Employment Dynamics

A Survey of Industries & Wages

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Abstract:
This paper examines unemployment, wages, hours worked and the composition of the labor market using cross-sectional data in the Panel Study of Income Dynamics (PSID). I find evidence of lingering unemployment after the 2001/2002 recession and evidence of shifts away from old bubble areas (information) to new ones (real estate and construction). There is also a focus on the Information Industry and certain characteristics that set it apart from other industries.

Keywords: Unemployment, labor, outsourcing, information industry, labor force composition, off-shoring

JEL Classifications: E24, J21, J24, J64, J82, L86

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0. Introduction

As a conscientious senior in high school choosing a field of study for college, I was careful to consider my future labor market prospects. I had some interest in computer science, but this was tempered by frequent reporting about the outsourcing of technology sector jobs and eventually my interest was squashed by a 60 Minutes story about the Indian Institute of Technology, an elite engineering school in India. It did not make sense for me to enter a field where I would be competing with others who could do the job just as well if not better, and for far less money. I eventually settled on Economics and Political Science as a pre-cursor to law school.

The motivation for this paper was the realization that I may have made a mistake. Many of my friends in computer science earned hefty multiples (2-4x) what I made at my summer job after junior year. Where was the supposed outsourcing and convergence of wages? The Panel Study of Income Dynamics (PSID) was a way to uncover the truth as the media was apparently not to be trusted. I began examining whether outsourcing was actually occurring in the Information Industry and later expanded my research to include a general study of unemployment and the composition of the American labor market (by industry and occupation).

The relevance of this study has become greater over the past few years as globalization has taken hold, the theory of decoupling has failed, and the global economy has fallen into recession. The Information Industry offers empirics of the effects of globalization and we can draw general inferences from these empirics to understand how other industries may be affected.

The first part of this paper will deal with data treatment and the idiosyncrasies of the PSID. The second part will describe the labor force as a whole in terms of wages, unemployment, hours worked, and composition by industry and occupation. Part Three will look

at the transitions workers made between industries and occupations from 2003 to 2005. Part Four looks at how workers become unemployed, that is, whether they are fired, laid off, quit, resigned, etc. It also includes a discussion of the characteristics of the unemployed compared to the employed. Part Five centers on a multiple linear regression to examine certain factors that may be associated with unemployment. There are four models, one focusing on economic factors, one on employee characteristics, one on industry differences and the last is a combined model. Part Six begins with a discussion of outsourcing and includes more analysis specific to the Information Industry.

I. Data

Some descriptive statistics were obtained from the Bureau of Labor Statistics (BLS) and also the U.S. Census Bureau. They are seasonally adjusted when appropriate. The rest of the data was obtained from the PSID. Instances where data calculated from the PSID was also available from official statistics, PSID data is used; however, despite a few exceptions, the differences are small.

The PSID groups sets of data by family through anchoring individuals to the head of the family, most often a male (and in some cases a single female). Each family is assigned a weight to represent how representative they are of the U.S. population as a whole. Larger weights mean a family (or family of one, in other words, an individual) is more commonly found in America. For example, the weight associated with a construction worker living in New York who is 35 years old would be greater than that of an 80 year old newspaper editor living in Alaska. As the goal of this paper is to make general statements about the U.S. population, I have used weights everywhere they are appropriate, which is everywhere data from the PSID is used. I have also used the weights to construct a few measures of industry and occupation growth.

Along with the weights, there is also the issue of dealing with family heads and their spouses. In some cases, it makes sense to include both, in others, using only heads makes more sense. For example, when computing the number of hours worked per week, I used only family heads as I wanted to leave out spouses who are far more likely to be doing part-time work to supplement family income. When calculating composition of the work force by industry or occupation, unemployment rates, and why individual's last job ended, I included both heads and spouses.

The survey nature of the PSID also presented a problem of matching up responses over time. Some questions were asked in 2002 and 2004, while others were asked in 2003 and 2005. Additionally, these questions may not have referred to the year in which the question was asked, for example, questions about how long someone was unemployed related to the previous year, not the current one. I was able to use questions asking for past period information that were from the 2003 and 2005 datasets, and use questions asking for current period information that were from 2002 and 2004. This way, the data aligns to the two sample years of 2002 and 2004.

The last difficultly presented by the data relate to the usual statistical problems with small sample sizes and debates of economic and statistical significance. In general, the sample sizes were decent for most categories of observation. However, industries such as mining, or categories such as "my last job ended due to strike" were so miniscule that they consisted of only four or five individuals. I included these data in the charts, but I limit the discussion of their presence and relevance as I would not purport to extrapolate a result found from a sample of 5 to even a population of tens of thousands.

II. Labor Force Survey: Wages, Hours Worked, Unemployment & Composition

The average wage rate increased 5.82% from 2002 to 2004 as shown in Table 1. The average hours worked omits individual who did not work at all and only includes data for the head of the family due to the ~300 hour difference between hours worked for heads and wives. The nineteen hour decrease in average hours worked is about half a week of work, so it is not practically significant and we can assume people are working the same forty hours a week in 2002 and 2004.

In 2002, one year after the beginning of the 2001 recession, the United States unemployment rate was 5.8%. Two years later, well into the recovery, the unemployment rate had dropped to 5.5% as shown in Table 1. Despite the decrease in the unemployment rate, both mean and median weeks unemployed increased from 2002 to 2004, 17.7% (21 days) and 6.73% (4 days) respectively. This indicates that not only are people's unemployment durations lasting longer, but the longest durations are becoming even longer. One of the stories of the current recession (2007- ?) is that unemployment never really recovered from the 2001 recession and the average worker was left out of the economic recovery both in terms of wages and employment opportunities. The large increase in mean weeks unemployed validates the idea that the jobs market in the United States has become structurally weak. It no longer rebounds in good times, but remains in decline.

The argument that people may simply be willing to remain unemployed longer (not choosing not to work, but holding out for better offers) in better economic times does not appear to hold water, because the unemployment rate in 2004 was not much better than it was in 2002. In fact, they are both stellar compared to the current unemployment rate of 8.1% (Q1 2009). Additionally, a large factor affecting a decision to stay unemployed for a longer period of time is

current savings: It is unlikely an individual would have saved much money in the few years after a downturn.

One explanation is that the better unemployed workers got jobs very soon after the recession ended, leaving a pool of less able workers still looking for a job. Because these remaining workers are not as good, they stay unemployed longer. Whether this is the case after any large labor dislocation when many good workers are laid off is unclear.

It is also possible that these unemployment numbers are understated in some sense if workers must completely leave their industry to find work. Chart 1 shows the composition of the labor force by industry. It does not exclude people who were unemployed, so Chart 1 is not perfectly representative of the distribution of workers by industry because there are some people who are not actually employed in these industries, but show up because their last job was in one of these industries. People who had not worked since 2001 do not show up, so the lag in this distribution is not too great.

Focusing on the largest percentage changes in the distribution of workers by industry from 2003 to 2005, Public Administration and Active Duty Military, Information, and Mining post the largest decreases, while Wholesale Trade, and Construction post the largest increases.

The decrease in Public Administration and Active Duty Military in 2005 can be explained by the reduction of people on active duty after the initial invasion of Iraq by the U.S. army. It may also be a result of shrinking state governments as state's try to deal with budget deficits. Workers in mining make up a small portion of all workers, however the decrease from 2003 to 2005 is dramatic, over 50%. It is possible this is just a cyclical issue, or that this industry is moving overseas where there may be greater sources of untapped resources and also cheaper labor to extract such resources.

The total distribution always sums to 100%, so if one industry decreases in prevalence then another, or others must increase. The increases in Wholesale Trade and Construction make sense. Wholesale Trade is the selling of everything from car parts to lamps to yams. Construction is construction. These are both industries that must take place domestically.

A chart similar to Chart 1 for workers distributed by occupation does not show significant changes from 2003 to 2005 among any of the occupations with the exception of an increase in Transportation and Material Moving from 4.8% to 5.7% of the population and an increase in Construction from 4.2% to 4.8% of the population.

A proxy for measuring the growth rate of these industries is the change in amount of family weight assigned to each industry from 2003 to 2005. The numbers from Table 2 are meaningless in absolute terms, but relative to one another there is some evidence about the growth rate of the industries. First, the total weight for all industries grew 27.58% from 2003 to 2005. This number or the 24.35% average can be used as a benchmark for average growth. Aside from Mining, Information is the only industry that actually shrunk in total family weight (-3.7%). The next closest is Public Administration and Active Duty Military's 8.92% gain, and then Utilities at 16.84%. This would seem to indicate Information is not just growing slower than other industries, but it is actually shrinking. This increase in total weight for all industries from 2003 to 2005 may come from more people getting into the labor force as the recession subsided or may just be a vagary of the PSID.

