

# Copper Super Cycle Impact on the Chilean Economy

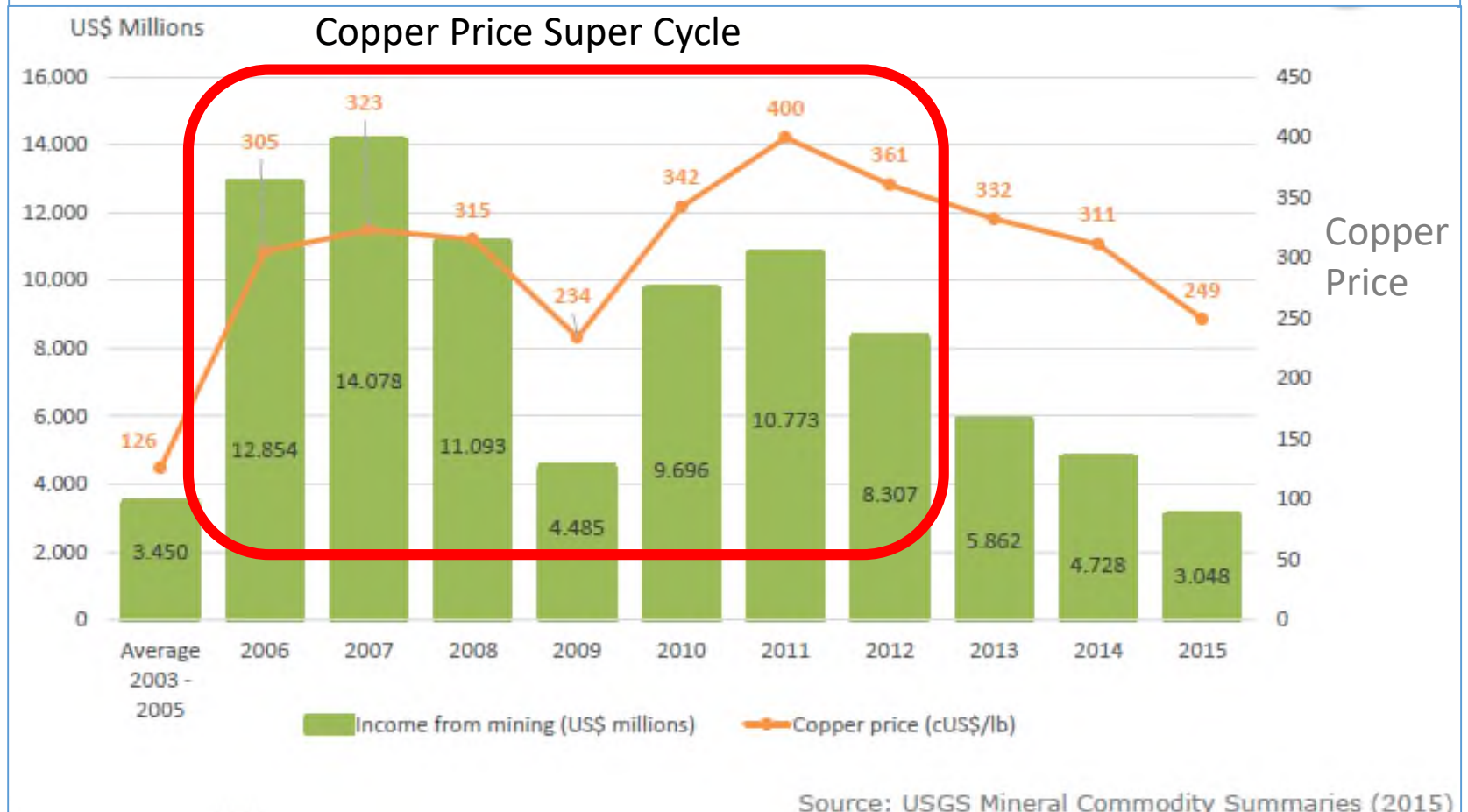
By

Patricio Aroca  
CEPR, Universidad Adolfo Ibáñez  
Viña del Mar, Chile

