COLLECTION MONETA • 194

FROM UNDERGROUND TO END-USERS

Global Monetary History in Scientific Context

Meeting at the University of the Pacific, San Francisco, Stockton,
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Mining, market volatility and exchange rate management in early modern Mexico: Zacatecas and Guadalajara 1578-1669[1]

Claudia de Lozanne Jefferies[2]

Abstract

This paper describes statistical evidence supporting the theory that early modern frontier mining towns in Mexico had more unstable economies than central agricultural towns. Series of sales tax revenues are used as a proxy for economic activity in the towns of Zacatecas and Guadalajara during the period of 1578-1669. A description of the analysis of variance will be presented, and differences in volatility patterns will be highlighted. Further, volatility will be placed within the context of the rate of discount paid by miners to exchange bullion for coins.

Introduction

Mining regions in the extensive territory of New Spain can be divided into two types, as identified by Garcia Ruíz:[3]The first one is characterized by dense populations of sedentary Indians with links to nearby agricultural areas. Such areas were what corresponds actually to the areas of Guerrero, Morelos, Mexico (City and State), Hidalgo, Michoacán and Jalisco. A second type of area was the northern frontier: today's Nayarit, Sinaloa, Durango, Chihuahua, Zacatecas and San Luis Potosi.

Zacatecas is an example of a frontier mining town, which was newly founded in 1546 on territory originally occupied by nomadic Indians (Chichimecas), to facilitate access to its rich neighbouring silver ores. Since no natural markets existed in its surroundings, provisioning farms had to be established on the few fertile spots that could be found in the arid region of north- eastern Nueva Galicia. The sole purpose of those farms was to produce provisions for Zacatecas. There was only a small number of suppliers catering for the town's market, which prevented competition and the formation of markets such as the ones that existed in areas surrounded by more fertile lands and higher population densities of sedentary Indians. As the consequence of a low number of sellers and a limited supply of agricultural produce, prices were higher in Zacatecas than in other regions.[4] In addition to their scarcity, goods had to be transported, which also contributed towards their high price.

As far as salaries are concerned, these were also higher than in other regions, given a low population density and cultural characteristics of nomadic Indians. Miners had to lure nomadic Indians to become part of their labour force and their retention was difficult, as they were alien to the use of money as a means of exchange and did not respond easily to monetary incentives. As a whole it is believed that, the frontier economy was subject to "ups and downs",[5] periods of scarcity and abundance of goods and silver, which did not always coincide with each other.

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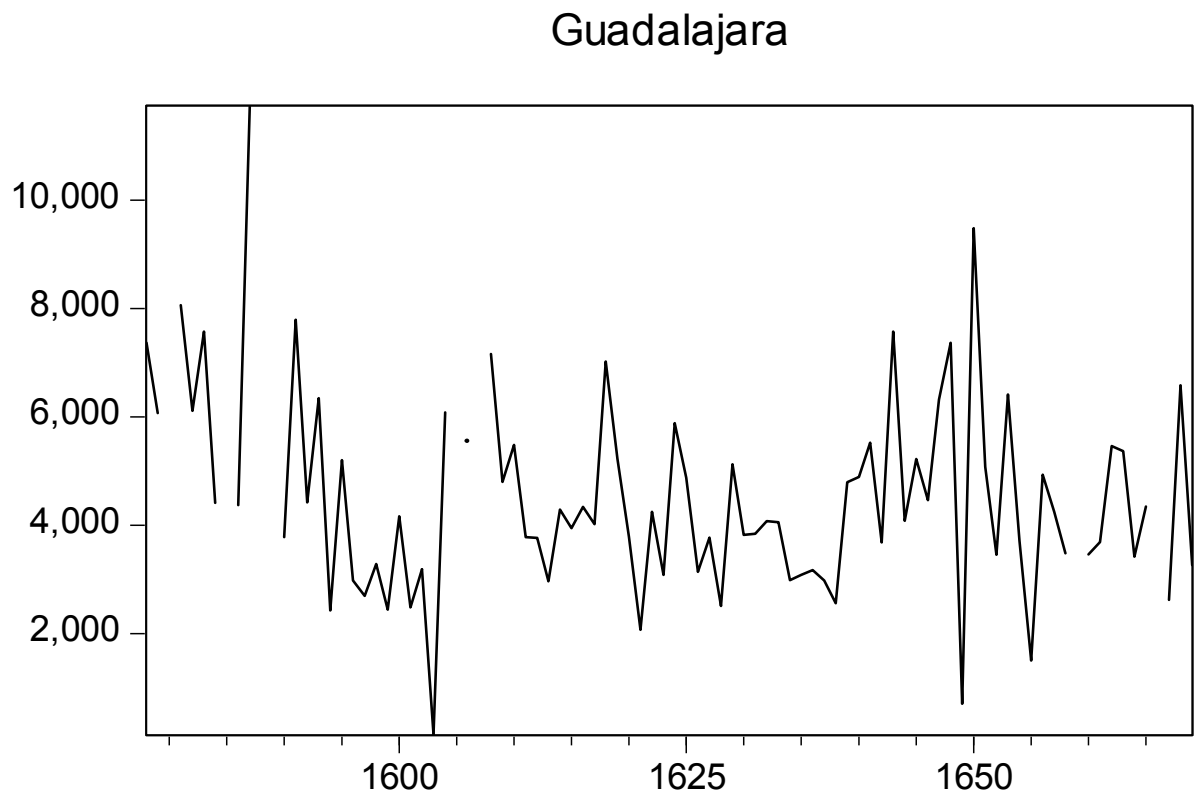
[1] This paper is thematically linked to *Selective adoption of mining and minting technological innovations in Habsburg colonial Mexico: Centralist policy or exchange rate management strategy?,* presented at the DAMIN conference in Copenhagen, May 28-29 2015: Mints, technology and Coin Production. The paper can be found in: Depeyrot, G and Marcher, M, 2015: 149-159.