In Chart 1, where Public Administration and Active Duty Military, Information, and Mining post the largest decreases in proportion of the total distribution of workers, while Wholesale Trade, and Construction post the largest increases in proportion of the total distribution of workers. In Chart 2, these same industries that had the largest decreases in

proportion of the distribution of workers from 2003 to 2005 also had a lower unemployment in 2005 than in 2003 and vice versa. This makes sense to some degree; as more and more people claim to belong to a certain industry, more of them are probably going to be unemployed at some time. Nonetheless, I would expect shrinking industries like Mining and Information to post increases in unemployment. It is possible after the technology bubble that many workers fled the information industry for others, so that by 2004/2005, there were fewer workers and less unemployment because many of the unemployed had already moved on to other industries (perhaps they are bubble workers and moved onto Real Estate).

It is possible that the Information Industry unemployment rate couldn't get any higher after the technology bubble in 2000 and 2001 whose effects lingered for a few years. Either way, it declined from 11.4% to 6.5% (these numbers are too high compared to BLS numbers, however the BLS decrease from 6.9% to 5.7% is still substantial) NOTE: the large majority of the other unemployment numbers match closely to available data from the BLS. The disparity may arise because I calculated the unemployment rate as the number of workers unemployed at some time in a given year divided by the total number of workers, as opposed to calculating the average or maximum percentage of people unemployed at any given time during a year. It is possible these two calculations would be the same, but if say 5 of 100 people were unemployed in the first six months of the year, and 5 of 100 people in the last six months, the BLS unemployment rate would be 5%, whereas the rate I calculated would be 10%.

III. Transitions Between Industries

To examine the earlier proposition about workers fleeing one specific industry to find work in another, I constructed Table 3 to show the industries family weights were affiliated with in one year compared to two years later. Industry affiliation does not mean the person has

necessarily found employment in that industry, it just means that is the industry they feel they are a part. The bottom row of the table, "% New to Industry", is the percentage of the total weight for a given industry in 2004 that was not in that industry in 2002.

Overall, it appears that the unemployed are not very "loyal" to their industry, as the average retention rate for all the industries is 38.5% (including the zeros from Arts, Utilities and Mining). Real Estate, Finance, and Agriculture have very high retention at 87.93%, 87.35%, and 69.31% respectively. Unemployment may simply be a part of the cyclical and seasonal nature of Real Estate, so many people who have been working Real Estate for a while may be moving in and out of employment. People working in Finance are probably specialized to some degree causing them to continually try and utilize their skills in that particular industry. As for Agriculture, maybe the adage "once a farmer, always a farmer" does indeed hold.

Aside from fresh entrants to the work force and retirees, Table 3 should capture much of the movement of workers between and within industries. We can also reasonably assume that an unemployed worker will be looking for a secure job in a secure industry, and thus Table 3 may also capture the perceptions of the unemployed about certain industries. Consider this example: In 2002, the Public Administration industry has 100 workers all working. In 2002, 10 of those workers become unemployed. If we use the numbers in Table 3 to apply to this situation, 5.467 of the 10 unemployed workers will still consider themselves as part of the Public Administration industry in 2004. Additionally, 4.008 unemployed workers from other industries in 2002 will become part of the Public Administration industry by 2004. 5.467 + 4.008 = 9.475. This number is very close to the original 10 unemployed workers, so we could say unemployed workers are not very averse to Public Administration as the inflow of workers closely matched the outflow. In other words, totaling the % New to Industry and the Retention Rate should indicate something

about the industry. Totals below 100% signify undesirable industries, as the unemployed are leaving and are not being replaced by unemployed from other industries. Totals close to 100% would indicate neutrality. Totals above 100% would indicate desirability as there are more unemployed people becoming affiliated with that industry than are necessary to compensate for the unemployed that disaffiliated themselves.

Almost all the industries lie in the 90% to 110% range, indicating neutrality. The exceptions are Real Estate at 125%, Finance at 126%, Education at 74%, Information at 80%, and No work at 85%. The desirability of Real Estate was undoubtedly part of the subprime real estate boom. Maybe unemployed people marveled at the large and easy commissions of selling real estate, or the wide availability of jobs related to homes and home ownership. The desirability of Finance may have come in part from the growth in entities that financed the loans for real estate. I am not sure what makes the Education industry undesirable, but it may be a result of state budget problems and the uncertainties of K-12 employment at times. It may also be associated with the low and relatively stagnant wages that are characteristic of public sector jobs.

The funny thing is, by this measure, being unemployed in 2002 and not affiliating with an industry by 2004 is more desirable than affiliation with the information industry by 2004. It is possible that sensationalized media information about off-shoring has deterred people from considering employment in the Information industry. It is even conceivable someone unemployed with a long-term horizon would decline employment in the Information industry seeing it as doomed and instead focused on Health or Finance. Anyhow, the Information industry at 80% receives the second lowest total after Education. Something must be truly toxic about the Educational industry because 8.55% of Educational unemployed jump ship to Information.

Another view of where the unemployed workers are going is presented below in Table 4. The table was constructed in the same way as Table 3 however the percentage values here represented the weighted percentage relative to all the people in the sample who were unemployed, not just any particular industry. The last row, "% Change from 2002 to 2004", is the percent change in the percentage of people affiliated with an industry. The data from Table 4 reinforces the conclusions from Table 3. The unemployed are leaving the Information Industry and looking for work elsewhere. If the unemployed are adjusting this quickly (at most 2 years delay) to the changing desirability of a job in the Information industry, unemployment may actually be lower in Information than the average for all the other industries. This has been the case since 2005, and in 2007, the U.S. unemployment rate was 4.6% while the unemployment rate for the Information Industry was 3.6%. If this is true, using unemployment statistics to support the argument that there is no problem with off-shoring may be deceiving. People are leaving the Information Industry, and no one is replacing them.

IV. How Workers Become Unemployed

The PSID uses six groups to categorize responses to the question, "How did your last job end?" These categories and their full descriptions from the codebook are below:

1 – Company folded/changed hands/moved out of town; employer died/went out of business

2 – Strike; lockout

3 – Laid off; fired

4 – Quit; resigned; retired; pregnant; needed more money; just wanted a change in jobs; was self-employed

7 – Other; transfer; any mention of armed services

8 – Job was completed; seasonal work; was a temporary job

Chart 3 was constructed using data for heads of families. This was to keep out any effects of any strange characteristics of jobs of secondary workers in a family. The percentages were

calculated by totaling the weight for each category (1, 2,3,4,7, or 8), and dividing that number by the total weight for all the categories combined and multiplying by 100. No workers had their last job end due to strike or lockout for any of the years in Chart 3 except for less than .05% in 1980, so category 2 is left out entirely. Another important note is that the data necessarily lags what is actually happening, because it asks people why their last job ended, whether the actual losing of their last job occurred the day before or up to a year before they were surveyed.

The most salient feature of this chart is the change in the proportion of people who quit, and the proportion of people who are laid off or fired from 1984 to 1985. While being laid off or fired was the number one reason for losing your job from 1981 to 1984, something happened by 1985, that this was no longer the case. The percentage of people responding their last job ended due to being laid off or fired decreased from 37.43% in 1984 to 20.51% in 1985. Absorbing all of this drop and more was the increase in the percentage of people whose last job ended due to quitting or resigning. This percentage increased from 24.91% in 1984 to 47.22% in 1985. The change is dramatic, and looks wrong, but the consistent average percentage of people whose last job ended due to quitting or resigning pre-1985 is around 30%, and post-1985 is around 45% just from looking at Chart 3. A shift must have happened at some point, it is just strange it would happen so abruptly.

It may be tied to the inflation rate that greatly decreased from 1980 to 1983. There is a theory about inflation affecting employment due to workers demanding higher wages than necessary to compensate for their expectation of higher inflation in the future (Friedman 1968). If inflation came under control, employers may have eased their labor cost cutting strategy of layoffs. That the total weight of people laid off or fired does decrease 26.5% from 1984 to 1985 supports this idea, however, the total weight of people quitting or resigning goes up 154% from

1984 to 1985, even though the total weight for the population only increased 34%. This would suggest most of the shift from layoffs and firings to quitting is more a result of increased firings and quitting than a decrease in layoffs. Another contributing factor may be the changes to Social Security that took place in 1983. The category for quitting and resigning also includes retiring, and the Social Security changes made in 1983 may have added to the incentives of retirement.

Category 4, quitting, resigning, etc., is the number one reason a person's last job ended in the most recent 20 years shown. It has generally declined during recessions as it does in the early 1980s, in the early 1990s, and in 2003. Being in a recession, or just coming out of one, people are more likely to value their employment and will hang onto their jobs. We would expect less people to be quitting, or "just wanting a change in jobs." Even if people thought they needed more money, they know any wage is better than none. People may also be more reluctant to retire in uncertain economic conditions.

As for the rise in category 4 from 39.9% in 1991 to 46.5% in 2001, this probably results from people feeling so good during that economic boom about income from the stock market, their ability to find a new job if necessary, and maybe a growing feeling (American Dream-itis?) among workers that they should pursue work that makes them happy and not waste their life at a job they hate.

