Electronic invoicing: a data revolution for applied macroeconomic research

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Motivation: traditional *aggregate data menu* becoming ill-suited for Central Banks

- Central Banks: intensive users of data for informing monetary policy decisions. Traditional menu includes

  - Monthly (1-3 m lag): supply-side activity; unemployment; int. trade; Inflation; wages; econ. expectations; etc.

  - Quarterly (3m + lag): demand-side activity (Q N. Acc.); investment surveys; listed firms income statements/bce sheets; etc.

- Three problems with the **traditional menu**:

  - *The lag problem*: most reliable activity indicators (eg., N. Acc.) and sectoral composition of demand (eg., mining-non-mining investment) are available with a 3-month lag or more.

  - *The aggregation problem*: under important structural changes, aggregate statistics become increasingly ill-suited to interpret and forecast economic trends (eg: flattening of the Ph. Curve; employment-wages puzzle; traction of MP at low yields environment).

  - *The research tax problem*: there is only so much you can squeeze out from aggregate macro data from an academic research perspective → macro analysis may become a "tax" researchers have to pay in some institutions (i.e., Central Banks).

Our medium-term goal (multi-division effort at the CBC): _change the menu_ towards increasing reliance on micro data

- Today´s presentation: potential of VAT-related data for addressing these problems

  - *The lag problem*: every single business-to-business (B2B) transaction available in real time –can be used to construct supply- and demand-side activity & B2B price indicators *contemporaneous* with MP decisions.

  - *The aggregation problem*: observation of individual firms & information about B2B environment can greatly enhance detection of structural changes and implications for the transmission mechanisms of MP.

  - *The research-tax problem*: VAT data can bridge the gap between high-quality academic research and analysis for applied MP decisions –especially, since it can be merged with other data.

- Electronic invoicing VAT data: what´s in it?

  - **F29**: since late 90´s, Chilean IRS (SII) has firm-level monthly digitalized data including overall sales; and purchases of different types of inputs.

  - **F3323**: since 2010, additional forms record net pair-wise B2B transactions (first bi-annual; then monthly).

  - **E-invoice**: starting in 2014, firms gradually required to upload **every transaction** into the IRS server, including

    1. Firm´s IDs (industry classification and address)
    2. Payment method (cash/credit, w. settlement date)
    3. Transaction type (input ,capital purchase, real state)
    4. Product name (non-standardized)
    5. Product price
    6. Product quantity.

Outline: illustrating potential through 3 applications

1. *The lag problem*: linking supply- and demand-side activity in real time

2. *The aggregation problem*: spotting structural changes from B2B network data

3. *The research tax problem*: hot academic topics with direct implications for MP

1. *The lag problem*

¿What´s driving investment in the Chilean economy right now?

Not all investment has the same economic traction, especially in a commodity-based economy

- Mining has a moderate direct impact on GDP. *Mining investment*, on the other hand, can explain substantial share of overall investment at times.

- Why is it important to distinguish between mining and non-mining (i.e., productive and residential) investment?

  - Mining investment is less-linked to the business cycle –less reliable as early indicator of macro turning points.

  - Expanded production capacity from mining investment is less labor-intensive and hence delivers less traction on overall economic activity, employment, and inflation.

- However, investment can only imperfectly be inferred from monthly activity data, and even at Q-frequency, it does not distinguish by economic sector (that takes about 8 Qs)

  - We currently rely on complementary data to proxy for sectoral composition (surveys; machinery imports; income statements), but room for judgement remains large.

- Recently available VAT data provides a valuable additional information source.

VAT declarations and sectoral investment: going beyond sectoral activity to signal pull factors over business-cycles

