ESSAYS ON INEQUALITY AND MACROECONOMIC POLICIES

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ABSTRACT OF THE DISSERTATION

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This dissertation studies the effects of inequality on macroeconomic policies. Inequality has become a very important issue, but there are few studies about the effects of inequality on monetary and fiscal policies. This dissertation attempts to fill this gap. The dissertation consists of three chapters.

Chapter 1, "Inequality and the Interwar Gold Standard" studies the relationship between inequality and the interwar gold standard. Many economic historians have argued that adherence to the gold standard was an important obstacle to recovery from the Great Depression. It is therefore important to understand the factors that affected a country's determination to remain on gold. Many proximate determinants of adherence have been identified, including democracy, creditor status, sterling bloc membership and the structure of a country's trade network. Here I explore a neglected but fundamental determinant: inequality. I find that countries with higher inequality at the start of the Great Depression remained on gold longer than countries with lower inequality. I conduct a survival analysis using two discrete time hazard models to test the effect of inequality on the probability of exiting gold for each country. The paper lays out the econometric

evidence for this relationship and analyzes the underlying political economy that explains the relationship between inequality and adherence to the gold standard. Four detailed case studies of the relationship are provided: Australia, New Zealand, France and the U.S., four cases that illustrate the general proposition.

Chapter 2, "The Short-Run and Long-Run Effects of Inequality on Inflation in the United States" studies effects of inequality on inflation in the in the United States. It uses a wide range of inequality measures. The cointegration test provides evidence that there exists a long-run relationship between inequality and inflation in the United States. The Vector Error Correction Model (VECM) and impulse response function indicate that inequality has a negative effect on inflation in the long run, however, the short-run effect is not significant.

Chapter 3, "The Short-Run and Long-Run Effects of Inequality on Inflation - Panel Data Analysis" expands the dataset to several panels and studies the effects of inequality on inflation. It uses several panels of international data covering different periods and monetary regimes. The Autoregressive Distributed Lag (ARDL) model shows a negative long-run relationship between inequality and inflation, and the Arellano-Bond GMM estimator reveals a negative causal effect running from inequality to inflation in the short run. The paper lays out the econometric evidence for these relationships and analyzes the underlying political economy that explains the relationships between inequality and inflation.

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Dedication

To my parents, Aili and Bin, and girlfriend, Lu

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Chapter 1

Inequality and the Interwar Gold Standard

1.1 Introduction

Although it had many critics, supporters of the classical gold standard (1879-1914) could point to stable prices, stable exchange rates, and generally rising incomes to make their case. During WWI, however, most countries (the U.S. was the major exception) left the gold standard because the seigniorage from printing money provided desperately needed resources. Beginning in 1925, many countries started returning to the gold standard. By 1928, most countries were on the gold standard; But during the Great Depression most again abandoned gold. All countries, however, did not abandon the gold standard simultaneously. Britain left gold in 1931, and most sterling bloc countries followed Britain. However, other countries including the U.S., Belgium, France, Netherlands and Switzerland left gold after 1933 and some left as late as 1936.

There is a vast literature which shows that leaving the gold standard was an important stepping-stone on the road to recovery from the Great Depression. Eichengreen and Sachs (1985) analyze 10 European countries and find that changes in exchange rate and industrial production were closely related. By 1935, countries with greater depreciation had higher industrial production relative to their 1929 level. Temin (1991) argues that monetary contraction inherent in the design of the gold standard prevented adjustment and recovery. Romer (1992) believes that the monetary expansion in the United States after 1933 was the real engine for recovery of the United States. Bernanke (1995) does a

cross-sectional analysis in as many as 26 countries which shows that monetary contraction contributed greatly to the severity of the Depression in all countries, and countries that left the gold standard earlier were able to follow expansionary monetary policies, contributing to a more rapid recovery. Bordo and Kydland (1995) provide a theoretical rationale for these results. They argue that when a country was in a banking crisis, it was possible to leave gold to increase the money supply and act as a lender of last resort. Adhering to the gold standard was a contingent and time-inconsistent rule. When a country was in an emergency, it would suspend its adherence to the gold standard.

Since leaving the gold standard promoted recovery, why did so many countries delay leaving for so long? Previous research has identified many variables that were correlated with length of time countries maintained their commitment to gold. Countries which suffered hyperinflation after World War I were more reluctant to adopt expansionary monetary policies. Also, unemployment was negatively related to the survival of the gold standard. The rise of unemployment pressured authorities who had been defending the gold standard to abandon their support for it (Eichengreen and Temin, 2000). Meissner (2005) shows that countries with higher real GDP per capita were more likely to remain on the gold standard. He argues that more developed countries experienced less domestic pressure to leave gold. Wolf (2008) shows that trade network and creditor status were two essential factors for remaining on the gold standard. When a country's main trade partner was still on gold, it was more likely to stay on gold. Creditor countries were reluctant to leave gold to avoid debt devaluation. Democratic countries were more likely to abandon gold than autocratic countries (Simmons, 1997; Wandschneider, 2008). There

was a large number of countries leaving gold following Britain in 1931, so sterling bloc membership affected the duration of remaining on gold. According to Simmons (1996) and Broz (2002), countries with independent central banks tended to stay on gold longer.

With so many proximate determinants of the time it took to abandon gold, one is naturally led to ask what the underlying determinants were. One of the most important factors, I show below, was inequality. Inequality influenced most of the economic and political factors identified in the literature because it determined the political power of economic groups. To some extent, success in the political arena, and hence the direction of economic policy, was the result of bargaining and compromising between rich and poor, and their relative bargaining powers depended on their access to resources.

To my best knowledge, this is the first study that looks at the correlation between inequality and the adherence to the gold standard in the Great Depression. The results show that greater inequality, other things equal, meant more time on gold. The mechanism was that the economic and political elite were worried about that leaving gold would be associated with an increase in government spending and redistribution that would be funded by higher top marginal income tax rates. As a result, they were the main resistance to abandoning the gold standard. Greater inequality meant more power for the wealthy, and hence more resistance to leaving gold.

The remainder of the chapter is organized as follows. First, some preliminary evidence is provided. Second, a survival analysis is conducted, which shows that with other variables controlled, inequality significantly reduced the probability of exiting the gold standard during the Great Depression. Next, I explain why the affluent favored the gold standard and discuss the mechanism through which the affluent affected adherence

to the gold standard through their political activities. Then, I provide more detailed case studies of the relationship between inequality and resistance to leaving gold in Australia, New Zealand, France and the U.S., four cases that illustrate the general proposition. Finally, the main conclusions are summarized.

1.2 Preliminary Evidence

The inequality data for interwar period is very limited. This chapter utilizes the top 1 percent income share from the World Inequality Database (WID) as a measure of inequality. The database was constructed by Thomas Piketty, Emmanuel Saez and other outstanding economists and include measures of both income inequality and wealth inequality, but the wealth inequality (top 1 percent wealth share) only covers very few countries, thus I use top 1 percent income share as the measure of inequality.

The top 1 percent income share in the year 1929 was collected for 13 countries.[1] Table 1.1 shows their 1929's top 1 percent income share and the time they left gold. The countries are ordered by inequality from Australia with the lowest level in 1929 to the United States with the highest. The correlation is evident. We can see that countries with relatively low income inequality such as Australia, New Zealand and Germany remained on gold for only a short time after the Depression took hold. Countries with moderate inequality including the Scandinavian countries and Canada remained on gold for a moderate time, and they left the gold standard in September/October of 1931. Countries with high inequality adhered to gold for the longest time. South Africa left gold in

[1] The sample was limited to these 13 countries because of data availability.

December 1932, the U.S. left gold in 1933 and France and Netherlands remained on gold until October 1936.[2]

Table 1.1: Inequality and Time Leaving Gold

Country	1929 Top 1% Income Share	Time Leaving Gold
Australia	10.67	12/1929
New Zealand	10.99	04/1930
Germany	11.1	07/1931
Switzerland	11.14	09/1936
Norway	12.57	09/1931
Denmark	13.29	09/1931
Finland	13.57	10/1931
Sweden	13.72	09/1931
Canada	15.64	09/1931
Netherlands	18.09	10/1936
France	19.28	10/1936
South Africa	20.15	12/1932
USA	22.35	04/1933

1.3 Discrete Time Hazard Model with Monthly Data

To see if inequality affected adherence to the interwar gold standard, the most straightforward way is to find the effect of inequality on the probability of exiting gold for each country. In this section, I conduct a survival analysis using two discrete time hazard models to test the argument that countries with higher inequality were more likely to stay on the gold standard longer. The survival analysis estimates the probability that a country exits the gold standard in a given month provided that the country has survived to that point. It is better than a probit model in this case because it takes account of the recent history leading up to an event.

[2] The only exception in my sample is Switzerland, which had moderate inequality but left gold late. The reason is not clear, and further research is needed.

1.3.1 Data

Monthly data was collected for 13 countries from June 1928 to the month when they left the interwar gold standard. The starting date of June 1928 was chosen because all countries had returned to the interwar gold standard by that date. Data was collected through the month in which a country left the gold standard, because in the hazard model, a country drops out of the sample when it leaves gold. Countries in the sample included Australia, Canada, Denmark, Finland, France, Germany, Norway, Netherlands, New Zealand, Sweden, South Africa, United Kingdom and the United States. These 13 countries are the only ones with sufficient inequality data. The dependent variable is a dummy taking the value zero in a month if the country was on gold and one in the month when it left gold.

For explanatory variables, first, the number of months a country had been on the gold standard (months on gold) was an important factor for the probability of leaving gold. The longer a country was on gold, the more pressure to devalue it would be exposed to. Second, for inequality, since the relative inequality of countries in the sample were stable over the Depression, I divide the countries into three groups based on their levels of inequality during the interwar period: low, medium and high inequality. In the model below, I include the interaction term of time and inequality. Dividing the countries into three groups could show the marginal effect of t on the probability of leaving gold for different inequality levels. In the 1920s the measures of income inequality were very limited. The share of income going to the top 1 percent was the only one that could cover the maximum number of countries. The top one percent income share used in the sample

was in the 1920s, right before the Great Depression.[3] Since it was not affected by the bank crashes and crises during the Great Depression, it could be regarded as predetermined, and the reverse causality was avoided.

Democracy is included because countries with higher democracy tend to have more flexible monetary policies when suffering from crises (Simmons, 1997; Wandschneider, 2008). The data I use is the Polity2 score in *Polity IV Project*, which ranged from -10 (strongly autocratic) to 10 (strongly democratic). Also, I control the *Creditor Status* and *Sterling Bloc Status* of each country. Creditor countries were reluctant to exit the gold standard to avoid debt devaluation and sterling bloc countries were more likely to follow the lead of the United Kingdom which left gold in 1931 (Wolf, 2008). France, Netherlands, United Kingdom and the United States were categorized as creditors, and all other countries as debtors. Sterling bloc countries in the sample include, of course, the U.K., Australia and New Zealand. I also include Denmark, Finland, Norway and Sweden in the "Sterling bloc" category because of their close economic ties to the U.K. Finally, I control the trade network. Countries adopted and exited the gold standard following their main trade partners (Meissner, 2005). When a country's main trade partner was still on gold, it was less likely to exit the gold standard. The *TradeGold* variable is a dummy taking the value one in a month if its main trade partner was still on gold and zero otherwise. I am not able to include other control variables due to data limitations. Definitions of all the variables are in Table 1.2. The sources and explanations for all of the data are in the Appendix.

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[3] The 1920s' data for the United Kingdom is not available, I compare 1919's data of the UK with other countries and make it into the high inequality group. One justification for this approach is that the relative inequality levels for the countries have a high degree of persistence.

Table 1.2: Definition of Symbols

i	Country i
t	Month t
Y_{it}	Whether the country was on gold
z_{it}	Including all explanatory variables for country i at month t
$Democracy_{it}$	Level of democracy
$CreditorStatus_{it}$	Creditor or not
$SterlingBlocStatus_{it}$	Sterling bloc member or not
$TradeGold_{it}$	The main trade partner was on gold or not
D_{2i}	Medium inequality or not
D_{3i}	High inequality or not
c	Constant term
αs	Coefficients of D_s
βs	Coefficients of control variables
p_{it}	Probability of exiting the gold standard (hazard rate)
S_{it}	Probability of remaining on the gold standard (survival rate)
L_i	Likelihood of each country
L	Likelihood
T_i	Total number of months being on the gold standard

1.3.2 Model

To test the hypothesis that countries with higher income inequality were more likely to leave gold later, we can test the effect of inequality on the probability of exiting the gold standard for each country at a specific time t. Two discrete time hazard models were used: the Logistic hazard model and the Complementary log-log ('cloglog') hazard model. The Logistic hazard model is equivalent to a proportional odds model (Thompson, 1977), and cloglog model is equivalent to a proportional hazards model in discrete time (Cox, 1972; Fahrmeir and Tutz, 2013).