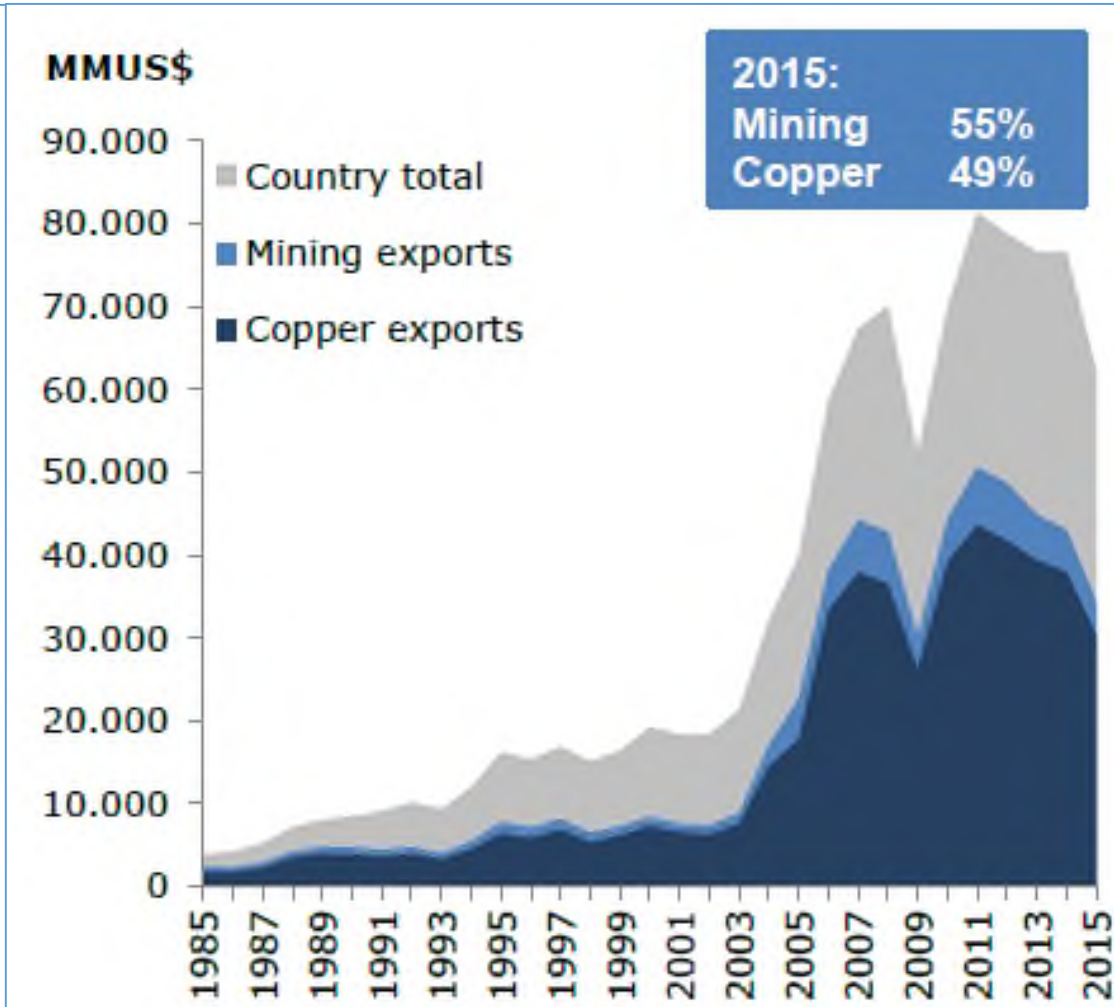
# Outline

- Motivation
  - There was a Copper Price Super Cycle
  - How big was the impact on the Chilean Economy