Value-added: Mining and Non-mining
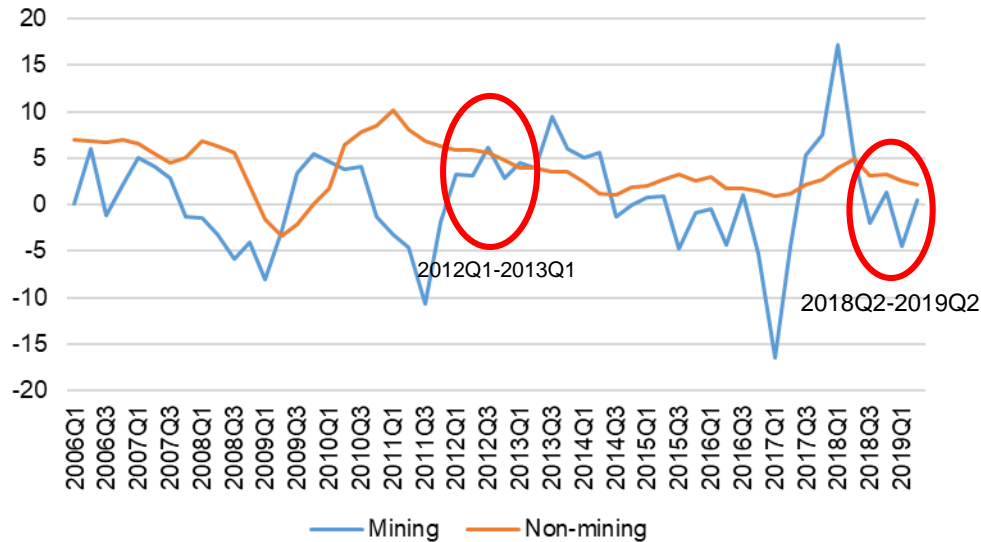
Machinery & Equipment from VAT forms: Mining vs. Non-mining
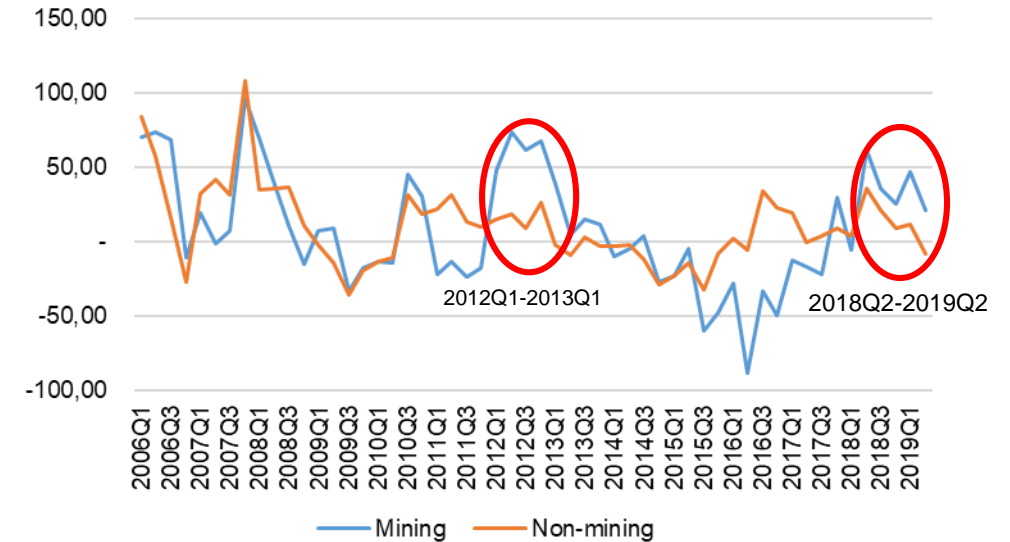
- The episodes of 2012Q1-2013Q1 and 2018Q2-2019Q2 show confounding signals between value added and machinery equipment growth.
  - Mining production has mostly dragged economic activity in the last few quarters –transitory supply-side disruptions
  - However, capital expenditure from **F29 VAT statements** suggests mining investment is leading the current investment cycle
    - This cannot be spotted with traditional sectoral investment data, officially released with 8 Q lags.
- **Next step**: use **e-invoicing** to quantitatively decompose both M&E, construction, and other type of investment into all economic sectors in real time!

