The Impact of the

Noranda New Madrid Smelter on the Missouri

Economy: A Quantitative Analysis

A report by

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December 19, 2014

I. Introduction

Noranda Aluminum, Inc. (hereafter Noranda) is an integrated aluminum manufacturer. It is an energy-intensive and capital-intensive commodity business. Noranda is a leading North American integrated producer of value-added primary aluminum products. Noranda is a publicly traded company on the New York Stock Exchange. The company was founded in 1968 and operates an aluminum smelting facility at St. Jude Industrial Park near New Madrid, Missouri. Throughout this report, the aluminum smelting facility is referred to as the New Madrid Smelter. In addition to the New Madrid Smelter, Noranda owns and operates a bauxite mine in Jamaica and an alumina refinery in Gramercy, Louisiana. The New Madrid Smelter produces molten aluminum and converts molten aluminum to aluminum products such as billet, rod, foundry products and primary ingots. The smelter has been operating in southeast Missouri since February 25, 1971. The New Madrid Smelter's primary commodity inputs are electricity and alumina. The alumina is delivered via barge over the Mississippi River. Alumina, also known as aluminum oxide, is produced from bauxite ore. The New Madrid Smelter processes the alumina through three production lines that electrolytically convert aluminum oxide into molten aluminum. The process requires a large amount of electricity. To provide some perspective on Noranda's electricity usage, the New Madrid Smelter purchases, on an annual basis, about the same amount of electricity as the entire city of Springfield, Missouri. Electricity supply must be constant to the production lines; any intermittent supply can potentially damage the lines as liquid metal solidifies. When at full production, the smelter produces more than 260,000 metric tons of aluminum per year. The aluminum is sold primarily in North America. Noranda is one of the largest foil producers in North America and a major producer of light gauge sheet products.

At Noranda's request, I have computed the economic impact that Noranda Aluminum's New Madrid Smelter has on the Missouri economy. Specifically, I have quantified the impact in terms of the effect on the value of final goods and services produced within Missouri's borders each year; that is, Missouri's state Gross Domestic Product. In addition, I have computed the effect on state and local government tax collections.

For the sake of disclosure, Noranda has supplied data on production and taxes paid at the New Madrid facility. In particular, I received sales data from the Noranda Holdings Corporation's *Consolidated Statement of Income for the Quarter ending September 20, 2014*. In addition, Noranda supplied a report entitled, New Madrid Sales Details. The latter report provides detail reports on aluminum production by type, amounts shipped, value-added premium, and realized Sow Revenue. Note that Sow Revenue is the market value of final goods and services produced at the New Madrid Smelter. In this report, I accept those data as factual. The economic modeling and the calculations are solely my responsibility.[1]

The chief reason for updating this report is to incorporate price changes that have occurred in the market for aluminum. According to YCHARTS, the December 2013 LME price of aluminum was $1739.81 per metric ton. By August 2014, the London Metal Exchange (hereafter, LME) price had risen to $2030.49 per metric ton. According to the LME, the December 3 buyer price was $2070.00 per metric ton.[2] Insofar as aluminum is traded in a competitive market, Noranda is a price-taker in that market, meaning that it does not have market power, but sells its production at the going price. With an increase in the price of its product, the value of its production increases. Thus, this report takes into account changes to the economic impact of the New Madrid Smelter precisely because its production is worth more now than it was a year ago.

In this report, the economic impact is assessed through three principal measures. In other words, I report the quantitative effect associated with closing of the New Madrid Smelter on (i) Missouri's real GDP; (ii) state and local tax collections; and (iii) unemployment insurance payments. I was asked to analyze three possible scenarios. One assesses the economic conditioned on the New Madrid Smelter shutting down completely in ** ___ **, another treats the shutdown date in ** ___ **, and the third treats the shutdown date in ** ___ **.

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[1] In addition, I reviewed annual reports published by Noranda. The data published in those reports are for the corporation and do not provide details at the level of the New Madrid Smelter. In particular, what is the value of production at that particular plant. The annual reports however, serve as a check in the sense that the quarterly sales data for the New Madrid Smelter are consistent with the company-wide figures reported.