# Importance of Mining in Chile: Tax collection plus CODELCO profits



# Importance of Mining in Chile: Exports



# News from 2016

## Economic context and mining investment

## Latest news for mineral commodities

HOME SEARCH

The New York Times

ENERGY & ENVIRONMENT

*Oil Price Falls as Global Growth Anxiety Weighs on Markets*



**Mining Ready for M&A  
Revival, Producers Fight for  
Survival**

World / Europe

Glencore seeks to refinance credit facility

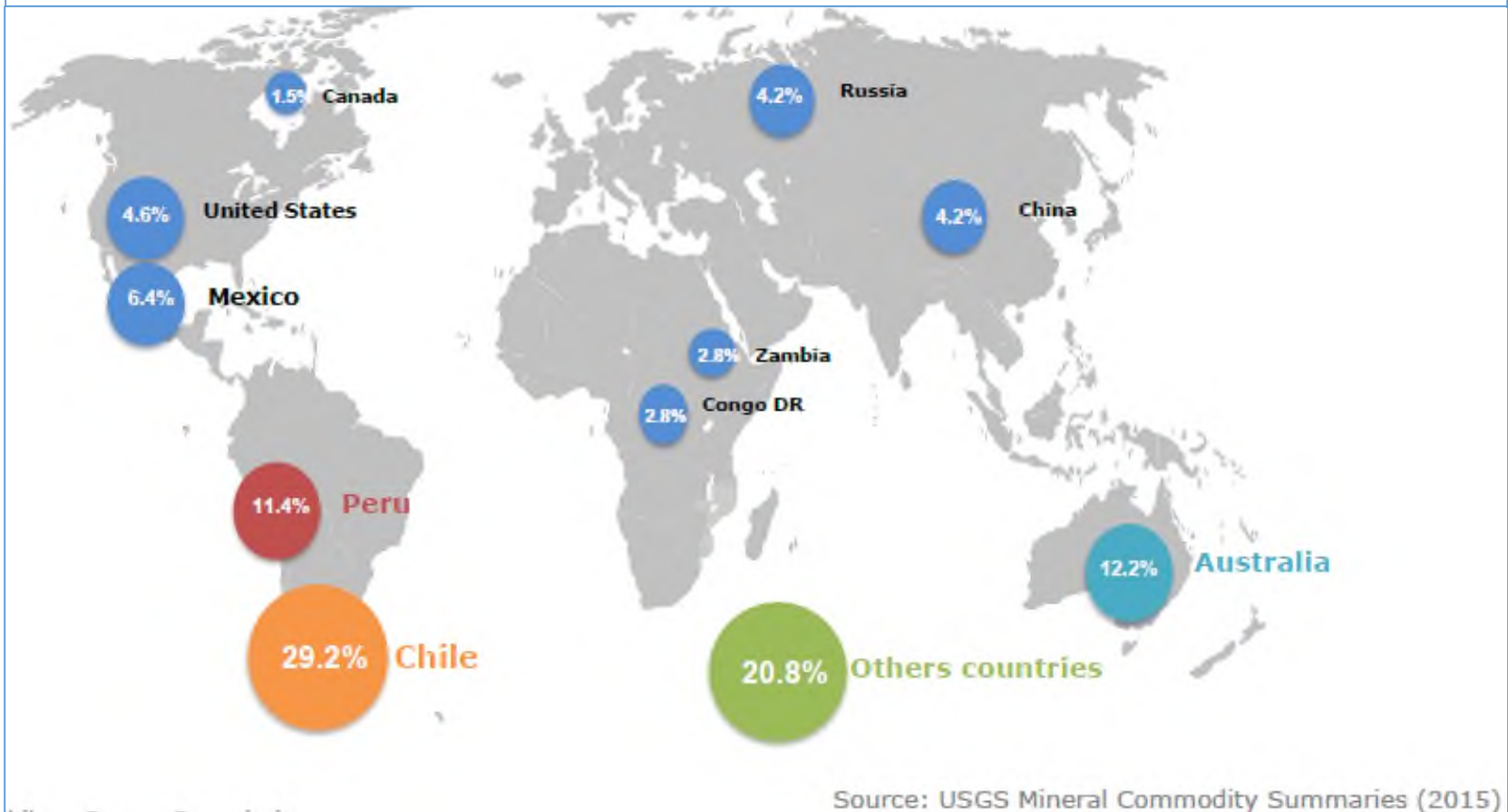
THE WALL STREET JOURNAL

**U.S. Industrial Production Dropped on Declines in Mining,  
Utilities**

Industries pulled back 0.4% in December; capacity utilization for utilities fell to lowest level since 1972