2. *The aggregation problem*

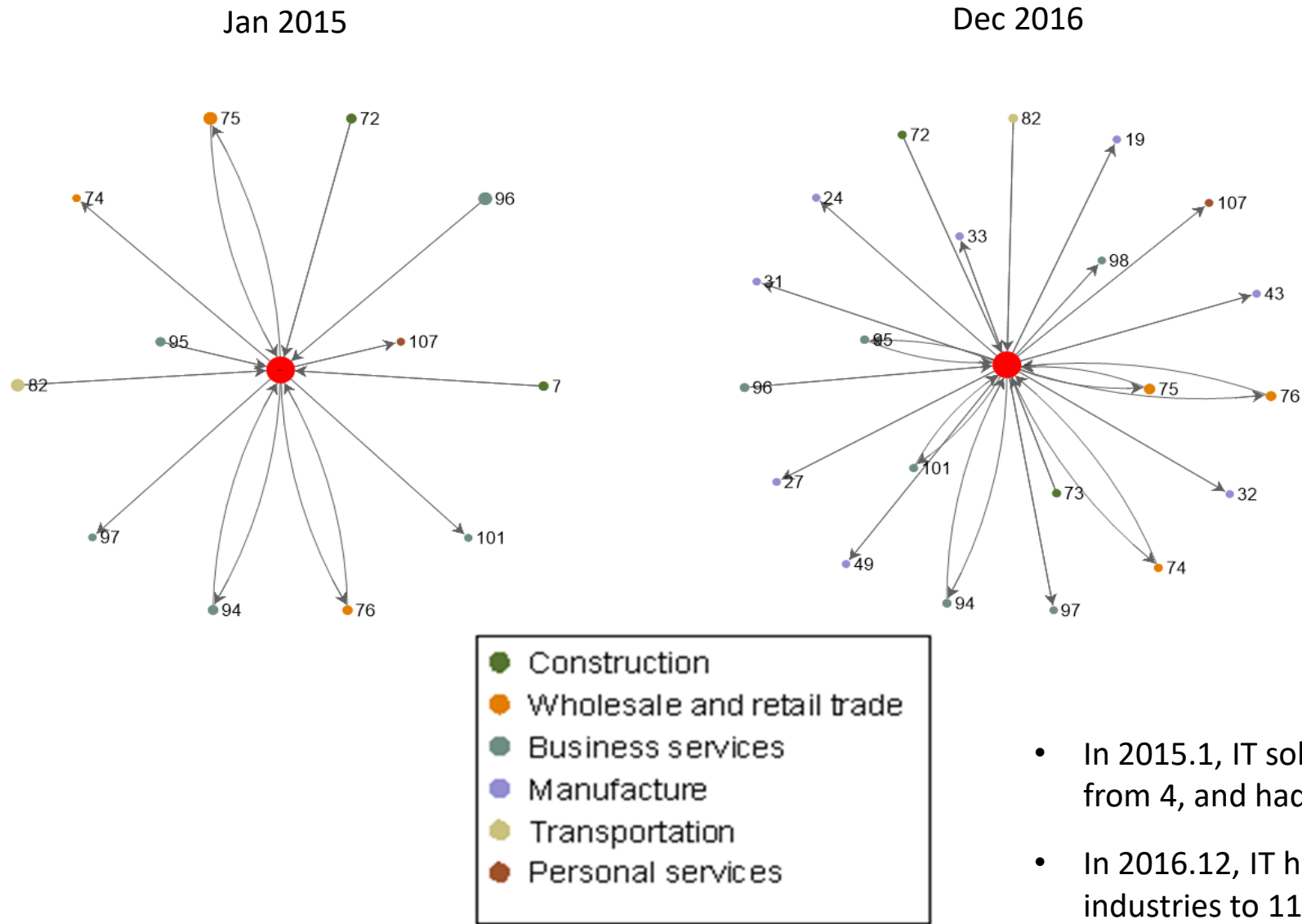¿How deep have IT services permeated into the overall economy?

Network data also useful to spot structural trends: irruption of IT services into different sectors

- The Chilean economy had a mediocre couple of years in 2015-16
  - Negative investment rates on aggregate; weak employment growth
  - Business services, closely linked to corporate investment, did poorly over the period
- Despite poor overall performance of the category, **IT services expanded two-fold** during this period
  - Apparently, the little investment there was become focused on enhancing efficiency through IT development
- But, how generalized is this expansion across sectors?
  - Does it reflect changes in particular industries, such as emergence of e-commerce?
  - Or, does it reflect more general trends of cost consolidation across the economy –with dire consequences on industry markups and inflation trends?
- Such trends can be better understood using **B2B VAT data (F3223)**