[2] See http://ycharts.com/indicators/aluminum_lme for the monthly price observations and http://www.lme.com/metals/non-ferrous/aluminium/ for most recent daily price.

The principal findings of my analysis are presented as follows:

1. <u>GDP Loss</u>

   Over a generation, the impact that the New Madrid facility has on the Missouri economy is, after discounting, computed to be $8,761.5 million if the shutdown occurs in ** ___ **. If the shutdown occurs in ** ___ **, the present value of economic impact is $10,080.5 million. In other words, Missouri's economy would forego between nearly $8 billion and $10 billion in economic activity if the Noranda facility were closed. Over a ten-year period, the expected value of state GDP loss would be as large as $4.806 billion if the shutdown occurs in ** ___ **.

2. <u>State and Local Taxes</u>

   Missouri's tax base shrinks with payments to factors used to produce aluminum at the New Madrid Smelter. At the state level, net general revenue funds over the next twenty-five years, after discounting, would be $383.1 million lower if the Noranda smelter closed permanently in ** ___ ** compared with an economic projection in which the Missouri economy grows at the expected pace over the same period. Over the ten-year period, the present value of lost net general revenue funds is $182.6 million. In addition, local taxes will be affected. By closing the Noranda smelter, the local property tax base would shrink. By my calculations, the present value of the local property receipts would be reduced by $62.49 million if the lost revenue from Noranda is not made up by increased collections on remaining taxpayers. Over the next ten years, the value of the local property receipts would be reduced by $28.82 million, provided the lost taxes paid by Noranda are not made up by increased collections from remaining taxpayers. When the tax base shrinks, the tax burden is frequently reallocated to remaining taxpayers. So, property taxes burdens are redistributed to citizens, thereby harming them by reducing their personal expenditures.

3. Unemployment Insurance Benefits

Were the Noranda smelter to shut down, layoffs would result. There are 889 employees at the New Madrid Smelter that would lose their jobs by ** ___ ** were the smelter to close. The expected value of unemployment insurance benefits paid by Missouri between now and ** ___ ** is equal to $2.7 million. In the current economic environment, however, the expected length of an unemployment spell is 33 weeks. With benefits paid for the entire spell, the expected unemployment insurance benefits would equal $9.4 million owing to closing the Noranda smelter.

Overall, the New Madrid smelting facility operated by Noranda has large economic impacts compared to the typical business operation. It employees a large number of people and has a large capital stock utilized to smelt aluminum. The calculations are based on the assumption that were Noranda to shut down the New Madrid, MO facility, then the productive inputs—namely, the people, machines, and other equipment—would be freed up by the shutdown and not be immediately employed in Missouri. Over time, these resources could be employed in Missouri as the state economy grows. The immediate effect reduces the amount of productive resources.

II. Economic Model

The question is, what is the quantitative effect of shutting down a production facility on the state economy? In my analysis, I will provide a baseline measure of the Missouri economy's performance, measured by its real GDP. I will establish this baseline for the period ** ___ - ___ **. To compute the economic impact, I compute the 25-year path for Missouri real GDP after subtracting the annual sales of the output produced at the New Madrid Smelter. I assume the shutdown occurs at the mid-year point of the year so that the total annual value of foregone production occurs during the shutdown year and the following year. The economic impact is then the discounted sum of the difference between the baseline, or control, path and the treatment path.[3]

In order to create a baseline and a treatment for the Missouri economy, we need a model. Economic theory provides the basis for my calculations. I follow the *Ak* growth model developed by Rebelo (1991) and implemented by Ireland (1996) to compute the effect that the reduction in the factor inputs—people, machines and equipment—would have on the Missouri economy. The basic idea is that physical capital and human capital are combined to produce goods and services. The value of those goods and services is what is known as Gross Domestic Product (GDP).

To make this more concrete, suppose that the Missouri economy was measured by valuing all the final goods and services produced within the state's boundaries. The value of this production is called Gross Domestic Product at the state level.