*Oil Prices: What's Behind the Drop? Simple Economics*

# Importance of Chile in Mining



# Methodology

- How to measure the impact?
  - Leontief model from Miller and Blair (2009)

Leontief Quantity Model  
(Demand-pull)  
[Prices fixed; quantities  
change]

Exogenous Variables

$$\mathbf{f}^1 = [f_i^1]$$

or

$$\Delta \mathbf{f} \leftarrow [\Delta f_i]$$

Variation in  
Exports

Endogenous Variables

$$\mathbf{x}^1 = \mathbf{L}^0 \mathbf{f}^1$$

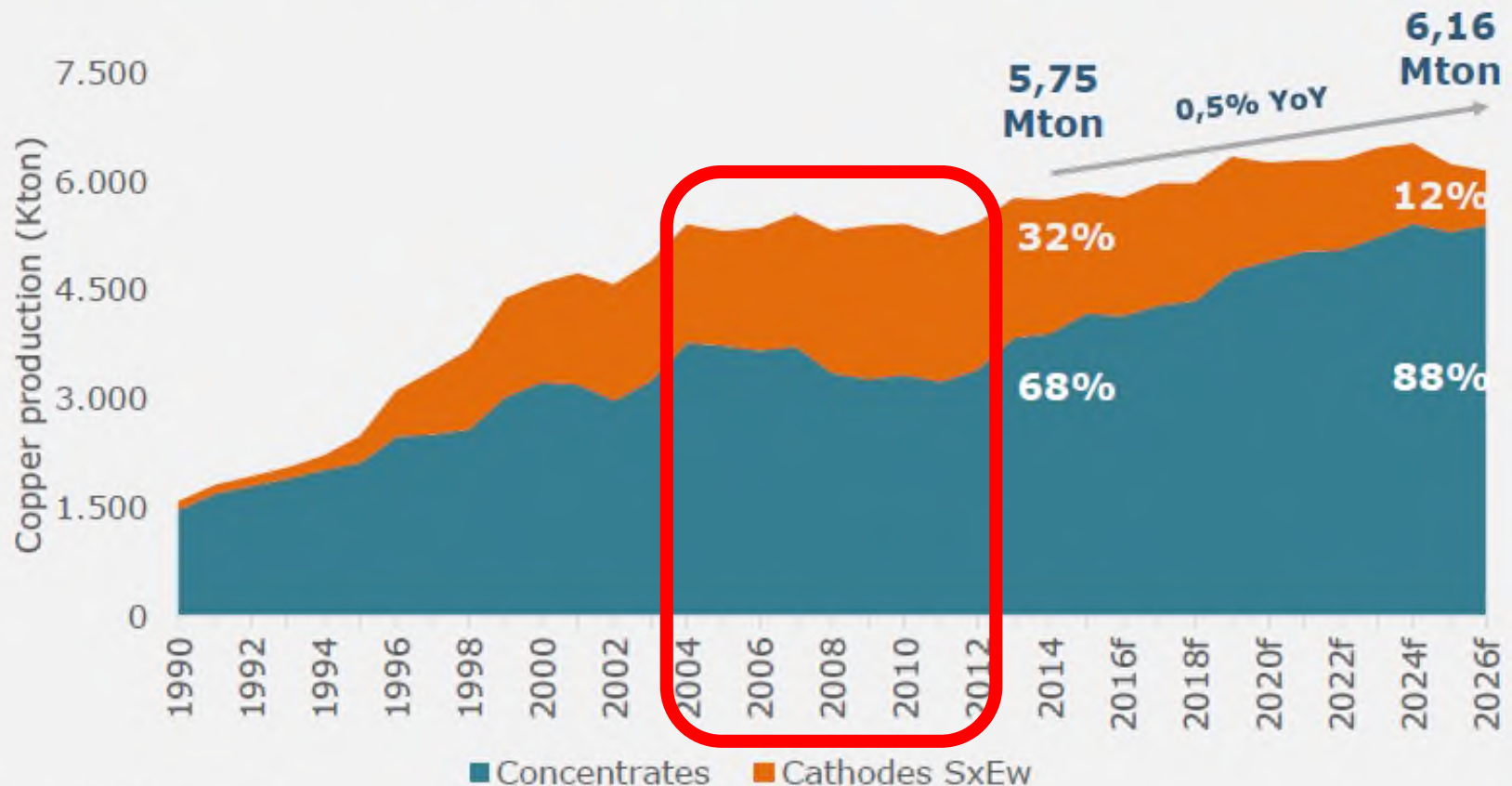
or

$$\Delta \mathbf{x} = \mathbf{L}^0 (\Delta \mathbf{f})$$



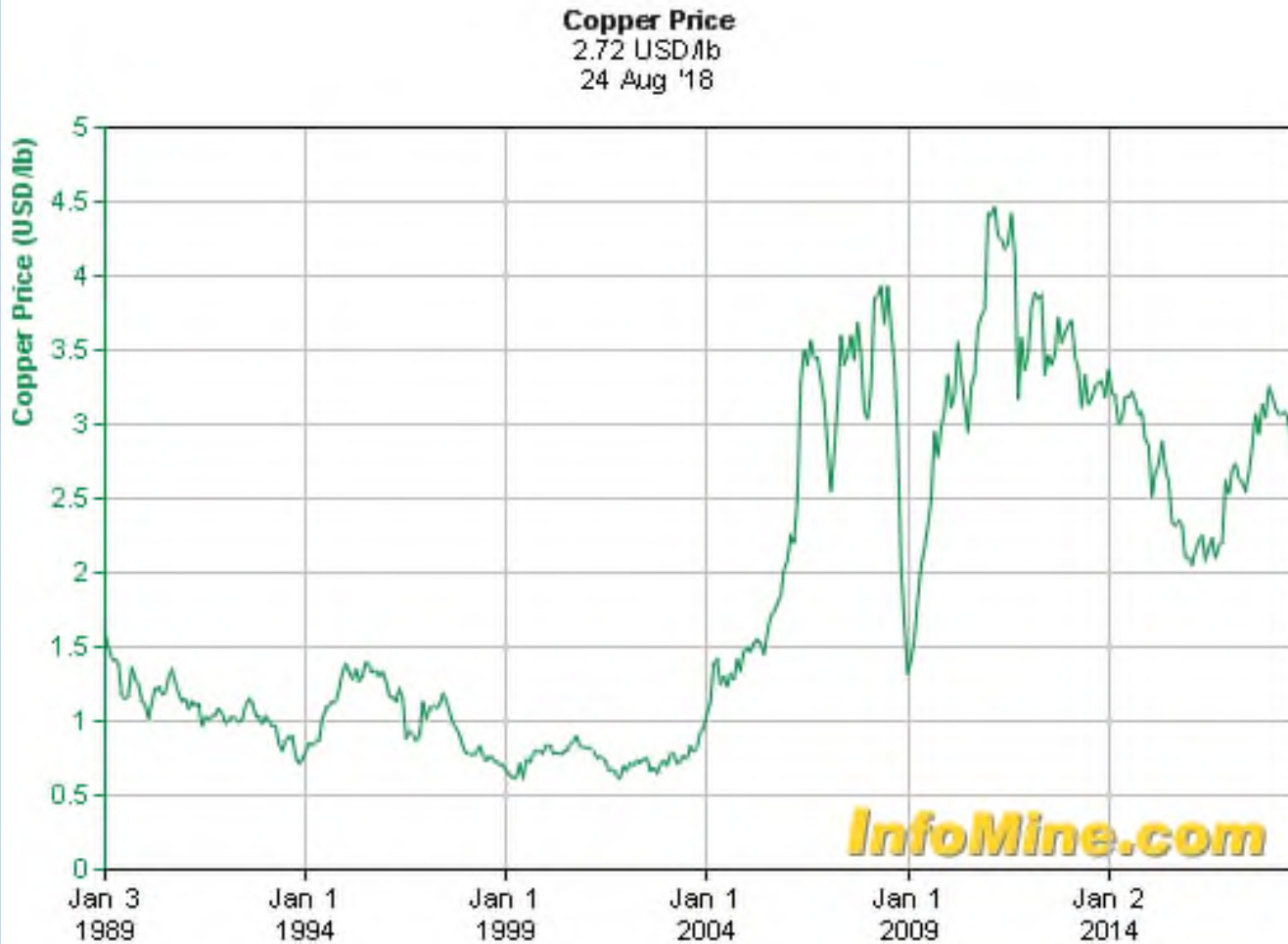
# Did quantity change?

