RESEARCH HIGHLIGHTS

Review of the current research conducted at the Central Bank of Chile

April 2024

This issue of the Research Highlights reviews the following subjects that have been recently analyzed at the Central Bank of Chile (CBC):

- **Input price dispersion across buyers and misallocation.**
- **High temperatures and rainfall shortage: the impact of climate change on Chile's economic activity.**
- **The role of parental altruism in parents consumption, college financial support and outcomes in higher education.**

Input price dispersion across buyers and misallocation

"Using a comprehensive dataset of electronic invoices issued by Chilean firms, we document pervasive dispersion in the prices that different buyers pay for the same intermediate goods."

The prices that firms pay when buying their productive inputs are key for understanding the production decisions that they make on a day-to-day basis. This affects how much and what they produce, and the price they themselves charge when they sell. Standard economic theory states that resource allocation is efficient when all firms face the same relative prices for the inputs they demand. Thus, when there are deviations and firms pay different prices for the same inputs, welfare losses result. If we further consider that these deviations occur in a network of firms interacting with each other, small discrepancies can be magnified throughout the supply chain.

Several papers in the literature have looked into this, but the limited availability of granular data has allowed only partial study. For consumer goods, there is evidence from the United States showing considerable price uniformity across branches of the same retail chain. Other papers examine this for specific industries, such as medical equipment or restaurant supplies in New York. Alternatively, some studies use international trade data and the codes used for customs duty purposes. However, research on price dispersion for highly detailed goods is non-existent at this time.

Central Bank of Chile economist Marco Rojas, in the working paper *"Input Price Dispersion across Buyers and Misallocation"*, co-authored with Ariel Burstein from University of California at Los Angeles and Javier Cravino from University of Michigan at Ann Arbor, study the price dispersion of products sold in the Chilean manufacturing sector to their domestic buyers. The authors document different measures of price dispersion for all those manufacturing products that have more than one buyer in the same month, which account for 53% of the sector's sales. Next, they examine what explains why some products have more dispersion, and which variables of the buyer can explain the price differences. Finally, they propose a model to calculate the welfare cost of the reported dispersion.

This working paper uses the firm-to-firm transactions from electronic invoices, where by identifying in great detail the products with more than one buyer, price dispersion is measured for each product in two ways: one measure is the ratio between the maximum and minimum prices paid by different buyers, and the other is the standard deviation of the price gaps, which are the difference between the price paid by each buyer and the average price of each product. Table 1 shows the distribution of both measures, which reveals that there is an average difference of 40.5% between the maximum and minimum prices, and that the mean standard deviation is 7%. These results are from June 2021, and are maintained for June 2022 or using a full year. The products with the highest dispersion are those produced by large firms and with many buyers. The Pharmaceuticals sector has the highest dispersion, while Furniture the lowest.

The paper then examines what can explain these price gaps.

Table 1: Input price dispersion across buyers

	Difference between highest and lowest (%)	Standard deviation (%)
P1	0	0
P5	0	0
P10	3	1
P25	13.9	2
P50	32.3	6.2
P75	63.2	10.5
P90	109.6	17.4
P95	156	23.4
P99	256.1	41.9
Mean	40.5	7.3

Note: The table reports the distribution of (i) the percent difference between the highest and lowest price paid by any buyer for each product, and (ii) the standard deviation of the gap between the price paid by each buyer and the mean. This table corresponds to the version in percentages in table 4 in the Working paper (DTBC).

First, these gaps are highly persistent, that is, if a buyer pays a low price today relative to other buyers, it is very likely that this buyerwill still be paying a low price in 12 months. Second, the authors show that the lower prices are paid by larger buyers, which have a longer-standing relationship with the producer, and which buy more of other products from the producer. While these variables are statistically significant, they do not explain much of the total magnitude of these price gaps. The same is true of the quantities traded, which do play a role but again their magnitude is irrelevant. Finally, the study shows that the distance between the selling and buying firms, and the payment format of the transaction do not play a role, suggesting that these price gaps reflect differences in the markups charged, and not in the marginal costs of selling to one firm or another.