In the case of Noranda's New Madrid smelting facility, it is producing aluminum that is sold to buyers. The buyers are using that aluminum to produce other goods and services. To measure the impact that the Noranda smelter has on the Missouri economy, we can compute the value of the production undertaken by Noranda. The value of the production represents resources used to pay workers, rental payments on the machines and equipment, interest payments to lenders, and returns to Noranda's owners. This approach follows the factor cost approach to measuring GDP.

Formally, the production of final goods and services produced within Missouri's boundaries is represented by the function

$$Y_t = Ak_t \tag{1}$$

where Y stands for Missouri's GDP for a year indexed by t, k the quantity of human and physical capital employed at date t, and A is the technology that represents the rate at which human and physical capital are transformed into units of final goods and services.

[3] Note that the analysis is conducted with the dynamics explicit in the model economy. Accordingly, people laid off because the New Madrid Smelter is shut down are considered to be re-employed over time. Their re-employment occurs because the Missouri economy grows over time and needs more workers.

This equation serves as the basis for computing both the baseline and the treatment paths for the Missouri economy. In other words, I measure the effect that Noranda's New Madrid Smelter has on the Missouri economy by generating a path for the Missouri economy with and without production.

The changes impact the Missouri economy over time. This model explicitly deals with changes occurring over time. You can see this explicitly in equation (1) by the fact that output and the capital input both have time subscripts. Equation (1) represents the relationship between output and the capital input at a particular date. In other words, output is measured *at a point in time*, which is typically a year. As the time subscripts change, the model economy is capturing how the Missouri's GDP evolves over time. For example, the *Ak* model allows for the Missouri economy, on average, growth over time. With this growth feature in the model economy, I can conduct the following experiment; specifically, I can compute the evolution of the Missouri economy over time, with and without production at Noranda's New Madrid smelting facility.

The purpose of this section is to familiarize the reader with the basic properties of the economic model used to quantify the impact that the Noranda smelter has on the Missouri economy. The economic impact is computed by considering the following thought experiment. The baseline path involves the path for the Missouri economy over time with the Noranda smelter, and all the other human and physical capital employed in Missouri. This baseline serves as the control for the experiment. If Noranda's New Madrid Smelter were subject to shutting down in ** ___ **, the resources employed at this facility are freed up. Over time, these resources can be utilized as part of the economy's growth. By shutting down the smelter, there is a new path for Missouri's GDP. I then compare the path for Missouri's GDP with and without the Noranda smelter operating. I conduct this analysis for a period of twenty-five years, the length of a generation. In addition, I compute the discounted sum of lost state GDP over a ten-year period. The difference between the two paths is a measure of the economic impact of the Noranda smelter.[4]

[4] Throughout this report, I use the term treatment to refer to the case in which the Missouri economy is "treated" by a shutdown at the New Madrid Smelter. Within the context of the model economy, I conduct a controlled experiment. I

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III. Measuring the Economic Impact

The purpose of this report is to compute the economic impact of the Noranda smelter in Missouri. More specifically, the question is, what would Missouri's economy look like with and without the existence of the smelter? I look at the question by comparing the expected path of Missouri economy with the smelter. The first step, or the baseline, is a forecast of the path of Missouri's Gross Domestic Product (GDP) for a twenty-five year period, assuming the Noranda smelter continues to operate. The second step is to compute the path of Missouri's GDP taking the capital of the Noranda smelter out of the equation.

The baseline path is constructed using the average annual growth rate in Missouri's real GDP between 1997 and 2013. I focus on real GDP in order to avoid having to forecast future movements in the inflation rate. Table 1 reports the values of real GDP in each year.

Table 1

(mils of 2009 chained $)

Year	1997	2013
Real GDP	$221,245	$258,135

Source: Bureau of Economic Analysis, Go to http://www.bea.gov

compare the Missouri real GDP path in the baseline—that is, no shutdown—setting with the state's real GDP path after the treatment is implemented. To draw on a medical analogy, consider two patients who have the same disease. The control patient is treated with a placebo while the other patient is treated with an experimental drug. The effect of the drug is measured by the difference between the health outcome of the control patient and the health outcome of the patient treated with the experimental drug. For the purposes of measuring the economic impact, hold everything else constant in the Missouri economy, close the Noranda smelter, and compare the two outcomes. Closing the Noranda smelter is essentially the treatment on the Missouri economy and I measure the effect of the treatment.