Business services sales by sub-category, 2015-2016
(CLP Billions, real)
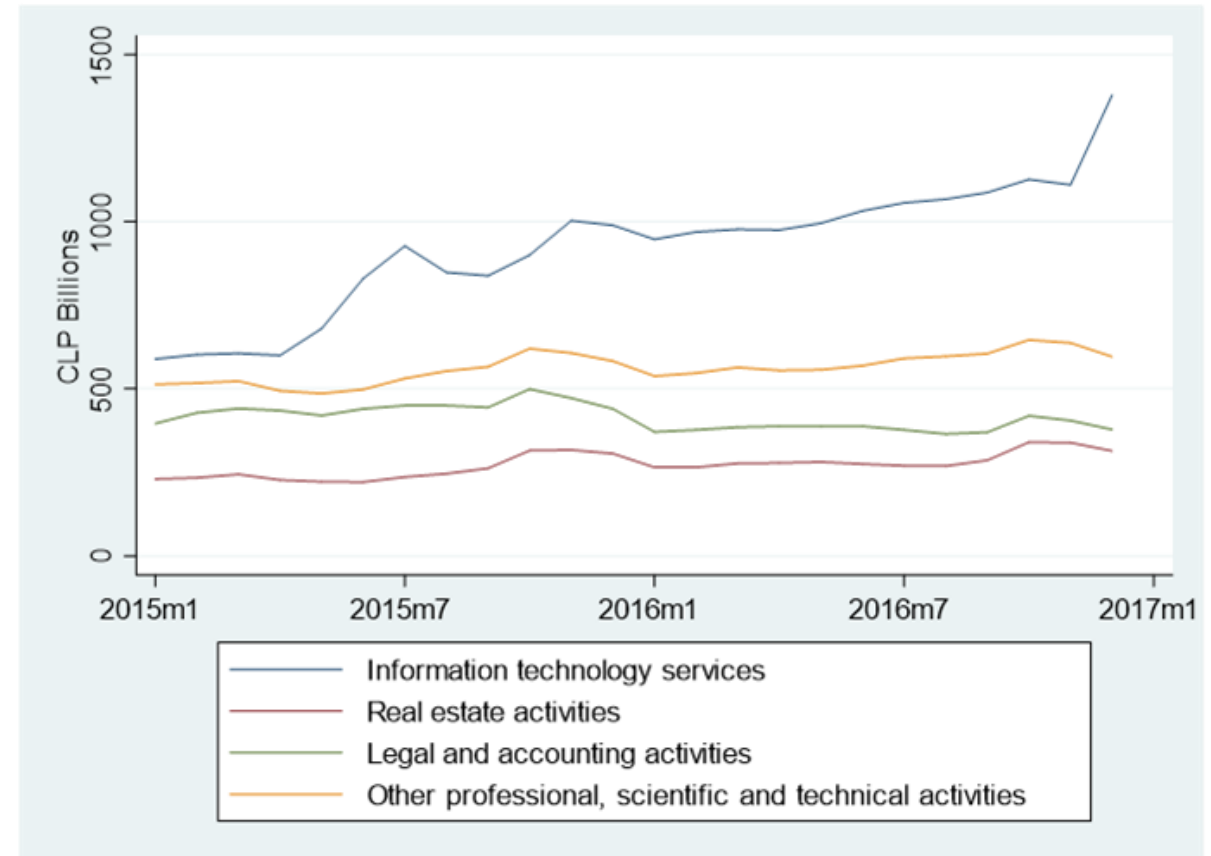
IT services indeed increased connections with other industries fairly quickly (based on 2-digit ISIC)

Jan 2015

Dec 2016

Legend:
- Construction
- Wholesale and retail trade
- Business services
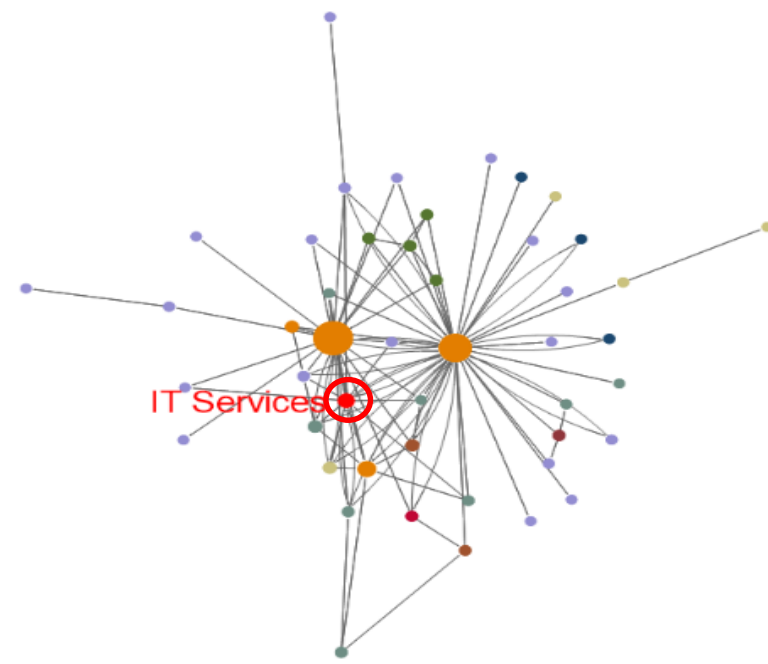- Manufacture
- Transportation
- Personal services

- In 2015.1, IT sold to 4 industries, bought from 4, and had bilateral flows with 3.