## Chilean expected copper production





# Is copper price constant?



# Methodology

- How to measure the impact?
  - Leontief model from Miller and Blair (2009)

Leontief Price Model

(Cost-push)

[Quantities fixed; prices change]

Exogenous Variables

$$\mathbf{v}_c^1 = (\hat{\mathbf{x}}^0)^{-1} \mathbf{v}^1 = [v_j^1 / x_j^0]$$

or

$$\Delta \mathbf{v}_c = (\hat{\mathbf{x}}^0)^{-1} (\Delta \mathbf{v}) = [\Delta v_j / x_j^0]$$

Endogenous Variables

$$\bar{\mathbf{p}}^1 = (\mathbf{L}^0)' \mathbf{v}_c^1$$

or

$$\Delta \bar{\mathbf{p}} = (\mathbf{L}^0)' (\Delta \mathbf{v}_c)$$

Variation in  
Price

# Methodology

Using an IO table, the  $j$  column can be represented by:

$$x_j = \sum_{i=1}^n z_{ij} + v_j$$

In matrix form, summing columns of IO table:

$$\mathbf{x}' = \mathbf{i}'\mathbf{Z} + \mathbf{v}'$$

# Methodology

By definition  $\mathbf{Z} = \mathbf{A}\hat{\mathbf{x}}$ , therefore  $\mathbf{x}' = \mathbf{i}'\mathbf{A}\hat{\mathbf{x}}$  and post-multiplying by  $\hat{\mathbf{x}}^{-1}$ ,

$$\mathbf{x}'\hat{\mathbf{x}}^{-1} = \mathbf{i}'\mathbf{A}\hat{\mathbf{x}}\hat{\mathbf{x}}^{-1} + \mathbf{v}'\hat{\mathbf{x}}^{-1}$$

$$\mathbf{i}' = \mathbf{i}'\mathbf{A} + \mathbf{v}'\hat{\mathbf{x}}^{-1} = \mathbf{i}'\mathbf{A} + \mathbf{v}'_c$$

Price decomposition

According to Miller and Blair (2009), “this illustrates the unique measurement units in the base year table – amounts that can be purchased for \$1. “

# Methodology

Denoting base year index prices by  $\bar{p}_j$  so  $\bar{\mathbf{p}}' = [\bar{p}_1, \dots, \bar{p}_n]$ , then the input-output price model is:

$$\bar{\mathbf{p}}' = \bar{\mathbf{p}}' \mathbf{A} + \mathbf{v}'_c$$

Which lead to:

$$\bar{\mathbf{p}}' = \mathbf{v}'_c (\mathbf{I} - \mathbf{A})^{-1} = \mathbf{v}'_c \mathbf{L}$$

Transposing and expressing in column vector:

$$\bar{\mathbf{p}} = (\mathbf{I} - \mathbf{A}')^{-1} \mathbf{v}_c = \mathbf{L}' \mathbf{v}_c \quad \leftarrow \text{Markup Model}$$

This is a mark-up price model, where the output price is determined by input prices plus the cost of labor per unit of output and the margin per unit.

