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Monetary Inflation's Effect on Wealth Inequality: An Austrian Analysis

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Abstract Austrian monetary inflation theory claims that changes in the money supply are disproportionately distributed throughout an economy, and as a result wealth is coercively redistributed. This study proposes and tests a model illustrating this connection by examining monetary inflation's effect on wealth inequality. After testing the model's validity, this study compares monetary inflation's effect on several measures of wealth inequality, concluding that not only is monetary inflation a significant variable, but its effect on wealth inequality is more pronounced at the extremities of the distribution.

Introduction

In his classic story, *The Time Machine*, H.G. Wells describes the horrific implications of a purely capitalistic system. His warning portends the inevitable consequence that wealth between social classes will necessarily diverge further and further if the lower classes are consistently exploited by what one would infer to be the social inefficiencies of capitalism. This kind of criticism should be expected from Wells and other Marxists, but this trend has spilled over into mainstream thought, and such critiques are commonplace. As a result, an expectation that the government will intervene and solve the inefficiencies of the market has taken root. Unfortunately, sometimes the cure is worse than the disease, and oftentimes, sweeping government actions have undesirable side effects. According to the Austrian School, this is the case with monetary inflation. This paper will analyze the implications that changes in the money supply have on wealth inequality and show how government-sponsored monetary inflation actually *exacerbates* wealth inequality.

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A new model is proposed here that links these two variables to demonstrate how changes in the money supply directly affect wealth inequality. This work further hypothesizes that these effects are more pronounced at the extremes of the wealth distribution. It subsequently tests that hypothesis by comparing the effects of our model to various measures of inequality, including some that emphasize inequality at the extremes. Finally, it is concluded that as a result of these effects, government monetary policy must be reexamined.

Literature Survey

The problem of wealth inequality has been a topic of debate for centuries, and much has been written on the subject. Marx and other socialist writers of the nineteenth century focused their analyses on the consequences of wealth inequality and the immorality of its existence. Contemporary writers, however, have analyzed its causes in an effort to find solutions to the problem. Kuznets (1955) drew a relationship between economic growth and wealth inequality, contending that the advancement of industrialization and urbanization widens the wealth gap. Over time, as more workers enter the newly-productive sectors of the industrialized economy, the gap will begin to tighten, creating an inverse-U-shaped path. The declining end of the Kuznets's U-curve is also marked by political and social factors that further bring the wealth extremities together. Kuznets's inverted-U hypothesis has been the topic of many studies since he first proposed it. Piketty and Saez (2003) expanded on Kuznets, noting that since the 1970s, the inverse-U seems to have doubled back on itself, and wealth inequality is back on the rise. They argued that possibly another industrial revolution has taken place and that we are on the increasing end of another Kuznets U-curve. Piketty and Saez also noted the precipitous drops in top wage shares after two major disasters in the 1900s: the Great Depression and World War II, emphasizing the role of the upper income brackets on wealth inequality.

Methods of measuring income inequality are very significant when discussing the widening of the wealth gap. Braun (1988) discussed eight different measurements of income inequality, including the Gini coefficient, Theil's index of inequality, Atkinson's measure, and the Nelson index.

Using 19 independent socio-economic status variables, Braun showed that the most significant factor in all relevant measures affecting income inequality is education, specifically the standard deviation of educational attainment. Mean family income comes in a distant second. Nelson (1984) suggested top wage earners are afforded more economic opportunities, leading to a further disparity between them and the lower and middle wage earners.

The wealth inequality literature to date has focused primarily on the ability of high-wealth individuals to compound their wealth by taking advantage of industrialization, education, or access to more economic opportunities relative to those with less wealth. These analyses imply that while wealth for all classes rises together, the resultant inequality comes from the rate of growth varying across different income brackets. This mode of thinking is one-sided, concentrating only on factors that increase wealth while neglecting possible causes of wealth erosion. If a disproportionate rate of growth widens the wealth gap, then certainly a disproportionate degree of wealth erosion is likely to exacerbate wealth inequality as well. When investigating the potential causes for wealth erosion, inflation immediately comes to mind, but wealth inequality literature has not analyzed inflation as an explanatory variable. While the majority of work written on wealth inequality seems to neglect the significance of inflation, does mainstream work written on inflation draw this connection?