According to Table 1, Missouri's real GDP was close to $220 billion in 1997 and nearly $260 billion in 2013.[5] I compute the average annual growth rate by applying the formula: $Y_T = (1+g)^T Y_0$, where Y_T stands for Missouri real GDP in some particular year represented by the subscript T and Y_0 is the initial reported value for Missouri real GDP. In our case, we know what Missouri real GDP is 1997. If I wanted to compute the value of Missouri real GDP after *t* years have passed, Y_{T+t} holding the growth rate constant, I would apply the average annual growth rate over those t years is measured by *g*. Based on the data presented in Table 1, Missouri's annual average growth rate between 1997 and 2013 was 1.0837 percent, or *g = 0.010837*.

Here, I begin to construct the baseline, or control, values of Missouri real GDP for each year between ** ___ ** and ** ___ **. I assume that Missouri's real GDP can be computed from the following equation: $Y_t = (1.010837)^{t-*\_*} * Y_{2013}$, for $t = *\_\_*, *\_\_*, \ldots, *\_\_*$ where Y is state real GDP. This process is used to develop the baseline path for Missouri's real GDP. According to the baseline path, note that formula yields $Y_{*\_*} = \$293,779$ million and $Y_{*\_*} = \$345,332$ million.[6]

In general, the treatment path is computed by implementing a shutdown plan for the New Madrid Smelter. The path for GDP is represented as follows: $Y_t^{'} = (1+g)^{t-*\_*} - pl_t$ where $Y_t^{'}$ stands for the

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[5] For those who have read earlier reports, the 1997 value of real GDP reflects a different "base" year that is used to calculate real GDP. By using 2009 prices as the focal point in the chain-weight procedure, the BEA is using more recent prices. To get a measurement of real GDP, the dollar value of GDP is measured first and then deflated by a chained measure of the price level in a base year. By using the 2009 prices as the base year, there is less deflating; in other words, the denominator in the real GDP equation is closer to one and real GDP is closer to actual dollar-value GDP.

[6] The *Ak* model yields a very simple expression for the average economic growth rate. In equilibrium, Ireland (1996) derives the economy's growth rate as $1+g = (\beta R)^{1/\sigma}$, where β stands for the rate at which people discount future economic outcomes, *R* is the gross after-tax real return and σ is the rate at which people value future consumption relative to present consumption. Armed with the value of Missouri's real GDP growth rate, I follow the convention and use β = 0.96. Here, the gross after-tax real return is represented by $R = (1-\tau)(A+1-\delta)$, where *A* is the rate at which physical and human capital are transformed into output (the *A* I am looking for), τ is the marginal income tax rate, and δ is the rate at which capital depreciates. Here, I used τ = 0.43224, which is the sum of the maximum federal marginal income tax rate plus the Missouri maximum marginal income tax rate after revising for the deductibility of federal income taxes. Following convention, I use δ = 0.1 and σ = 1.5. With these values, I compute *A = 0.8646*.

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treatment level of Missouri real GDP and pl_t represents the value of production loss associated with the New Madrid Smelter in date *t*. In this framework, I allow for the production shutdown to occur in different years. To compute the effect on Missouri's real GDP, I compute the present value of the difference between the baseline path and the treatment path; formally,

$$\mathrm{I}_T = \sum_{t=*\_\_*}^{T} \rho^t \left(Y_t - Y_t^{'}\right) \tag{2}$$

where I denotes the economic impact of the shutdown.

