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**ACCOUNTING FOR THE IMPACT OF THE EARTHQUAKE IN THE CHILEAN NATIONAL
ACCOUNTS**

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ACCOUNTING FOR THE IMPACT OF THE EARTHQUAKE IN THE CHILEAN NATIONAL ACCOUNTS

1. INTRODUCTION

The occurrence of a noneconomic phenomenon like a natural disaster can cause the destruction of economic assets, which affects the macroeconomic flows measured in the national accounts. This loss of value and its impact on the transactions must be recorded in the national accounts, because a natural disaster can jeopardize the stocks and flows in the different accounts of the system. The main items that can be affected are the current accounts (production and income), accumulation accounts (changes in assets and liabilities and changes in net value, including other changes in the volume of assets) and balance sheets (asset and liability stocks and net value).

One of the challenges is to adequately implement the accounting of economic activity at different frequencies (monthly, quarterly and annually), given the difficulties in terms of data availability and the methodological adjustments that this implies.

The disaster that occurred in Chile on 27 February 2010, which mainly affected three central-southern regions of the country, had an impact on the data generation process. In this case, the measurement challenge was mainly centred on the *production accounts* in terms of the value added of the industries affected by the natural disaster; the reduction in the *capital stock* due to the destruction of assets; *GDP expenditures* in the consumption, gross fixed capital formation, and exports and imports components; and *national income* in terms of current transfers from abroad.

The objective of this document is to present a general framework of the challenges involved in accounting the earthquake in the Chilean national accounts and how they were addressed. The first section examines the earthquake's impact on the data sources used in the compilation of statistics. The second section describes the effects on gross domestic product (GDP) recorded in the Monthly Index of Economic Activity (IMACEC)¹ for the months closest to the event, estimates the capital losses deriving from the disaster and analyses the effects on national income.

¹ The Index of Economic Activity (*Índice Mensual de Actividad Económica*, IMACEC) is an estimate that summarizes the production of the different economic industries in a given month, at prices of a given year. Its movement over the course of the year, given some assumptions, constitutes an approximation of the monthly gross domestic product (GDP). The calculation of the IMACEC rests on multiple supply indicators, combined with projections when direct monthly data are lacking; these are weighted by the economic activities' share in GDP in base year 2003. The Central Bank of Chile has compiled and published the IMACEC since 1986. The indicator is currently released on the 5th of each month, with a lag of 35 days. Details on the methodology used to calculate the IMACEC are available in "Indicador Mensual de Actividad Económica IMACEC base 1996: Nota metodológica," Economic Studies Series N°48, Central Bank of Chile (<http://www.bcentral.cl/estudios/estudios-economicos/pdf/serieestudios48.pdf>). Updating for base year 2003 can be found at the following link: <http://www.bcentral.cl/publicaciones/estadisticas/actividad-economica-gasto/xls/2006/Actualizacion-metodologia-IMACEC-base-2003.pdf>".

2. THE IMPACT OF THE EARTHQUAKE AND TSUNAMI ON DATA SOURCES

The Chilean national accounts are fed from a wide range of data sources, which vary depending on the frequency at which the economic activity is measured. In general, the sources can be grouped into five types: administrative records; economic surveys; financial statements; statistical reports and yearbooks; and miscellaneous statistics.

The administrative records mostly comprise tax data, customs records and budget performance reports. Economic surveys, in turn, are used in various industries; they are carried out either by the National Statistics Office (INE) or directly by the Central Bank of Chile. A third data source is financial statements, which are used as inputs for various industries and are provided directly by the firms. The statistical reports and yearbooks are compiled by different industrial organizations and by the INE.

Finally, regularly published economic statistics on volumes and prices are used to measure certain industries and also to provide sources for comparison. The price statistics include the consumer price index (CPI) and the wholesale price index (WPI).

The earthquake and tsunami had an impact on the data sources used to measure economic activity, which was evident from the disruptions in the flow of information and in the administration and execution of the compilation process.

Thus, the earthquake on 27 February hindered the collection of core data necessary for estimating certain activities in the IMACEC that month, due to the impact on both those reporting the data and those collecting it. Some informants suffered serious damage to their offices and/or corporate buildings, the collapse of their data systems and total or partial disruption of their operations, all of which interfered with data preparation and reporting. Additionally, there were problems locating some informants, especially in the most affected areas, which further delayed the collection of administrative records.

These limitations had to be taken into account in the IMACEC estimates for the months of February and March, and the changes had to be incorporated in the calculations for the following months. These estimates were later reflected in the quarterly and annual accounts.

In February, the core statistics used to estimate the IMACEC were affected. The data received were divided into three categories: complete (effectively collected), partial and missing data records.