Let p_{it} be the probability (hazard rate) of exiting the gold standard for country i at month t, provided the country remained on gold to month t.

$$p_{it} = Prob(Y_{it} = 1|z_{it}) \tag{1.1}$$

$$z_{it} = c + (\alpha_1 + \alpha_2 D_{2i} + \alpha_3 D_{3i})t + \beta_1 Democracy_{it} + \beta_2 CreditorStatus_{it} + \beta_3 SterlingBlocStatus_{it} + \beta_4 TradeGold_{it} \tag{1.2}$$

where z_{it} represents a country i at month t. The dependent variable equals zero in any month when a country was on the gold standard and equals one in the month when it left gold. After a country has exited the gold standard, it drops out of the sample. The probability of exiting the gold standard can be explained by the variables t, D_2, D_3, $Democracy$, $CreditorStatus$, $SterlingBlocStatus$ and $TradeGold$.

The income inequality is fixed for each country and is indicated by variables D_{2i} and D_{3i}.

$$D_{2i} = \begin{cases} 1 & if\ the\ country\ i\ is\ in\ medium\ inequality\ group, \\ 0 & otherwise \end{cases} \tag{1.3}$$

$$D_{3i} = \begin{cases} 1 & if\ the\ country\ i\ is\ in\ high\ inequality\ group, \\ 0 & otherwise \end{cases} \tag{1.4}$$

For low inequality group, $D_{2i} = D_{3i} = 0$; for medium inequality group, $D_{2i} = 1, D_{3i} = 0$; For high inequality group, $D_{2i} = 0, D_{3i} = 1$. The four control variables include: $Democracy$, $CreditorStatus$, $SterlingBlocStatus$ and $TradeGold$. The constant term c, coefficients αs and βs are to be estimated.

For the logistic discrete time hazard function:

$$p_{it} = [1 + \exp(-z_{it})]^{-1} \tag{1.5}$$

For the cloglog discrete time hazard function:

$$p_{it} = 1 - \exp\left[-\exp(z_{it})\right] \tag{1.6}$$

The discrete time survival function:

$$S_{it} = [1 - p_{i1}][1 - p_{i2}][1 - p_{i3}] \cdots [1 - p_{it}] \tag{1.7}$$

I then use the Maximum Likelihood Estimation method to calculate the coefficients. The likelihood function takes the form:

$$L = \prod L_i \tag{1.8}$$

where L_i is the likelihood of each country. Let T_i be the total number of months of country i being on the gold standard. If country i is at month $t < T_i$, it is a censored spell (not completed), and the likelihood contribution is:

$$L_{it} = \prod_{k=1}^{t} (1 - p_{ik}) \tag{1.9}$$

If country i is at the month $t = T_i$, it is a completed spell, then the likelihood contribution is:

$$L_{it} = f_i(t) = p_{it}S_i(t-1) = p_{it}\prod_{k=1}^{t-1}(1-p_{ik}) \tag{1.10}$$

Thus, country i's likelihood contribution is:

$$L_i = [\prod_{t=1}^{T_i-1}\prod_{k=1}^{t}(1-p_{ik})][\,p_{iT_i}\prod_{k=1}^{T_i-1}(1-p_{ik})] \tag{1.11}$$

The definitions of symbols are listed in Table 1.2.

The coefficients αs and βs cannot be interpreted as the direct marginal effects on the dependent variable, but they do reflect the sign and significance of the marginal effects. As discussed above, the longer a country remained on the gold standard, the more likely it would leave the gold because of the pressure to depreciate to save the economy. Therefore, the probability of exiting the gold standard is increasing in t.

However, the marginal effect of t on the probability of leaving gold could be different for different inequality groups. From equation (1.2) with other variables controlled, for low inequality countries (D_{2i} = 0 and D_{3i} = 0) a one unit increase in t causes z to change by α_1; for medium inequality countries (D_{2i} = 1 and D_{3i} = 0) a one unit increase in t causes z to change by $\alpha_1 + \alpha_2$; for high inequality countries (D_{2i} = 0 and D_{3i} = 1) a one unit increase in t causes z to change by $\alpha_1 + \alpha_3$. If the hypothesis is correct, the coefficient α_2 and α_3 would be negative, which indicates countries with high inequality were less likely to exit the gold standard.

1.3.3 Results

Tables 1.3 and 1.4 show the results of the two models. The results of the two discrete hazard models are similar. After controlling other variables, the coefficient of $D_3 \times t$ is negative and significant, which is consistent with the hypothesis: other things equal, countries with high inequality were less likely to exit the gold standard than countries with low inequality. The coefficient of $D_2 \times t$ is not significant at conventional significance levels, but the sign is consistent with the hypothesis: other things equal, countries with medium inequality were less likely to exit the gold standard than countries with low inequality. For control variables, the $TradeGold$ is significant, which indicates when a country's main trade partner was still on gold it was more likely to stay on the gold standard. $Democracy$, $CreditorStatus$, $SterlingBlocStatus$ are not significant, but the signs are as expected. Democratic countries were more likely to leave gold. Countries who were creditors remained on gold longer to avoid debt devaluation. Sterling Bloc countries tended to follow the United Kingdom to leave the gold standard early.

Table 1.3: Logistic Hazard Model Results

Variable	Coefficient	Std. Err.	Robust Std.Err
t	**0.140**	0.042	0.046
$D_2 \times t$	-0.038	0.027	0.025
$D_3 \times t$	**-0.096**	0.039	0.042
$Democracy$	0.068	0.185	0.235
$CreditorStatus$	-1.990	1.950	3.152
$SterlingBlocStatus$	0.384	1.067	1.744
$TradeGold$	**-2.264**	1.029	1.182
$Constant$	**-5.582**	1.770	1.774
Observations	636		

Note: Bold letters indicate significance at 5% or better. Dependent variable=1 in the month of exit, 0 otherwise.

Table 1.4: Complementary Log-Log Hazard Model Results

Variable	Coefficient	Std. Err.	Robust Std.Err
t	**0.137**	0.040	0.047
$D_2 \times t$	-0.036	0.024	0.021
$D_3 \times t$	**-0.092**	0.037	0.042
$Democracy$	0.072	0.163	0.196
$CreditorStatus$	-2.041	1.877	2.964
$SterlingBlocStatus$	0.281	1.028	1.659
$TradeGold$	**-2.162**	0.902	0.939
$Constant$	**-5.627**	1.695	1.697
Observations	636		

Note: Bold letters indicate significance at 5% or better. Dependent variable=1 in the month of exit, 0 otherwise.

Table 1.5 shows the average marginal effect of each variable on the probability of leaving gold.[4] The results of the two models are similar. In the Logistic Model, for example, the marginal effect of t is 0.0024, which means for low inequality group, one additional month of staying on gold increases the probability of leaving gold by 0.24 percent on average. In contrast, for high inequality countries, one additional month of remaining on the gold increases the probability of abandoning the gold standard by only 0.07 percent.[5] The marginal effect of $TradeGold$ is -0.0392, which means that with other variables controlled, if a country's main trade partner left gold ($TradeGold$ changes from one to zero), the probability of the country exiting the gold standard would increase by 3.92 percent on average.

[4] The marginal effects are calculated for each observation and then averaged.

[5] $0.0024 - 0.0017 = 0.0007$.

Table 1.5: The Average Marginal Effects on Dependent Variable

Variable	Logistic Hazard Model	Cloglog Hazard Model
t	**0.0024** (0.006)	**0.0025** (0.006)
$D_2 \times t$	-0.0007 (0.173)	-0.0007 (0.146)
$D_3 \times t$	**-0.0017** (0.025)	**-0.0017** (0.024)
$Democracy$	0.0012 (0.713)	0.0013 (0.657)
$CreditorStatus$	-0.0345 (0.318)	-0.0376 (0.289)
$SterlingBlocStatus$	0.0067 (0.719)	0.0052 (0.785)
$TradeGold$	**-0.0392** (0.033)	**-0.0399** (0.019)

Note: p-values are in parentheses, and bold letters indicate significance at 5% or better.

1.4 Explanations

From the empirical analysis, we have learned that inequality was an important factor affecting the time each country remained on the gold standard during the Depression. Higher inequality, which means that the affluent have greater power and influence, led to remaining on gold longer. To complete the argument, there are two important questions to answer. First, why did the affluent oppose leaving the gold standard? Second, why did higher income inequality mean more power and influence for the wealthy and hence more effective resistance to leaving gold? Third, how was the economic elite defeated?

1.4.1 Why did the Affluent Oppose Leaving the Gold Standard?

Although the affluent, or at least a large segment of the affluent, were concerned that abandoning gold would produce inflation that would reduce their wealth, there was something, perhaps of even more concern, on the minds of the affluent. The gold standard was an important component of the nineteenth-century macro-economic orthodoxy that included balancing government spending and taxes at a small share of national income as well as maintaining stable prices and fixed exchange rates through the

gold standard. If the gold standard was wrong and could be abandoned, then the case for continued allegiance to the traditional fiscal orthodoxy was weakened as well.

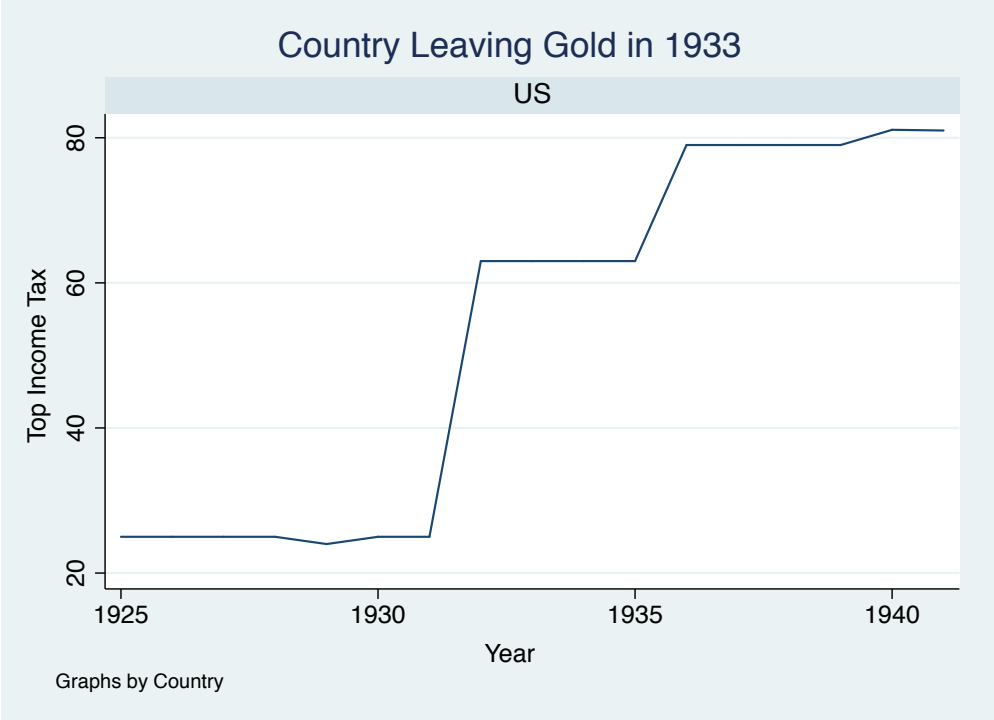
Abandoning the nineteenth-century macro-economic orthodoxy was by no mean, a theoretical possibility. During the First World War the industrial countries had abandoned the gold standard and printed money to pay for the increase in government spending needed to finance the war; but they also raised taxes and marginal tax rates. The top marginal income tax rates jumped aggressively during the First World War for industrial countries. Now many politicians and economists, including importantly John Maynard Keynes, were pushing for a reprise of World War I macro-economic policies to cure the Depression.

And that is exactly what happened. Welfare and social spending increased dramatically in the 1930s. In the U.S. for example, the New Deal included a series of social programs. The Federal Emergency Relief Administration (FERA) was created in May 1933. As a granting agency to the states, it provided local governments with assistance to relieve unemployment. More than $3 billion was granted to the states through FERA from 1933 to 1935. The Committee on Economic Security (CES) was created by Roosevelt in June 1934 and the Social Security Act was passed by Congress in August 1935 aimed at helping the elderly, the unemployed and people in need. In industrial countries as a whole the average share of subsides and transfers was about 10 percent of public expenditure in the late 19th century, but it increased to almost 20 percent by the end of the Great Depression (Tanzi and Schuknecht, 1995).

Top marginal income tax rates were kept high following World War I until the mid-1920s, when most advanced countries had recovered from the war. At that time, most

countries returned to the old monetary and fiscal orthodoxy. They returned to the gold standard and top marginal income tax rates were reduced and then stayed relatively stable or were gradually reduced further until the first years of the Great Depression. As the Depression intensified, the pressure from the working class for expansionary policies and more generous transfers to reduce unemployment and poverty increased. Resistance from the affluent could lengthen the life of the old orthodoxy. But eventually that resistance was overcome. And when a country left the gold standard, it raised the top marginal tax rate and increase the social spending. Indeed, almost every advanced country increased their top marginal income taxes at approximately the same time that they left gold. Figure 1.1 shows the top marginal income tax rates for the major advanced countries from 1925 to 1941. Table 1.6 shows that in case after case the time when top income tax rates were increased was also the time when a country left gold. As shown in Figure 1.1, for the two countries leaving gold standard before 1931, Australia abandoned gold in December 1929 and raised the top marginal income tax rate in 1930; New Zealand abandoned gold in April 1930 and raised the top marginal income tax rate in 1931. There was a large number of countries leaving gold following Britain in 1931. For the six countries that left the gold standard in 1931, Britain started to raise top marginal income tax rate in 1929 and the remaining five countries raised the top marginal income rates at around 1931.