The idea of an "inflation tax" has been well documented since as early as the 1700s, when David Hume formulated his quantity theory of money. Hume (1970) focused on the units-change aspect of money stock inflation and how such changes would be irrelevant to rational people. Changing the number of monetary units in circulation in the economy would only have a proportional effect on prices in terms of that money while leaving economic behavior unaltered. It should be noted that in such a situation, there would be no widening of the wealth gap because the inflation tax would erode everyone's money equally, and inflation would seem to not have an effect. In theory, this notion is absolutely correct if two assumptions are made: that the additional money stock is distributed equally to all economic actors in proportion to their current money stock and that all actors are fully aware of this change in the money stock at the same time. Since these assumptions are not likely to hold, the consequences of relaxing these assumptions should be discussed. Hume recognized that money changes are not implemented proportionally and as a result wrote:

> When any quantity of money is imported into a nation, it is not at first dispersed into many hands but is confined to the coffers of a few persons, who immediately seek to employ it to advantage. Here are a set of manufacturers or merchants, we shall suppose, who have received returns of gold and silver which they sent to Cadiz. They are thereby enabled to employ more workmen than formerly, who never dream of demanding higher wages, but are glad of employment. (Hume 1970, p. 38)

At the same time, Hume also touched on the consequence of imperfect information distribution: In this example, the merchants who have the additional money have an advantage over the workmen who are unaware of the shift in the money supply and have no reason to think anything has changed.

Lucas (1996) emphasized the distinction between anticipated and unanticipated inflation. Lucas first cited McCandless and Weber (1995) to give strong statistical support for the monetary neutrality aspect of Hume's quantity theory. McCandless and Weber (1995) showed strong correlations between the inflation rate and M2 (.95), M1 (.96), and the monetary base (.92).[1] He then expanded on Hume, noting a paradox that while changes in money are "neutral-units changes," they can also induce movements in employment and production. The solution to this paradox has come from the extensive research done in the 1970s, revealing that anticipated changes and unanticipated changes in inflation have very different effects. Fully anticipated inflation would have no real effects, implied by Hume, but unanticipated inflation can lead to an array of consequences from stimulating production to inducing depression.

[1] The monetary base is the value of all currency and coin in circulation. M1 is a measure of the money supply that adds checkable and demand deposits to the monetary base. M2 is a measure of the money supply that adds time deposits and short term investments to M1.

Bulíř (2001) demonstrated that inflation is indeed a factor affecting income distribution. He first grouped people into two types of workers: "insiders" who accept inflation-adjusted wage contracts and "outsiders" who accept only nominal contracts. Bulíř analyzed how inflation would affect either group. His primary argument, however, focused on the classical definition of the "inflation tax," which is the erosion of value from holding a nominal asset, implying that correctly anticipating inflation is the major factor that separates both ends of a widening wealth spectrum. While it is clearly true that inflation would widen a gap between those who hold inflation-indexed investments and those who do not, such an analysis is an oversimplification and downplays the more important redistributive effects of inflation as discussed by Mises (1996) and Rothbard (1994).

Nordhaus (1973) came closest to a statistical argument closely connecting inflation and wealth inequality. He also identified the same problem with current work on the subject:

> Virtually all *empirical* work on the distributional effects of inflation considers the effects on short run income, with little consideration of effects on assets; virtually all theoretical work considers long-run effects in equilibrium systems. (Nordhaus 1973, p. 478)

While Nordhaus claimed to be applying empirical work to long-run scenarios, his only data source for economic distribution was the Federal Reserve *Survey of Financial Characteristics of Consumers*. This survey focused only on the wealth distribution in 1962. Nordhaus still used theoretical arguments to estimate the effects of inflation, albeit very complex theoretical models of his own. Comparing the theories of three separate schools, Classical, Neoclassical, and Keynesian, Nordhaus augmented his complex model to predict the distribution of welfare in the future. His model, by his own admission, "is quite complicated [and] is sensitive to the assumptions." His model differentiated economic actors based on a variety of factors; however, his models did not take into consideration the dissemination of information or distribution of monetary units over time, which would expose actors to the redistributive effects of inflation differently.

The focus here differs from the above work in several ways. It will differ from the work on wealth inequality in that its focus will be on the erosion of wealth of those at the lower strata of the wealth spectrum rather than the compounding of wealth at the upper strata. The analysis of inflation will transcend the simple notion of the "inflation tax," which simply wears away the value of nominally held assets, and will focus more on inflation's redistributive effects. The motivation for this paper is primarily Austrian, and thus the theoretical framework for this work will come from the writings of Mises (1996) and Rothbard (1994). This paper will apply empirical statistical analysis to provide evidence consistent with their hypotheses.

