	-0.215	<b>-6.308</b>	-6.289	-0.019	<b>-5.789</b>	-5.749	-0.040
59 Piscos	<b>-0.450</b>	-0.414	-0.036	<b>-0.329</b>	-0.514	0.186	<b>-0.793</b>	-0.951	0.157
60 Vinos	<b>0.129</b>	-1.017	1.145	<b>-4.788</b>	-0.644	-4.143	<b>-3.951</b>	-0.822	-3.130
Total in Chile	<b>-0.044</b>	0.043	-0.088	<b>-0.159</b>	-0.107	-0.052	<b>-0.048</b>	-0.012	-0.035

**higher cost of  
production, higher  
consumer price**

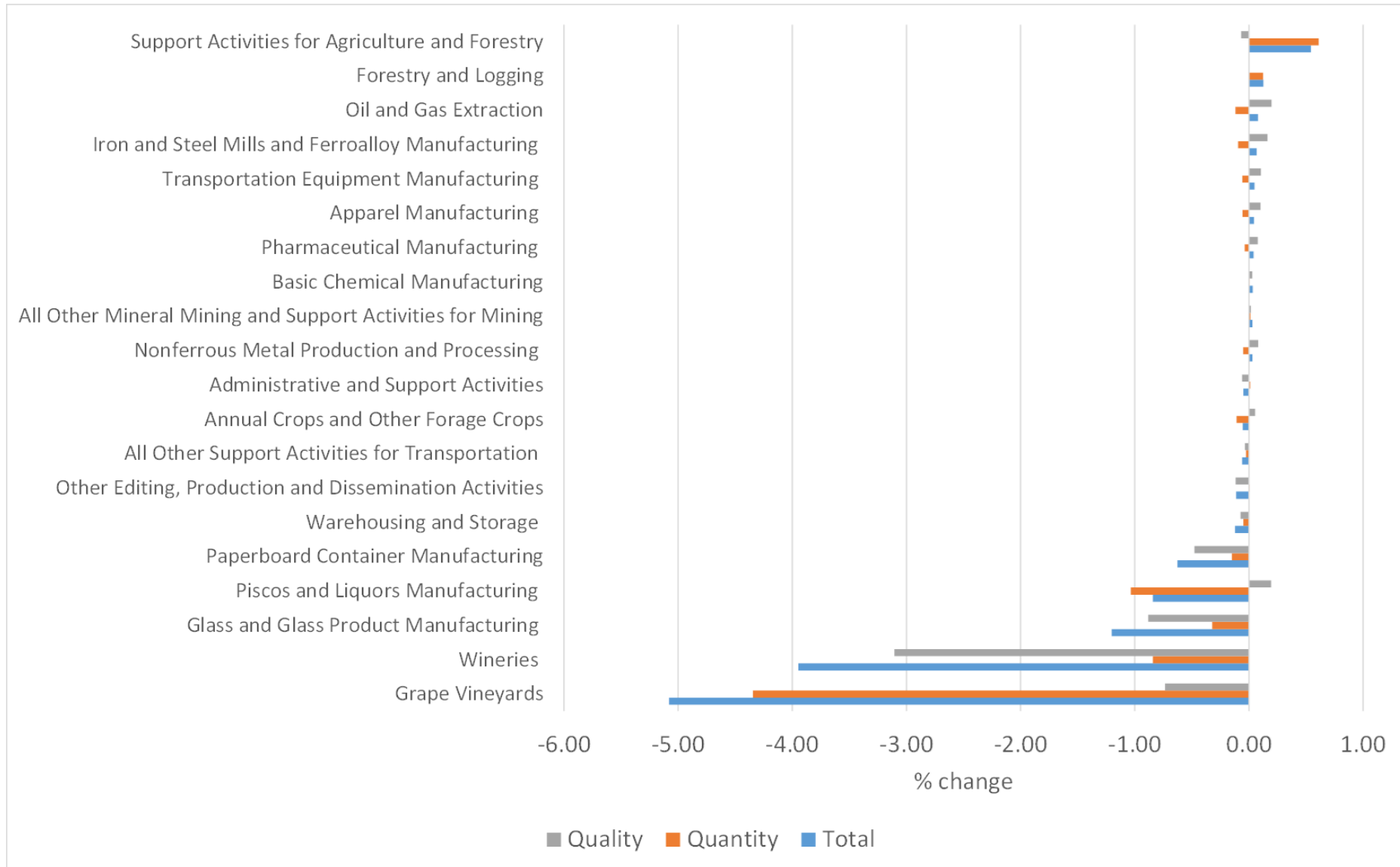
**higher consumption  
of domestic wine**