Figure 1.1: Top Marginal Income Tax Rates 1925-1941


Country Leaving Gold in 1933
US
Top Income Tax
20
40
60
80
1925
1930
1935
1940
Year
Graphs by Country

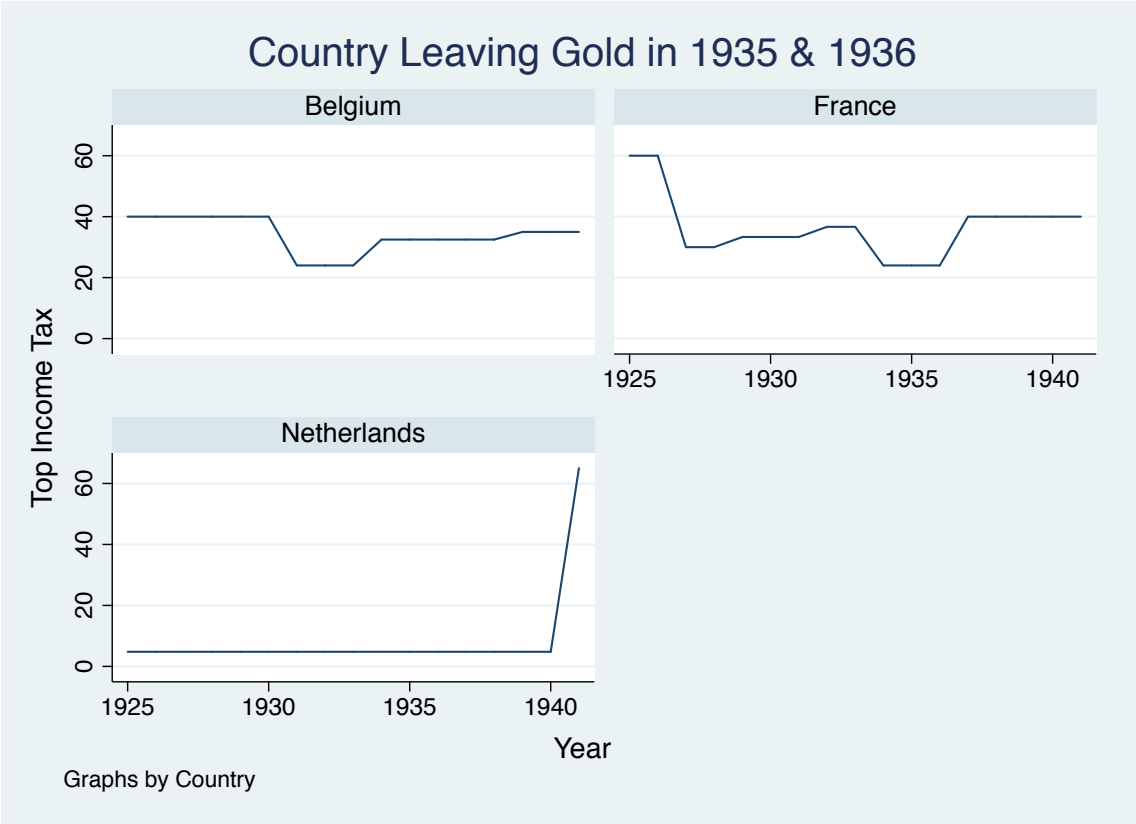

Country Leaving Gold in 1935 & 1936
Belgium
France
Netherlands
Top Income Tax
0
20
40
60
1925
1930
1935
1940
Year
Graphs by Country

Table 1.6: Time of Leaving Gold vs. Time of Increasing Top Income Tax Rate

Country	Time Leaving Gold	Time Increasing Tax	Change in Top Tax Rates
Australia	12/1929	1929-30	27%-30.35%
New Zealand	4/1930	1930-31	22.5%-31.75%
United Kingdom	9/1931	1928-29	50%-57.5%
Denmark	9/1931	1929-30	17.48%-22.68%
Austria	9/1931	1931-32	45%-53.45%
Canada	9/1931	1930-31	40%-52.5%
Sweden	9/1931	1931-32	20.3%-24.3%
Norway	9/1931	1932-33	50%-60%
United States	4/1933	1931-32	25%-63%
Belgium	3/1935	1933-34	24%-32.5%
France	10/1936	1936-37	24%-40%
Netherlands	10/1936	1940-41	4.8%-65%

The United States left the gold standard in April 1933. The Revenue Act of 1932 raised top marginal income tax rate from 25 percent to 63 percent. The Revenue Act of 1935 provided graduated taxes on corporation incomes and intercorporate dividends and raised estate and gift taxes, which was earmarked for national debt reduction. It was regarded as a “soak the rich” or “share the wealth” program and received strong opposition from the wealthy and conservatives (Blakey and Blakey, 1935).

Countries that left the gold standard later raised the top income taxes later. Belgium left the gold standard in March 1935 and raised the top marginal income tax rate in 1934. France left the gold in October 1936 and raised top marginal income tax rate in 1937. Netherlands left the gold standard in October 1936, and in 1937, a Dutch committee discussed a proposal of raising the top marginal income tax rate, however, the Germans invaded Netherlands and the proposal was suspended. In 1941, the Germans adopted the plan proposed by the committee and raised the top marginal income tax rate from 4.8 percent to 65 percent.

1.4.2 Why did Higher Income Inequality Mean More Power and Influence for the Wealthy and Hence More Effective Resistance to Leaving Gold?

Economic inequality and political inequality are closely related. Considerable empirical evidence shows that greater inequality means that the wealthy have more impact on political outcomes, even in countries enjoying well-established democracies. Political engagement requires resources. According to Benabou (2000), in the United States and Western Europe, the propensity for political participation is highly correlated with income and education. The most affluent citizens have more resources to contribute to political campaigns, and more generally, to support their favorite candidates. Solt (2008) studies 23 advanced countries finding that higher levels of economic inequality depress the political interest, political discussion and electoral participation among poorer citizens. Domhoff (2014) points out that wealthy people work through lobbyists, foundations and think-tanks to dominate the key issues of the public policy.

Higher economic inequality is clearly associated with less redistributive spending. When the wealthy had more power and influence on the political arena, they became the biggest obstacle to redistributive policies. A striking piece of supporting evidence is provided by Ramcharan (2010) who uses county-level data in the U.S. from 1890-1930 to study the effect of inequality on redistribution. He finds that there was a strong negative relationship between inequality and redistribution. While these findings are based on the American experience, it seems plausible that similar forces were at work in most countries. For example, Rodriguez (2004) also finds a negative correlation between inequality and redistribution using panel data for 20 advanced countries.

Leaving the gold standard means the abandonment the old macro-economic orthodoxy. It leads to greater government spending and higher top marginal income tax, which was regarded as a "soak the rich" policy and opposed by the economic elite. Overall, the evidence suggests that in the context of the Great Depression countries with high levels of inequality would be slow to abandon policies that were favored by the wealthy or at least by a large segment of the wealthy.

1.4.3 How was the Economic Elite Defeated?

The Great Depression was a shock, perhaps a greater shock, to the income share of the top 1 percent. The decline in income share reduced the power of the affluent, which reduced their influence on monetary policies and caused many people within the wealthy elite to rethink their commitment to price-level stability. Besides the affluent, the defeat of the supporters of the gold standard also turned on the role of the middle class. Before the Great Depression, they were relatively neutral or leaned toward the gold standard because while some, such as homeowners with mortgages to pay, stood to benefit from inflation, others who were net monetary creditors stood to lose. However, as the depression intensified, middle-class unemployment rose and the middle class suffered large income and wealth losses.

In the U.S., the unemployment rate increased from 3.9 percent in 1929 to 26.4 percent in 1933. In France, the depression was relatively mild, the unemployment rate was below 5 percent at the peak (Beaudry and Portier, 2002). In the United Kingdom, by the end of 1930, the unemployment rate reached 20 percent. Bank failures in some countries, moreover, had wiped out the savings of many members of the middle class. Inflation was

not a threat to deposits that no longer existed. Members of the middle class, moreover, were more likely to borrow to preserve their consumption. So many members of the middle class hoped that monetary expansion permitted by abandoning gold would help to restore full employment and relieve their financial burdens. Thus, as the Great Depression deepened, the political position of the middle class shifted to the left.

Peter Lindert (2004, 187) puts the point clearly:

> "There are good reasons to believe that redistributive taxing and spending should depend in part on whether median, typical, or middle-income voters feel affinity with those lower, or with those higher, in the income ranks. The more a middle-income voter looks at the likely recipients of public aid and says 'that could be me', the greater that voter's willingness to vote for taxes to fund such aid."

I would simply add abandoning gold in the 1930s to Lindert's list of policies. Finally, as the support for devaluation and inflation rose, the economic elite compromised with the middle and working classes and agreed to leave the gold standard.

1.5 Case Studies: Australia, New Zealand, France and the United States

In this section, I discuss in more detail the political debate about leaving the gold standard in four countries, showing how each country abandoned the gold standard and devalued. Spaces does not permit me, of course, to provide narrative histories of all the countries in my sample, but the narrative histories of these four, which include countries with different levels of inequality, help to explain the connection between inequality and time on gold revealed by the econometric evidence. The four countries were Australia, New Zealand, France and the United States. Australia and New Zealand, with relatively equal income distribution, met fewer obstacles and became pioneers of leaving gold.

France and the United States, with far less equality, experienced more effective political resistance from the economic elite and left gold later.

Australia, the first nation to leave the gold standard, was a small open economy that relied heavily on international investment and trade, especially on exports of two commodities, wheat and wool. The Great Depression was transmitted to Australia in 1929 through a decrease in international commodity prices and a decline in foreign investment. Export prices fell rapidly but import prices declined moderately, causing a huge current account deficit.

As early as October 1929, the government started to realize that it was hard to maintain its oversea exchange reserves. Because of a decline in exports and London loans, the demand for sterling had pushed an increase in sterling price. The exchange premium increased to a rate slightly above the gold export point, which put a lot of pressure on the Commonwealth Bank to devalue.9 Indeed, Eichengreen (1985) concluded that Australia's devaluation might be characterized as involuntary rather than deliberate.

In mid-December 1929, a Bill proposed by the Commonwealth Bank and revised by the Treasurer became law. The main provisions enabled the Bank to require gold to be exchanged for Australian notes and gave the Treasurer the authority to prohibit gold exports. Afterward, the trading banks were allowed to retain a proportion of their gold to dispose of and the gold could not be exported without restrictions. All of this meant that Australia became the first nation in our sample to leave the gold standard. The exchange premium continued to increase until the first devaluation occurred in March 1930 and relieved the balance of payments crisis.

With relatively equal income distribution (the most equal in my sample), the devaluation did not meet much resistance from the economic elite. The biggest opponent of the devaluation was the Commonwealth Bank Board, but by March 1930 they had come to accept the idea that a temporary devaluation was justified. Under the pressure of wheat growers, pastoral farmers and other export industries the Australian pound was devalued further in January 1931. Schedvin (1970, 156) argued that its devaluation could be regarded as a market reaction to the shortage of sterling exchange.

Similar to Australia, New Zealand was a small open economy with less than two million population and also suffered from falling commodity prices. As opposed to Australia, New Zealand's imports fell, thus its balance of payments pressure was milder than Australia's. Many farmers had taken on large mortgages on land after World War I when land was expensive and they were under a heavy burden to repay these loans. The depression started in agriculture and was transmitted to most other industries. The only beneficiaries were creditors or debt collectors (Singleton, 2003).

The two major parties, the United and the Reform, both supported the gold standard. The only advocate of devaluation was the third party, Labor. The left-wing Labor Party believed that the depression was caused by the instability of the international monetary system and they campaigned for expansionary (both fiscal and monetary) policies to reverse the deflation and stimulate the economy (Sinclair, 1976, 90-98). Abandoning the orthodox economic policy and devaluation was regarded as a means of redistribution from the wealthy to farmers who suffered most from the depression.

With relative less income concentration (the second most equal in my sample), devaluation in New Zealand did not encounter effective resistance from the economic

elite. Starting from April 1930 to early 1931, the United-led government despite its earlier commitment to gold devalued the New Zealand pound against sterling by about 10 percent, which indicated the departure from the gold standard. The banks hoped that the devaluation would be temporary and the parity would be restored when the depression was relieved. However, support for a further devaluation gathered steam in 1932. Promoted by Gordon Coates, the leading advocate of devaluation in the cabinet, the banks complied and conducted a further devaluation in 1933. As a result, New Zealand became one of the countries that got out of the trough very fast.