The other responses appear less volatile and trend. There has been a general decrease in companies folding or moving out of town from 11.12% in 1980 to 5.35% in 1990 and 2.66% in 2005. While this category posted a 10.5% in 1999, this is the only year since 1988 the figure is above 7%. This category does not really capture off-shoring because with off-shoring, the company does not move out of town, the jobs do. Category 7, "other/transfer", appears to be steady over the 25-year period averaging 2.89% while rising as high as 5.69% in 1992, and

falling to as low as 1.29% in 1989. Category 8, “the job was completed or it was seasonal or temporary work”, rises during difficult economic times and falls during better times. One thing to note is in 2003, in response to the 2001 recession, this category’s percentage at 14.25% was higher than at any other time in the 25-year period shown, and in 2005, the “recovery”, this category’s percentage posted its second highest ever mark at 14.02%. If temporary work is indicative of difficult economic times, we should expect that it would have dropped to perhaps 12 or 13% or lower by 2005. It may be possible that temporary work is becoming a *permanent* mainstay of the labor market.

Table 5 was calculated using only heads of families in 2005. It includes workers from all industries but divides them based on whether they reported being unemployed at some time in the previous year or so. The last two columns, “Years at Current Job” were calculated by adding the variables for length of present employment. One variable was for the year, one for the months, and one for the weeks. I created a new variable equal to the years + months/12 + weeks/ 52. The reason I included the years at current job number for both 2003 and 2005 is because if someone was unemployed last year, obviously their years at their current job will be less than a year. Since my purpose for including length at present employment was to see if longer term workers were safer from losing their job or less likely to quit, it made sense to include length at present employment for a time period before unemployment.

We can see from Table 5 that the unemployed made far less money while they were working, they were also much younger, had slightly better health (lower is better, 1=excellent, 2=very good, 3=good, 4=fair, 5=poor) (although given the age difference, we could say the employed are relatively healthier), slightly less education, and had worked almost two years less

at their current job relative to their employed counterparts. In simple terms, the unemployed are the more obviously expendable workers.

V. Why Someone Might Be Unemployed

Table 7 contains three linear probability models with a dummy variable capturing whether a person was unemployed at some point in the year or so previous to 2005 as the independent variable. Thus, the coefficients listed are either increasing (positive values) or decreasing (negative values) the probability of someone being unemployed. The first model captures different economic situations by grouping states by their unemployment rates. The low unemployment states had 3-4.99% unemployment, the medium unemployment states had 5-5.99% unemployment, and the high unemployment states had 6%+ unemployment. The low unemployment states are the excluded group.

As we would expect, residing in a state with a higher unemployment rate and thus poor economic conditions will increase the probability that you are unemployed. The coefficient on medium unemployment states is not significant, but the coefficient on high unemployment states is both statistically significant, and practically significant at 2.12%.

The next model uses worker characteristics such as age, age squared, years of education completed, health status, and the wage rate from the previous year to predict the probability of unemployment. The excluded group is people with poor health. The coefficients on the age variables suggest that the probability of being unemployed decreases with age; this supports the earlier finding that workers on average in all industries who were employed were about 12 years older than the unemployed workers. The coefficients on health status show a decrease in the probability of being unemployed by 4.24 points for people in excellent health relative to people with poor health. This coefficient is also statistically significant. The other coefficients on health

also seem to suggest the unhealthy are more likely to find themselves unemployed. The negative coefficient on wage rate from the previous year indicates that the higher one's wage, the less likely one is going to be unemployed. The coefficient may seem small, but for a $20/hour wage, it can amount to a decrease in probability of unemployment by about 1/2 point.

The third model uses the different industries as the independent variables. The excluded group is those reporting they did not work prior to the survey question being asked. Information, Management, and Food Services provoke the highest increases in probability of unemployment at 5.26 points, 6.85 points, and 6.54 points respectively and all these coefficients are significant. Being in Public Administration or Active Duty Military decreases the probability of unemployment by 3.15 points, but this coefficient is not statistically significant. Nonetheless, it would be quite a stretch to imagine high unemployment in the military.

Combining models 1-3 into a single model causes the health coefficients to become slightly larger and slightly more significant. One interesting thing to note is that being in the Information industry now increases the probability of unemployment by more than any other variable, and has around 3x the effect of residing in a poor economic situation. This would seem to be strong evidence for deterioration of the Information industry job market.

None of the models have very high r-squared values…in fact, they are very low. However, the F-statistics are high enough to show that none of the models are completely insignificant. The combined model explains more of the variation in the probability of unemployment than the other models, and the model with worker characteristics comes in second place.

VI. Off-Shoring & the Information Industry

Off-shoring is when a company moves business processes abroad to affiliated or unaffiliated firms. The jobs, but often not the workers, associated with these business processes are also transferred abroad. During the 1990s, technological growth and innovation helped off-shoring take hold of white-collar jobs after it had already diminished the role of blue-collar manufacturing jobs in the U.S. Off-shoring is not an issue for every worker. A bartender does not have to worry about people traveling to another country to have their drinks served. However there are instances where different sectors are interconnected in such a way that job loss in one affects another, for example, if there is less manufacturing in the U.S., there is less material for truck drivers to transport. So, less truck drivers have jobs and thus buy fewer drinks (or maybe more to drown their job loss sorrows) from their bartender. Workers with jobs that are most likely to be moved offshore are 1) highly repetitive (accounting), 2) consist of predictable and well-defined work (customer service), 3) can be broken down into small manageable parts (software development), 4) can be turned into a routine (tele-marketing), 5) do not need to be close to the end customer (phone based tech support), 6) have end customers that have already moved offshore (semiconductor sales) (Career Planner).

There are several reasons a company may want to send business processes abroad, the main one being to cut costs. Cost cuts can be quite dramatic, for example, a computer programmer in the U.S. may make around $78,000 a year with benefits while the same job in India pays $8,000 a year (Economic Policy Institute). Other reasons to move offshore are 1) to enter a foreign market, 2) to gain technical skill sets that are unavailable domestically, and 3) to increase quality by using more skilled, but cheaper labor. The end goal of all these reasons is greater profit for the company through a combination of reduced overall cost of production and

an increase in market share resulting from higher quality products. Thus, the presumed winners of off-shoring are the consumer and the firm. The consumer gets a better product or service for the same or lesser price and the firm makes more money.

To examine the how people are leaving the Information industry we can check to see if larger shares of people are seeing their jobs end due to layoffs and firings as opposed to quitting. The sample sizes for Charts 4 & 5 are both around 20. In addition to the low sample size, I could not setup a chart to establish any long-term trend because the Information Industry did not exist as a category in the PSID codes for industry pre-2003, and I thought it would be dubious to attempt to artificially place people for the years 1991-2001 in the Information Industry based on whether or not they were in the information industry in 2003, and again in 2005 (to make sure they are persistently there, and not industry-hoppers). On top of all this, the person's last industry may or may not have been Information. For example, someone could have been laid off from a manufacturing job in 2002, and then have gotten a job in the Information industry. Thus, these charts are not necessarily characteristic of the Information industry.

Nonetheless, the total disappearance of category 8, temporary work, from 2003 to 2005, from 25% to zero, is astonishing. Perhaps the market for temporary work dried up quickly after the recession and people returned to permanent work. Even with this scenario, 25% to 0% is unlikely and most certainly a product of the small sample size.

The proportions for category 4, quit, resigned, etc. for the Information industry workers are close to the proportion for all workers. However, the proportions for category 3, laid off/ fired are higher for the Information industry workers than for all workers. In 2003, category 3 accounted for 29% of jobs ending for workers in all industries and 31.2% for workers in the Information industry, but in 2005, the percentages were 22.7% and 40.7% respectively. Because

of all the data issues discussed above, it does not seem responsible to infer that this is an indicator of off-shoring in the Information industry and that all the employers are firing their U.S. labor to hire overseas labor.

Table 6 describes the unemployed in the Information Industry. Health is similar in both groups, and the employed are older than the unemployed on average. The similarities end there. Not only is the age gap far less pronounced, we can see the Information Industry has much younger workers. Also, surprisingly, the unemployed earned significantly higher wages, and also were more educated.

The Information Industry unemployed also have spent much less time at their current job than the average for all industries, 1.88 years versus 3.39 years respectively. These results probably come from a combination of factors, among them (1) the small sample size of unemployed workers in the Information Industry, and (2) the relatively young age of the Information Industry. It is interesting that higher paid workers are being fired or quitting. Perhaps all the "hotshots" left over from the tech-boom have failed to prove their worth.

Also, maybe it is possible that younger and more costly workers are the ones more likely to see their jobs sent overseas, since the greatest amount of labor cost savings would arise from these jobs. It doesn't seem to be much of a stretch, and indeed explains the disparity between the "All Industries" and "Information Industry" data, that employers in the other industries fire the workers who are least critical when they need to cut costs, thus leading to an unemployed pool that receives a lower pay and is less educated. Employers in the Information Industry instead just send the most critical and expensive jobs to someone overseas who probably does an equal or better job for far less money. Other industry employers cutting from the bottom and Information Industry employers cutting from the top would explain the differences in Tables 5 & 6.