**higher cost of  
production, higher  
consumer price**

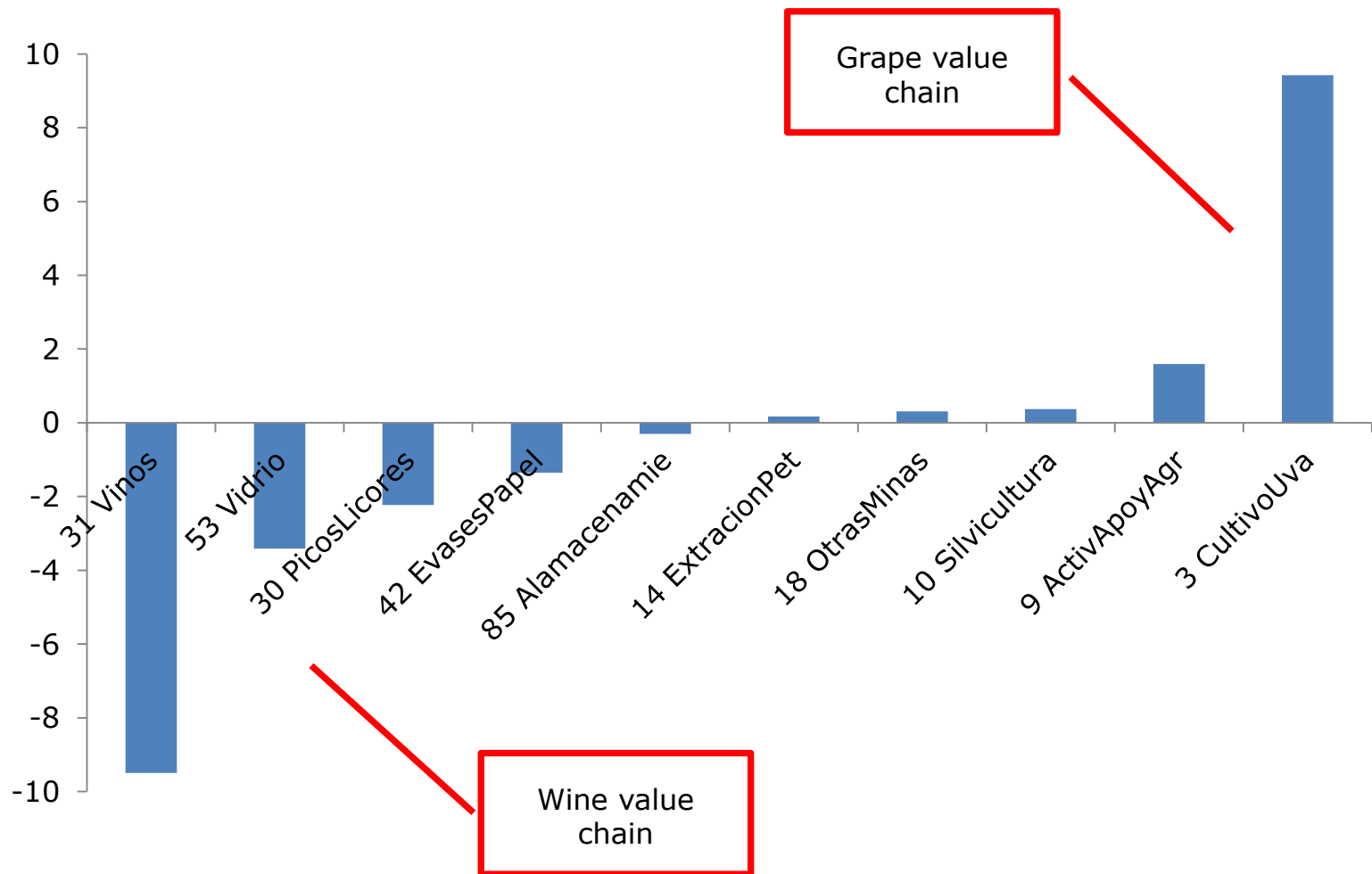
**lower quality, decreases  
exports**



# Sectoral results – Activity level (% change)



# Labor absorption - short run (% change)



# Structural Analysis of Sectoral Activity Results\*

*Dependent Variable: ACT\_SECT*

<i>Variables</i>	<i>Total</i>	<i>Subtotal</i>	
		<i>Quantity</i>	<i>Quality</i>
WINE_SH	-4.205*** (0.301)	-1.006** (0.432)	-3.199*** (0.132)
HH_SH	-0.089*** (0.032)		-0.048*** (0.018)
D_GRAPE	-4.143*** (0.118)	-4.064*** (0.174)	
D_WINE	-3.945*** (0.098)		-3.145*** (0.054)
EXP_SH		-0.121** (0.058)	0.051** (0.022)
MAT_SH		-0.121 (0.076)	
Constant	0.023* (0.013)	0.073 (0.045)	0.012 (0.008)
Observations	111	111	111
R-squared	0.977	0.899	0.975

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Note: \*ACT\_SECT = percentage change in sectoral activity level; WINE\_SH = share of total sales to the wine sector; HH\_SH = share of total sales to households; D\_GRAPE = dummy for the grape sector; D\_WINE = dummy for the wine sector; EXP\_SH = share of total sales to exports; MAT\_SH = share of materials in total costs.