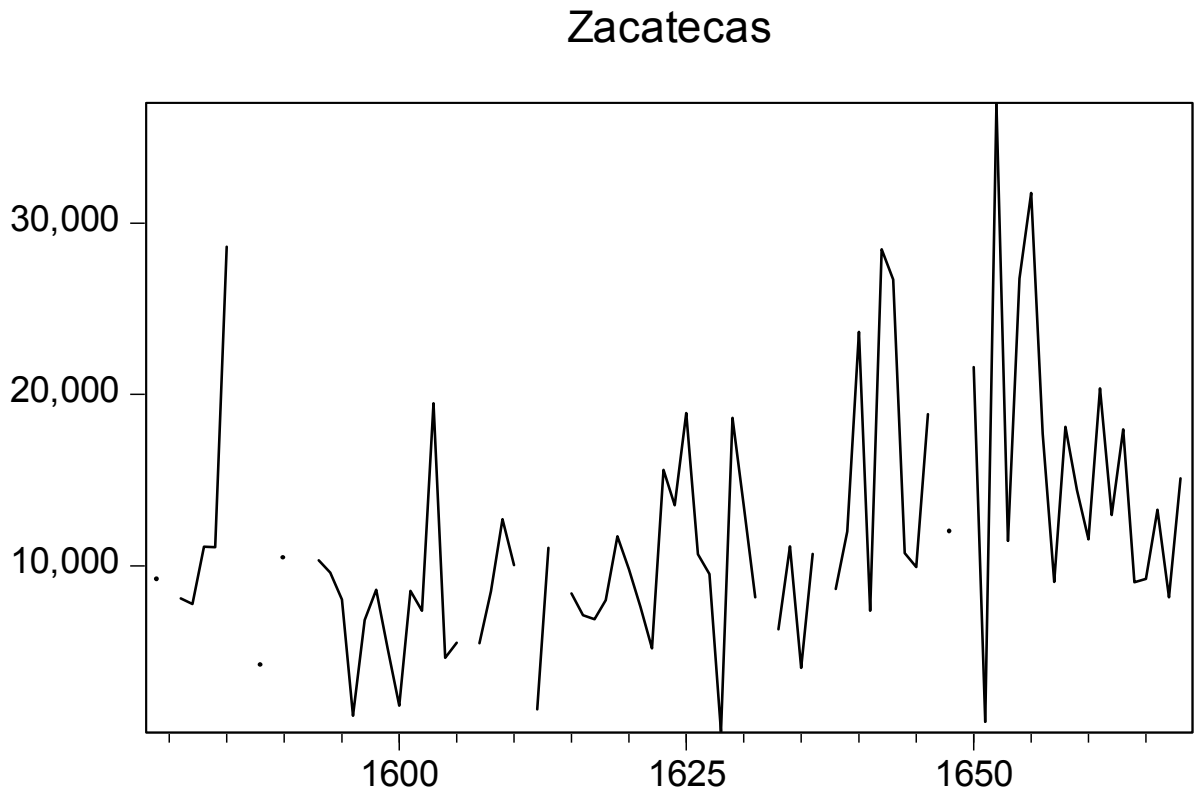
[2] City University London.