In France, by 1935, the economy was under terrible pressure from deflation. Domestic demand had fallen dramatically. The main trade partners of France all abandoned the gold standard, and the devaluation brought competitive advantages to those countries. The gold reserve fell by 11 percent in June 1935, and the Prime Minister Pierre-Étienne Flandin, who aimed at economic recovery, was forced to decide between reflation and recovery or deflation and convertibility (Eichengreen, 1992, 369). He finally chose the latter because of the resistance from the Bank of France. The famous "200 families", who were the largest 200 shareholders, had the right to vote in the Bank's annual meeting; and they were able to influence the central bank's cooperation with the government's policy. The "200 families" became one of the main targets of attacks from left parties in the 1936 election (Mouré, 2002, 123).

In the 1936 election, the Radical party, which represented the middle classes, cooperated with other parties on the left. After intense negotiations, Radical, Socialists and Communists formed a new party, the Popular Front. The Popular Front won the election; and Leon Blum, the head of Popular Front, took office in 1936. Blum weakened

the rights of the "200 families" and introduced a series of reforms similar to Roosevelt's New Deal (Eichengreen, 1992, 376). Finally, with the pressure of gold losses and broad anticipation of devaluation, France abandoned the gold standard in September 1936.

The Great Depression also took a terrible toll on the United States. Many countries had followed Britain in leaving gold in 1931, President Herbert Hoover–a Republican whose party represented, to some extent, the affluent, however, insisted on staying on gold. Hoover then lost the presidential election to Franklin Roosevelt. During the break between the election of Roosevelt and when he took office, Hoover tried to get Roosevelt to promise that he would not abandon the gold standard. But Roosevelt refused. After Roosevelt took office, Hoover criticized Roosevelt's decision to leave the gold standard:

> "Had Mr. Roosevelt acceded to my strong recommendation, the Economic Conference would have been held much earlier, and had he adhered to his own promises and to my urging we never would have gone off the gold standard. The Conference would have been entered upon with the United States as a member of the Gold Bloc and able to force the other countries on the gold standard, with the corresponding rise in prices from a sound and enduring foundation."
> (Letter from Herbert Hoover to Henry L. Stoddard, a New York journalist and publisher, Criticizing Roosevelt and the New Deal, 7 August 1933)

6. Conclusion

Adherence to the interwar gold standard, as many prominent economic historians have argued, was a major obstacle to recovery from the Great Depression. Some countries left the gold standard soon after Britain in 1931 and then began to recover, however, others including the United States, Belgium, France and Netherlands left gold after 1933 and suffered more as a result. What factors affected adherence to the interwar gold standard? The existing literature includes many factors, what might be thought of as proximate determinants: democracy,

creditor status, trade network, and sterling bloc membership. Here I suggest another and perhaps more fundamental factor: inequality. In the empirical part of the paper, I show that after controlling for other variables previously identified in the literature, I find that inequality was a very significant and important factor affecting adherence to the gold standard.

An examination of the historical circumstances surrounding the abandonment of the gold standard in several countries suggests a straightforward explanation for these results. The affluent were worried about that leaving gold would be associated with an increase in government spending and redistribution that would be funded by higher top marginal income tax rates. As a result, they were the main resistance to abandoning the gold standard. The affluent used their resources to influence public policy through lobbyists, sympathetic journalists, politicians, academics, and so on. As the Depression intensified, the enormous losses experienced by the wealthy made some members of the affluent rethink the gold standard and the tradeoff between economic recovery and the real value of debt fixed in nominal terms. Moreover, the middle class shifted to the left and opposed the gold standard, just as they supported other left policies such as higher taxes on the wealthy, increased public works spending, and so on. As a result, all countries eventually abandoned the gold standard.

The main contribution of this chapter is to provide evidence for a fundamental factor that has been somewhat neglected in previous studies of the abandonment of the gold standard during the Great Depression. I develop an explanation for this

relationship, but further research is needed to fully delineate the mechanism that explains the relationship between inequality and adherence to gold.

Appendix

Definitions of the Variables

Gold Standard

Dummy variable, taking the value of zero in a given year if the country was on gold and one in the year when it left gold. Data are taken from Eichengreen, *Golden Fetters*; Bernanke and James, "Gold Standard,"; and Bordo, Helbling and James, "Swiss Exchange,"

Democracy

Taken from Polity2 score in *Polity IV Project*. The Polity2 score was the subtraction of autocracy score from democracy score with adjustments for regime transitions. It ranges from -10 (strongly autocratic) to 10 (strongly democratic).

Inequality

Top 1 percent of income share, taken from *World Inequality Database*.

Sterling Bloc Membership

Sterling bloc membership includes countries with close ties to Britain and the majority of their reserves are British pounds. Data are taken from Ritschl and Wolf, "Endogeneity," and Eichengreen, *Golden Fetters*.

Top Income Tax Rate

Marginal income tax rate for people in the highest bracket. When a law was passed in the first half of the year, it is coded as applying for the entire year, otherwise, it was coded as taking effect in the subsequent year. Data are taken from Federica Genovese, Kenneth Scheve, and David Stasavage, *The Comparative Income Taxation Database*.

TradeGold

Dummy variable taking the value one in a month if its main trade partner was still on gold and zero otherwise. Data are taken from League of Nations, *The Network of World Trade*.

Creditor Status

Dummy variable indicating whether a country was a net creditor or debtor. Data are taken from Eichengreen, *Golden Fetters*; and Simmons, *Who Adjusts*.

Chapter 2

The Short-Run and Long-Run Effects of Inequality on Inflation in the United States

2.1 Introduction

The growth of inequality in the United States and other industrial nations since the 1980s has generated considerable and growing attention from the public, from politicians, and from economists, especially since the publication of Pikettys's (2014) *Capital in the Twentieth Century*. Growing inequality raises many questions for economists and there have been several studies about the effects of inequality on macroeconomic performance. For example, Barro (2000), Forbes (2000), Banerjee and Duflo (2003) study how growth rates of real income will be affected; Bordo and Meissner (2012) study whether growing inequality produces financial crises.

However, there is remarkably little study about the effects of increases or decreases in inequality on inflation. Doepke and Schneider (2006) compare the nominal assets and nominal liabilities of different groups in the U.S. and they find: "The main losers from inflation are rich, older households, the major bondholders in the economy. The main winners are young, middle-class households with fixed-rate mortgage debt." The higher income inequality is, the more the mean income exceeds the median income, as a result the affluent voter will become richer and the median voter will be more likely to be poor. Then macroeconomic policies might be affected by two forces.

First, the median voters want more redistribution and it causes intense political pressures for governments to raise the income of lower and middle-income groups. These pressures are likely to produce expansionary monetary and fiscal policies resulting in higher inflation. Beetsma and Van Der Ploeg (1996) argue that in an unequal democratic society, people elect political parties that represent the interests of poor. Once in power they levy inflation taxes in order erode real value of debt service and redistribute wealth from the rich to the poor.

Second, and operating in the opposite direction, since with rising inequality the affluent can muster a higher percentage of income and wealth, they can use those resources to advocate for price stability and lower inflation and influence macroeconomic policies. According to Benabou (2000) and Domhoff (2014), the wealthy, play an outsized role in the political arena for several reasons. The propensity for political participation is highly correlated with income and education. The most affluent citizens have more resources to contribute to political campaigns, and to buy influence with politicians and bureaucrats. They work through lobbyists, foundations and think-tanks to dominate the key issues of the public policy. The affluent tend to be more conservative on taxes, economic regulation, and social welfare, and more critical of expansionary monetary and fiscal policies (Page, Bartels and Seawright 2013).

Which force is dominant? Sachs (1990) finds that in Latin American, governments tend to use expansionary policies to reduce inequality and poverty, which leads to high inflation. Does this populist policy cycle apply to the United States? To my knowledge, this is the first study of the effect of the inequality on inflation in the United States. The remainder of the chapter is organized as follows. Section 2 describes the data. Section 3

applies a vector error correction model to study both the short-run and long-run effect of inequality on the United States. Section 4 summarizes the main conclusions.

2.2 Data

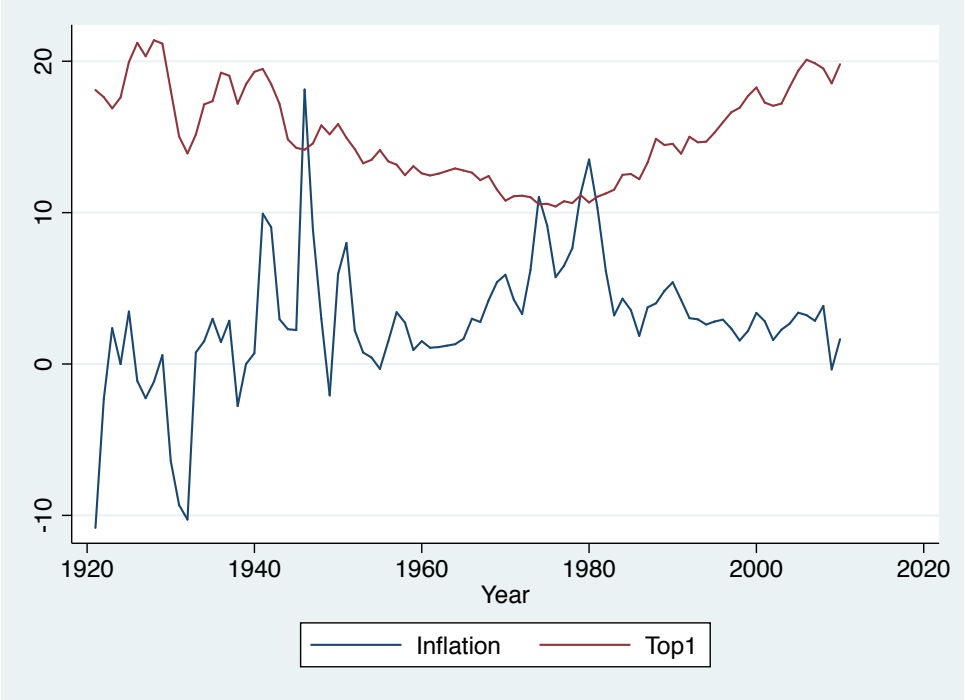
This chapter utilizes data from the World Inequality Database (WID), which was constructed by Thomas Piketty, Emmanuel Saez, Anthony Atkinson and other outstanding economists. There are four major measures of inequality available in the WID: top 1 percent income share (Top1), top 10 percent income share (Top10), top 1 percent wealth share (Top1w) and top 10 percent wealth share (Top10w). Top1 and Top10 measure the percentage of pre-tax national income going to the top 1 and top 10 percent population, indicating the level of income inequality. Similarly, Top1w and Top10w measure the net wealth owned by the top 1 and 10 percent population, indicating the level of wealth inequality.

The Gini coefficient is another widely used inequality measure. However, it is only available starting from 1960. To cover the longest period, this chapter uses these four inequality measures form the WID database. The database covers the period 1913-2010 for the U.S. But the fact that inflation rate during the World War I was unusually high, which has a large effect on the test results. For that reason, in the work reported here I start with 1921; that is after the return to peacetime economic conditions. The inflation rates are calculated based on the Consumer Price Index that is collected from the International Financial Statistics of the IMF, supplemented by the Global Financial Database.

2.3 Empirical Study

Let us first take a look at the long run trend of inequality and inflation. In Figure 2.1, we can see that the share of income going to the top 1 percent was generally decreasing in the United States from 1921 to 1980 and increasing thereafter. The inflation rate followed a reverse pattern; which is broadly consistent with the second view of the relationship between inequality and inflation: that rising inequality strengthens the hand of the affluent and produces more conservative monetary and fiscal policies.

Figure 2.1: U.S: 1921-2010



In the next section, a unit root test is conducted first to check the stationarity of the time series. It shows that the inequality measures and inflation are all integrated of order one, or in other words, I(1). A cointegration test shows there exists a long-run cointegrating relationship between inequality and inflation. A vector error correction

model and impulse response function are estimated to show the short-run and long-run effects of inequality on inflation.

2.3.1 Unit Root Test

The Augmented Dickey-Fuller (ADF) unit root test was conducted to examine the stationarity of five variables: inflation, Top1, Top10, Top1w and Top10w. Consider a simple AR(1) process:

$$y_t = \rho y_{t-1} + x_t'\delta + \varepsilon_t \tag{2.1}$$

where x_t are exogenous regressors which consist of constant or/and trend. If the absolute value of $|\rho| < 1$, y is a stationary series, otherwise, nonstationary series.

The ADF test assumes that the time series y follows an AR(p) process. After adding p lagged difference of y to the right-hand side of the equation and subtracting y_{t-1} from both sides of the equation:

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \cdots + \beta_p \Delta y_{t-p} + \varepsilon_t \tag{2.2}$$

where $\alpha = \rho - 1$. The null hypothesis is that the variable has a unit root, that is $\alpha = 0$. The alternative hypothesis is $\alpha < 0$. The optimal lag length was selected by the Schwarz Information Criterion and the results are shown in Table 2.1.