To compute the economic impact, therefore, we need to compute the treatment path for Missouri's real GDP. I consider three separate cases: one in which the New Madrid Smelter shuts down in ** ___ **, another in which the shutdown occurs in ** ___ **, and a third in which the shutdown occurs in ** ___ **. I assume the shutdown is implemented midyear. Thus, the one-half of the annual production is assumed to be lost in the year of the shutdown. By the following year, the full amount of the production loss is realized.[7]

According to the data supplied by Noranda, the market value of aluminum produced at the Noranda smelter was $152.142 million during the third quarter of 2014. Quarterly production was reported at product of 138.408 million pounds of aluminum with a realized Sow price of $1.08 per pound.[8] I compute the path for Missouri's real GDP with one-half of the production occurring in the year of the shutdown and the full loss realized in the following year. The Missouri economy continues to grow at the same rate—that is, 1.010837—for the next twenty-five years. For completeness, note that for the case in which the New Madrid Smelter shuts down in ** ___ **, the "treatment" value of Missouri real GDP is $Y_{*\_*}^{'} = \$293{,}111.8$ million and $Y_{*\_*}^{'} = \$344{,}548.5$ million.

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[7] To illustrate the assumption, suppose the shutdown occurs in ** ___ **. I assume that the Missouri economy reports one-half of the production loss in ** ___ **. The New Madrid Smelter is at full production during the first half of ** ___ **. In ** ___ **, therefore, the full amount of the production loss is realized.

[8] Note that the realized Sow price reflects the fabrication premium, the London Metal Exchange (LME) cash price and the Midwest premium.

With a baseline and a treatment path for Missouri real GDP, I use equation (2) to compute the economic impact. I use ρ = 0.96 in my calculations. Applying this formula, I compute the discounted sum of Missouri's foregone GDP associated with Noranda's physical capital lost and report the values for two different time periods—25 years and 10 years—and for the three cases. Table 2 presents the results. By my calculations, the economic impact of closing the New Madrid Smelter in ** ___ ** is $10.08 billion over the next 25 years. Over the next ten years, shutting down the New Madrid Smelter would result in a $4.81 billion reduction in Missouri's real GDP. If the New Madrid Smelter stays in operation until ** ___ ** and then shuts down, the value of foregone real GDP is $3.6 billion over the next ten years and $8.8 billion over the next 25 years. The implication is clear, shutting down the New Madrid Smelter in the next couple of years would result in a large decline in Missouri's GDP compared with a case in which it continued its normal course of operations.

Table 2
Economic Impact on Missouri Real GDP
Associated with Closing New Madrid Smelter
(mil of $)

	Shut Down in ** ___ **	Shut Down in ** ___ **	Shut Down in ** ___ **
T = 10 (** ___ - ___ **)	$4,806.058	$4,188.13	$3,599.483
T = 25 (** ___ - ___ **)	$10,080.541	$9,406.067	$8,761.479

Note that in a previous report, I reported the 25-year loss of real GDP to be $8.9 billion. Why is the economic impact larger in this report? The answer is because the base value of real GDP is larger. In the previous report, Missouri's real GDP was $221 billion in 2012 when calculated using 2005 chair-weight prices. With the data revision, the 2013 value of Missouri real GDP is $258 billion when calculated using the 2009 chain-weight prices. In addition, the growth rate is slightly higher when computed over the

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1997-2013 period than when computed using the 1997-2012 values. Together, a larger starting value and faster growth rate in the compounding process result in a larger economic impact.

A. Net General Revenue lost

In Missouri, the key sources of Net General Revenue are the individual income tax and the sales tax.[9] Here, the modelling approach relies on the fraction of Missouri income as the notion that Missouri's income is the key tax base variable. Formally, I assume there is no change in the price level of the simulation period. This assumption amounts to treating the lost Net General Revenue as being measured in 2009 dollars. Next, I compute the product of Missouri's projected real GDP and 0.038. Missouri collected 3.8 cents, on average, per dollar of GDP. Therefore, my approach is to use Missouri's income as its path for the tax base and then use the historical average rate applied against that base.

One implication of this approach is that it focuses on the tax base and not the source of the change to the Missouri economy. For example, a combination of businesses the size of the New Madrid Smelter could shut down resulting in the same reduction in Missouri's GDP. According to my approach, the effect on Missouri's Net General Revenue would be the same as the effect of the New Madrid Smelter shutdown. The basis for this argument is straightforward; GDP measures the value of the final goods and services produced in Missouri and also measures the total factor payments received by people working in Missouri. Income serves as the primitive base for individual income, corporate income, and sales taxes.[10]

In Table 3, I report the lost Net General Revenue for each of the three shutdown scenarios and for both the ten- and 25-year simulation horizons. In each case, the lost Net General Revenue is the discounted

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[9] Corporate income taxes and county foreign insurance collections raise around $400 million and $175 million, respectively. The amounts collected by both taxes are not trivial. However, the state of Missouri relies less heavily on these two taxes. Since 2010, individual income and sales tax collections account for over 90 percent of Missouri's Net General Revenue.