Theoretical Framework

The foundation for this work comes principally from two prominent Austrian authors. Mises (1996) and Rothbard (1994) elaborate on Hume's theory on disproportionate monetary distribution, claiming that increasing the money supply is tantamount to a tax that penalizes those who see the new money last. This view of monetary redistribution is a cornerstone of Austrian inflation theory. Mises writes in *Human Action*:

> Let's assume that the government issues an additional quantity of paper money. The government plans either to buy commodities and services or to repay debts incurred or to pay interest on such debts.…The prices of some commodities—viz., of those the government buys—rise immediately, while those of other commodities remain unaltered for the time being. But the process goes on. Those selling the commodities asked for by the government are now themselves in a position to buy more than they used previously…. Thus the boom spreads. …[and] the rise in prices is thus not synchronous for the various commodities and services…. [T]here are people who are in the unhappy situation of selling commodities and services whose prices have not yet risen or not in the same degree as the prices of the goods they must buy for their consumption. (Mises 1996, p. 412)

Rothbard (1994) echoes this sentiment by equating the Fed's printing of money to counterfeiting. He critiques Hume for neglecting the vital redistributive effects of monetary inflation, and Friedman dismisses Milton Friedman's "helicopter theory," where Friedman postulates that the Federal Reserve showers newly created money on the people proportionally according to their current money stock. Rothbard's "counterfeiting argument" further explains why monetary inflation is an insidious process that relies on imperfect information:

> It would be difficult to see the point of counterfeiting if each person is to receive the new money proportionally. In real life, then, the very point of counterfeiting is to constitute a *process*, a process of transmitting new money from one pocket to another, and not the result of a magical and equi-proportionate expansion of money in everyone's pocket simultaneously. (Rothbard 1994, p. 23; emphasis in original)

Lucas's comments on anticipated and unanticipated inflation are also a driving force for this work as they, along with Rothbard's analysis, highlight another area of importance: the consequences of government manipulation of the money supply. The implications of these analyses show that government-sponsored inflation is a catch-22. Rational expectations and the quantity theory would have all prices adjusted and no real effect realized when inflation is perfectly anticipated and equally distributed; however, throwing unanticipated inflation into the markets leads to a coercive redistribution of wealth. While any coerced redistribution is inherently unacceptable, the matter seems more egregious when it is concluded that this redistribution runs counter to an all but stated government agenda to reduce wealth inequality.

The theoretical arguments presented here so far serve as explanations for wealth *redistribution*, not wealth inequality. That this redistribution tends to favor those who already possess wealth over those who do not provides the link to wealth inequality. The connection is rather intuitive; one needs only to do a basic analysis of the Federal Reserve's methods for adjusting the money supply. Whether through the use of open market operations or issuing discount loans to banks, the Fed clearly has a select clientele to whom it issues new money directly, namely banks. This relationship is certainly a benefit for the banks involved as they can loan out the newly printed money, keeping only fractional reserves. Since it is likely that banks, in trying to manage their risk exposure, will loan newly injected money to creditworthy individuals, and since the amount one can borrow is a direct function of one's established wealth, the link between redistribution and wealthy individuals becomes apparent. Therefore, if monetary inflation does indeed have statistically significant adverse effect on the wealth gap, this paper will conclude that Austrian monetary theories are accurate in examining how inflation contributes to coercive redistributions of wealth. Furthermore, that this redistribution exacerbates wealth inequality demonstrates the limitations of using monetary policy to effect any egalitarian wealth distribution.

Data

Measuring Wealth Inequality

The data available on wealth, and consequently on wealth inequality, are limited. A standard source is the *Survey of Consumer Finances* (SCF), published by the Federal Reserve Board triennially; however, since the SCF has only been published regularly since 1983, there are too few observations available to yield rich results. This paper will follow suit with many other works and use income inequality data as a proxy for wealth inequality. This practice is common in the wealth inequality literature, with the justification that since wealth is a direct function of the present value of future income, abnormal consumption patterns aside, income data should provide a satisfactory measure of wealth inequality.

We use several measures of income inequality. The first set of data used comes from the U.S. Census Bureau Historical Income Tables (2004b). Table IE-6: Measures of Household Income Inequality (pp. 565–566) yields various measures of income inequality including the Gini coefficient, the Theil index, and Atkinson's measure at e =0.25 and 0.75. While the Gini coefficient tends to be the standard measure in most research, the Theil and Atkinson measures are useful for comparisons with Gini, as all three measures are highly correlated. The data ranges from 1967 to 2001. Over this span, all measures of inequality rose by at least 17% with the highest measuring 44%. Given any measure of income inequality, the number of years that showed an increase in inequality from the previous year dwarf those few instances where they do not. With regard to any measure of income inequality, the general trend over the past 30 years has been greater inequality (see Fig. 1).

The second set of income inequality data also comes from the U.S. Census Bureau (2004a). Table IE–5: Household Income Ratios by Selected Percentiles (1967–2001, pp. 563–564) provides a way to further isolate certain wealth distribution data to see if monetary inflation influences certain wealth groups more than others. Included are various ratios between the 95th, 90th, 80th, 50th, 20th, and 10th percentiles.