Table 2.1: ADF Unit Root Test for the US: 1921-2010

Variable	Level	First Difference
Inflation	0.1031	0.0000
Top1	0.6648	0.0000
Top10	0.6777	0.0000
Top1w	0.6831	0.0000
Top10w	0.4701	0.0007

The null hypothesis: the variable has a unit root
Exogenous: Constant
Lag Length: based on SIC
p-values are shown in the table

The results indicate that all variables are nonstationary in levels but stationary in first differences. Thus we can conclude that all variables are I(1), and we can test for a cointegrating relationship between the variables to see if they are linked to form an equilibrium in the long run. If they are cointegrated, the error correction model is applicable to determine the short-run and long-run relationship between the variables.

2.3.2 Cointegration Test

The Johansen Cointegration Test is used to examine the cointegrating relationship between inflation and inequality. The methodology was developed in Johansen (1991, 1995), and the setup is as follows. To test the cointegrating relationship of a k-vector I(1) variables Yt, consider a VAR of order p:

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + B x_t + \varepsilon_t \tag{2.3}$$

where x_t is a d-vector of deterministic variables and εt is a vector of innovations. We can rewrite the VAR as:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + B x_t + \varepsilon_t \tag{2.4}$$

where $\Pi = \sum_{i=1}^{p-1} A_i - I,\ \Gamma_i = -\sum_{j=i+1}^{p} A_j$. If the coefficient matrix $\prod$ has reduced rank $r < k$, then there exists $r * k$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is I(0). The number of cointegrating relations is r, and the columns of β are the cointegrating vectors. Johansen cointegration test is to estimate the matrix $\prod$ to see whether we can reject the restrictions implied by the reduced rank of $\prod$.

The results of the Johansen Cointegration Trace and Maximum Eigenvalue tests are shown in Table 2.2 and 2.3. If we can reject the hypothesis that there is no cointegrating

equation but fail to reject the hypothesis that there is at most one cointegrating equation, we can conclude that there exists cointegrating relationship between inequality and inflation. The tests results show that Top1, Top10, Top1w and Top10w are each cointegrated with inflation at the 5 percent significance level.

Table 2.2: Johansen Cointegration Test (Trace)

Variable	Hypothesized No. of CE	
	None	At most 1
Top1	0.0416	0.8493
Top10	0.0115	0.8773
Top1w	0.0038	0.8534
Top10w	0.0004	0.5812

Series: Inflation and the variable
Trend assumption: No deterministic trend (restricted constant)
p-values are in parentheses

Table 2.3: Johansen Cointegration Test (Maximum Eigenvalue)

Variable	Hypothesized No. of CE	
	None	At most 1
Top1	0.0415	0.8493
Top10	0.0030	0.8773
Top1w	0.0009	0.8534
Top10w	0.0001	0.5812

Series: Inflation and the variable
Trend assumption: No deterministic trend (restricted constant)
p-values are in parentheses

2.3.3 Vector Error Correction Model

Since the variables are cointegrated, we can apply the Vector Error Correction Model (VECM) which can distinguish the long-run and short-run relationships in variables. For a bivariate panel, the model set up is as follows:

$$\Delta y_t = \lambda_1 ECT_{t-1} + \sum_{k=1}^{q} \theta_{11k}\, \Delta y_{t-k} + \sum_{k=1}^{q} \theta_{12k}\, \Delta x_{t-k} + \mu_{1t} \qquad (2.5)$$

$$\Delta x_t = \lambda_2 ECT_{t-1} + \sum_{k=1}^{q} \theta_{21k}\, \Delta x_{t-k} + \sum_{k=1}^{q} \theta_{22k}\, \Delta y_{t-k} + \mu_{2t} \quad (2.6)$$

where y is inflation; x is inequality; the long-run cointegration equation is: $y_t = \beta_0 + \beta_1 x_t + \varepsilon_t$; $ECT_{t-1} = y_{t-1} - \beta_0 - \beta_1 x_{t-1}$ is the lagged error correction term derived from long-run cointegrating equation; λ is the adjustment coefficient; θ represents the short-run relationship; q is the number of lags determined by the SIC (Schwarz Information Criterion), μ is the serially uncorrelated disturbance term.

Table 2.4: Vector Error Correction Estimates (Inflation and Top1)

Cointegrating Eq:	CointEq1	
Inflation(-1)	1.000000	
Top1(-1)	0.713089*	
	(0.19183)	
	[3.71739]	
C	-13.83406*	
	(2.94772)	
	[-4.69314]	
Error Correction:	D(Inflation)	D(Top1)
CointEq1	-0.548212*	-0.051847*
	(0.09245)	(0.02786)
	[-5.93002]	[-1.86085]
D(Inflation(-1))	0.147631	0.016373
	(0.09702)	(0.02924)
	[1.52167]	[0.55995]
D(Top1(-1))	0.606755	0.353035*
	(0.36069)	(0.10871)
	[1.68222]	[3.24762]

Note: Standard errors in ( ). t-statistics in [ ]. C stands for the constant. Assume there exists intercept in Cointegrating Equation and no trend in the data.
The model with substituted coefficients are represented below:
D(INFLATION) = - 0.548212*(INFLATION(-1) + 0.713089*TOP1(-1) - 13.83406) + 0.147631*D(INFLATION(-1)) + 0.606755*D(TOP1(-1))
D(TOP1) = - 0.051847*(INFLATION(-1) + 0.713089*TOP1(-1) - 13.83406) + 0.016373*D(INFLATION(-1)) + 0.353035*D(TOP1(-1))

Table 2.5: Vector Error Correction Estimates (Inflation and Top10)

Cointegrating Eq:	CointEq1	
Inflation(-1)	1.000000	
Top10(-1)	0.443476*	
	(0.12165)	
	[3.64557]	
C	-20.83350*	
	(4.89266)	
	[-4.25811]	
Error Correction:	D(Inflation)	D(Top10)
CointEq1	-0.540188*	-0.048634
	(0.10181)	(0.03308)
	[-5.30605]	[-1.47030]
D(Inflation(-1))	0.191316*	-0.059614*
	(0.10189)	(0.03310)
	[1.87770]	[-1.80079]
D(Top10(-1))	0.442780	0.310043*
	(0.30333)	(0.09855)
	[1.45972]	[3.14590]

Note: Standard errors in ( ). t-statistics in [ ]. C stands for the constant. Assume there exists intercept in Cointegrating Equation and no trend in the data.
The model with substituted coefficients are represented below:
D(INFLATION) = - 0.540188*(INFLATION(-1) + 0.443476*TOP10(-1) - 20.83350) + 0.191316*D(INFLATION(-1)) + 0.442780*D(TOP10(-1))
D(TOP10) = - 0.048634*(INFLATION(-1) + 0.443476*TOP10(-1) - 20.83350) - 0.059614*D(INFLATION(-1)) + 0.310043*D(TOP10(-1))

Table 2.6: Vector Error Correction Estimates (Inflation and Top1w)

Cointegrating Eq:	CointEq1	
Inflation(-1)	1.000000	
Top1w(-1)	0.361468*	
	(0.07789)	
	[4.64067]	
C	-14.26859*	
	(2.46644)	
	[-5.78510]	
Error Correction:	D(Inflation)	D(Top1w)
CointEq1	-0.628522*	-0.062381
	(0.10187)	(0.06170)
	[-6.17005]	[-1.01109]
D(Inflation(-1))	0.219354*	-0.015755
	(0.09926)	(0.06012)
	[2.20998]	[-0.26208]
D(Top1w(-1))	0.181109	0.023563
	(0.17917)	(0.10852)
	[1.01080]	[0.21713]

Note: Standard errors in ( ). t-statistics in [ ]. C stands for the constant. Assume there exists intercept in Cointegrating Equation and no trend in the data.
The model with substituted coefficients are represented below:
D(INFLATION) = - 0.628522*(INFLATION(-1) + 0.361468*TOP1W(-1) - 14.26859) + 0.219354*D(INFLATION(-1)) + 0.181109*D(TOP1W(-1))
D(TOP1W) = - 0.062381*(INFLATION(-1) + 0.361468*TOP1W(-1) - 14.26859) - 0.015755*D(INFLATION(-1)) + 0.023563*D(TOP1W(-1))

Table 2.7: Vector Error Correction Estimates (Inflation and Top10w)

Cointegrating Eq:	CointEq1	
Inflation(-1)	1.000000	
Top10w(-1)	0.342944*	
	(0.06579)	
	[5.21240]	
C	-27.14178*	
	(4.68062)	
	[-5.79876]	
Error Correction:	D(Inflation)	D(Top10w)
CointEq1	-0.583677*	-0.126605*
	(0.10917)	(0.03931)
	[-5.34627]	[-3.22039]
D(Inflation(-1))	0.225364	0.030665
	(0.10496)	(0.03780)
	[2.14719]	[0.81134]
D(Top10w(-1))	-0.155400	-0.138138*
	(0.29046)	(0.10459)
	[-0.53502]	[-1.32072]

Note: Standard errors in ( ). t-statistics in [ ]. C stands for the constant. Assume there exists intercept in Cointegrating Equation and no trend in the data.
The model with substituted coefficients are represented below:
D(INFLATION) = - 0.583677*(INFLATION(-1) + 0.342944*TOP10W(-1) - 27.14178) + 0.225364*D(INFLATION(-1)) - 0.155400*D(TOP10W(-1))
D(TOP10W) = - 0.126605*(INFLATION(-1) + 0.342944*TOP10W(-1) - 27.14178) + 0.030665*D(INFLATION(-1)) - 0.138138*D(TOP10W(-1))

The results of the VECM model are shown in Tables 2.4-2.7. The coefficient of inequality in cointegrating equations are all negative and significant ($\beta_1 < 0$). It indicates there is a negative long-run relationship between inequality and inflation. For example, from the cointegrating equation of table 2.4 we can see that when the top 1 percent income share increases by 1%, inflation decreases by 0.713% in the long run. The coefficients of the lagged ECT terms (λ_1) are negative and significant in all four tables, which confirms that the inflation would return to the long-run equilibrium in response to a shock to inequality. However, the short-run coefficients of inequality are not

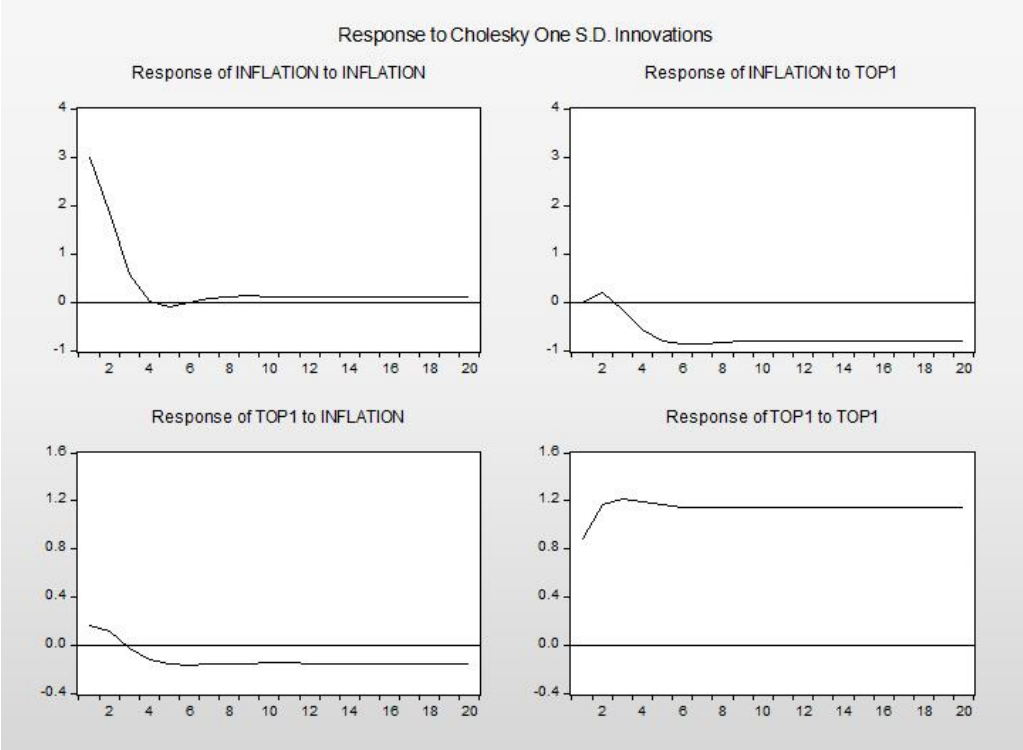
significant, thus, we do not have enough confidence to claim the existence of short-run effects running from inequality to inflation in the United States.

