Analysis of the evolution of labor market flows in Argentina

Viktoriya Semeshenko[1] and Sergio Andrés De Raco[2]

[1] Universidad de Buenos Aires. Facultad de Ciencias Económicas. Buenos Aires, Argentina. CONICET-Universidad de Buenos Aires. Instituto Interdisciplinario de Economía Política de Buenos Aires. Buenos Aires, Argentina
[2] Universidad de Buenos Aires. Facultad de Ciencias Económicas. Buenos Aires, Argentina. CONICET-Universidad de Buenos Aires. Instituto Interdisciplinario de Economía Política de Buenos Aires. Buenos Aires, Argentina

Abstract. Labor mobility plays an important role for macroeconomic analysis. Employment flows carry information about the productive structure, diffusing knowledge among economic activities. Using administrative records for Argentina for 1996-2018 at four different levels of granularity, we explore the networks of inter-industry connections and characterise underlying structural and dynamic aspects of the national productive structure. Our analysis suggests that in order to appreciate the temporal evolution of labor flows, more disaggregated data can bring up a richer picture than looking at the evolution of aggregated labor flows.

Keywords: Labor flows · Data granularity · Network analysis

1 Introduction

Labor mobility plays an important role for macroeconomic analysis. Employment flows across industries carry information about the productive structure and diffuse knowledge among economic activities. Administrative records provide support to these flows, giving origin to a network of connections between industries from which valuable information about interactions among different sectors can be extracted. In turn, this allows to characterise underlying aspects of the national productive structure. Here we are interested in studying the evolution of the Argentinian labor market system, looking at its network of labor flows. To this end, we look at three periods of relative macroeconomic stability between which we expect to observe structural changes in labor flows: 1996-2003 ("Convertibility"), 2003-2011 (post-Convertibility recovery with mild global financial crisis effects), and 2011-2018 (local stagnation).

Data used here are job-to-job transitions from administrative records of private sector formal employment (Sistema Integrado Previsional Argentino (SIPA)) for 1996-2018, by activity sector at 4-digits of the ISIC Rev. 3 activity classifier, provided by official authorities (Ministerio de Trabajo, Empleo y Seguridad Social (MTEySS)).[3] This disaggregation allows to go beyond a simple taxonomy to get insights about where specific activities contribute significantly. In addition, we built datasets at three different levels of aggregation (v.g.: sector letter, 2-, and 3-digits) to further analyze the effects of different levels of information on the structure of inter-industry interactions.

Increasing the granularity of data increases the complexity, but at the same time allows us to access details of the interactions between sectors and get more information. Although, this information gain comes at a cost. If the level of detail is increased systematically for all categories, the economic interpretation becomes more complex because the essential differences between those activities are not easily comparable nor representative. While if the disaggregation is made only for certain (*ad-hoc*) categories, the method itself becomes more complex because of the mixed levels of categories. This last kind of disaggregation is ruled out of our analysis.

Importantly, the nodes of the network are activity sectors at the chosen level of granularity, so data aggregation determines its size. In our case, data at the sector letter level (v.g.: A through O) has 14 nodes and 182 observed edges, at 2-digits has 55 nodes and [2.8k–2.9k] expected edges, at 3-digits has 150 nodes and [15k–17k] observed edges, and at 4-digits has 300 nodes and [49k–58k] observed edges, which puts in evidence the increases in complexity. We shall also expect differences in network properties at different levels of detail. Naturally, questions related to the effects of granularity arise. When is best to look for more detail in labor flows? What is an adequate level of granularity which provides enough information of sectoral aggregation and allows to characterize employment flows and the structure of inter-industrial relations? Ideally, this analysis should give support to the choice of data granularity adequate for economic modeling and interpretation.

2 Analysis of Flows and Results

To address the issues mentioned previously, we build heatmaps and compute dendrograms to show the hierarchical relationships between industries, as a visual compressed representation that is amenable to human interpretation. Given that all the flow transition matrices resulted to be predominantly symmetrical, we choose the more appropriate method of hierarchical clustering with complete linkage for the analysis of meso-structures [1]. We discuss results following a two-fold, interrelated, temporality-granularity axes of analysis.

2.1 The Evolution of Network Flows

A convenient way of looking at the evolution of the flow network is to focus on the reorganization of inter-industry interactions. Therefore, we seek for the

[3] This dataset is an outcome of a joint project with the MTEySS and members of our research group. The timing of the periods was chosen in order to have matrices of the same size.