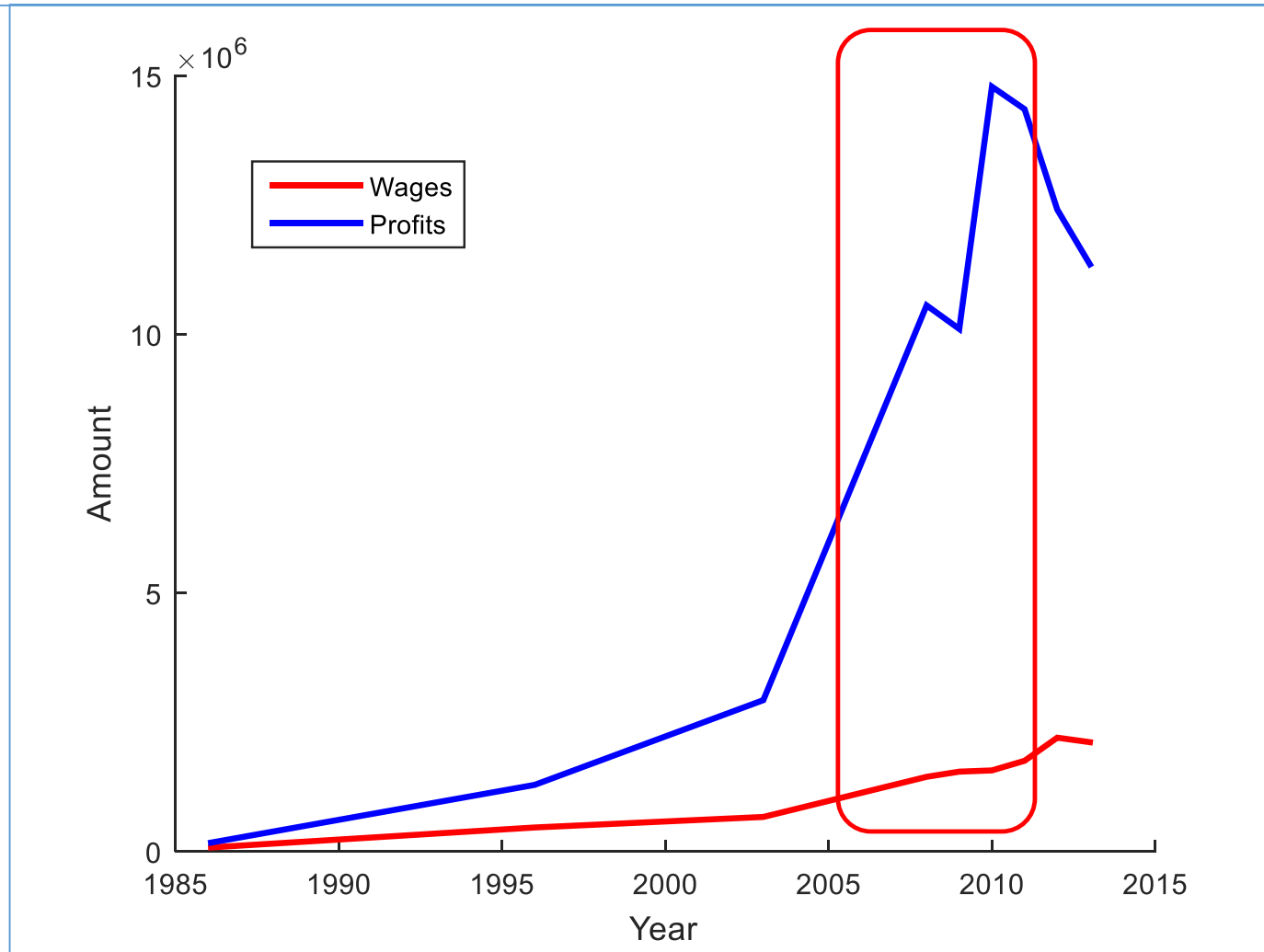
# Results

Price

$$\bar{\mathbf{p}} = (\mathbf{I} - \mathbf{A}')^{-1} \mathbf{v}_c = \mathbf{L}'^* [\mathbf{wage\ profits}]$$