VII. Conclusion

The data from the PSID definitely shows something is happening in the Information Industry. It is shrinking relative to other industries and maybe even in absolute terms, a greater share of its workers are being laid off over time, unemployed people seem weary of the industry, and being a part of it greatly increases one's chances of being unemployed. Exacerbating the problem, it appears as though the higher earning, and more educated Information Industry workers are the ones becoming unemployed. The silver lining to what appears to be a dark cloud for some American workers is that they appear to be adapting quickly to the changing job market conditions as they enter other industries.

However, as the economy enters new recessions, unemployment seems to linger and employment prospects appear more hopeless. That lesser skilled workers suffer longer unemployment spells, and the very unskilled suffer much longer unemployment spells is indicative of a smaller labor demand for menial labor jobs. Perhaps some of these have been moved overseas as the U.S. economy has transformed.

There is also evidence of quite a few bubble workers whose skills do not seem to pertain to any particular industry. They just go from one 'hot' job to another, for example, the latest shift was from the Information Industry to Real Estate. What they will do when there is no burgeoning bubble is unclear; there may be an unexpected jump in unemployment.

Bibliography

Bureau of Labor Statistics. 17 March 2009. <www.bls.gov>

Economic Policy Institute. “Offshoring.” 17 April 2008.

<http://www.epi.org/Issueguides/offshoring/epi_issue_guide_on_offshoring.pdf>

Robinson, Michael. “The Offshoring of America’s Top Jobs.” Career Planner. 17 March 2009.

<http://www.careerplanner.com/Career-Articles/Offshoring-Jobs.htm>

U.S. Census Bureau. 17 March 2009. <www.census.gov>

Figures:

2002	5.8	16.66	9.20	21.11	2068
2004	5.5	19.61	9.82	22.34	2049

Table 1: What the population looks like (weighted)

Chart 1: Distribution of workers by industry (weighted)

Agriculture, Forestry, Fishing, and Hunting	18.11
Mining	-39.64
Utilities	16.84
Construction	47.45
Manufacturing	26.43
Wholesale Trade	60.70
Retail Trade	27.03
Transportation and Warehousing	21.31
Information	-3.70
Finance and Insurance	24.03
Real Estate and Rental and Leasing	35.74
Professional, Scientific, and Technical Services	38.24
Management, Administrative and Support and Waste Management Services	39.65
Educational Services	23.87
Health Care and Social Assistance	31.02
Arts, Entertainment, and Recreation	33.05
Accommodations and Food Services	21.59
Other Services (Except Public Administration)	32.01
Public Administration and Active Duty Military	8.92
Un-weighted Average	24.35
All Industries	27.58

Table 2: Change in total family weight by industry

Chart 2: Unemployment rate by industry (weighted)

Chart 3: Why Did Your Last Job End? (Weighted Percentages)

Employed	17.87	50.41	2.52	12.44	5.14	5.33
Unemployed	12.74	38.42	2.44	11.83	3.39	0.56

Table 5: Summary of Workers in All Industries In 2005 (weighted)

Employed	25.61	37.56	2	11.88	6.01	5.87
Unemployed	36.9	32.37	2.02	12.45	1.88	1.28

Table 6: Summary of Information Industry Workers in 2005; Sample size = 11 for unemployed.

Dependent Variable: Dummy Variable for Whether Unemployed (2005)				
Variable Name	Underlying Economic Situation	Worker Characteristics	Different Industries	Combined
State of Residence has Medium Unemployment	.0028502 (.708)			.0018429 (.808)
State of Residence has High Unemployment	.0212901 (.006)			.0194542 (0.011)
Age		-.0021472 (.000)		-.0019576 (.000)
Age^2		0 (.475)		0 (.699)
Years of Education Completed		.0001414 (.307)		.0001739 (.210)
Fair Health		-.018362 (.155)		-.0215259 (.096)
Good Health		-.0198509		-.0233379

	(.094)		(.051)
Very Good Health	-.033721		-.0367223
	(.005)		(.002)
Excellent Health	-.0424675		-.0442327
	(.001)		(.001)
Wage Rate from Previous Year	-.0002917		-.0002995
	(.000)		(.000)
Agriculture, Forestry, Fishing, and Hunting		.0172051	-.012939
		(.341)	(.480)
Mining		.0204873	-.0078456
		(.569)	(.835)
Utilities		-.0134942	.0208641
		(.113)	(.461)
Construction		.0269854	. 0203946
		(.000)	(.106)
Manufacturing		.0220579	. 0212227
		(.000)	(.041)
Wholesale Trade		-.0165237	-.0065957
		(.200)	(.702)
Retail Trade		.0295931	. 0177656
		(.000)	(.135)
Transportation and Warehousing		.0150609	. 015456
		(.003)	(.279)
Information		.0526823	. 0667953
		(.000)	(.000)
Finance and Insurance		-.0066807	-.0016511
		(.097)	(.922)
Real Estate and Rental and Leasing		-.0036154	.0026016
		(.243)	(.902)
Professional, Scientific, and Technical Services		-.0034653	.007923
		(.033)	(.580)
Management, Administrative and Support, and Waste Management Services		.0685273	. 0542749
		(.000)	(.001)
Educational Services		-.0075029	-.0014223
		(.080)	(.914)
Health Care and Social Assistance		.0205615	. 0128289
		(.001)	(.290)
Arts, Entertainment, and Recreation		.0201193	-.0015551
		(.228)	(.948)
Accommodations and Food Services		.0654233	. 0656375
		(.000)	(.000)
Other Services (Except Public		.0061706	.0085726
		(.004)	(.555)

Administration)				
Public Administration and Active Duty Military			-.0315845 (.797)	-.0298141 (.021)
Excluded Group	State of Residency with Low Unemployment	People with Poor Health	People who list "No Work" for Industry	The three groups to the left…
Intercept	.0526676	.2007407	.0301438	.1734198
Adjusted R-squared	.0013	.0279	.012	. 0338
F-Statistic	6.45	30.76	6.41	11.03

Table 7: Linear Probability Regressions (weighted); p-values in parentheses

Charts 4 & 5: Why Did Your Last Job End? For the Information Industry 2003 & 2005 (weighted)

54.67%	0.00%	9.45%	0.00%	5.94%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.13%	10.28%	0.00%	0.00%	14.26%	0.00%	0.00%	0.00%	1.28%
0.00%	**23.07%**	4.25%	0.00%	6.61%	0.00%	13.37%	0.00%	0.00%	1.84%	0.00%	0.00%	0.00%	5.86%	0.00%	8.82%	10.73%	0.00%	0.00%	25.46%
0.00%	0.35%	**44.54%**	0.00%	5.00%	0.00%	15.55%	2.09%	0.00%	0.00%	0.00%	8.39%	3.47%	5.38%	8.25%	5.24%	0.00%	0.00%	0.00%	1.75%
0.00%	0.00%	0.00%	**0.00%**	7.23%	0.00%	16.46%	39.34%	20.81%	0.00%	0.00%	0.00%	0.00%	0.00%	4.94%	0.00%	0.00%	0.00%	0.00%	11.21%*
0.00%	4.60%	1.01%	0.00%	**44.66%**	7.44%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	16.09%	0.00%	0.00%	21.15%	0.00%	0.00%	2.19%	2.86%
2.50%	0.00%	0.00%	0.00%	13.34%	**29.86%**	14.49%	0.00%	0.00%	0.00%	8.55%	4.70%	13.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	13.53%
0.00%	4.44%	5.28%	8.31%	1.72%	4.44%	**21.71%**	5.66%	0.00%	0.00%	0.00%	0.91%	21.77%	3.79%	7.45%	11.50%	0.00%	0.00%	0.00%	3.02%
5.63%	0.00%	18.02%	0.00%	0.00%	3.01%	0.00%	**28.88%**	0.00%	4.91%	9.51%	0.00%	10.61%	0.00%	15.55%	0.00%	0.00%	0.00%	0.00%	3.86%
0.00%	3.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**87.93%**	0.00%	0.00%	0.00%	1.10%	0.00%	7.91%	0.00%	0.00%	0.00%	0.00%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.38%	6.82%	0.00%	**87.35%**	0.00%	4.45%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.00%	0.00%	3.72%	0.00%	0.00%	0.00%	0.00%	23.82%	0.00%	0.00%	**35.00%**	3.72%	20.79%	0.00%	0.00%	9.24%	0.00%	0.00%	0.00%	3.72%
0.00%	0.00%	0.00%	0.00%	0.80%	2.43%	0.00%	0.00%	14.14%	0.00%	9.43%	**37.36%**	16.73%	0.00%	15.89%	2.43%	0.00%	0.00%	0.00%	0.80%
4.12%	5.51%	2.33%	0.00%	7.98%	0.79%	1.82%	2.07%	0.00%	0.00%	0.45%	5.50%	**38.33%**	1.68%	12.23%	2.27%	0.00%	0.00%	0.00%	14.91%
8.10%	0.00%	0.00%	0.00%	0.00%	0.00%	10.39%	22.73%	0.00%	0.00%	4.17%	3.03%	3.79%	**24.09%**	23.70%	0.00%	0.00%	0.00%	0.00%	0.00%
0.00%	4.13%	3.83%	0.00%	9.42%	0.00%	6.67%	1.09%	0.00%	7.91%	0.00%	5.26%	6.29%	1.33%	**43.14%**	6.86%	0.00%	0.00%	4.06%	0.00%
0.00%	8.25%	6.42%	0.00%	1.20%	0.00%	10.83%	0.00%	0.00%	0.00%	0.00%	3.97%	2.47%	0.00%	6.02%	**52.78%**	2.29%	5.76%	0.00%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**	0.00%	0.00%	0.00%*
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**	0.00%	0.00%*
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.75%	0.00%	0.00%	0.00%	0.00%	4.56%	6.79%	6.92%	10.66%	0.00%	0.00%	0.00%	**69.31%**	0.00%
1.00%	2.43%	5.89%	0.00%	7.09%	0.00%	3.31%	6.52%	0.00%	0.00%	0.00%	0.19%	10.81%	2.69%	8.64%	3.32%	0.00%	0.00%	0.00%	**48.11%**