[3] Garcia Ruiz, 1954: 26-27.

[4] Borah, 1994: 68.

[5] Garcia Ruiz, 1954: 28.





Alcabala revenues Guadalajara and Zacatecas 1580- 1680 City University London (constructed on the basis of Te Paske + Klein's data) (Pesos de ocho)

The hypothesis that the economies of frontier towns were more unstable than those of more central towns with links to nearby agricultural areas has been tested. For this purpose, series of sales tax data for the regions of Zacatecas and Guadalajara have been put together, based on John Te Paske's and Herbert Klein's Cajas Reales data. Sales taxes (*alcabalas*) were used as proxies for overall economic activity for each one of the two tax districts.

There are two reasons for focusing on those two towns in particular: Series are sufficiently long and complete for the time around the turn from the 16th into the 17th century, and the two towns were similarly sized at that time in terms of population. There was Spanish migration from Guadalajara into Zacatecas during the 16th- century, which reverted after the turn of the century. Guadalajara had about 3000 inhabitants in 1600,[6] about a third more than Zacatecas, although there was a higher number of Spaniards with higher purchasing power in Zacatecas. Guadalajara's population continued to grow quickly, reaching 10000 inhabitants in 1700, whereas Zacatecas' fluctuated alongside the mining cycles as did its economy. Guadalajara, as a centre of agricultural production and with links to other mining towns, became increasingly consolidated.

After testing for equality of variances between the two series, an analysis of their conditional variance will be carried out using multivariate GARCH techniques. Further, market volatility will be placed within the context of the difference between the prices of bullion and specie in frontier mining towns.

Comparison and analysis of market volatility: Zacatecas and Guadalajara 1578-1669

Using sales tax series as a proxy for overall economic activity in the two towns, tests of difference of variances have been carried out. Given the difference in size of the two economies, as well as the composition of their populations, the variation coefficient has been used in lieu of the variances.

The following paragraphs will describe the results obtained through the econometric analysis of the two series. Test and regression results are available from the author upon request.

Out of five different tests, three suggest that there is insufficient evidence to reject the hypothesis of equality of variances in the volume of economic activity of the two towns. This prompted a closer look into the nature of the variability of the two tax revenue series.

The two series have been found to be conditionally heteroskedastic, as they present periods of high volatility, followed by periods of lower volatility, in other words, volatility clusters can be observed in both series. The possibility of volatility spillovers was also taken into consideration, through the conditional covariance analysis of the two series. No volatility spillovers could be observed, which points towards the suggestion that the two urban economies were independent from each other, and fluctuations of silver production in Zacatecas had no direct effect on market fluctuations in Guadalajara.

The development of the conditional variance in the two series throughout time has also been compared, and marked differences between the two series can be established, with conditional variance persisting in Zacatecas and diminishing in Guadalajara throughout the period in question. The development of conditional variance shows different characteristics of conditional variance in the two towns: declining conditional variance in Guadalajara is in line with its increasing consolidation as an agricultural centre, whereas the persistent conditional variance in Zacatecas is in line with Garcia Ruiz's theory that the town was subject to "ups and downs", consequence of the volatile nature of mining production.

[6] Calvo, 1992: 579.

Market volatility and the rate of discount of silver exchange

Throughout the colonial period, coins were scarce in the Viceroyalty of New Spain. There were a number of means of exchange that were perpetuated from pre- Hispanic times, which acted as complements to specie. Cotton sheets, gold dust in feather quills, tin and wood tokens, jade beads and cocoa beans were some of them.[7] Barter, circulation of silver bullion and the payment of tributes in kind also helped counteract monetary scarcity. Whilst scarcity of specie affected the whole of the economy, the mining sector was particularly hampered by it, as coins were needed to pay for miner salaries. In miming regions, silver bullion was allowed to circulate and acted as a complementary mean of exchange after being assayed and stamped, although its circulation was limited to the locality where it had been produced and it could not be used to pay miner salaries.