Inflation Data

Any discussion on inflation must first clarify whether the variable of concern is price or monetary inflation. The difference is subtle, and surely the two are strongly

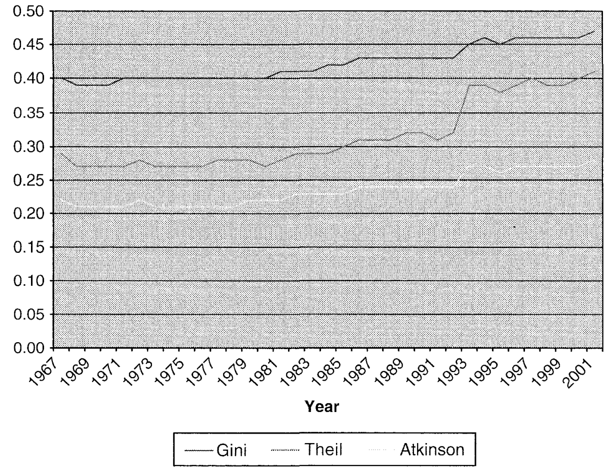

Fig. 1 Income inequality in the U.S. (1967–2001) (2004b)

correlated; however, for the purposes here it must be noted that the effects of monetary and price inflation are very different. A change in prices is all encompassing; in an efficient market, prices reveal every bit of information known to every market participant. If, for example, a study is done revealing significant health benefits for eating bananas, it should not surprise anyone if the price of bananas goes up. Consider also the case when the money stock in circulation literally doubles overnight. The rational economic actor would double all prices for all goods he controlled. Bananas would be included in this shift. So while the price of bananas increased in both scenarios, the methods by which the price change occurred are clearly different. And as explained at length above, the latter situation of monetary inflation can lead to undesirable consequences. Therefore, this study primarily uses measures of the money stock rather than measures of price inflation.

The monetary inflation data used here comes from monthly historical money stock tables published by the Federal Reserve. Seasonally adjusted measures of M1, M2, and the monetary base (M0) are taken directly from these tables. The data available ranges from 1959–2003. The measures for M1 and M2 are included because they are obviously correlated strongly with M0 and represent newly printed money already having circulated through the economy. The money supply has dramatically expanded since 1950 by 1,332%, 828%, and 1,943% for M0, M1, and M2 respectively (see Fig. 2).

Miscellaneous Data

This study also includes a number of explanatory variables to control for other possible contributing factors. Giving deference to previously written work, data on educational attainment is incorporated into the models. U.S. Census Bureau reports on educational attainment from 1967 to 1998 provide the data used in this analysis. Historical data are posted by the Census Bureau in separate tables by year. The data set over time of the percentage of people of all races and both sexes who have

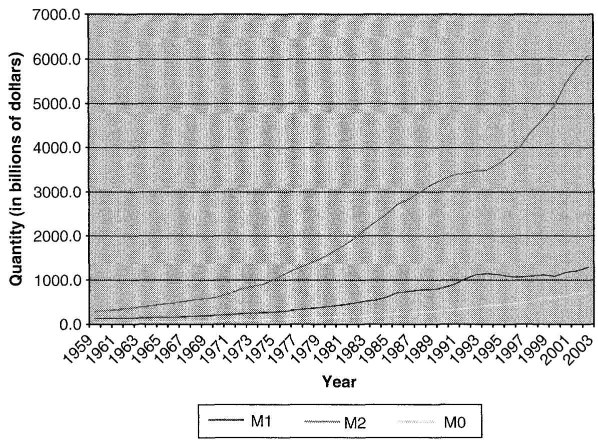

Fig. 2 Measure of U.S. money stock (1959–2003)

attained the status of "High school graduate or more" is compiled. When this figure was not published directly, it was calculated by combining the numbers of all educational levels greater or equal to "High school graduate" and dividing by the total population.

It is commonly accepted that the federal government's fiscal policy is a tool used to reduce wealth inequality. Reasoning that fiscal policy is enabled by the collecting and spending of tax receipts, government revenue and expenditure data, ranging from 1962 to 2001, is obtained from figures published by the U.S. Office of Management and Budget (2007).

Lastly, to correct for possible endogeneity with the money supply and wealth inequality data, I have included figures for real GDP, which will act as an instrumental variable in some of the regressions. Data for real GDP comes from Johnston and Williamson (2004). Their work, "The Annual Real and Nominal GDP for the United States, 1789–Present," extrapolates data available from the U.S. Bureau of Economic Analysis.