Table 3: What Industry the Unemployed in 2002 Ended Up in by 2004 (By Weighted Percentage of Specific Industry); *= industry sample size less than 1/10 average industry sample size

1.70%	0.00%	0.29%	0.00%	0.18%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.32%	0.00%	0.00%	0.44%	0.00%	0.00%	0.04%	3.10%
0.00%	**0.92%**	0.17%	0.00%	0.26%	0.00%	0.53%	0.00%	0.00%	0.07%	0.00%	0.00%	0.00%	0.23%	0.00%	0.35%	0.43%	0.00%	0.00%	1.02%	4.00%
0.00%	0.03%	**4.08%**	0.00%	0.46%	0.00%	1.42%	0.19%	0.00%	0.00%	0.00%	0.77%	0.32%	0.49%	0.76%	0.48%	0.00%	0.00%	0.00%	0.16%	9.16%
0.00	0.00%	0.00%	**0.00%**	0.11%	0.00%	0.26%	0.63%	0.33%	0.00	0.00%	0.00%	0.00%	0.00%	0.08%	0.00%	0.00%	0.00	0.00%	0.18%	1.59%*

%									%									%			
0.00									0.00									0.00			
%	0.25%	0.05%	0.00%	**2.40%**	0.40%	0.00%	0.00%	0.00%	%	0.00%	0.00%	0.87%	0.00%	0.00%	1.14%	0.00%	%	0.12%	0.15%	5.38%
0.10									0.00									0.00			
%	0.00%	0.00%	0.00%	0.56%	**1.25%**	0.61%	0.00%	0.00%	%	0.36%	0.20%	0.55%	0.00%	0.00%	0.00%	0.00%	%	0.00%	0.57%	4.18%
0.00									0.00									0.00			
%	0.25%	0.30%	0.48%	0.10%	0.25%	**1.24%**	0.32%	0.00%	%	0.00%	0.05%	1.25%	0.22%	0.43%	0.66%	0.00%	%	0.00%	0.17%	5.73%
0.30									0.26									0.00			
%	0.00%	0.97%	0.00%	0.00%	0.16%	0.00%	**1.55%**	0.00%	%	0.51%	0.00%	0.57%	0.00%	0.83%	0.00%	0.00%	%	0.00%	0.21%	5.36%
0.00									0.00									0.00			
%	0.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**1.60%**	%	0.00%	0.00%	0.02%	0.00%	0.14%	0.00%	0.00%	%	0.00%	0.00%	1.82%
0.00									**2.08**									0.00			
%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%	0.16%	0.00%	**%**	0.00%	0.11%	0.00%	0.00%	0.00%	0.00%	0.00%	%	0.00%	0.00%	2.38%
0.00									0.00									0.00			
%	0.00%	0.19%	0.00%	0.00%	0.00%	0.00%	1.19%	0.00%	%	**1.75%**	0.19%	1.04%	0.00%	0.00%	0.46%	0.00%	%	0.00%	0.19%	5.00%
0.00									0.00									0.00			
%	0.00%	0.00%	0.00%	0.03%	0.10%	0.00%	0.00%	0.60%	%	0.40%	**1.59%**	0.71%	0.00%	0.68%	0.10%	0.00%	%	0.00%	0.03%	4.26%
0.34									0.00									0.00			
%	0.46%	0.19%	0.00%	0.66%	0.07%	0.15%	0.17%	0.00%	%	0.04%	0.46%	**3.19%**	0.14%	1.02%	0.19%	0.00%	%	0.00%	1.24%	8.33%
0.24									0.00									0.00			
%	0.00%	0.00%	0.00%	0.00%	0.00%	0.31%	0.68%	0.00%	%	0.12%	0.09%	0.11%	**0.72%**	0.71%	0.00%	0.00%	%	0.00%	0.00%	2.99%
0.00									0.96									0.00			
%	0.50%	0.47%	0.00%	1.14%	0.00%	0.81%	0.13%	0.00%	%	0.00%	0.64%	0.76%	0.16%	**5.24%**	0.83%	0.00%	%	0.49%	0.00%	12.14%
0.00									0.00									0.45			
%	0.64%	0.50%	0.00%	0.09%	0.00%	0.84%	0.00%	0.00%	%	0.00%	0.31%	0.19%	0.00%	0.47%	**4.09%**	0.18%	%	0.00%	0.00%	7.74%
0.00									0.00									0.00			
%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**	%	0.00%	0.00%	0.00%*
0.00									0.00									**0.00**			
%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**%**	0.00%	0.00%	0.00%*
0.00									0.00									0.00			
%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%	0.00%	0.00%	%	0.00%	0.11%	0.17%	0.17%	0.27%	0.00%	0.00%	%	**1.73%**	0.00%	2.49%
0.14									0.00									0.00			
%	0.35%	0.84%	0.00%	1.02%	0.00%	0.48%	0.94%	0.00%	%	0.00%	0.03%	1.55%	0.39%	1.24%	0.48%	0.00%	%	0.00%	**6.90%**	14.34%
2.83									3.37									0.45			
%	3.46%	8.05%	0.48%	7.03%	2.23%	6.73%	5.96%	2.53%	%	3.18%	4.67%	11.62%	2.52%	11.85%	9.22%	0.61%	%	2.34%	10.86 %	100.00%	

Table 4: What Industry the Unemployed in 2002 Ended Up in by 2004 (By Weighted Percentage of Total Population); *= industry sample size less than 1/10 average industry sample size

Theories of Gold Price Movements:
Common Wisdom or Myths?

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Abstract:
This paper examines several of the explanations commonly provided regarding gold and its price movements. We consider the safe haven, inflation hedge, and dollar destruction hypotheses. The results are mixed. Our data do not support the theories that gold is a safe haven or an inflation hedge. We find that gold is a zero-beta asset and there is a strong negative correlation between gold and the value of the US dollar in the post Bretton-Woods era. The decomposition of gold prices under a semi-structural model find the aggregate demand shock, monetary policy shock and precautionary demand shock of gold all only have modest influence on the price movement of gold.

Keywords: Gold price; safe haven; inflation hedge; zero-beta asset; dollar destruction; inflation forecast; exchange rate shocks; macro-economy shocks

JEL Classifications: E37, E31, Q31, Q39

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Common Wisdom or Myths?

1. Introduction

Gold has a unique status in the economic world, a precious metal with wide uses, a store of wealth, and for a long time, the measure of economic power for nations and the cornerstone of international monetary regimes. In recent years, the world has witnessed an aggressive increase in gold prices. Additionally, gold as an investment has drawn more attention since this transformational crisis began to unfold. This paper is another attempt to disentangle the price movement of gold in the after the Bretton-Woods system, the last international monetary regime based on gold: To what extent can we understand the price movement of gold? Can we find support for some popular opinions about gold and gold price on the finance media, for instance: a safe haven, a negative-beta asset, or an inflation hedge? How should we think about gold: a commodity or a monetary unit? This paper provides some thoughts on these questions.

1.1 The Gold Standard

Returning to the gold standard has never been seriously discussed for decades and after the waves of gold reserve sales in the last fifteen years or so, gold is more and more seen as a common commodity or jewelry metal. However, history has a long shadow in economic thinking and economic activities; one cannot fully understand the current status of gold and its price fluctuations while totally disregarding its history.

Gold has been used in rituals, decorations and jewelry for thousands of years. Its usual chemical properties—high density, superb malleability and the imperishable shine—and its genuine rarity all contribute to it being the most coveted commodity. But it was not until in the late nineteenth century when the gold standard was created that gold stepped onto the central stage of global economic life. In that half century, on one hand there were huge supply shocks of

gold as a result of the Gold Rushes; on the other hand there was soaring demand for a global monetary medium of high value to finance the rapid industrialization and the emerging international trade and banking. That Britain, the indisputable super power then, had adopted the gold standard coupled with a series of historical incidents led all major economies except China sign up to gold by 1900.