Miners were forced to resort to the service of so called "silver merchants", who would provide specie in exchange for bullion. For this service, they charged a fee called "rate of discount". Their service saved miners the trip from Zacatecas to Mexico City (600km). Silver merchants charged normally 1 real/peso, or 8.1 reales /mark of 65 reales. The total rate of discount was about 12.5%, and fluctuated according to the level of specie abundance. The rate fluctuated between 1 and 3 reales/peso.[8]

The exchange mechanism was as follows: Merchants supplied miners with currency on credit and miners were due to repay within a time frame of 40-50 days. Merchants received silver (bullion) with a higher degree of purity: legal price of the mark was 65 *reales*, purer silver was worth 67-78 *reales* plus 1 *real*/peso= 11.1% (rate of discount) plus 5% interest. Taking into consideration transport costs and minting charges, merchant profit was of about 15% on average.

Miners complained to royal authorities on several occasions about having to pay for the rate of discount to silver merchants and about scarcity of specie. They also requested the establishment of a mint in Nueva Galicia, request which was rejected.[9]

One further issue of discontent amongst miners was the provision of mercury, which had been delegated by the viceregal authority to local mayors, who had gained bargaining power over miners and engaged in corrupt practices.[10] As an attempt to address this issues, the Viceroy Gaspar de Zúñiga, Acevedo y Fonseca, Count of Monterrey (1560-1606), enhanced the functions of the Royal Assay in 1604. His intention was to centralise the distribution of both, specie and mercury and to eliminate the role of silver merchants as suppliers of specie to frontier towns. The Viceroy had put the scarcity of specie problem down to a low number of silver merchants. Through the Royal Treasury taking control of the supply of specie, the Viceroy attempted at eradicating the difference between the prices of bullion and specie: 65 reales of bullion would be exchanged against 65 reales of specie, through a single transaction and with no credit. Miners welcomed the Treasury taking over such functions, although it was foreseen that by eliminating the discrepancy between the prices of specie and bullion, the price level would experience increases.[11]

As it was predicted, the measure carried out altered the relative prices of bullion in respect to all other commodities and in respect to specie. The measure was the equivalent of a devaluation of the currency, despite the fact that the nominal value of the coins remained unchanged. The relative price of specie in respect to bullion decreased, which triggered inflation. As a consequence, the purchasing power of specie decreased. Moreover, the gap between minting and melting points of the *reales* disappeared. As commodity prices increased, so did the demand for specie, as people needed more coins to pay for increased prices. This

[7] Giraldez, 2012: 158, see Brevoort, 1885: 3-5 and Humboldt, 1811, vol.3:308-309.
[8] Bakewell, 1971: 211.
[9] Garcia Ruiz, 1954: 31-32.
[10] Schell Hoberman, 1991: 77.
[11] Garcia Ruiz, 1954: 34.

exacerbated the problem of scarcity of specie. Since silver merchants were no longer operating, credit had also disappeared, so credit could no longer act as a partial cover for scarcity of specie. Against to the Viceroy's plans, bullion had to keep on circulating, as it was the only way to avoid even further damage to economic activity.

For some years (it is unclear how many), the Treasury carried on with the plan, although there was a further obstacle to its functioning, which had not been taken into consideration when devising it. Chichimeca Indians were at war defending their territory against Spanish expansion, and did not miss the chance to retaliate by targeting the *conductas*, carts used to transport bullion and specie between mining towns and the mint in Mexico City. [12]

The scheme was finally abandoned, as silver merchants continued to informally supply miners with specie. It was only in 1625 that their role was formally reinstated. The number of merchants offering these services seems to have increased over time, which made the credit market more competitive, and, as a consequence, the "rate of discount" charged by merchants for exchanging specie for bullion on credit showed a downward trend throughout the 17th-Century.[13] It must be added that the downward trend might also have been consequence of town economies becoming more consolidated and less volatile. Also, as mining towns multiplied, markets could rely on various sources of demand and supply of specie, which also helped diminish market volatility.

Preliminary conclusions and scope for further research

The statistical analysis that has been carried out with sales tax series for Zacatecas and Guadalajara, have confirmed Garcia Ruiz's theory about the economies of frontier mining towns showing "ups and downs" unlike more central agricultural towns. Whilst the overall levels of volatility in the two economies are not statistically different, there are differences in volatility patterns: Conditional volatility is persistent throughout the period studied in Zacatecas, whereas it is declining in Guadalajara. This is in line with Guadalajara's economy becoming increasingly consolidated and experiencing population growth.

In areas producing the raw material that money is made out of, and from which it gathers its intrinsic value, there must be a differentiation between the prices of bullion and specie in order to keep the purchasing power of money from following the volatile patterns of mining. Melting point and minting points must be different to each other in order to allow the price level to fluctuate within a range that prevents money from depreciating against the rest of the commodities.