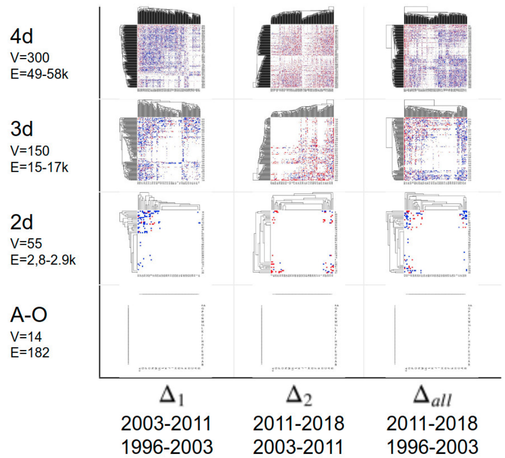

Fig. 1. Heatmaps of inter-period difference adjacency matrices of inter-industry links at each granularity level, ordered by hierarchical clustering with complete linkage. Discrete color scale: blue (new link creation), white (no change), red (old link destruction).

creation and destruction of connections between industries from one period to another. To that end we first compute the unweighted adjacency matrices of flows at all levels of granularity and time periods. Then, at each level of granularity we compute difference matrices between periods for: a) Δ_1 (2003-2011 vs 1996-2003), b) Δ_2 (2011-2018 vs 2003-2011), and c) Δ_{all} (2011-2018 vs 1996-2003). Using a heatmap representation of the networks we found that at low level of detail (sector letter level) no connection changes are detected, while the greater the granularity (and network size) the more change events are detected and the difference matrices become more dense, as can be seen through the vertical axis of Fig. 1 from bottom (low-detail) to top (high-detail).

Regarding temporal evolution, through the horizontal axis of Fig. 1 and more clearly at greater granularity levels, it can be observed that Δ_1 shows a positive transition of relatively more creation of new connections than destruction of existing ones (see predominance of blue dots in the first column). This result is as expected as we compare labor dynamics in a strong recession period (1996-2003) with labor dynamics in a post-crisis fast recovery period (2003-2011). Conversely, in Δ_2 we observe a prevalence of connections destruction (see prevalence of red dots in the second column), also in line with expectations as labor market dynamics in the following period (2011-2018) decelerated substantially destructing previous inter-industry connections mediated through labor flows. Lastly, in Δ_{all} the results are less clear because of the mixed effects of connections' creation and destruction occurred in the longer transition period from the 1990's pre-Convertibility crisis recession to the 2011-2018 post-global financial crisis stagnation. Nevertheless, the information contained in the results for Δ_{all} can show relevant qualitative information about the transformation of inter-industry relations through employment exchanges more than a decade (and two, substantively different, crisis) later.

2.2 Data Granularity

Regarding data aggregation, our results show that at the lower granularity there is no information gain in using labor flows to evaluate connection changes, showing a network of stable connectivity structure. As granularity increases, more change events are detected and matrices become more dense. In turn, the ordering and grouping of changes pose a direct challenge on interpretation. We use cophenetic correlations to compare our clusterings for each granularity level between periods (Fig. 2). Results show that the hierarchical clustering dendrograms for sector letter and 2-digits granularities present high pairwise correlation between all periods, which expresses the presence of certain ordering stability through time. On the other hand, 3- and 4-digits data show correlations diminishing with increased granularity and mark a difference between the dendrograms for Convertibility (1996-2003) and post-crisis stagnation (2011-2018) periods.

96-03		**A-O**
0.93	03-11	
0.93	**0.95**	11-18

96-03		**2d**
0.96	03-11	
0.94	**0.97**	11-18

96-03		**3d**
0.91	03-11	
0.82	**0.93**	11-18

96-03		**4d**
0.88	03-11	
0.85	**0.91**	11-18

Fig. 2. Inter-period cophenetic correlations of dendrograms at each level of aggregation.

Thus, in order to appreciate the temporal evolution of labor flows, more disaggregated data can bring up a richer picture than looking at the evolution of aggregated labor flows.

This paper is an ongoing work and is part of a line of research on labor transitions from a complex systems viewpoint [3, 4]. In particular, the groupings or communities of productive activities associated with the exchange of employment between industries can be further analyzed. As pointed out in [2], flow networks analysis should contemplate both structural and dynamical representations integrated as topological characteristics may influence differently the dynamical processes of the respective flows. We expect that future studies will shed more light on the structural changes in labor mobility and patterns dynamics.

References

1. Carlsson, G., *et al.*.: Hierarchical quasi-clustering methods for asymmetric networks. In: Intl. Conf. on Machine Learning (pp. 352–360). PMLR (2014)
2. Lambiotte, R., *et al.*.: Flow graphs: Interweaving dynamics and structure. Physical Review E **84**(1) (2011).

3. De Raco, S., Semeshenko, V.: Labor mobility and industrial space in Argentina. Journal of Dynamics & Games, **6**(2), pp. 107–118 (2019)
4. De Raco, S., Semeshenko, V.: The network structure of inter-industry labor mobility in Argentina. In: 6th Conf. Regulating for Decent Work, ILO, Geneve, July (2019)