The gold standard, under which gold coins and fiat money central banks issued could be converted at banks freely at a pre-set official rate and nations settled balance differences in gold, has intrinsic deflationary pressure: the inelastic supply of gold always made the money supply insufficient in a growing economy with rising productivity (insufficient liquidity). To keep up with demand for money, monetary authorities developed "gold-exchange standard": bank notes of major economies could also be treated as reserve assets. But the faith in the convertibility of foreign reserves and foreign countries' monetary policies was always fragile. The huge global deflation after the collapse of foreign reserves under the interwar gold-exchange standard and the "beggar thy neighbor" policies largely caused the Great Depression.

The implemented Bretton-Woods system[2] was a fixed exchange rate gold-dollar standard regime. The U.S. monetary authority was put into a dilemma: whichever policy the Fed implemented—expansionary or tight money, it would lead to either deflationary pressure or the erosion of confidence on the dollar. Also, the domestic policy goals, such as maintaining economic growth and low employment and the responsibility of reserve-currency country—to stabilize the value of the dollar were often conflicting. The problem worsened in 1960s with the expenditure on social welfare programs and the war in Vietnam. Pressure from foreign governments and speculators on financial markets and U.S. government pushed Bretton-Woods

[2] The implemented Bretton-Woods system is pretty different from the designs. See the book "A Retrospective on the Bretton Woods System" for reference.

System to an end.

Since 1973, gold was publicly traded, with prices driven by market forces. It was not directly linked to any nation's monetary policy or the value to any currency. The central banks continued to hold considerable amount of gold reserves, for strategic or confidence reasons. There have been debates in academia on the better use of the former monetary gold.[3] Since 1990s, Bank of England, Swiss National Bank and central banks of Eastern Bloc countries have sold great amounts of their gold reserves.

1.2 Gold Demand

Gold has both private demand/use and government demand/use. As previously discussed, in the gold-standard era, government demand is monetary gold. In the post Bretton-Woods era, central banks still hold great amount of gold reserves as strategic assets ("war chest") but government demand is not very active and as influential as it was during the gold-standard years. Private use can be further divided using different criteria. One division is investment (ETFs, bullions, bars etc.) and non-investment (jewelry, industrial and dental). Another division is depletive uses (manufacturing and dentistry) and non-depletive uses (bullions, jewelry, ornamentation and hoarding etc.).

What are the shares of different gold demands? We could not find any data for gold-standard era. But there have been estimates that between half and two-thirds of the annual production went to private use.[4] One snapshot of recent years' gold demand breakup came from 2007. In that year, the gold reserves of central banks and international institutions (the IMF, for instance, is a large holder of gold reserves) decreased by 504.8 tons, which meant a negative demand or a net supply. All newly mined gold went to private sector: More than two thirds of it

[3] For instance, see the paper "The benefits of expediting government gold sales" by Henderson and Salant et al.
[4] The discussion is in Barsky and Summers (1988).

(2398.7 out of 3558.3 tons) went to jewelry; industrial and dental demand used up approximately 13% of the production. The remaining went towards private investment needs. Geographically, India consumed 773.6 tons of gold, about 20% of the world's production; ranked second was the greater China region consumed 363.3 tons. In terms of "stock", a rough estimate is that the total above-ground stocks of gold are about 161,000 tons[5], 51% of which are in terms of jewelry. Official sectors hold nearly 30,000 tons (18%), (private) investment 16%, and industrial 12%.[6]

1.3 Gold Supply

Gold supply for private use comes from mining, sales of gold reserves and "old gold scrap" (the recycling of gold). Gold mining went hand in hand with the geographical discovery of the earth by mankind. During the Gold Rush years (1850 to 1900), about twice as much gold was mined as in previous history. The annual production of gold continued to increase dramatically in the twentieth century: from less than 500 tons per year in the 1900s all the way to more than 2000 tons per year in late 1980s. In the last fifteen years though, the annual mining production fluctuated around 2500 tons,[7] which revealed the increasing difficulty of finding new deposits and mining and extraction in non-rich sites. Most of the gold left to mine exists as traces buried in marginal areas of the globe, for instance, in the rain forest in Indonesia, the Andes and on the Tibetan plateau of China. The environmental disasters[8] that accompanied gold mining in Africa, Latin America and East and Southeast Asia have drawn more and more attention.

[5] Whether this figure means the amount of gold have been mined in all human history or only those that are available to this generation is unclear.
[6] From World Gold Council website.
[7] The sources of data for the gold worksheet are the mineral statistics publications of the U.S. Bureau of Mines (USBM) and the U.S.Geological Survey (USGS)—Minerals Yearbook (MYB).
[8] In forms of mercury linkage, deforestation, waste rocks etc..

1.4 Gold Price Movements

We chose the perspective of testing the commonly-held and hotly-debated opinions about the gold prices as a means to analyze its price movement. We considered several common-wisdom "theories."

First, people claim that because gold remains the eternal symbol of wealth in people's minds, people will switch their investments to gold in ages of turbulence. Gold is the "safe haven" in the financial market. To test this hypothesis, we look into various "fear" measures: volatility in the stock market, consumer expectations of the future, and bond risk premiums (the yield difference between Aaa and Baa bonds). A somewhat related hypothesis "gold goes up when everything else going down"—the negative-beta asset hypothesis is also tested.
Second, people marketing gold investment products will always describe gold as an "inflation hedge". A straightforward analysis is provided on the real gold price (level), the return of gold and expected and actual inflation to disprove this claim.

Instead of viewing gold as a special asset, the data suggest it is more reasonable if we view gold as a currency, whose value is a reflection of the value of U.S. dollar (or whichever currency its prices are denominated in). We extensively investigate the relationship between gold prices and the dollar and dollar-valued assets in section 5.

Some other less theoretical sayings are considered too, for example the effect of a surging demand in India and/or in China and the central bank gold reserve sales on the gold price.

The paper is organized as follows: section 2 describes the data used in this study; section 3 focuses on the safe haven hypothesis and whether gold behaves as a negative beta asset; section 4 is on the inflation hedge hypothesis; section 5 investigates the relationship between

gold prices and the U.S. dollar; section 6 reports results from multiple linear regressions. A semi-structural VAR model is constructed in section 7 before we conclude.

2. Data

Our data includes real gold prices, various "fear" indicators, the U.S. inflation rate, the real long-term interest rate, a few indicators of real economic activity and the exchange rate. Our sample period is from January 1978 to October 2008. We used monthly data. Most of the data are of daily averages or are available monthly.[9] When necessary, we converted variables to real terms using the monthly change in U.S. Consumer Price Index obtained from the Federal Reserve Bank of St. Louis website, to adjust for inflation.

For gold prices, we used the closing price on the last trading day each month for gold on the New York Mercantile Exchange. The data series ranges from January 1956 to October 2008 and is available on the Commodity Research Board (CRB) website. We converted the nominal figures to real terms in October 2008 dollars.

For our simple linear regressions we used the following model:

$$r_t^g = \beta_0 + \beta_1 f_t + \varepsilon_t$$

r_t^g is the monthly gold return in real dollars for period t, and f is the value of the independent variable of interest. We initially used the logarithm of gold prices as the dependent variable. This yielded results with high statistical significance and high R-squareds, but also high serial correlation evidenced by Durbin-Watson statistics in the .05-.2 range. There is a lot of inertia in gold prices from month to month. If gold prices are high one month, they are likely to be high in the next month as well. We also had to make sure to correct for stationarity as gold prices have at

[9] The monthly available series include: US Industrial Production Index, U.S. CPI, Kilian Dry Cargo Freight Rate Index and University of Michigan Consumer Expectation Index. The Moody's BAA and AAA seasoned corporate bond yields, Trade Weighted Exchange Index: Major Currencies, 10-year Treasury bond rate are averages of daily data.

times exhibited heavy upward trends (2000-2008) and also heavy downward trends (1980-2000). Overall, gold prices appear to have been in a downward trend since the peak in the early 1980s as shown in Figure 1.

We addressed both serial correlation and trending by using monthly gold return in dollars as the dependent variable as did Baur and Lucey (2007). Figure 2 shows monthly gold returns are not serially correlated. Month to month, returns are quite noisy. Additionally, the returns appear to be stationary as they are pretty much fixed oscillating around zero rather than trending upwards or downwards. For a given month, the monthly return is the change in the real gold price from the last day of the previous month to the last day of the current month. Regressing real gold prices on a one period lag along with the independent variable of interest proffers the same conclusions as the model proposed above so we do not report those values in this paper.

3. Safe Haven Hypothesis & Gold as a Negative-Beta Asset

People often associate gold with the notion of a safe haven. We define safe haven assets to be assets that people would like to invest in when uncertainty and fear increases. These assets would preserve their values in times of turmoil or recession. The safe haven hypothesis is closely related to the negative-beta hypothesis. What distinguishes safe haven assets from negative-beta assets is that that a safe haven is weakly or even negatively correlated with other major assets in times of stress only and not necessarily on average. Negative-beta assets are those that are (strictly) negatively correlated with other assets on average.