Volatility implies risk, so a rate of discount can be justified as a means for covering the merchant against such risk. How exactly the rate of discount was calculated remains a question, which might find some answers in documents of the time. Volatility is likely to have been behind the calculation of the rate of discount. This point will be further explored.

[12] Garcia Ruiz, 1954: 37-38.
[13] Schell Hoberman, 1991: 90.

Bibliography

Bakewell, Peter, *Silver Mining and Society in Colonial Mexico Zacatecas 1546-1700*, Cambridge, UK, Cambridge University Press, 1971

Bakewell, Peter, ed. *Mines of Silver and Gold in the Americas*. Aldershot, UK, Variorum, 1997.

Bakewell, Peter J., "Mining" in: *Colonial Spanish America*. Edited by Leslie Bethell, 203–249. Cambridge, UK: Cambridge University Press, 1987.

Calvo, T. and Zamudio, M., Demografía y economía: la coyuntura en Nueva Galicia en el siglo XVII, *Historia Mexicana* 41: 4 (1992): 579- 613.

Borah, Woodrow, *Tendencias de precios de bienes de tributo real en la Nueva Galicia, 1557-1598*, Michoacán, El Colegio de Michoacán, 1994,

Borah, Woodrow, *Price Trends of Royal Tribute Commodities in Nueva Galicia 1557-1598*, Berkley, University of California Press, 1992**.**

Borah, Woodrow Wilson, *New Spain's Century of Depression*. Berkeley, University of California Press, 1951.

Brading, D. A., and Harry E. Cross. "Colonial Silver Mining: Mexico and Peru", *Hispanic American Historical Review* 52:4 (1972): 545–579.

Brading, D. A., *Miners and Merchants in Bourbon Mexico: 1763-1810,* New York, Cambridge University Press, 1971.

Brading, D. A., "Mexican Silver Mining in the Eighteenth Century: The Revival of Zacatecas", *Hispanic American Historical Review*, 50:4 (1970): 665-681.

Brading, D. A., "La minería de la plata en el siglo XVIII: El caso Bolaños", *Historia Mexicana*, 18:3 (1969): 317-333.

Brevoort, J. Carson, *Early Spanish and Portuguese coinage in America*, Boston, 1885.

Chaunu, Pierre, *Les Philippines et le Pacifique des Ibériques*, Paris, SEVPEN, 2 volumes, 1960-1966.

Chaunu, Pierre and Huguette, *Séville et l'Atlantique (1504–1650)*, Paris, SEVPEN, 12 volumes, 1955-1960.

Depeyrot, G and Marcher, M (eds*), Documents and Studies on 19th c. Monetary History, Mints, Technology and Coin Production*, Wetteren, Moneta, 2015.

Flynn, Dennis and Giráldez, Arturo, "Born with a "Silver Spoon": The Origin of World Trade in 1571", *Journal of World History* 6: 2 (1995): 201-221.

Flynn, Dennis and Arturo Giraldez, Arturo, "Arbitrage, China, and World Trade in the Early Modern Period", *Journal of the Economic and Social History of the Orient.* 38: 4 (1995): 429–448.

Garcia Ruíz, Alfonso, "La moneda y otros medios de cambio en la Zacatecas colonial", *Historia Mexicana*, 13 (1954):20-46.

Garner, Richard L., *Mining trends in the New World 1500-1810*, http://www.insidemydesk.com/lapubs/miningtrends.pdf, 3/9/2007 last consulted: 15.4.2016.

Garner, Richard L., TePaske Page, Gold and Silver Registrations for the Spanish Colonial Viceroyalties and for the Colony of Brazil, 1492-1810, http://www.insidemydesk.com/hdd.html, last consulted: 15.4.2016.

Garner, Richard L., "Long-Term Silver Mining Trends in Spanish America: A Comparative Analysis of Peru and Mexico," *American Historical Review*, 93:4 (1988): 889-914.

Giraldez, Arturo, "Cacao Beans in Colonial Mexico: Small change in a global economy", in: *Money in the Pre- Industrial World"* (John Munro ed.), London, Pickering and Chatto, 2012. p. 147-161.

Hamilton, Earl, *War and Prices in Spain*, 1651-1800. Cambridge MA, Harvard University Press, 1947.