Model

The model takes the form:

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

where, Y_1 corresponds to a measure of income inequality, and $X_{1,2,3}$ represent a measure for the money supply, educational attainment, and federal fiscal policy respectively. All of the measures for the dependent variable, income inequality, are highly correlated, and therefore after developing a suitable model around the independent variables, the model will be applied to the other measures of income inequality to see if there is any significant variance in the results among them.

All measures of inequality are reported in such a way that higher values represent greater inequality. The hypothesis claims that increases in the money supply would increase the measure of inequality, so it is expected that the coefficient on the money supply variable is to be positive. Conversely, since increases in educational attainment have been shown to tighten the wealth gap, β_2 is expected to be negative. β_3 is also expected to be negative since federal fiscal policy is argued to alleviate wealth inequality.

Running several exploratory regressions to compare the relative effects of M0, M1, and M2 yielded unexpected results. M1 consistently seemed to have more predictive value than both M0 and M2. My initial hypothesis suggested that M0 would be the most significant measure of the money supply because of the allocation of newly printed money. However, as discussed earlier, it is the purpose of this work to show that allocation itself is not sufficient to account for monetary policy's effect on wealth inequality. Our model must be equally concerned with its distribution. Therefore, our measure of money supply must capture the transactional flow of money. M1 and M0 are clearly more distributive than M2 simply by definition. M2 incorporates measures of money that does not circulate quickly over time, such as time-deposits and assets invested for the short term. Furthermore, it should be clear that M1 is a better tool to analyze the flow of money, as technology has introduced a variety of noncash mediums with which transactions are conducted: credit cards, debit cards, electronic transfers, online payments, etc. This trend can be seen in Fig. 2 where the graphs of M0 and M1 diverge as time and technology move forward. However, it should still be noted that if every transaction in the economy was conducted with Federal Reserve notes, then wealth can only be affected by changes in the monetary base, and M0 would be our variable of choice. But this is not the case here.

Deciding which measure of educational attainment (X_2) would have the most explanatory power for income inequality was more difficult. Comparing money supply measures is straightforward since one can perform multiple regressions on each measure individually and observe which, if any, of the variables are significant. Educational attainment data has no such standardization, and thus a separate model for education had to be formulated and tested. Using educational attainment data, three separate classifications of the population that encapsulated inequality best were created: percentage of population with a high school diploma and no further education ("terminal_hs"), percentage of population with at least a high school diploma ("hs_plus"), and the percentage of population with at least a bachelor's degree ("bachelor_plus"). Exploring these variables, the variable hs_plus was found to be most significant. This result makes intuitive sense because having a high school diploma has become the litmus test for a considerable number of available jobs in the U.S in the last 30 years. While the same logic can be applied to the bachelor_plus variable, it was found to be less significant than hs_plus. It is reasoned that since college education still only affects a minority of the population (24% as of 2004), studying changes in the number of people receiving bachelor's degrees neglects changes in the education of the majority of the population. While they are likely correlated, the measure of hs_plus has more explanatory power when applied to a category as broad as income inequality.

Finally, when choosing an appropriate variable to account for the government's fiscal policy, several factors needed to be considered. First, government expenditures were deemed to have more explanatory power than government receipts. The intent of this variable is to capture how effectively the government redistributes wealth. While data on government receipts would capture the effect of progressive taxation, it would say nothing of how those receipts are allocated. Government expenditures, on the other hand, are able to capture the effect of the disbursements in addition to any redistributive taxation. Tax receipts also cannot measure the effect of how borrowed money is spent. But the model cannot simply use nominal expenditures as they are obviously correlated with the money supply data. One consideration would be to use figures adjusted for inflation, but this approach is also flawed since inflation-indexed expenditures would still be directly correlated with economic growth. As previously discussed, Kuznets had shown economic growth to be a contributing factor to wealth inequality. Therefore, to isolate the effect of fiscal policy from economic growth, the model incorporated government expenditures as a percentage of GDP ("gov_exp") as the final explanatory variable.

After a model was constructed around the independent variables, a measure of income inequality to use as a benchmark for regression analysis was selected. The present study follows other works and uses the Gini coefficient ("gini") as its primary measure of income inequality. The regressions here will therefore use a form of the following model:

$$\boldsymbol{gini} = \beta_0 + \beta_1 \boldsymbol{M1} + \beta_2 \boldsymbol{hs\_plus} + \beta_3 \boldsymbol{gov\_exp} + \varepsilon$$

Regression, Analysis and Discussion

Regression Methods

Using the model described in the previous section as a base, the validity of the model was tested by regressing the data using two different methods:

1. Regression in logs
2. Regression in first differences

A double-log regression will yield results with units-free elasticities so the marginal effects the explanatory variables have on income inequality can be easily compared. A regression in first differences will give further support to the hypothesis by drawing a more direct link between *changes* in money supply and changes in wealth inequality. Demonstrating a connection between the changes in the levels will carry more weight when considering short-term policy implications.