In March, after the earthquake, the problem of data reception was resolved, as the reporting institutions met the established deadlines for data delivery. However, there will still be problems with data collection from the direct source, as well as other complications related to the impact of the earthquake on production.

Given the data availability issues in these two months, the economic activity estimates for February and March display some differences, which are described in the next section.

3. PROBLEMS WITH MEASURING AND RECORDING THE IMPACT OF THE EARTHQUAKE AND TSUNAMI IN THE CHILEAN NATIONAL ACCOUNTS

3.1. *Effects on GDP*

3.1.1. *The IMACEC calculation in February*

i) General strategy

In February, activity unfolded normally through the 26th. Starting in the early morning of the 27th, a large part of the country was paralyzed by the damages and problems caused by the earthquake.² The activity estimate for that month therefore considers the following factors:

- Two working days were lost (a weekend), which must be subtracted from the full month's activity;
- The month had 28 days, so it was not comparable to the preceding months;
- Some activities are at a seasonal low in February (due to vacations), while others have seasonally high production, so the assessment/adjustment cannot be made across the board for all activities.

Consequently, the analysis, validation and imputation were carried out using seasonally-adjusted series. Specifically, the following processes were implemented with the core data, depending on whether there were imputed data or missing records:

- a. If the data received were subject to imputation, a validation process was applied to the data. First, the series was seasonally adjusted to January 2010, and then February was extrapolated using the average velocities of the last three months. Next, the level (or rate) was corrected to reflect the estimated two fewer days, and the series was seasonally adjusted again. Where the original imputation turned out to be invalid, the estimated value was used instead.
- b. If the data were not available, related indicators at the most detailed level possible were used to reproduce the evolution of the data in the estimated series. The series was then extrapolated using the auxiliary variable (in seasonally adjusted terms and corrected to reflect the effect of the two fewer days), and the relevant activity series was seasonally adjusted again. The missing data were thus imputed and then later replaced with real data when these became available.

ii) The effects of the calculation by economic activity

a. Industries subject to the new estimation strategy

The industries that were analysed under the approach described above were manufacturing and trade, restaurants and hotels, given that they rely on massive data collection.

Manufacturing output is estimated on the basis of data collected by the INE (the Physical Sales and Production Index, or IPVF), while the others are estimated using VAT data collected by the Chilean

² The 27th was a Saturday.

Internal Revenue Service (SII). In the case of the former, the February data were available on the scheduled date, but some of it was imputed. The series was therefore revised, applying the method described in the previous section (point a).

The VAT data were not available because the tax deadline was postponed by official decree until 31 March. Consequently, activity in the trade, restaurants and hotels sector and part of personal services were estimated indirectly, according to the proposed method (point b).

b. Industries in which data collection was not affected

For the remaining economic activities, the February measurement was not affected. Thus the respective monthly data were available for estimating the following industries: mining; electricity, gas and water; transport; communications; and financial services. Industries with a quarterly estimate—such as agriculture, ranching and forestry; construction; residential property; education; health care; and public administration—were not affected by data availability problems in February given their estimation methodology.

3.1.2. The IMACEC calculation in March

Three types of problem were encountered in constructing the IMACEC in March:

a) Data collection: This was affected by the damages suffered by some informants, as well as by some data collectors (structural damage or damage to their records or data systems). The IMACEC calculations considered that when the data collector dealt with these cases, the records could have been left blank or a value could have been imputed.

In the case of missing records, the data were compared with alternative information, so as to determine whether the issue was an absence of data or an absence of production. If the data collector made imputations for cases in which no data were collected, the values were validated and, if necessary, replaced by internal imputations.

b) Methods associated with the core indicators: In some industries, the measures did not fully reflect the earthquake's effects on output, such that the core indicators did not capture them.³

c) Identification of relevant variables: Given the new reality in the country following the earthquake, some less significant activities became more relevant, such as demolitions. These had to be identified, and steps had to be taken to ensure that their measure reflected the effects of the earthquake.

i) General strategy

To get around these problems, alternative estimation strategies were designed.