Motivated by these stylized facts, the paper concludes with a network production model to quantify the welfare cost of markup dispersion. This model can be accurately calibrated with the information described above. A first exercise evaluates the counterfactual of what happens if markup dispersion across buyers within the same product is eliminated. In other words, if all buyers pay the average price. Once rescaled, this has a welfare effect between 2% and 7%, which is of a comparable magnitude to the second exercise, which is something the literature has already done. It consists of assessing the effect of eliminating the dispersion of markups between products once the gaps between buyers have already been closed

High temperatures and rainfall shortage: the impact of climate change on Chile's economic activity

"The aggregate results show that an increase of 0.2º C in the average temperature with respect to its historical pattern lowers long-term GDP growth by roughly 0.5 percentage points per year, with heterogeneous effects across sectors and with stronger effects in the summer months."

Climate change is one of the most complex hazards the world is facing. Among its many consequences are its effects on the production of goods and services, which can take various forms, such as damage to physical infrastructure or reduced workers' productivity. Due to the multiple mechanisms through which production can be disrupted, its effects are heterogeneous across productive sectors. For example, while agriculture relies directly on climate, the effects on industrial sectors may be more indirect, according to each specific productive process.

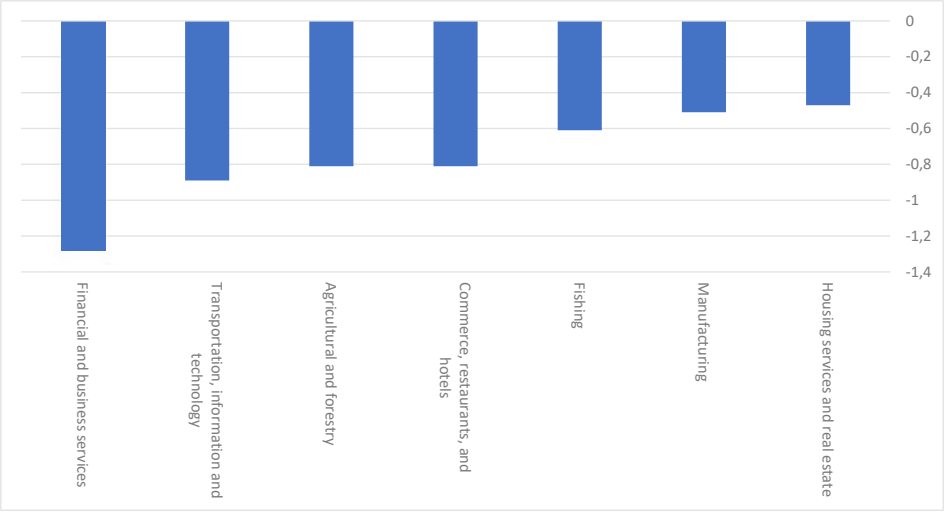
The available data show increases in temperature and decreases in rainfall over the last century in Chile. Specifically, the average temperature has risen by about 0.5 degrees Celsius (°C) (0.9°F), while the average annual rainfall has fallen by about 200 millimeters, a change that has been manifested mainly during the last two decades. However, these changes have not been homogeneous across regions. For example, temperatures in the central areas of the country have risen by about 0.7°C (1.26°F), exceeding those observed in the north and south extreme zones. These differences add a new source of heterogeneity to the effects of climate change on production.

Central Bank of Chile economist María Teresa Reszczynski, in her working paper *"Altas Temperaturas y Escasez de Lluvia: el Impacto del Cambio Climático en la Actividad Económica de Chile"*, quantifies the effects of climate change on GDP, by analyzing the differences both between productive sectors and by regions in Chile. For this purpose, she examines temperature and rainfall data by geographical area, along with quarterly production data by sector and region since 1997, to estimate flexible growth regressions that make it possible to verify the long-term effects of changes in climate-related variables in each productive sector, including heterogeneous effects by season of the year, occurrences of droughts and periods with a high number of days with abnormally high temperatures.