First, we look at the "fear premium" side to the safe haven hypothesis. If this hypothesis is true, if people become more fearful in the markets, the price of gold should rise. The first issue in testing this claim is defining fear. Newspaper or website articles often cite the CBOE Volatility Index as their measure of fear to the extent that it has been nicknamed the Fear Index.

The CBOE VIX uses put and call option prices to calculate expected near-term volatility in the S&P 500. While this is currently the most common measure of fear used in the financial press, it did not exist until 1990. We cannot generate the CBOE VIX from mid-1970s to 1989, so we followed Cutler, Poterba and Summers' (1988) method of constructing a volatility measure based on squared monthly returns of the S&P 500 Index. For robustness, we also included other fear indicators incase following the general definition of fear was not accurate.

Our second measure of fear is the University of Michigan Index of Consumer Expectations. It represents sentiment of the general public about the economy in the near future. This index is based on the relative scores (the percent giving favorable replies minus the percent giving unfavorable replies plus 100) of each of the five survey questions. Higher scores represent optimism and lower scores represent pessimism. The indices are monthly published by Reuters and Survey Research Center of University of Michigan. The index is by construction both stable and stationary.

Our last measure of fear is a bond premium; the difference in yields between Moody's Aaa and Baa seasoned corporate bond. The monthly data for the two series are available on FRED. This widening of the premium is an indicator of growing uneasiness on the market.

We then turn to the negative-beta asset side of the safe haven hypothesis. An asset's beta coefficient tells how its expected return is correlated to the return of the market as a whole. A negative beta means the asset's movements are opposite that of the market. In other words, the claim here is that the price of gold should increase as the market falls, and vice versa. There is some disagreement over what exactly constitutes "the market", so we have included analysis of the traditional favorite, the S&P 500, along with an index of industrial production and a dataset of cargo freight rate changes.

The industrial production index is seasonally adjusted and in real terms. It can be obtained from FRED.

The cargo freight rate change dataset was constructed by Professor Killian using "representative single voyage freight rates collected by *Drewry Shipping Consultants Ltd*. for various bulk dry cargoes consisting of grain, oilseeds, coal, iron ore, fertilizer and scrap metal." It is in real terms, and has been de-trended. Among Kilian's rationale for the index are it is an indicator of the impulse of the world economy and it avoids the exchange rate. The dataset range ends in December 2007, instead of October 2008 like the rest of our data.

3.1 Gold & Volatility

We started looking at the effect of volatility on the price of gold to test the safe haven hypothesis. Looking at Figure 3, a graph of the logged real price of gold and the constructed volatility measure, the safe haven effect is not evident. Many of the most salient moves in the graph either provide evidence that is contrary to the idea of gold being a safe haven, or provide no evidence at all. From 1978 to 1980, the price of gold rises from $611 to $1897 (in 2008 dollars), while volatility falls from 37 to 33. The safe haven hypothesis does not require volatility is the only factor in gold price movements, and there is a lot of noise in the volatility data from month to month, but we would expect the overall mean of volatility to be elevated during a tripling of the gold price. Additionally, elevated levels of volatility such as 1998 to 2003 are accompanied by falling gold prices. One period where the fear premium seems to hold is from 1987-1988 where volatility is at its highest level ever in the sample period and the price of gold rises. The only caveat is the price of gold does not rise by as much as the fear premium hypothesis would lead us to expect.

According to the hypothesis, we would expect β_1 to be positive, that is, increases in the fear indicator should lead to increases in the monthly gold return. Regressing monthly gold returns on the constructed volatility measure yields an R-squared of only .00003 and a p-value of the beta coefficient .738. So it is statistically insignificant. The coefficient on the volatility measure at .415 means a one percent rise in volatility leads to a monthly increase in the gold price by 42 cents, which is economically insignificant. This confirms what the graph shows. Gold returns and volatility are uncorrelated and changes in volatility do not seem to have any effect on the price of gold.

It is possible that market participants do not interpret volatility in the market as risk and thus see no reason to buy gold. Evidence of this is in the technology sector boom in the late 1990s where volatility rose to much higher levels but the gold price declined. The volatility increase in this period was a result of equities rising by large amounts day after day. If investors were afraid of anything, it was that they would wake up late and miss an opportunity for a huge return.

Along these lines, it is possible that the CBOE VIX is a better measure of fear as it moves relatively higher for large negative moves than for large positive moves and thus is more representative of fear rather than just volatility. However, regressing monthly gold return on the logarithm of the monthly high of the CBOE VIX for the sample period of January 1992 to October 2008 yields a co-efficient of -10.604, a p-value of .0461, and an R-squared of .01974. Not only is the coefficient significant, it is the wrong sign for the hypothesis, negative. This reinforces the result obtained from using S&P 500 constructed volatility.

Nonetheless, there are two spots in Figure 3 where volatility and gold prices move in tandem: 1987 and 2007, two periods of genuine stress in the markets. They suggest we look at alternative measures of fear to further investigate the fear premium hypothesis.

3.2 Gold & Consumer Expectations

Substituting the University of Michigan Index of Consumer Expectations (ICE) for the fear indicator leads to a similar result. For the "fear premium" hypothesis to hold here, gold should rise as the expected index falls. For comparison with the S&P 500 constructed volatility measure, ICE should be high when volatility is low. Graphically, the "fear premium" relationship looks stronger. During the 1990s as the expectations index was rising, the price of gold was falling, and then when ICE began to fall in 2000, gold began to rise. The same relationship held in the 1980 period with the large increase in the price of gold at the same time of a large decline in ICE.

The data nearly establishes the conclusion that rising expectations are associated with lower gold prices and vice versa. A one percent increase in the expectations index leads to a decrease in monthly gold return by $23.90. The R-squared from this model is .006; not much of the variation in monthly gold return is explained by consumer expectations. The p-value of .1307 also makes the coefficient statistically insignificant. Nonetheless, the sign is consistent with the theory; if consumers have low expectations of the economy and are thus fearful of the future, the price of gold should rise.

We would expect consumer expectations to give an overall picture of longer term trends in the economy. This characteristic would make ICE less able to inform the return on gold prices for any given month. Using quarterly and bi-annually gold returns yields coefficients of -38.71 and -42.83, respectively. Both coefficients are statistically significant, and the R-squared

increases as the frequency decreases. The interpretation is that declines in consumer confidence are more reliably indicative of increasing gold prices in the longer term.

3.3 Gold & Bond Premiums

It is not straightforward that expectations of consumers in general represent the mentality of the small group of much more sophisticated gold traders. A more appropriate fear indicator might the Baa/Aaa bond premium. The Baa/Aaa bond premium we constructed is Moody's Aaa Corporate Yield subtracted from Moody's Baa Corporate Yield. In scarier times, Baa bonds are relatively more risky because lower rated companies become relatively more likely to default, thus investors require a greater premium over the Aaa yield.

In 1982 and 1983, the bond premium is rises significantly while the gold price falls. In 1991, there is a spike in the bond premium (perhaps related to the Savings and Loan crisis and or the declaration of the Persian Gulf War) but no similar spike in the gold price. The same thing happens again from 1998 to around 2002 as the bond premium jumps while the price of gold falls or stagnates.

The fear premium hypothesis fails here again. The regression result of a $7.13 decrease in the monthly gold return for a one percent rise in the bond premium is economically insignificant and the p-value of .35 makes it statistically insignificant. Moreover, the sign contradicts the hypothesis. As the bond premium rises, the gold price should also be rising as should gold returns. Regardless of whether quarterly or bi-annual returns are used, the coefficients still remain negative and small, and also statistically insignificant. Nonetheless, the bond premium is a better match than volatility for the fear premium hypothesis as it has a larger R-squared, but is not as good as the Index of Consumer Expectations.

The theory of buying gold in hopes of high returns during hard times in the market is defeated. We next turn to gold and its relationship over time to the market in general.

3.4 Gold as a Negative Beta Asset

In 1981, gold appears to peak with the S&P 500. In 1983, they appear to bottom out together. In 1984, they again appear to peak together. This co-movement appears roughly throughout the sample period with the exception of 1990-2003. These thirteen years are probably the foundation upon which the hypothesis that gold is a negative beta asset is based.

The simple linear regression rejects the negative beta asset hypothesis. Regressing monthly gold return on the difference in the S&P 500 month to month yields a coefficient of . 0221 with a p-value of .7382 (using the logarithm of the S&P 500 yields nearly identical results) and an R-squared of .0003. This means, not only does the S&P 500 explain less than 1% of the variation in monthly gold return, but we cannot reject the hypothesis that the coefficient for the S&P 500 is zero. McCown and Zimmerman (2006) get the same result over a slightly different sample period of 1970 to 2003, stating that, "gold shows the characteristics of a zero-beta asset." Zero-beta in this instance means gold does not follow or counter the S&P 500 at all, instead, it is uncorrelated.