Hamilton, Earl, *American Treasure and the Price Revolution in Spain, 1501-1650.* Cambridge MA, Harvard University Press, 1934.

Humboldt, Alexander von, *Essaie Politique sûr le Royaume de la Nouvelle Espagne*, 5 volumes, F. Schonel, Paris, 1811.

Israel, J. I. “Mexico and the ‘General Crisis’ of the Seventeenth Century,” *Past and Present*, 63 (1974): 33-57.

Schell Hoberman, Louisa, *Mexico's Merchant Elite, 1590-1660: Silver, State, and Society,* Durham N.C. Duke University Press, 1991.

TePaske, John, Brown, Kendall W (ed.), *New World of Gold and Silver* (Atlantic World), Brill, Leiden, 2007.

TePaske, John J, Klein, Herbert S. et al. *The Royal Treasuries of the Spanish Empire in America*. 4 volumes, Durham N.C., Duke University Press, 1982, 1990.

TePaske, John J., Klein, Herbert S. et al. *Ingresos y egresos de la Real Hacienda de Nueva España*. México, D.F., Instituto Nacional de Antropología e Historia, 1986.

Pérez Herrero, Pedro, *Plata y libranzas. La articulación comercial del México borbónico*. Mexico, El Colegio de México, 1988.

Vilar, Pierre, *Or et monnaie dans l'Histoire: 1450-1920*, Paris, Flammarion, 1974.

Contents

This volume contains proceedings of a 2016 California meeting, following the pattern established by the DAMIN program *La Dépréciation de l'Argent Monétaire et les relations Internationales – Silver Monetary Depreciation and International Relations* (www.anr-damin.net). This series of conferences encourages cross-disciplinary conceptualizations of monetary history in global context. Past meetings have encouraged fruitful interchanges among numismatists and monetary historians and the 2016 California conference was designed to encourage inclusion of mining historians – along with contributions from Geology – in coordination with contributions by numismatists, monetary historians, and business historians. Specialized expertise is essential for advance of scholarly research, of course, but insights from one specialty can (and do) trigger innovative ideas across traditional disciplinary boundaries. Contents of this volume attest to benefits from cross-disciplinary fertilization.

Given emphasis upon nineteenth-century topics at this 2016 California conference, organizers decided to meet initially for two days in San Francisco, a city founded in response to California's post-1848 Gold Rush, yet propulsion of metropolitan San Francisco to global status depended upon post-1859 Comstock Lode silver discoveries in Nevada (as emphasized in conference presentations). The conference venue shifted on Day 3 eighty miles eastward to the School of International Studies, University of the Pacific, in Stockton, a deep-water port founded at the time of the California Gold Rush. A lecture at Lake Tahoe on Day 4 focused on provision of water from the Nevada-side of the Sierra Nevada Mountains – gravity fed eastward down into the Carson Valley – then pushed up to the Comstock Lode farther eastward during the 19th century. The venue for Day 5 was historic Virginia City, Nevada, which is sinking due to its location directly atop a vast maze of mines shafts of the Comstock Lode, world dominant source of silver for decades. (There was also a side-visit to Sutro Tunnel, designed to drain wastewater from deep within Comstock Mines westward down into the Carson Valley.) An afternoon in Old Town Sacramento, historic port-city and railroad town through which Nevada silver was exported, highlighted the return trip to San Francisco on Day 6. It is hoped that in-person views of California/Nevada geological formations, challenging transportation routes, mines, coins, and environmental legacies have helped participants to visualize integrated systems that have historically linked – and continue to link – underground activities to diverse end-market destinations over thousands of years.

This volume is the proceedings of the San Francisco/Stockton/Lake Tahoe/Virginia City/Sacramento conference with the participation of Simon James BYTHEWAY (Nihon University, Tokyo), CAO Jin 曹晉 (Tübingen University), Julien CAVERO (Labex TransferS, ENS, Paris) Georges DEPEYROT (CNRS, Paris), Dennis O. FLYNN (University of the Pacific, Stockton), Saul GUERRERO (Independent scholar, London), Claudia de LOZANNE JEFFERIES (City University, London), Ursula KAMPMANN (Lörrach), Ivar LEIMUS (Estonian History Museum and Tallinn University), Michael MÄRCHER (National Museum, Copenhagen), David J. ST. CLAIR (California State University), Brigitte TOUITOU-MICHON (Paris) Agnès TRICOCHE (Labex TransferS, CNRS, Paris).

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Hoenderstraat 22, 9230 Wetteren, Belgique

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