[10] Another approach might try to separate the tax effects by payments to workers, corporate income and the sales tax collected from the business' product. By constructing the impact on Missouri Net General Revenue, one would have to make assumptions about how much and where workers spent their funds on items subject to the Missouri sales tax. Regarding the type of product, one would have to assume what fraction of the product was sold inside Missouri's borders and would be subject to the state sales tax. Such data are kept neither by the businesses nor by the state. As such, no one could assess the validity of any assumptions related to the fraction of product subject to the Missouri tax code.

sum over the period of interest. So, over a generation, the amount of Missouri Net General Revenue collected is $383 million lower if the New Madrid Smelter shuts down in ** ___ ** compared with operating over its expected lifetime. Over the next ten years, Missouri's Net General Revenue collections are $136 million if the New Madrid Smelter ceases operations in ** ___ **.

Table 3
Net General Revenue Loss for Missouri
Associated with Closing New Madrid Smelter
(mil of $)

	Shut Down in ** ___ **	Shut Down in ** ___ **	Shut Down in ** ___ **
T = 10 (** ___ - ___ **)	$182.63	$159.15	$136.78
T = 25 (** ___ - ___ **)	$383.061	$357.431	$332.936

B. Other taxes

In addition, Noranda reports that in 2014, it paid $3.782 million in property taxes on tangible personal property and real estate to New Madrid County. This $3.782 million is owed on the value of land, machines and equipment held by Noranda in 2012. When the Noranda smelter is subject to shutting down in ** ___ **, I assume the property tax base will shrink. One scenario, for example, is that the property tax on unused land goes to zero.

To compute the impact on the county property tax bill, I assume that the property tax bill would have increased at the same rate at the state real GDP growth rate. Thus, barring the New Madrid Smelter shutdown, the Noranda's ** ___ ** property tax bill would be $3.782*(1.010837\wedge 3)=3.906\,\text{million}$. I compute the lost property tax collections as the difference between the operating New Madrid Smelter and shutting down for both a ten- and 25-year horizon. I discounted the future tax liabilities at the same rate as I did in the case of the foregone state GDP.

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A more likely scenario is that with the shrinking property tax base, the local government tax burden will be shifted to those households and businesses that remain in the taxing jurisdiction. The harm, therefore, will not be borne by the local government, but the tax bill will shifted onto those properties in the tax jurisdiction. By raising their property tax bills, the people and businesses would realize a reduction in their disposable income and a reduction in their personal expenditures; in other words, the residents and businesses would not be able to spend as much on cars, foods, and new equipment, for instance.

Table 4 summarizes the cost to the state and local governments in the form of lost tax receipts. The upshot is that if the Noranda New Madrid Smelter were closed, there are costs in the form of foregone state GDP. Because the Missouri economy shrinks, there are fewer taxes collected by both state and local governments. After discounting, the sum of lost state and local revenues is projected to be more than $445 million over a generation and more than $211 million over the first ten years after the plant ceases operation.

Table 4

Summary of Tax Effects based

on Closing Noranda's New Madrid Smelter in ** ___ **

Tax Category	Present value summed over 25 year period	Present value summed over 10 year period
Net General Revenue foregone	$383.06 million	$182.63 million
Property Tax (not collected)	$62.49 million	$28.82 million

C. Unemployment insurances benefits

If the Noranda smelter were shut down in ** ___ **, there would be additional costs to Missouri state government in the form of unemployment insurance claims made by workers separated from work.

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The average unemployment duration is 9.5 weeks.[11] Missouri's unemployment benefits are computed based on the worker's quarterly wages: specifically, a workers weekly benefit amount (WBA) will be 4% of the average of your two highest quarters, but cannot be more than $320.