Regression in Logs

The following model for double-log regressions was used:

$$\log(\text{gini}) = \beta_0 + \beta_1 \log(\text{M1}) + \beta_2 \log(\text{hs\_plus}) + \beta_3 \log(\text{gov\_exp}) + \varepsilon$$

Table 1 displays the results from a basic regression.

This first regression establishes the strength of the model. All independent variables are statistically significant with better than 95% confidence. The R^2 measure is also extremely high, with the independent variables explaining 94.70% of

Table 1 Double-log regression of gini on M1, hs_plus and gov_exp

	Coef.	*Std. error*	*t-stat*	*P>∣t∣*
Log(M1)	0.1345	0.0213	6.33	0.000
Log(hs_plus)	−0.1995	0.0955	−2.09	0.046
Log(gov_exp)	−0.1658	0.0489	−3.39	0.002
Constant	−0.3705	0.2213	−1.67	0.105

Regression Stats
# of obs=32
$F(3,28)=166.61$
Prob.>F=0.0000
R-squared=0.9470

the variation in wealth inequality. The coefficients, β_1, β_2, and β_3, turned out as expected. This model confirms previous work by showing that disproportionate education is the most significant factor affecting income inequality. The negative sign on β_2 makes sense because as the percentage of the population graduating from high school increases, one would expect those graduates to now have opportunities to increase their wealth share, which they did not have before, and as a result, income inequality would decrease. The negative sign on β_3 is also appropriate as government fiscal policy is argued to redistribute wealth in favor of less inequality.

Most rewarding, however, is the result for β_1. As predicted by the hypothesis, the money supply *is* a significant factor in determining wealth inequality. From the coefficients, it can be seen that a 1% change in the money supply, namely M1, is nearly as influential as a 1% change in the measure of high school education. This is a very powerful result. However, such a strong result may indicate statistical flaws in the model. Two potential pitfalls in the model are possible autocorrelation and/or endogeneity of M1. Table 2 and Table 3 correct for these problems. Table 2 shows the results of a Prais–Winsten regression to correct for AR(1) serial correlation.

The results are very similar to the first regression, which suggests that any serial correlation in M1 does not bias the original results. The second concern is the potential endogeneity of M1. Assuming endogeneity, a two-stage least squares regression using Real GDP as an instrumental variable for M1 was run. Real GDP is

Table 2 Double-log regression of gini on M1, hs_plus, and gov_exp with Prais–Winsten correction for AR(1) serial correlation

	Coef.	*Std. error*	*t-stat*	*P>∣t∣*
Log(M1)	0.1423	0.0284	5.02	0.000
Log(hs_plus)	−0.2405	0.1231	−1.95	0.061
Log(gov_exp)	−0.1439	0.0547	−2.63	0.014
Constant	−0.3133	0.3079	−1.02	0.317

Regression Stats
# of obs=32
$F(3,28)=316.97$
Prob.>F=0.0000
R-squared=0.9714

Table 3 Two-stage least squares double-log regression of gini on M1, hs_plus, and gov_exp using Real GDP as an Instrument for M1

	Coef.	*Std. error*	*t-stat*	*P>|t|*
Log(M1)	0.1504	0.0278	5.42	0.000
Log(hs_plus)	−0.2697	0.1237	−2.18	0.038
Log(gov_exp)	−0.1486	0.0529	−2.81	0.009
Constant	−0.2282	0.2732	−0.84	0.411

Regression Stats
# of obs=32
$F(3,28)=160.03$
Prob.>F=0.0000
R-squared=0.9459

suitably correlated with M1 but is arguably not correlated with the error term in the model. Table 3 displays the results of this regression.

From Table 3, one can see that the model also survives the test of endogenous variables. Since the results are not drastically altered after correcting for autocorrelation and endogeneity, this suggests that the original double-log regression is still a valid instrument for analyzing the relationship between monetary inflation and wealth inequality.

Regression in First Differences

To put aside any uncertainty that the double-log level regressions still contain flaws, the model was applied to the *changes* in the independent variables with first differencing, which removed any linear time trend. Table 4 shows the results of a basic regression in first differences.

Unfortunately, the results from the double-log regressions are not completely confirmed by Table 4. While the first difference of M1 is still significant within a 10% level and the R^2 value indicates some explanation of variance, the education and government variables are not statistically significant. However, since the intent is to explore how changes in M1 affect income inequality, there is no reason to assume that the first difference in these latter variables should be directly applicable.