- In 2016.12, IT had increase its client industries to 11, and bilateral flows to 6.

Indeed, IT services quickly moved closer to the center of the economic network

Jan 2015

Dec 2016

IT Services

IT Services
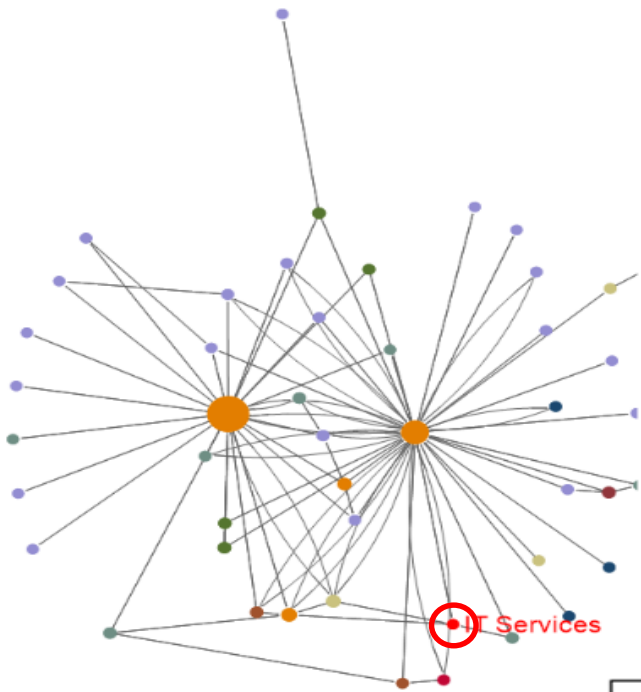
Research questions:

- Did IT adopters substitute technology for labor?

- Did they manage to increase productivity/lower costs? Increase market share?

- What is the overall effect on market competition in different sectors?

- What are the consequences for medium-term inflationary pressures?

Legend:
- ● Agriculture
- ● Minning
- ● Construction
- ● Wholesale and retail trade
- ● Business services
- ● Public services
- ● Manufacture
- ● Transportation
- ● Personal services

3.   The research tax problem

A few examples of hot research projects... which are also high priorities for central bankers

VAT data and macro research projects

- **Prices and quantities can be observed separately (e-invoicing)**

  - Most firm micro datasets observe sales, but not prices & quantities separately

  - Such distinction is key to measure market power, and understand pricing dynamics and other margins in response to different shocks –important to better anticipate inflationary pressures

- **Firm-level investment can be traced at a daily frequency (e-invoicing)**

  - Allows to study investment response at event-study frequency (key for identification)

  - …including the sensitivity of investment to interest rate changes in alternative contexts

- **B2B structure can be exploited to build early indicators of business cycle turning points (F3323; e-invoicing)**

  - Network structure can be studied to understand the propagation of shocks between firms and industries, hopefully summarizing impending vulnerabilities in a manageable set of moments from the micro-data

  - Once such indicators are constructed, the real-time availability of the data allows their inclusion in applied, everyday MP analysis and decisions

- **Physical locations useful to address a variety of questions in spatial economics (e-invoicing)**

  - Regional N. Accounts; local input and labor markets; exposure to climate risks; among others

Summing up: digitalization is drastically changing the set of tools available for applied macroeconomic analysis –CBs need to stay ahead of curve

- Recently available VAT data for tax purposes has the potential of rattling the business-as-usual model of Central Banks, traditionally based on monitoring aggregate (& lagged) data

  - *The lag problem*: it is available in real time at a much greater level of detail, increasing the accuracy of our macro diagnostics.

  - *The aggregation problem*: its atomistic nature and network structure allows to spot and monitor economic trends with important implications in how shocks transmit within the economy.

  - *The research tax problem*: awesome data facilitates recruiting and maintaining talent, aligning economic research interests of top academics with questions that are central for MP decisions.

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