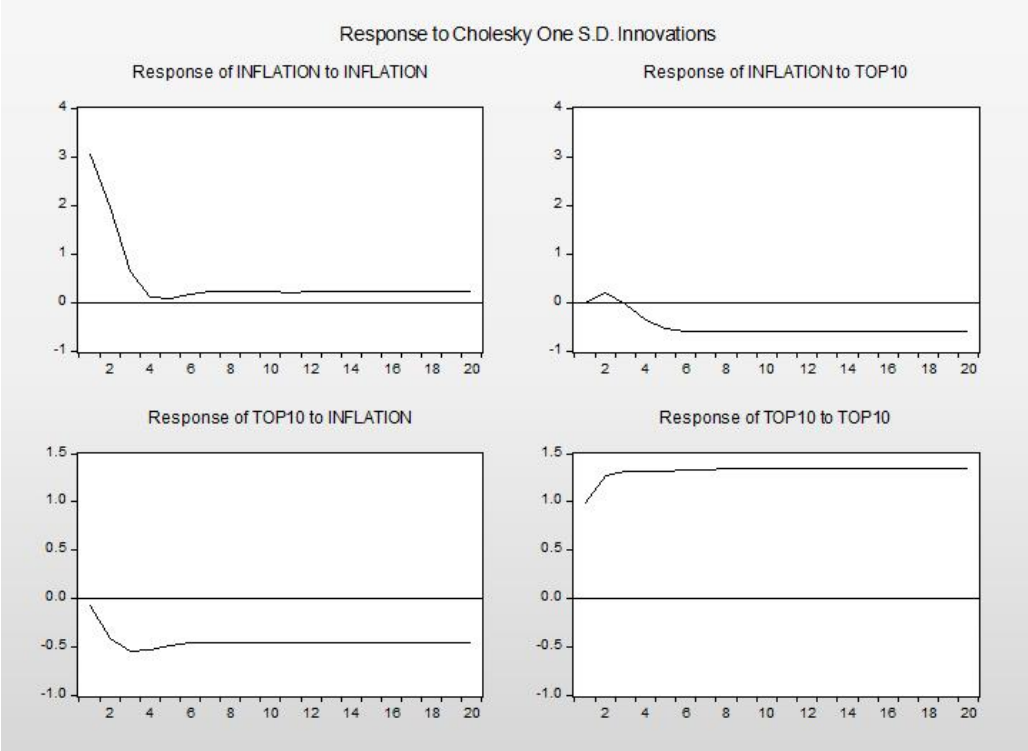
2.3.4 Impulse Response Analysis

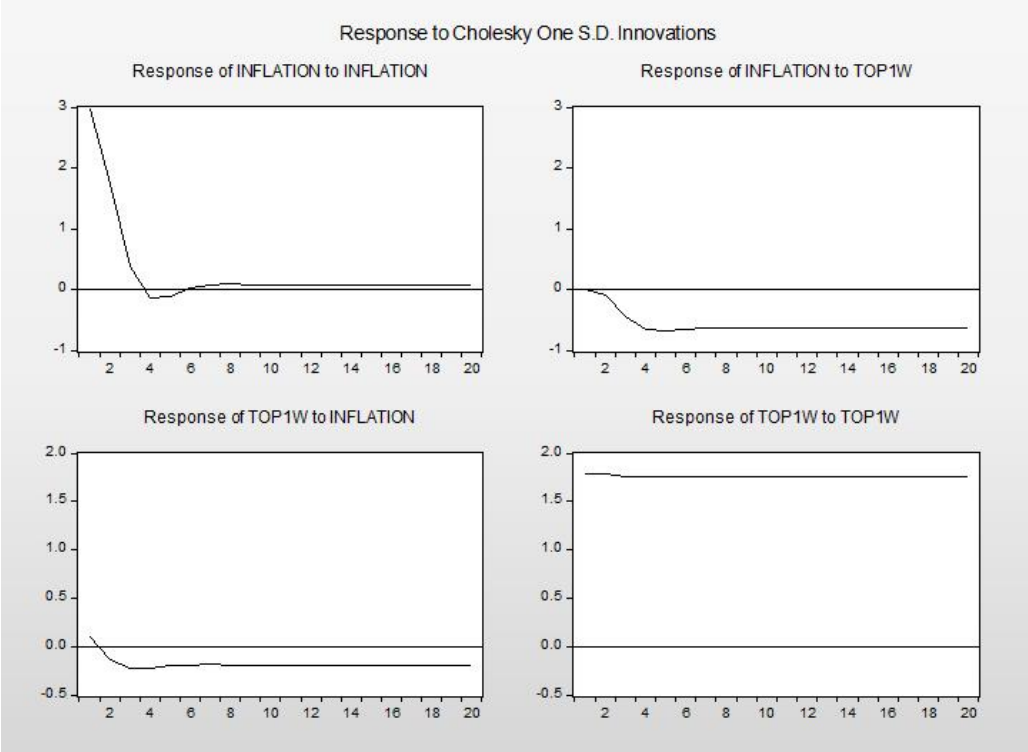
We can see the response of inflation to a shock to inequality in Figure 2.2. The horizontal axis is time (number of years), and the vertical axis is the unit of change in the response variable. For example, in the top-right graphs the vertical axis shows the change in the percentage rate of inflation. From the top-right graphs, we can see that in response to an exogenous one standard deviation increase in inequality, inflation will decrease permanently and converge to the new equilibrium in the long run. Since I use the Cholesky decomposition, which avoids the contemporaneous effects from inflation to inequality, so the shock to inequality can be seen as exogenous and not affected by inflation. Although one can see small positive short-run responses of inflation to increases in Top1 and Top10, these results must be regarded as suggestive because they are not statistically significant.

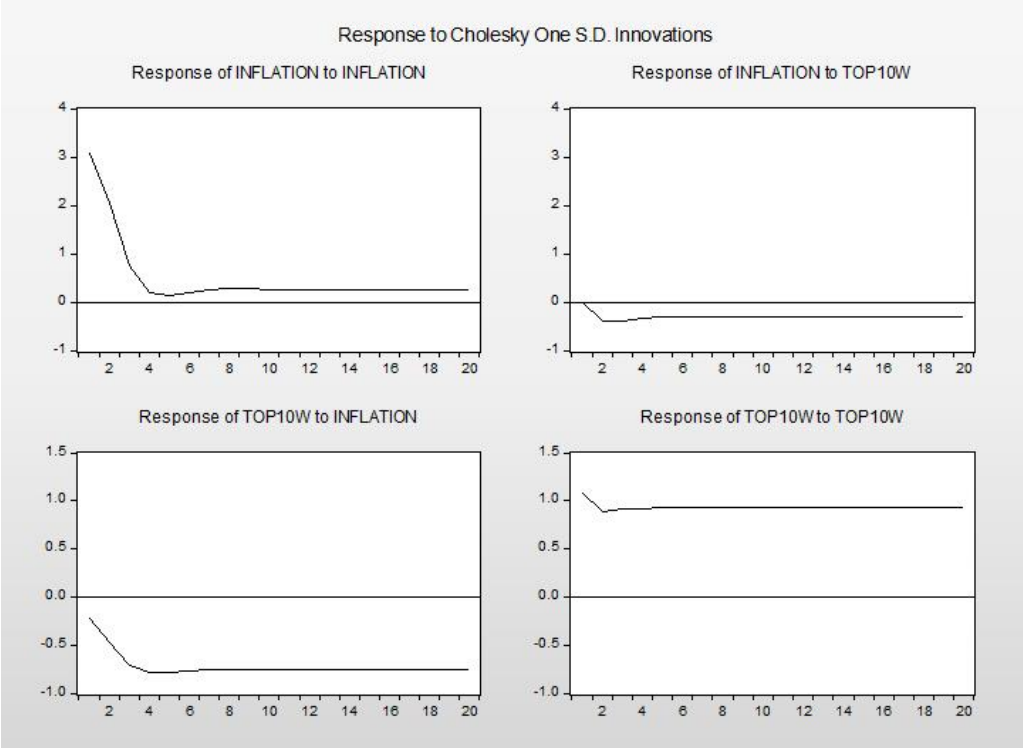
Specifically, in response to an exogeneous one standard deviation shock to income inequality (Top1 and Top10), inflation declines and converges to a lower equilibrium in the long run after about 6 years. The rate of convergence is faster in response to a shock to wealth inequality (Top1w and Top10w). In response to a shock to the Top1w, inflation takes about 4 years to converge to a lower equilibrium. Inflation takes about 2 years to converge in response to a shock to the Top10w.

Figure 2.2: Impulse Response Analysis






Response to Cholesky One S.D. Innovations
Response of INFLATION to INFLATION
Response of INFLATION to TOP1W
Response of TOP1W to INFLATION
Response of TOP1W to TOP1W


Response to Cholesky One S.D. Innovations
Response of INFLATION to INFLATION
Response of INFLATION to TOP10W
Response of TOP10W to INFLATION
Response of TOP10W to TOP10W

2.4 Conclusion

The main contribution of this chapter is that it is the first that studies the effects of inequality on inflation in the United States. Covering four inequality measures and a long period from 1921-2010, a Vector Error Correction Model and Impulse Response Analysis provide evidence that inequality has negative effects on inflation in the long run, but the short-run effects are not clear.

It seems that the affluent play a dominant role in policy making in the United States. Increased inequality typically produces a lower rate of inflation because it means that the affluent can muster more resources to influence public opinion, legislators, and bureaucrats.

Chapter 3

The Short-Run and Long-Run Effects of Inequality on Inflation - Panel Data Analysis

3.1 Introduction

Chapter 2 finds that inequality has negative long-run effects on inflation in the United States, but what about other countries? This chapter expands the dataset to four panels with different inequality measures and includes up to 32 countries.

In the very limited existing literature, economists argue that increases in inequality have a positive effect on inflation. Al-Marhubi (1997) studies 72 countries for the period 1973-1990 and finds that countries with greater inequality have higher mean inflation. Beetsma and Van Der Ploeg (1996) argue that in an unequal democratic society, people elect political parties that represent the interests of poor people, levy inflation taxes in order erode real value of debt service and redistribute wealth from the rich to the poor. However, greater inequality may increase ability of the affluent to influence economic policy, which results in lower inflation.

To begin, we can look at Figures 3.1 and 3.2 which provide broad-brush pictures of the relationship between inequality and inflation. The inequality measure is the share of income going to the richest 1 percent. This measure will be discussed in detail in section 3. Figure 3.1 includes 6 advanced countries and covers the period 1961-2010. Figure 3.2 includes 13 advanced countries but could only cover the shorter period from 1981-2010.

We can see a generally negative relationship between inequality and inflation in Figures 3.1 and 3.2.

Figure 3.1: Six Countries: 1961-2010

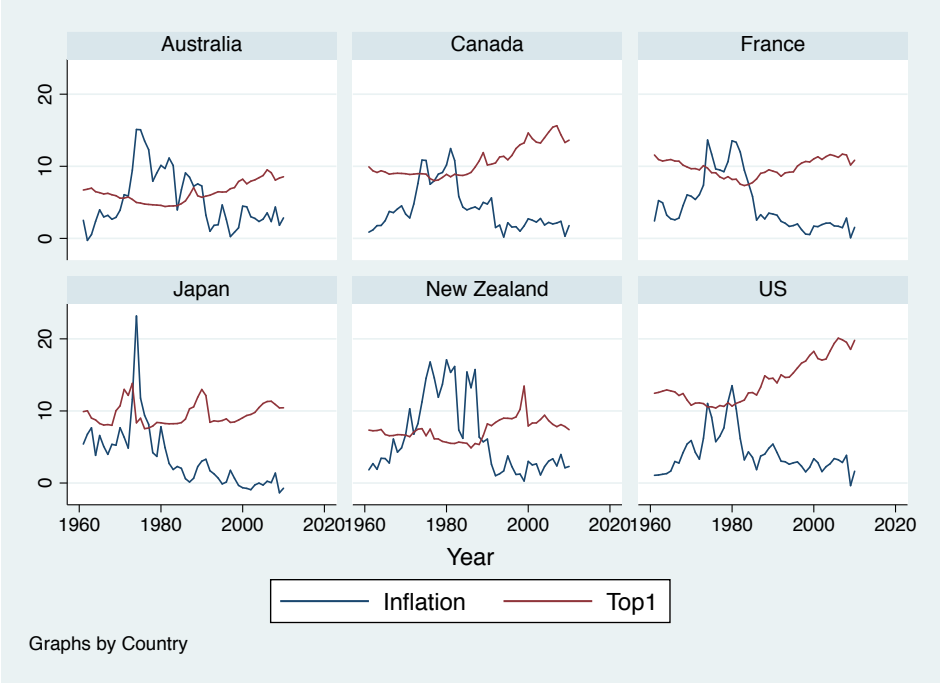
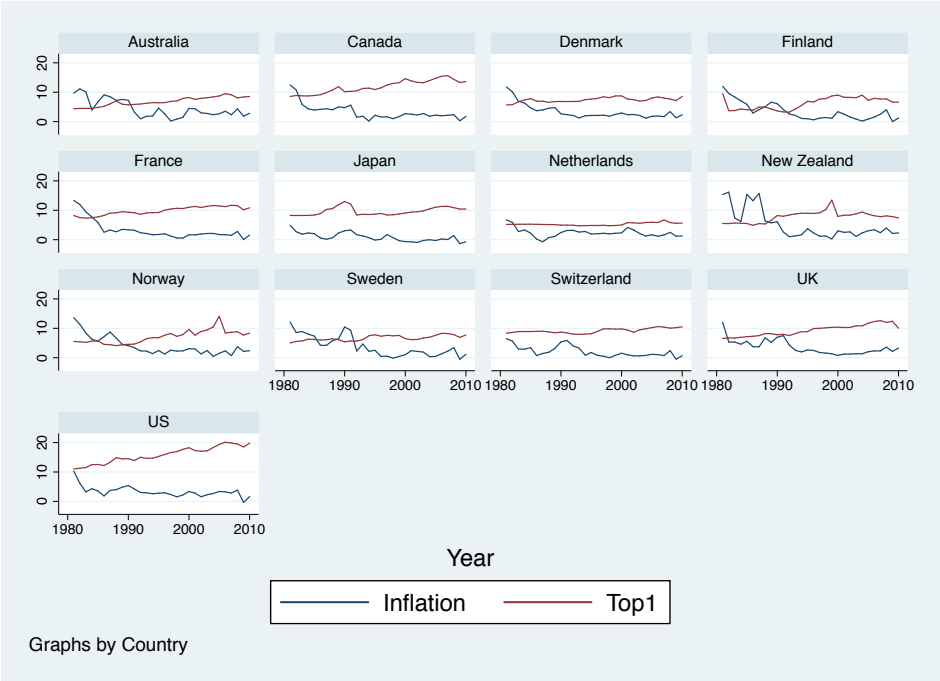


Figure 3.2: 13 Countries: 1981-2010



Why does the preliminary result contradict the literature? Can we confirm econometrically that there is a long-run negative relationship between inequality and inflation suggested by an inspection of Figures 3.1 and 3.2? And what about the short-run relationship? The existing literature is based on limited data and simple linear regression. What is missing in the literature is an econometric analysis that identifies both the short-run and long-run effects of inequality on inflation and explores the relationship in a wide variety of countries over long periods of time. This chapter attempts to fill this gap in the literature. It uses two most popular inequality measures and examines several panels of international data covering different periods and monetary regimes and up to 32 countries.