While I do not have data on the individual worker's salaries at Noranda, officials tell me that the average salary for hourly Noranda employees is $60,000 in 2008. Average salaries have not fallen at the facility since that time. Based on this data, the workers average quarterly wage is $15,000. Weekly unemployment benefits in Missouri are calculated as 4 percent of average quarterly salary or $320, whichever is smallest. Because 0.04 times $15,000 is $600, which is greater than $320, I assume that each of the 889 employees at the Noranda smelter in New Madrid, Missouri will received weekly benefits equal to $320 when laid off in ** ___ **.

I compute the expected costs of the unemployment spells for workers at the New Madrid Smelter using three different measures of the central tendency. I use 9.3 weeks, which is the unconditional sample mean. In other words, if I took the duration of all the unemployment spells reported and divided by the number of unemployed people, I would get 9.5 weeks. If I think that the current economic conditions matter, I would take the current set of unemployed people and measure the duration of their unemployment spell. In this case, the sample mean is 33 weeks. Finally, if I think the current economic conditions matter and I realize the distribution is not a bell-shaped curve, I would use the sample median. Recall that the median is another measure of a central tendency. The median divides the distribution in half; in other words, the median takes the set of current, reported unemployed people and finds the duration for which half of the population has unemployment spells less than that value and half of the population have unemployment spells greater than that value. In November 2014, the median duration is 12.8 weeks.

I report the results of the three sets of calculations in Table 5. The New Madrid Smelter employs

[11] Note that the 9.5 is the unconditional average number of weeks that a person is unemployed. In other words, the average duration is not conditional on the current state of the aggregate United States' economy. According to November 2014 data published by the Bureau of Labor Statistics, the average duration of an unemployment spell is 33.0 weeks. The median—that is, half of the unemployment spells are shorter and half are longer—is 12.8 weeks. See http://www.bls.gov/news.release/empsit.t12.htm for these data.

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Table 5

Expected Unemployment

Insurance Benefits

Employee category	Unconditional Mean unemployment duration = 9.5 weeks	Median unemployment duration = 12.8 weeks	Cyclically -adjusted Mean unemployment duration = 33 weeks
Complete Shutdown	$2,702,560	$3,641,344	$9,387,840

889 people eligible for unemployment insurance benefits. Each week that all the employees from the New Madrid Smelter are unemployed results in a Smelter-aggregate unemployment insurance benefit equal to $284,480. If the New Madrid Smelter employees experience unemployment duration equal to the sample mean the expected cost is $2.7 million. Suppose that the New Madrid Smelter employees experience spells equal to the sample median duration. The expected unemployment insurance benefits paid to all New Madrid Smelter employees is $3.6 million. Finally, if the New Madrid employee's unemployment spells is equal to the mean duration for the current business cycle, unemployment insurance benefits equal $9.4 million.

IV. Summary

In this report, I have applied standard economic theory to compute the effect that eliminating Noranda's New Madrid Smelter would have on the Missouri economy.

For the twenty-five year period after the smelter is subject to closure in ** ___ **, the discounted sum of lost state GDP is $10.080 billion. For the first ten years after plant reduction, the amount is $4.806 billion. As the tax base shrinks, state and local government revenue collections decline. If the New Madrid Smelter ceases operations in ** ___ **, the discounted sum of lost net general revenue paid to the state is

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$383.06 million over the twenty-five year period and $182.63 million over a ten-year period. Second, local property taxes are also reduced by $62.49 million over a twenty-five year period if the lost revenue from Noranda is not made up by increased collections on remaining taxpayers. Over a ten-year period, the amount is $28.82 million lost revenue from Noranda is not made up by increased collections on remaining taxpayers. Third, the state will incur some costs in the form of unemployment insurance benefits. If the smelter shutdown occurred, on average, the state would expect to pay $2.7 million in unemployment insurance benefits. If, however, the smelter shutdown occurred with the current expected unemployment duration equal to its current mean value, the state would expect to pay $9.4 million in unemployment insurance benefits to Missourians.

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