The aggregate results show that an increase of 0.2°C in the average temperature compared to its historical norm lowers long-term GDP growth by approximately 0.5 percentage points per year. Not surprisingly, the effects are heterogeneous across sectors, with the most affected being agriculture & forestry, manufacturing, trade, restaurants & hotels, transportation, information & communications, and financial and business services. Figure 1 shows the effects of a 0.2°C increase in temperature for each economic sector. Most of the effects are exacerbated in the summer months as shown by estimates that include seasonal interactions. Additional estimates find that it is increases in the high-, not the low-extreme temperatures, which would explain the negative effects on GDP. In this case, significant negative effects are found for all economic sectors.

About the decrease in rainfall, the only sector that is significantly affected is agriculture, livestock & forestry. Extending the estimates to include seasonally differentiated effects, the total effect is negative and significant during the summer months, with considerable decreases in almost every economic sector.

Figure 1: Effect of climate change on sectorial GDP



Note: The bars display the effect of a 0.2C rise in temperature, respect to its historic average, on sectorial annual GDP growth, measured in percentage points. The graph only includes sectors that have statistically significant effects.

The role of parental altruism in parents consumption, college financial support and outcomes in higher education

Parents' actions play a fundamental role in the income and consumption trajectories of their offspring. Therefore, understanding parents' decisions and the way they affect the decisions of their children is key to analyzing issues such as intergenerational income mobility or the evolution of college education coverage. If parents are altruistic and concerned about the welfare of their children, it follows that their savings and consumption decisions will reflect this, and that they will be willing to give away a significant portion of their wealth to improve the opportunities that their children will face in the future.

Along these lines, a vast series of studies have looked into how parental investments are relevant to their children's schooling decisions --and the likelihood that the latter will successfully complete higher education--, the determinants of bequest decisions, or how families provide insurance mechanisms to address the income- and consumption-related risks their members might face.

Contributing to this literature, in the working paper *"The Role of Parental Altruism in Parents Consumption, College Financial Support, and Outcomes in Higher Education"*, Central Bank economist Agustín Díaz studies how parents' valuation of their children's welfare leads them to provide them with resources in different ways, from direct transfers and bequests to help in funding their college education. The first part of the article studies empirically how the income attained by their adult children affects their parents' consumption decisions, and how shocks to their children's consumption also have an impact on what their parents consume. The author then uses and calibrates a dynamic model of dynasties that captures the decision of children whether or not to attend college, and how this is affected by the resources that may be transferred to them by their parents. The model also allows for the analysis of interactions between the decisions of parents and children; for example, how the parents' bequest decision affects the children's willingness to save, and how the parents incorporate this into their own decisions.

"Parents have a significant impact on funding their children's education, and this relationship influences both parties throughout their lifetime."

A first result of the paper, using data since 1999 from the Panel Study of Income Dynamics (PSID) survey in the United States, is that their children's income does affect parental consumption. In particular, for a given level of parental wealth, parents whose adult children have lower income consume less, suggesting that they sacrifice some of their consumption to increase their children's welfare by transferring resources to them. Table 2 shows that, for example, a parent who is in an upper wealth quartile than his or her adult son or daughter consumes US$1,500 less than another parent whose child is in the same quartile. There is also evidence finding that parents adjust their consumption when shocks to their children's consumption happen, thus providing partial insurance.

A second result comes from a complementary analysis that measures lifetime transfers and a proxy for bequests left by parents, and again relates them to their offspring's income. Although there is evidence of parental altruism (all else constant, parents transfer more to children who have been relatively less successful in terms of income), the magnitude of the effect on these direct transfers is significantly smaller than the magnitude of the effect on parental consumption. This suggests that part of the decline in parental consumption may be associated with the provision of indirect transfers, such as the financing of college education.