The remainder of the chapter is organized as follows. Section 2 describes in more detail the political economy stories that imply a relationship between changes in inequality and changes in inflation and discusses some historical case studies that illustrate different aspects of the story. Section 3 describes the empirical data. Section 4 utilizes four panel datasets with different inequality measures and include up to 32 countries. The Autoregressive Distributed Lag Model (ARDL) confirms the negative long-run relationship between inequality and inflation, and the Arellano-Bond GMM estimator confirms a negative short-run effect of inequality on inflation. Section 5 summarizes the main conclusions.

3.2 The Implications of Inequality for Economic Policy

Why do we see a result that apparently contradicts the existing literature? The theory of the positive effects of inequality on inflation is based on the Median Voter Theorem and

"one person one vote." At times the less affluent may benefit from expansionary monetary and fiscal policies. Increased unemployment benefits, for example, will help unemployed workers. And inflation resulting from expansionary monetary policies may relieve debt burdens. Binder and Spindel (2019) find both econometric and qualitative evidence that Congress and the Fed are interdependent, and show how Congress has influenced the Fed. It is possible then that when inequality rises, political pressure from the less affluent will lead to more expansionary monetary and fiscal policies and greater inflation.

The wealthy, however, do play an important role in the political arena. The propensity for political participation is highly correlated with income and education. The most affluent citizens, moreover, have more resources to contribute to political campaigns, and to buy influence with politicians and bureaucrats. They work through lobbyists, foundations and thinktanks to dominate the key issues of the public policy (Benabou 2000; Domhoff 2014). They tend to be more conservative on taxes, economic regulation, and social welfare, and more critical of expansionary monetary and fiscal policies (Page, Bartels and Seawright 2013). If this is true, an increase in income inequality means the wealthy would have more resources to influence macroeconomic policies. Therefore we may see negative effects of inequality on inflation. This will more likely be the case if a substantial share of the resources available to the wealthy are in the hands of old wealth: families whose wealth is in the form of assets fixed in nominal terms such as private and government bonds. The nouveau riche, whose wealth is more likely to be in the form of business ownership, may be less disturbed by inflation.

Thus we have two contending stories about how increased inequality will affect inflation. One story stresses the anger of the less affluent over low wages, unemployment, and debt burdens. The result, it is said, is pressure on governments to adopt inflationary policies. The other story stresses the power of the affluent to obtain what they want from governments: conservative monetary and fiscal policies. Some historical examples will show how this conflict has played out in particular cases.

3.2.1 The Debate in the U.S. in the 1890s over Bimetallism

Class conflict over the price level has been a fixture in American politics. One famous case is the debate over bimetallism at the end of the nineteenth century. Prices declined after the United States returned to the gold standard in 1879 until, about, 1896 when increased supplies of gold from South Africa and other parts of the world began to turn a mild deflation into a mild inflation. The GDP deflator, for example, fell about 0.76 percent per year from 1879 to 1896, and then rose about 2.17 percent per year from 1896 to 1906. Inequality also rose steadily over this period (Steckel and Moehling 2001). The Populists, led eventually by the charismatic William Jennings Bryan, blamed the gold standard for producing the initial phase of deflation which they believed hurt indebted farmers. They demanded an end to the gold standard and the adoption of bimetallism (gold and silver) in the hopes of producing inflation and relieving the debt burdens of farmers. The Populists were soon absorbed by the Democratic Party. The 1896 platform of the Democratic Party explained that:

> "The act of 1873 demonetizing silver without the knowledge or approval of the American people has resulted in the appreciation of gold and a corresponding fall in the prices of commodities produced by the people; a heavy increase in the burdens of taxation and of all debts, public and private; the enrichment of the money-lending

> class at home and abroad; the prostration of industry and impoverishment of the people."

The Republicans, however, representing a wealthier segment of the population, remained supporters of the gold standard, although they softened their position by advocating an international conference.

> "The Republican party is unreservedly for sound money. It caused the enactment of a law providing for the redemption [resumption] of specie [gold] payments in 1879. Since then every dollar has been as good as gold. We are unalterably opposed to every measure calculated to debase our currency or impair the credit of our country. We are therefore opposed to the free coinage of silver, except by international agreement with the leading commercial nations of the earth, which agreement we pledge ourselves to promote, and until such agreement can be obtained the existing gold standard must be maintained."

Although Bryan was by far the more charismatic candidate, his campaign for bimetallism failed. The Republicans were able to mount a vigorous campaign with the help of the warchest raised by Mark Hanna, the chair of the Republican National Committee, who lobbied major industrialists for contributions. Republican William McKinley won the election and the United States remained thoroughly committed to the gold standard.

3.2.2 The U.S. Debate over the Price Level in the Great Depression

A similar debate over the price level and the gold standard became part of the Presidential campaigns in 1932. The GDP deflator fell a startling 9.04 percent per year between 1929 and 1932. The Republicans were again the staunch supporters of the gold standard.

> "The Republican Party established and will continue to uphold the gold standard and will oppose any measure which will undermine the governments credit or impair the integrity of our national currency. Relief by currency inflation is unsound in principle and dishonest in results. The dollar is impregnable in the marts of the world today and

> must remain so. An ailing body cannot be cured by quack remedies. This is no time to experiment upon the body politic or financial."

Many Democrats were now calling for paper money or the old idea of bimetallism to produce inflation. The Democratic Party platform reflected these ideas, but now it was the turn of the Democrats to soften their position by advocating an international conference.

> "We advocate a sound currency to be preserved at all hazards and an international monetary conference called on the invitation of our government to consider the rehabilitation of silver and related questions."

This time the Democrats were more successful in their quest for expansionary monetary and fiscal policies. The extremity of the Depression and the shrewd campaign run by Franklin Roosevelt, for example advocacy of a balanced budget, produced victory for the Democrats. The Roosevelt administration took the United States off the gold standard and ran fiscal deficits. But even in the dire circumstances of the Great Depression the success of the inflationist was limited. The Roosevelt administration attempted to return to a balanced budget in the later years of the Depression. And the Federal Reserve, although it did expand the monetary base, never did so to the extent needed to substantially increase the stock of money.[1]

3.2.3 The French Debate over Price Level during the Great Depression

Similar debates between the affluent and the poor also happened in France. In 1935, although recovery had begun in some other countries, France was still in the throes of the

[1] The literatures on both the 1896 and 1932 campaigns and their consequences for monetary and fiscal policies is enormous. Monetary historians will all be familiar with the accounts in Friedman and Schwartz (1963, 116-119, 462-483).

great depression. The economy was under terrible pressure from deflation. Domestic demand had fallen dramatically. The main trade partners of France had all abandoned the gold standard, and the devaluation brought competitive advantages to those countries. The gold reserve fell by 11 percent in June 1935, and the Prime Minister Pierre-Étienne Flandin, who aimed at economic recovery, was forced to decide between reflation and recovery or deflation and convertibility (Eichengreen, 1992, 369). He finally chose the latter because of the resistance from the Bank of France. The famous 200 families, who were the largest 200 shareholders, had the right to vote in the Banks annual meeting; and they were able to influence the central banks cooperation with the government's policy. The 200 families became one of the main targets of attacks from left parties in the 1936 election (Mouré, 2002, 123).

In the 1936 election, the Radical party, which represented the middle classes, cooperated with other parties on the left. After intense negotiations, Radical, Socialists and Communists formed a new party, the Popular Front. The Popular Front won the election; and Leon Blum, the head of Popular Front, took office in 1936. Blum weakened the rights of the 200 families and introduced a series of reforms similar to Roosevelts New Deal (Eichengreen, 1992, 376). Finally, with the pressure of gold losses and broad anticipation of devaluation, France abandoned the gold standard in September 1936.

The implementation of inflationary policies can be seen as a product of the debate between the affluent and the poor, over the distribution of income. When the level of inequality changes because of exogenous factors such as economic crises and globalization, the original balance of power between the wealthy and the poor will be altered, and as a result the inflation rate changes and approaches a new equilibrium. Thus,

a clear prima facie case based on the historical narrative can be made that changes in inequality produce changes in the rate of inflation in both the short run and the long. I now turn to the quantitative data.

3.3 Data

The two most frequently used measures of inequality are the Gini coefficient and the share of income going to a top percentage of the population, typically the top 1 percent. The Gini coefficient puts more weight on the middle and low-income groups and describes the general extent of inequality. The share of income going to the top 1 percent emphasizes, obviously, the income of the wealthiest. For this chapter, I utilize data from two sources: the Standardized World Income Inequality Database (SWIID) and the World Inequality Database (WID).

The SWIID created by Frederick Solt standardizes observations from the OECD Income Distribution Database, the Socio-Economic Database and many other sources (Solt, 2019). Compared to other frequently used databases like the Luxembourg Income Study (LIS) and World Income Inequality Database (WIID), it contains more countries and improves compatibility for cross-country study. The SWIID database includes the disposable Gini index (Gini(disp)) and the market Gini index (Gini(mkt)). The disposable Gini index estimates post-tax/post-transfer income of each percentile of the population, and the market Gini index estimates pre-tax/pre-transfer income of each percentile of the population.

The World Inequality Database (WID) was constructed by Thomas Piketty, Emmanuel Saez, Anthony Atkinson and other outstanding economists. Top 1 percent

income share (Top1) measure the percentage of pre-tax national income going to the top 1 and top 10 percent population, indicating the level of income inequality. For some countries, the database also includes the fiscal income going to the top 1 percent population.[2] To make international comparisons for income inequality, I use the pre-tax national income share. The inflation rates are calculated based on the Consumer Price Index that is collected from the International Financial Statistics of the IMF, supplemented by the Global Financial Database.[3]

I utilize four panel datasets with both the Gini indexes and Top1 as inequality measures and include up to 32 countries. The first panel dataset includes Top1 of 6 countries from 1921-2010 as independent variable.[4] In the second dataset, I expand the number of countries to 13 and it covers the period 1981-2010.[5] In the third and fourth dataset, I use the disposable Gini index and the market Gini index as inequality measures. These measures of inequality are available for 32 countries for the period 1976-2015.[6] In

[2] According to the descriptions from the database: "Pre-tax national income is the sum of all pre-tax personal income flows accruing to the owners of the production factors, labor and capital, before taking into account the operation of the tax/transfer system, but after taking into account the operation of pension system. Fiscal income is defined as the sum of all income items reported on income tax returns, before any deduction. It includes labor income, capital income and mixed income. The concept of fiscal income varies with national tax legislation, so in order to make international comparisons it is preferable to use the concept of national income."

[3] The GDP deflator is not always available. For countries for which GDP deflator is available, the results are similar to those obtained with CPI.

[4] 6 countries: Australia, Canada, France, Japan, New Zealand, U.S.

[5] 13 countries: Australia, Canada, Denmark, Finland, France, Japan, Netherlands, New Zealand, Norway, Sweden, Switzerland, UK, US.

[6] 32 countries: Australia, Canada, Colombia, Costa Rica, Denmark, Egypt, Finland, France, Greece, Hungary, Indonesia, Ireland, Italy, Japan, Kenya, Korea, Malaysia, Mexico, Norway, Panama, Peru, Philippines, Portugal, Singapore, South Africa, Spain, Sri Lanka, Sweden, Tanzania, Thailand, UK, U.S.

the four datasets, there is no hyperinflation. Datasets 2-4 cover the post-Bretton Woods System periods, thus the structural breaks produced by regime change are avoided.