For cases with data collection problems, a general imputation method was defined, aimed at (possibly) replacing missing records that reflected absence of data, as well as externally imputed values that had not been validated by the Department of National Accounts. The method consisted in comparing

³ One example is health care, whose output is reflected in service provision measured by “sum of costs”. In the short term, this method didn't reflect the volume of services provided, so the production was calculated using an ARIMA model; clearly, this method would not capture the direct effects of the disaster on the industry.

the velocity of the seasonally adjusted series, which included the earthquake's effect on activity, with exogenous industrial I data; if the estimated velocity of the original series was significantly different from expectations based on alternative data, the seasonally adjusted value was replaced by the assumed effect. Finally, the series was seasonally adjusted again, obtaining an estimate at the original level.

ii) The calculation by economic activity

With regard to problems in the core data, the most vulnerable industries were those with indicators based on massive data collection, as was the case in February. The INE indicators were the main issue in March, in particular the Physical Sales and Production Index (IPVF), which provides the basis for compiling the manufacturing and some segments of other economic activities. Consequently, manufacturing and some segments of transport and of agriculture, ranching and forestry were subject to validation or replacement of the imputations.

Industries affected by problems with the estimation method were agriculture, ranching and forestry; fishing; construction; trade, restaurants and hotels; transport; and personal services.

In general, the earthquake and tsunami had an impact on GDP in the affected industries. Specifically, in the month of March 2010, the earthquake's effect on the IMACEC was approximately 8 percentage points. This was recovered in subsequent quarters.

At the activity level, the biggest effect was seen in manufacturing (wood pulp and paper, fuel refineries, base metals and so on), as well as fishing and housing services.

In terms of the domestic demand, the quarters following the disaster saw an increase in household consumption (replacement of durable goods) and gross fixed capital formation (mostly machinery and equipment).

The earthquake had a strong impact on the government consumption in the first quarter, as a result of the delay in the start of the school year in the public education (which represents about a third of the total). Value added contracted, due to the effect of the postponement of classes and the resulting non-provision of education services.

The earthquake's impact on inventories has not been specifically estimated due to a lack of timely information. However, this variable recovered in the months following the disaster, which points to a recovery within the different industries.⁴

3.2. *Impact on the Capital Stock*

As established in the Central Bank of Chile's *Monetary Policy Report* in March 2010,⁵ one of the effects of the natural disaster in Chile was a loss of capital stock (that is, loss in the stock of homes, productive infrastructure, highways, ports, schools, hospitals, etc.).⁶

⁴ However, this recovery could also be due to the expansion cycle of the Chilean economy.

⁵ Available online at <http://www.bcentral.cl/publicaciones/politicas/pdf/ipm032010.pdf>.

⁶ The gross capital stock is the value of assets used in the productive process, valued "as if they were new." That is, the gross nominal value of the capital stock can approximate the replacement value. The net value of the capital stock is the gross value of the capital stock less asset depreciation. The latter is the reduction of the value of the fixed assets employed in production as a result of physical deterioration, normal obsolescence or normal accidental damage (<http://www.bcentral.cl/publicaciones/politicas/pdf/ipm032010.pdf>).

In this context, one of the challenges faced was to estimate the capital stock level with the primary objective of establishing the economy's consumption of fixed capital (depreciation). This section describes the estimation made, considering the general methodology used and the estimation of the capital losses deriving from the earthquake.

3.2.1. Current methodology

The current capital stock measures⁷ are consistent with the latest recommendations in the 2001 publication, "Measuring Capital: OECD Manual." This manual formalizes the quantification of capital stock from the perspective of the compilation of capital statistics, promoting the permanent inventory method.

The application of this method requires the compilation of long investment series by type of fixed asset, which are accumulated from period to period, taking into account assumptions on useful life, survival/withdrawal models (for estimating the gross capital stock) and depreciation (for estimating net capital). This yields a measure of capital at constant prices, whereas the measure at current prices is obtained through the application of price indexes by type of asset from the national accounts.

The assumptions on useful life are based on tax sources, business accounting or estimates reported in the literature. Under the current compilation methodology, capital stock estimates are made using useful life figures from other studies carried out for Chile, together with estimates associated with tax records, business accounting (FECUs) and so on. In addition, useful life is based on a declining-balance depreciation—by period—for residential buildings, machinery and equipment and transportation equipment. The use of this type of depreciation method is based on the hypothesis that an asset's useful life decreases over time, as is evident in goods with a high technological content.

Survival functions show the percentage of an asset that is still being used, while withdrawal functions denote how a capital good is withdrawn based on its half-life. There is a broad range of possible models available for these functions; the Winfrey S-3 is the model currently being used. This type of curve looks a lot like a normal distribution, but the tails are not asymptotic. Their main characteristic is that the withdrawals are greatest around the half-life.

Finally, the depreciation functions indicate the share of investments made that have not yet been amortized. The current compilation methodology considers that this variable is linear.