Table 4 Regression in first differences of Gini on M1, hs_plus, and gov_exp

	Coef.	*Std. error*	*t-stat*	*P>|t|*
D.(M1)	0.00005	0.00003	1.83	0.079
D.(hs_plus)	−0.0018	0.00241	−0.75	0.460
D.(gov_exp)	−0.0017	0.00134	−1.26	0.219
Constant	0.0020	0.00257	0.79	0.437

Regression Stats
# of obs=31
$F(3,27)=2.03$
Prob.>F=0.1340
R-squared=0.1837

Furthermore, this regression neglects a fundamental characteristic among our independent variables: that changes in educational attainment and government spending manifest themselves differently compared to changes in inflation. With monetary inflation, every individual transaction theoretically contributes to a redistribution of wealth, so long as there is imperfect information. Given the countless number of transactions that occur in a year and the infinitesimally short time frame between them on a scale as large as our economy, the effect of monetary inflation on wealth inequality would closely resemble a smooth, continuous function. Whereas, given the nature of our education and government variables, effects are realized in discreet iterations at specified times, whether it is a high school graduation or the initiation of a social welfare program. While the regression gave us mixed results, fortunately, for our purposes, monetary inflation had shown itself again to be a significant variable affecting wealth inequality.

Despite the relatively small number of observations, the results of these regressions give sufficient support for the initial hypothesis. Not only has the model verified the importance of educational attainment's effect on income inequality, but it also has demonstrated money supply's effect on the Gini coefficient in log levels and first differences. Using the support from the latter regressions, I conclude that my initial log-level model has reasonable predictive value. Using the log-level model, the following sections will vary the dependent variable. "Comparison Among Summary Measures of Inequality" will compare the model's effect on the various summary measures of income inequality. "Comparison Among Select Income Ratios" will test the hypothesis that the income inequality generated by changes in the money supply affects certain income ratios more significantly than others.

Comparison Among Summary Measures of Inequality

This study so far has used the Gini coefficient as its standard for measuring income inequality. In this section other measures of income inequality and how they differ from Gini will be discussed. Then analysis of whether the model reflects those differences will be undertaken.

One of the shortcomings of the Gini coefficient is that it is biased toward changes in income of the middle classes. In response to this, other measures of inequality have surfaced that focus more on changes at the extremes. Entropy measures, such as the Theil index, do just that. Since the second hypothesis claims that redistributive inflation predominantly affects the extremes, I expect the independent variables, monetary inflation, educational attainment, and fiscal policy to have stronger effects on a measure that gives weight to the extremes. This was tested by performing a regression using the Theil index as the dependent variable.

Table 5 confirms the hypothesis. As shown by Table 5, the coefficients on the explanatory variables are much higher than those from the first regression with the Gini coefficient. These variables are also statistically significant with a greater than 99% confidence and with R^2 revealing that 90% of the variance is explained.

The second summary measure tested was the Atkinson index. The Atkinson index has the distinguishing feature of being able to adjust its weighting scheme based on the parameter for "inequality aversion." The parameter ("e") is bound by 0 and 1. As e approaches 0, the Atkinson index gives more weight to the upper end of the

Table 5 Double log regression of Theil on M1, hs_plus, and gov_exp

	Coef.	*Std. error*	*t-stat*	*P>|t|*
Log(M1)	0.4433	0.0719	6.16	0.000
Log(hs_plus)	−1.0242	0.3230	−3.17	0.004
Log(gov_exp)	−0.5371	0.1654	−3.25	0.003
Constant	1.9698	0.7488	2.63	0.014

Regression Stats
\# of obs=32
$F(3,28)=84.90$
Prob.>F=0.0000
R-squared=0.9010

income distribution. Census inequality data offers measurements of the Atkinson evaluated at e=0.25 and e=0.75, representing weighting of higher and lower incomes respectively. Regardless of the weighting scheme, both Atkinson measures show an increase in inequality from 1967–2001. Table 6 shows the regression results from applying the model to either measure of Atkinson.