The third result comes from the model of dynasties, which allows to examine in more detail the mechanisms through which parents try to increa-

se their children's welfare. In the model, parents can provide financial support to their children to help them pay for their college education, or transfer resources to them in the future. The model shows how parents of children with relatively low cognitive skills may prefer to help them attend college in order to increase their future income, rather than giving them resources (transfers, bequests) directly later in life. This does not affect the more capable youth, who will still attend college optimally, even without parental support. Summing up, the paper shows that parents are concerned about their children's welfare even when they are adults, and are therefore willing to make sacrifices in order to provide funding to help them soften the effect of adverse shocks. One important form of financing is associated with college education. This implies that the decisions, returns and consequences associated with college education must be analyzed not only from the student's perspective, but also from that of the student's family of origin. This must be considered when analyzing the effects of changes in the costs of attending college, or policies that alleviate potential financial restrictions to access higher education.

Table 2: Effects on parents' consumption of the relative income/wealth of their offspring (dollars)

	(1) Classified by child's wealth Parents' consumption	(2) Classified by child's income Parents' consumption
Child 3 quartiles bellow parents'	718 0.44	-1969 (-0.86)
Child 2 quartiles bellow parents'	-380 (-0.34)	-1387 (-1.23)
Child 1 quartile bellow parents'	-246 (-0.30)	-1446** (-2.04)
Child and parents in same quartile	-170 (-0.27)	91 0.14
Child 1 quartile above parents'	332 0.5	1371** 2.25
Child 2 quartiles above parents'	1492** 2.18	2414*** 3.6
Child 3 quartiles above parents'	1145 (1.08)	3393*** 2.93
Constant	-16675 (-0.54)	-18993 (-0.62)

*Note: The table shows the results of a regression of paternal household consumption in dollars with respect to the relative position of their child in income distribution and other demographic controls, by using PSID data for the United States. In parentheses, t statistics, clusterized standard errors at the household level. *p<0.10, **p<0.05, ***p<0.01.*

Publications in academic journals by researchers of the Central Bank of Chile

Albagli, E., Arias, A. & Kirchner, M. (*Forthcoming*). "Collective Savings Pension Policy in an Economy with Heterogeneity and Informality". *Estudios de Economía*.

Albagli, E., Canales, M., Syverson, C., Tapia, M., & Wlasiuk, J. (*Forthcoming*). "Productivity Gaps and Job Flows: Evidence from Censal Microdata". *The Economic Journal*.

Albagli, E., Ceballos, L., Claro, S., & Romero, D. (2024). "UIP deviations: Insights from event studies". *Journal of International Economics*, 148, 103877.

Albagli, E., Chovar, A., Luttini, E., Madeira, C., Naudon, A., & Tapia, M. (2023). "Labor market flows: Evidence for Chile using microdata from administrative tax records". *Latin American Journal of Central Banking*, 4(4), 100102.

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Beltrán, F., & Coble, D. (2024). "Monetary policy surprises on the banking sector: The role of the information and pure monetary shocks". *Latin American Journal of Central Banking*, 5(3), 100127.

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Cox, L., Mueller, G., Pasten, E., Schoenle, R., & Weber, M. (*Forthcoming*). "Big G". *Journal of Political Economy*.

De Gregorio, J., García, P., Luttini, E. E., & Rojas, M. (*Forthcoming*). "From Dominant to Producer Currency Pricing: Dynamics of Chilean Exports". *Journal of International Economics*.

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Latest working papers of the Central Bank of Chile

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1007	UIP Deviations: Insights from Event Studies	Elias Albagli, Luis Ceballos, Sebastian Claro, Damian Romero	March 2024
1006	Input price dispersion across buyers and misallocation	Ariel Burstein, Javier Cravino, Marco Rojas	January 2024
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