3.2.2. Effects of the earthquake on Capital Stock

The benchmark for estimating the earthquake's effect on the capital stock was the net capital stock level at 2009 prices, disaggregated by economic activity and by product and estimated using the permanent inventory method. This stock level was regionalized based on the implicit industry/region structure present in the available statistics on 2008 regional value added at 2003 prices⁸. For each industry, the ratio of capital stock to value added was assumed to be the same across all the regions.

7 The methodology is described in "Stock de capital en Chile (1985:2005): Metodología y resultados," Economic Studies Series N°63, Central Bank of Chile (<http://www.bcentral.cl/estudios/estudios-economicos-estadisticos/063.htm>).

8 The regional GDP methodology is described in: "Nota Metodológica 2003 – 2005 Base 2003: <http://www.bcentral.cl/publicaciones/estadisticas/actividad-economica-gasto/regionalizadas/pdf/Notametodologica2003.pdf>"

Based on information in the press and direct questions, assumptions were made about capital stock losses by industry, differentiating between losses at the earthquake epicentre—in regions VII (Maule) and VIII (Bío-Bío)—and losses in affected areas further out—in regions V (Valparaíso), Metropolitan, VI (Libertador) and IX (Araucanía). It is estimated that approximately 3% of the net capital stock of the Chilean economy, equivalent to about US\$13.2 billion, was lost as a result of the earthquake. The results for the capital stock losses by economic activity are shown in Table 1.

Table 1. Gross Capital Stock Losses by Economic Activity

Industry	% stock
Agriculture, ranching, forestry and fishing	3.4
Mining	0.2
Manufacturing	4.5
Electricity, gas and water	0.6
Construction	0.0
Trade, restaurants and hotels	1.5
Transport and communications	3.5
Financial and business services	0.0
Residential property	2.3
Personal services	19.8
Public administration	1.3
TOTAL	2.9

Source: Own elaboration, based on estimates from the Department of National Accounts.

As the table shows, the largest impact was in personal services, as a result of the destruction of hospitals and educational establishments, and in manufacturing, due to the loss in productive capacity in industries like wood pulp, shipyards and industrial fishing, wine, fuels and so on. The housing stock was strongly affected due to the severe damage or destruction of homes caused by the earthquake and tsunami. Transport and communications also suffered losses in productive capacity.

3.3. *Impact on National Income*

Finally, the effect on the rest-of-the-world account and the balance of payments was seen in current transfers, in terms of the increase in transfers received from abroad due to insurance and aid in response to the earthquake. In addition, the indemnities received for damages caused by the earthquake were recorded as capital transfers, since the majority of the assets were reinsured overseas. In this case, the item entry was made at the time of occurrence (income).

The amount received from indemnification for damages caused by the February 2010 earthquake was quantified at US\$6.8 billion, based on data provided by the Superintendence of Securities and Insurance. Of this amount, US\$5.6 billion corresponded to capital transfers associated with the recovery of fixed assets damaged by the earthquake and indemnities paid⁹ by foreign reinsurance companies, which began to be received in the months following the disaster. Current transfers, in turn, represented US\$1.2 billion and corresponded to indemnities received for production losses, associated with the cessation of work in the affected sectors (lost earnings).

⁹ First quarter of 2010.

4. CONCLUSIONS

The earthquake and tsunami on 27 February 2010 affected economic activity in the three central-southern regions of the country. It had a direct impact through the destruction of economic assets and the capital stock, which presented a challenge in terms of incorporating the phenomenon into the Chilean national accounts.

The measure of the impact centred on the effect on GDP. This was incorporated through the calculation of the Monthly Index of Economic Activity (IMACEC) in the months of February and March, which were the most affected in terms of data availability. Additionally, the reduction of economic assets was recorded via an estimate of the capital stock level, given a regional disaggregation, in order to establish the economy's fixed capital consumption (depreciation). This document has described the measures carried out in the Chilean national accounts for both variables.

As discussed above, the challenges that needed to be addressed included the availability of data flows and the compilation methods used. With regard to the former, the key issues involved restoring the usual sources of information, searching for alternative or complementary data sources and revising and complementing the data validation methods. With regard to compilation methods, data validation and imputation processes were incorporated.

With regard to macroeconomic results, for the month of March 2010 the earthquake's effect on GDP was 8 percentage points. However, the impact of the disaster was felt throughout 2010 as a result of the affected supply chains (wood pulp, fuels, steel and so on). This lower production was recorded through the available indicators, which gradually showed signs of recovery.

In terms of recording capital stock losses (estimated at 3%), the adjustment is equivalent to estimating the change in the volume of the accumulation accounts, which are not elaborated in the Chilean case. Finally, total indemnities for damages caused by the February 2010 earthquake were quantified at US\$ 6.8 billion; this amount was recorded in the capital account of Chile's balance of payments.