# Sensitivity Analysis Results: Export Demand Elasticity for Wine

	<i>Benchmark</i>			<i>2x</i>			<i>5x</i>		
	<i>Total</i>	<i>Quantity</i>	<i>Quality</i>	<i>Total</i>	<i>Quantity</i>	<i>Quality</i>	<i>Total</i>	<i>Quantity</i>	<i>Quality</i>
<i><u>Household consumption</u></i>									
Wine grapes	<b>0.000</b>	0.000	0.000	<b>0.000</b>	0.000	0.000	<b>0.000</b>	0.000	0.000
Table grapes	<b>-4.932</b>	-4.717	-0.215	<b>-5.099</b>	-4.736	-0.363	<b>-5.398</b>	-4.770	-0.628
Piscos and liquors	<b>-0.450</b>	-0.414	-0.036	<b>-0.472</b>	-0.415	-0.057	<b>-0.503</b>	-0.416	-0.088
Wine	<b>0.129</b>	-1.017	1.145	<b>1.060</b>	-0.901	1.961	<b>2.784</b>	-0.687	3.471
<i><u>Exports</u></i>									
Wine grapes	<b>0.000</b>	0.000	0.000	<b>0.000</b>	0.000	0.000	<b>0.000</b>	0.000	0.000
Table grapes	<b>-6.308</b>	-6.289	-0.019	<b>-6.330</b>	-6.294	-0.035	<b>-6.374</b>	-6.304	-0.070
Piscos and liquors	<b>-0.329</b>	-0.514	0.186	<b>-0.175</b>	-0.491	0.316	<b>0.104</b>	-0.448	0.551
Wine	<b>-4.788</b>	-0.644	-4.143	<b>-8.182</b>	-1.102	-7.080	<b>-14.429</b>	-1.946	-12.483
<i><u>Output</u></i>									
Wine grapes	<b>-3.194</b>	-0.751	-2.443	<b>-5.197</b>	-1.023	-4.174	<b>-8.881</b>	-1.524	-7.357
Table grapes	<b>-5.789</b>	-5.749	-0.040	<b>-5.826</b>	-5.755	-0.071	<b>-5.897</b>	-5.768	-0.129
Piscos and liquors	<b>-0.793</b>	-0.951	0.157	<b>-0.656</b>	-0.927	0.271	<b>-0.397</b>	-0.883	0.486
Wine	<b>-3.951</b>	-0.822	-3.130	<b>-6.517</b>	-1.171	-5.346	<b>-11.236</b>	-1.813	-9.423
<i><u>Macroeconomic aggregates</u></i>									
Real GDP from expenditure side	<b>-0.067</b>	-0.031	-0.036	<b>-0.096</b>	-0.035	-0.061	<b>-0.147</b>	-0.042	-0.104
Aggregate real investment expenditure	<b>0.000</b>	0.000	0.000	<b>0.000</b>	0.000	0.000	<b>0.000</b>	0.000	0.000
Real household consumption	<b>-0.044</b>	0.043	-0.088	<b>-0.114</b>	0.033	-0.147	<b>-0.236</b>	0.016	-0.251
Export volume index	<b>-0.159</b>	-0.107	-0.052	<b>-0.201</b>	-0.112	-0.089	<b>-0.277</b>	-0.122	-0.155
Aggregate real government demands	<b>-0.006</b>	0.005	-0.011	<b>-0.015</b>	0.003	-0.018	<b>-0.029</b>	0.001	-0.030
Import volume index, CIF weights	<b>-0.043</b>	0.075	-0.119	<b>-0.138</b>	0.062	-0.200	<b>-0.305</b>	0.038	-0.343
Aggregate employment, wage bill weights	<b>-0.017</b>	0.056	-0.073	<b>-0.075</b>	0.047	-0.122	<b>-0.176</b>	0.032	-0.209

# Next steps (room for collaboration)

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Estimate models linking grape crop yields and wine prices to climatic conditions

- ✓ Quantity and quality estimates for Chile

Update elasticities (key parameters)

Modeling integration to deal with uncertainties

- ✓ Climate anomalies (short term variability)
- ✓ Climate change scenarios (long term averages)

Include “land” as a specific primary factor



## **A Bad Year? Climate Variability and the Wine Industry in Chile**

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