The model is validated by all regressions on Atkinson, regardless of weighting, with nearly all of the independent variables being significant within a 99% confidence. As with the Theil index, the coefficients on the money supply variable indicate a stronger redistributive effect when compared to regressions on Gini. This lends further support to our second hypothesis with respect to the extremes of a wealth distribution. The only variable shown not to be significant within a 99% confidence was fiscal policy when applied to a weighting of lower incomes, yet our results from previous regressions have shown fiscal policy to be significant when

Table 6 Double log regresion of Atkinson (measured at e=.25/.75) on M1, hs_plus, and gov_exp

	Coef.	*Std. error*	*t-stat*	*P>|t|*
e=0.25				
Log(M1)	0.3805	0.0394	9.66	0.000
Log(hs_plus)	−0.9743	0.1769	−5.51	0.000
Log(gov_exp)	−0.3026	0.0906	−3.34	0.002
Constant	0.0486	0.4101	0.12	0.907
e=0.75				
Log(M1)	0.2717	0.0454	5.98	0.000
Log(hs_plus)	−0.5730	0.2040	−2.81	0.009
Log(gov_exp)	−0.1808	0.1045	−1.73	0.095
Constant	−0.2106	0.4730	−0.45	0.660

Regression Stats (e=0.25)
\# of obs=32
$F(3,28)=169.40$
Prob.>F=0.0000
R-squared=0.9478
Regression Stats (e=0.75)
\# of obs=32
$F(3,28)=97.01$
Prob.>F=0.0000
R-squared=0.9122

Table 7 Double-log regressions of select income ratios on M1

	Coef. on log(M1)	*Std. error (M1)*	*t-stat (M1)*	*P>|t| (M1)*
80th/50th	0.0250	0.0124	2.02	0.053
90th/50th	0.1045	0.0143	7.30	0.000
95th/50th	0.1080	0.0202	5.34	0.000
95th/20th	0.1726	0.0241	7.14	0.000
90th/10th	0.2054	0.0317	6.48	0.000

applied over the entire distribution. Such a result may require further study to analyze fiscal policy's effect on various income brackets.

Comparison Among Select Income Ratios

The final set of regressions use income ratio data to compare the effects of monetary inflation on various income ratios. A corollary of the second hypothesis would claim that M1 has a greater effect on ratios that are wider apart. The results from these last regressions are mixed. While M1 was still consistently significant, the significance and sign of the other variables was inconsistent. This is most likely due to the fact that the education and expenditure data are a reflection of the entire population, while the dependent variable neglects large portions of it. If it had been possible to obtain educational attainment data and government expenditure data subdivided by income percentile, it is hypothesized that such data would prove to be significant in this class of regressions. Nonetheless, given the consistency with which money supply has been a significant variable, this set of regressions was confidently performed using money supply as the only dependent variable.

Table 7 reports the results of several double-log regressions of multiple income ratios on M1. All ratios in the table "(X/Y)" are reported as "ratio of highest 'x' percentile to lowest 'y' percentile."

When observing the trend in the coefficients, one can see a direct correlation between the difference in income ratios and the coefficient on log (M1), thus giving further support to the hypothesis that the extremities of the income distribution are more significantly affected by monetary inflation.

Conclusions

Using measures of monetary inflation, educational attainment, and fiscal policy a model was constructed with reasonable predictive value for several measures of income inequality (as a proxy for wealth inequality). M1 proved to be the best measure of the money supply; "percentage of population with at least a high school diploma" was the most valuable educational variable; and federal expenditure as a percentage of GDP was the most significant metric with respect to fiscal policy for explaining wealth inequality and changes in it. The validity of the model was tested by observing its consistency through multiple regressions in logs and a regression in first differences. In all of these regressions, the independent variables were significant at a 10% level with R^2 values ranging from .18 to .97. Given the strength of the statistical results, the hypothesis that monetary inflation does not have an adverse effect on wealth inequality is rejected.

The model was subjected to tests for autocorrelation and possible endogeneity of the variables. Finding no significant effect of either, the strength of the model was reaffirmed. Once the predictive ability of the model was assured, it was used to gain further insight on wealth inequality by regressing various measures of income inequality against the explanatory variables.

Regressions with summary measures of income inequality revealed that monetary inflation seems to affect measures that emphasize the extremities of the income distribution (Theil, Atkinson) more than those that tend to weight median income (Gini). To further support this notion, the effects of the model on various income ratios was reviewed. Not only was M1 a significant variable in every regression, but the marginal effect M1 had on income inequality was positively correlated to the degree of separation of income ratios.

These results have far-reaching macroeconomic implications. From an economic standpoint, these results indicate that monetary policy must be revisited to account for its direct effect on wealth redistribution. However, the political implications are just as significant. If the government is to pursue a policy of social welfare and income equality, it must reconcile this conflict between monetary and social policy. Monetary inflation clearly leads to a coercive redistribution of wealth. That this redistribution tends to penalize lower-income individuals is even more outrageous from a social welfare point of view. The limitations of effecting an egalitarian social order through manipulation of the money supply should be apparent. This position, long held by Austrian economists, is once again vindicated, and the author can only hope that the statistical support this paper lends can offer teeth to an already sound theory.

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