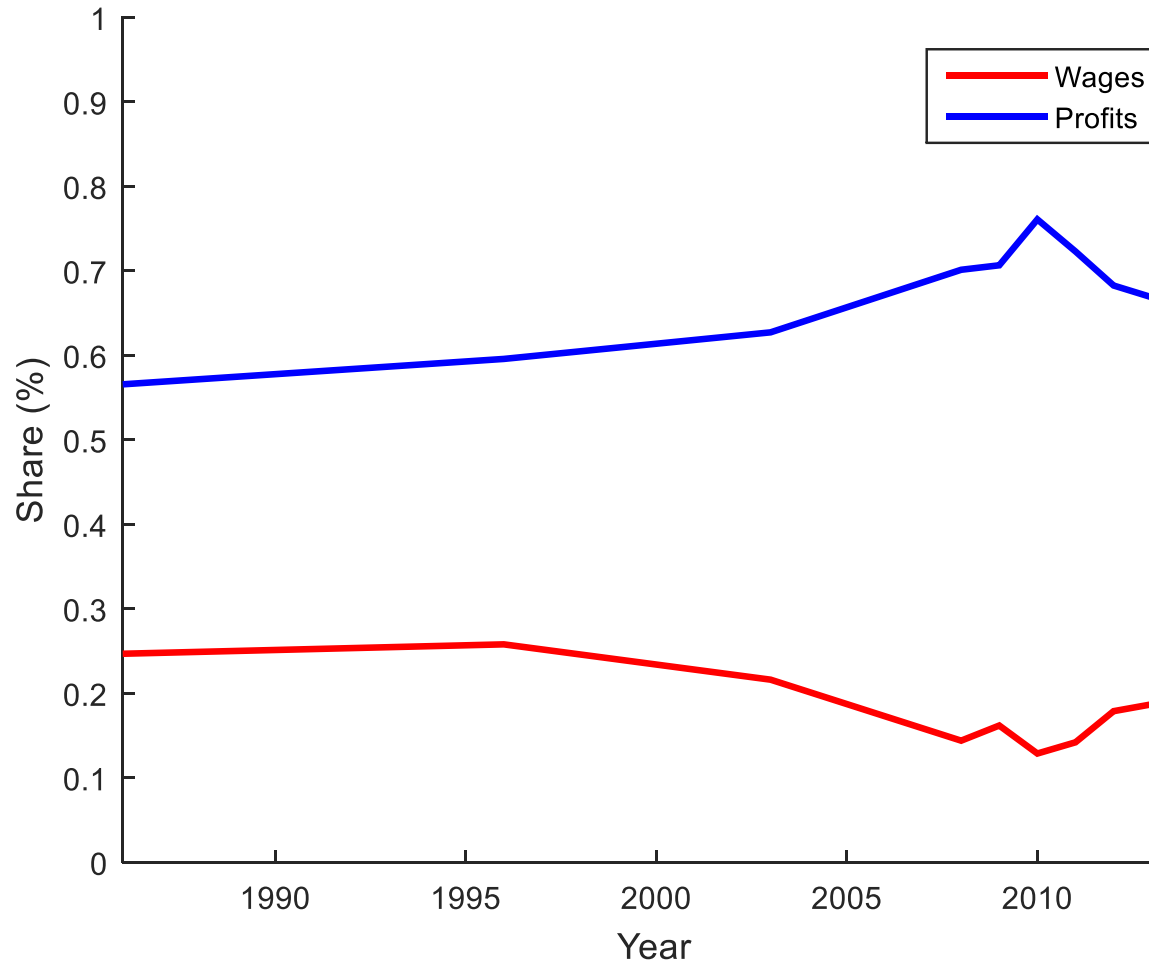
Where wage and profits are the share of wage and profits on the total buys by the sectors.

# Wage and Profits in the Copper Sector





# Results: wage and profits share participation on copper price



# Next step

- Split the impact among domestic and foreign ownership
- Determine how those share are affected by the price cycle,

Conclusion

# Copper Super Cycle Impact on the Chilean Economy

By

Patricio Aroca  
CEPR, Universidad Adolfo Ibáñez  
Viña del Mar, Chile