3.4 Empirical Analysis

In this section I first conduct panel unit root tests to examine the stationarity of the data. Then I employ the panel autoregressive distributed lag (ARDL) model to study the long-run relationships between inequality and inflation. Finally, I apply the Arellano-Bond GMM estimator to study the short-run effect running from inequality on inflation.

3.4.1 Panel Unit Root Test

For panel data, the panel-based Levin, Lin and Chu test (LLC), the Im, Pesaran and Shin test (IPS), the Fisher-ADF test, and the Fisher-PP test were used to examine the degree of integration (Levin, Lin and Chu 2002; Im, Pesaran and Shin 2003; Maddala and Wu 1999 ; Choi 2001). The tests are based on the ADF test and have the following expression in panel settings:

$$\Delta y_{it} = \alpha_i + \delta_i t + \beta_i y_{i,t-1} + \sum_{j=1}^{p_i} \theta_{ij} \Delta y_{i,t-j} + \varepsilon_{it} \tag{3.1}$$

where $i = 1, \cdots, N$, $t = 1, \cdots, T$; α_i and $\delta_i t$ are individual and trend effects which may be set to zero if desired; y_i is the series of observations for country i, p_i is the number of lags selected for the ADF regression, ε_{it} are independently and normally distributed random variables for all i and t with zero means and finite heterogenous variances.

The LLC test assumes that the coefficients of the autoregressive term is homogeneous. That is, $H_0: \beta_i = \beta = 0 \; \forall i$, against the alternative $H_1: \beta_i = \beta < 0 \; \forall i$, which requires all individual series to be stationary.

The IPS test allows for the heterogeneity in the autoregressive coefficient. That is, $H_0: \beta_i = 0 \; \forall i$, against $H_1: \beta_i < 0, i = 1, \cdots, N_1; \; \beta_i = 0, i = 1, \cdots, N$, which allows for some of the individual series to be integrated.

The Fisher-ADF and Fisher-PP tests have the same alternative hypothesis as the IPS test and they combine the p-values from individual unit root tests. These tests use π_i to represent the p-value from individual unit root test for each cross-section i, then

$$-2 \sum_{i=1}^{N} \ln (\pi_i) \rightarrow \chi^2_{2N} \tag{3.2}$$

$$Z = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} \Phi^{-1}(\pi_i) \rightarrow N(0,1) \tag{3.3}$$

where Φ^{-1} is the inverse of the standard normal cumulative distribution function.

The LLC, IPS, Fisher-ADF and Fisher-PP tests results are shown in Table 3.1. In all datasets, inflation is stationary in level, and inequality measures Top1, Gini(disp) and Gini(mkt) are stationary in first difference.

Table 3.1: Panel Unit Root Tests Results

Variable	LLC	IPS	Fisher-ADF	Fisher-PP
Dataset 1: 6 countries, 1921-2010				
Inflation	**-7.3489**	**-8.0337**	**91.0201**	**93.3086**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Top1	**-2.0101**	-1.55279	18.0192	16.6949
	(0.0222)	(0.0602)	(0.1151)	(0.1614)
ΔTop1	**-22.8741**	**-21.5944**	**173.245**	**170.516**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Dataset 2: 13 countries, 1981-2010				
Inflation	**-9.8688**	**-8.9184**	**127.265**	**163.238**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Top1	**-2.5560**	-1.54478	35.4249	24.5811
	(0.0053)	(0.0612)	(0.1028)	(0.5428)
ΔTop1	**-12.6621**	**-13.4779**	**203.469**	**258.436**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Dataset 3: 32 countries, 1976-2015				
Inflation	**-5.5829**	**-5.3116**	**145.172**	**159.585**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Gini(disp)	**-3.2024**	2.0942	56.9021	52.2853
	(0.0007)	(0.9819)	(0.72236)	(0.8523)
ΔGini(disp)	**-17.4882**	**-11.5568**	**277.380**	**278.795**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Dataset 4: 32 countries, 1976-2015				
Inflation	**-5.5829**	**-5.3116**	**145.172**	**159.585**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Gini(mkt)	**-3.8687**	1.5753	77.2682	48.7341
	(0.0001)	(0.9424)	(0.1234)	(0.9214)
ΔGini(mkt)	**-8.7692**	**-10.5858**	**250.001**	**255.751**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Note: p-values are in parentheses, and bold letters indicate significant at 5% or better.
The optimal lag length is selected by the Schwarz Information Criterion.

3.4.2 Autoregressive Distributed Lag Model

Since the variables have mixed order of integration, the error correction model is not appropriate. Instead, we can apply the panel Autoregressive Distributed Lag (ARDL) model to the datasets. More specifically, to study the long-run relationship between inflation and inequality, for panel time series data with mixed order of integration, we can

apply the ARDL model with the mean group (MG) estimator and the pooled mean group (PMG) estimator introduced by Pesaran, Shin and Smith (1995, 1999).

Consider the following long-run equation:

$$y_{it} = \theta_{0i} + \theta_{1i} x_{it} + \mu_{it} \tag{3.4}$$

where y_{it} is the rate of inflation, and x_{it} is the measure of income inequality. We expect a negative long-run relationship between inflation and income inequality, thus, we would expect $\theta_{1i} < 0$. The Schwarz Criterion suggests using the ARDL(1,1) model:

$$y_{it} = \mu_i + \beta_i y_{i,t-1} + \alpha_{1i} x_{it} + \alpha_{2i} x_{i,t-1} + \varepsilon_{it} \tag{3.5}$$

and the error correction equation is:

$$\Delta y_{it} = \emptyset_i \left(y_{i,t-1} - \theta_{0i} - \theta_{1i} x_{i,t-1} \right) + \alpha_{2i} \Delta x_{it} + \varepsilon_{it} \tag{3.6}$$

where $\theta_{0i} = \frac{\mu_i}{1-\beta_i}$, $\theta_{1i} = \frac{\alpha_{1i}+\alpha_{2i}}{1-\beta_i}$, $\emptyset_i = \beta_i - 1$.

Both the MG and PMG estimations assume there exists a long-run relationship between inflation and income inequality. The MG approach estimates N separate regressions and calculates the means of long-run and short-run coefficients. The PMG estimation constrains the long-run coefficients to be identical but allows short-run coefficients and error variances to differ across groups. The PMG estimation allows us to estimate a homogenous long-run coefficient. The PMG estimation is more efficient but it has the risk of being inconsistent. The Hausman test can be used to evaluate the consistency of the PMG estimator (Hausman,1978). The null hypothesis is that both the MG and the PMG estimators are consistent. The alternative hypothesis is that only the MG estimator is consistent. If we fail to reject the null hypothesis, we can trust the result of the PMG estimator, which is more efficient.

The long-run coefficients of the measure of inequality, the speed of adjustments and the Hausman test results are shown in Table 3.2. The Hausman tests indicate that the PMG estimators are consistent in all four datasets, so we can trust the results the PMG estimators. In dataset 1, 3 and 4, the long-run coefficients of inequality are negative and significant. In dataset 2, the coefficient of inequality is not significant, but it has the correct sign. Therefore, we can conclude that the negative long-run effects running from inequality to inflation has been a near universal rule.

Table 3.2: ARDL(1,1) long-run equation

Variable	Mean Group Estimator	Pooled Mean Group Estimator
Dataset 1:		
Top1, (θ_1)	**-0.7531**	**-0.5544**
	(0.033)	(0.000)
Speed of adjustment, (∅)	**-0.3610**	**-0.3498**
	(0.000)	(0.000)
Hausman Test: p-value=0.5403		
Dataset 2:		
Top1, (θ_1)	-0.3320	-0.1232
	(0.247)	(0.218)
Speed of adjustment, (∅)	**-0.3946**	**-0.3435**
	(0.000)	(0.000)
Hausman Test: p-value=0.4776		
Dataset 3:		
Gini(disp), (θ_1)	2.0844	**-0.6856**
	(0.468)	(0.000)
Speed of adjustment, (∅)	**-0.3736**	**-0.3315**
	(0.000)	(0.000)
Hausman Test: p-value=0.3395		
Dataset 4:		
Gini(mkt), (θ_1)	-0.5725	**-0.7478**
	(0.781)	(0.000)
Speed of adjustment, (∅)	**-0.4425**	**-0.3696**
	(0.000)	(0.000)
Hausman Test: p-value=0.9324		

Note: Bold letters indicate significant at 5% or better.
p-values are in parentheses.

3.4.3 Identifying the Short-Run Relationship Using the Arellano-Bond GMM Estimator

The long-run relationship has been proved, but is there a short-run effect running from inequality to inflation? We are interested in estimating the parameters of the following dynamic model:

$$y_{it} = \alpha y_{i,t-1} + \beta x_{it} + \mu_i + \varepsilon_{it} \tag{3.7}$$

where y_{it} is the dependent variable (inflation), x_{it} is the explanatory variable (inequality), μ_i is the fixed effect. $y_{i,t-1}$ is correlated with the individual fixed-effect μ_i.

Since inflation may have a reverse effect on inequality, we have an endogeneity problem. The problem can be solved If we can find the proper instrumental variables for inequality. In this section, I use the Arellano-Bond GMM estimator, which has become the most widely used model for addressing this problem. It uses the lagged values of inequality as instruments to find the short-run effect of inequality on inflation. Differencing the model yields:

$$\Delta y_{it} = \alpha \Delta y_{i,t-1} + \beta \Delta x_{it} + \Delta \varepsilon_{it} \tag{3.8}$$

The μ_i is gone, but the $y_{i,t-1}$ is a function of the $\varepsilon_{i,t-1}$, so $\Delta y_{i,t-1}$ is correlated with ε_{it}. Also, Δx_{it} is correlated with $\Delta \varepsilon_{it}$ if there exists a reverse causality from y_{it} to x_{it}.

Assuming ε_{it} is i.i.d over i and t, Anderson and Hsiao (1981) use lagged values of the variables as instruments to solve the endogeneity problem. For example, $\Delta y_{i,t-2}$ would be a valid instrument for $\Delta y_{i,t-1}$. Arellano and Bond (1991) use GMM framework to construct estimators based on further lagged levels of endogenous variables. For period p, $p-2$ instruments are available for an endogenous variable. For example, in period 3,

y_{i1} is a valid instrument for Δy_{i3}; In period 4, y_{i1} and y_{i2} are valid instruments for Δy_{i4} and so on. Treating variables as endogenous quickly increases the size of the instrument matrix, which can cause the GMM estimators to perform poorly. To solve this problem, I set the maximum number of 2 lagged levels of the endogenous variable (inequality) to be included as instruments for x_{it}.

To get a consistent estimate, we need to apply the Arellano-Bond test to make sure that there is no autocorrelation in first-differenced errors. A valid instrumental variable should be uncorrelated with the error term. The Sargan test can be used to examine the validity of the instrumental variable. Among the 4 panel datasets, only dataset 2 passes both the Arellano-Bond and Sargan tests. Here I just report of the results from dataset 2, the effects of ΔTop1 on inflation in the 13 countries from 1981-2010.

The results of the short-run effects using the Arellano-Bond GMM estimator are shown in Table 3.3 below. The Arellano-Bond test indicates there is no autocorrelation in first-differenced errors, and the Sargan test confirms the validation of the instruments. The coefficient of the Top1 is negative and significant at the 5 percent confidence level, indicating that inequality has a negative short-run effect on inflation. When the top 1 percent income share increases by 1 unit (for example, increase from 10% to 11%), the inflation rate decreases by 0.125 units (for example, decrease from 5.125% to 5%).

Table 3.3: Arellano-Bond GMM Estimator Results (13 countries: 1981-2010)

Variable	Coefficient	P-value
D(Inflation (-1))	**0.655**	0.000
D(Top1)	**-0.125**	0.050
Arellano-Bond test	z(order 2)=0.416	0.677
Sargan test	chi-square(306)=217.987	0.920

Note: Bold letters indicate significant at 5% or better.

3.5 Conclusion

The existing literature argues based on limited data that increased inequality tends to increase inflation. The story is that an increase in inequality creates intense political pressures on governments to employ expansionary policies, to improve the economic condition of the poor directly by redistributing income or indirectly by creating inflation that reduces debt burdens. This story is based, to oversimplify, on the assumption of "one person one vote" and the Median Voter Theorem. However, in many cases, again to oversimplify, the political reality may actually be closer to "one dollar one vote", Greater inequality may increase ability of the affluent to influence economic policy. If this is true, we will see increased inequality producing a lower rate of inflation. The data explored here contradicts the thrust of the current literature and shows that the latter case, increased inequality produces lower inflation, has been the rule.

Utilizing four panel datasets and employing the Autoregressive Distributed Lag Model, a negative long-run relationship has been confirmed. The short-run analysis employs the Arellano-Bond GMM model which solves the reverse causality problem by using lagged values of inequality as instruments. The results indicate that there exists a negative causal effect running from inequality to inflation in the short run. The dominant story seems to be that increased inequality typically produces a lower rate of inflation because it means that the affluent can muster more resources to influence public opinion, legislators, and bureaucrats.

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