We also considered measures that are not the market itself, but represent market conditions. The index of U.S. Industrial Production from the FRED, is even worse for the negative beta asset hypothesis. Industrial production decreases over the sample period because it has been deflated by the Consumer Price Index and is shown in real terms. From 1978 to 1981, the negative beta theory seems to be in effect as gold rises and industrial production falls. From 1982 to about 1993, gold and industrial production appear to rise and fall together.

We regressed monthly gold returns on the difference in industrial production from one month to the next. The coefficient was -3.87 with a p-value of .4766. This is statistically insignificant and tells us the same thing as our analysis of gold and the S&P 500. Gold is not a negative beta asset. If anything, it is a zero-beta asset.

Our last measure is more indicative of global market conditions. Cargo freight rates are a particularly good indicator of economic activity because the supply of ships is very sticky. If there is a demand surge due to increased economic activity, it takes a long time for new ships to be built to accommodate the new demand. Thus, in the short to medium term, there are large increases in shipping rates. These large increases leave room on the way down for huge plunges. This sensitivity makes shipping rates a good indicator of exactly what is going on in the world markets at a given period in time.

Our data comes in the form of percent changes from one month to the next and1978-1982 do not look promising for the negative-beta hypothesis. The only really convincing negative-beta movement is around 1990 to 2001 where cargo freight rates spike for a little bit and the gold price bottoms. The regression of monthly gold returns on the cargo freight rate change yields a coefficient of .0818 and a p-value of .5533. Negative beta theory fails again.

Figure 4 confirms gold is a zero-beta asset as the slope from the regression line for the scatter plot of monthly gold returns and cargo freight rate change is nearly zero.

4. Inflation Hedge

Gold is also commonly believed to be a hedge against inflation. We define inflation as the general rise in the price level (rather than an increase in the money supply) and use changes in the Consumer Price Index as the measure of monthly inflation. To be a hedge against inflation

as the idea is most commonly understood, gold would not only have to be uncorrelated with inflation, it would have to be negatively correlated.

In 1978, Roy Jastram, a professor of business at Berkeley, wrote a book titled *The Golden Constant* that says since the 1560 gold has held its purchasing power in England and the United States. The theory also claims commodity prices move towards the gold price rather than the other way around. This thinking is in line with inflation hedge theory: an investment in gold should at minimum retain its purchasing power by responding to rising inflation through increased returns. Stated differently, as the general price level is increasing, or the purchasing power of the dollar is decreasing, gold will increase in value thus counteracting an investor's loss in purchasing power. We expect gold prices to respond more to expected inflation rather than actual inflation, because it is the perception of future inflation risk that this hypothesis posits as the reason for fluctuations in the gold price. Our measure of expected inflation comes from the University of Michigan/Reuters Survey of Consumers. The survey reports the median price change expected over the next 12 months. A graph of expected inflation shows it to be somewhat sticky. When actual inflation is rising sharply as it did in the early 1980s, people were expecting it to come back down. When it falls sharply as it did in 1987 and 1998, people were expecting it to rise back to a more normal level.

If the price of gold responded to inflation alone, a graph of the real gold price would be a horizontal line. If gold prices responded to inflation among other things and a graph of the real gold price was an upward sloping line, we would assume its returns outpaced inflation as we would assume its returns trailed inflation if the line sloped downwards. A graph of nominal gold prices should slope upwards at or above the rate of inflation if gold were to be a hedge against

inflation. All these examples are assuming the current United States environment of constant targeted inflation of two to three percent each year.

For our Consumer Price Index monthly data, the beginning of a period is the first day of the previous month and the end of the period is the first day of the current month. Because the gold price data is from the last day of the previous month to the last day of the current month, we do not have to use lagged variables to capture effects of inflation on gold.

4.1 Gold & Expected Inflation

Graph 6 shows the close relationship between the gold price and expected inflation. The two curves nearly mirror each other, through the peaks of the early 1980s, to the decline in 1986, to the troughs in 2000. However this relationship is very crude. Looking closer, we can see that in 1983 inflation is dropping dramatically, but the gold price is rising. There are also numerous instances such as 1986, 1988, and 1998-2004 where either expected inflation or the gold price are making large moves but the other remains quite stable or behaves in a way contrary to what inflation hedge theory would suggest. McCown and Zimmerman (2006) find the same result for monthly returns, however, they do find when annual frequency (but not quarterly frequency) is used higher inflation is associated with higher gold returns.

Regressing monthly gold returns on the logarithm of expected inflation yields a coefficient of 3.98 with a p-value of .5833. The simple linear model rejects the inflation hedge hypothesis.

4.2 Gold & Actual Inflation

We get the same result using actual inflation. When actual inflation is used as the independent variable, the coefficients are much smaller and are even more statistically insignificant. A graph of expected and actual inflation gives some insight as to why this is true.

Actual inflation is much more volatile than expected inflation. People do not wildly change their expectations of future inflation but instead look to see what has happened both in the recent past and further back historically to inform their expectations. As stated earlier, expected inflation is sticky. Actual inflation, on the other hand, fluctuates a lot even when it is in a downward or upward trend. From 1985 to 1992, expected inflation rises a little bit gradually while actual inflation rises sharply, plateaus for a year, rises sharply again, only before dropping dramatically in 1992. These whiplashes are not as present in the expected inflation index and thus that model allows for a stronger relationship with gold returns.

5. Dollar Destruction

Connected to the idea of gold and inflation is the theory of gold responding to "dollar destruction." Inflation can also be defined as increases in the money supply. As the money supply increases while productivity and output remain the same, prices increase. This has occurred on numerous occasions as bad governments print large amounts of money and eventually send their countries into hyperinflation. The somewhat analogous story, as purported by defenders of this theory is that when, by decreasing interest rates, or running a budget deficit, the Federal Reserve or the government decreases the value of the dollar. They believe the best defense to the loss of purchasing power that comes about from these government and government-like actions is to buy gold. This is distinct from the inflation hedge theory because it involves not only loss in purchasing power due to the general rise in prices, but also to a loss in purchasing power in a global environment due changes in exchange rates that are unfavorable to dollar holders.

We look at the issue from two angles: first, we investigate the relationship between gold and real interest rates, and second, we investigate the relationship between gold and exchange rates.

5.1 Gold & Real Interest Rates

The real interest rate hypothesis suggests that as real interest rates in the United States increase, investors should sell their gold and buy treasuries. There are multiple rationales for this behavior. First, if the return to a risk-free asset, or any asset for that matter increases, the demand for that asset should also increase, thus decreasing the funds available for purchases of gold. Another rationale is related to the value of the dollar. As the U.S. real interest rate increases, the demand for the dollar should increase as investors from around the world should be purchasing dollars to take advantage of treasuries that now carry a higher return. As they purchase dollars the value of the dollar should increase, thus decreasing the relative value of gold. If an ounce of gold is worth $50 today, and tomorrow the dollar is worth twice as much as a result in a surge in demand, that same ounce of gold should only be worth $25.

However, following the same analogy, future gold investors should now expect a higher yield from gold as the required rate of return has risen as a result of a rise in the real interest rate. Thus, when real interest rates rise, we would expect a decrease in the gold price and a later rise in the gold return.

The real interest rate used here is the 10-Year Treasury bond rate minus the expected inflation number discussed earlier. The argument for using expected inflation here instead of actual inflation is similar to the earlier argument. According to the real interest rate hypothesis, the price of gold would be affected by future expectations of inflation, not old values. We can see in the early 1980s as gold performs two drops, the real interest rate has two peaks. From

1987 to around 2006, the relationship does not appear to be as strong but it still appears to be there.

For our real interest rate monthly data, the beginning of a period is the first day of the previous month and the end of the period is the first day of the current month. Once again, because the gold price data is from the last day of the previous month to the last day of the current month, we do not have to use lagged variables to capture the relevant effect of the real interest rate on gold.

Regressing monthly gold returns on real interest rates yields a coefficient of -3.31 with a t-statistic of -2.89 and an R-squared of .022. This means a one point rise in the real interest rate is associated with a $3 decrease in the price of gold over a month. This is economically insignificant as a one point rise in interest rates is huge. Regressing monthly gold returns on real interest rates for the current period, previous period, two periods past, and three periods past results in two significant coefficients: the contemporaneous coefficient is -9.85 with a t-statistic of -1.92. This is the same sign as before and is what we expect, a drop in gold prices (we can assume a fall in monthly gold return for the current period is the same as an immediate drop in gold prices). The coefficient for three periods (months) in the past is 16.919 with a t-statistic of 3.312. Thus, increases in the real interest rate in the past lead to increases in the monthly gold return. It is worth noting the R-squared value increases to .057 from .022 for this model with three independent variables.

A one point rise in real interest rates this month corresponds to a decrease in gold prices this month of $9.85, and an increase in gold prices three months from now of $16.92. This is what we were expecting. Once the real interest rate rises, monthly gold returns should rise as investors are now demanding a higher rate of return since the return on risk-free assets has risen.

5.3 Gold and the Dollar Exchange Rate

The exchange rate hypothesis is similar to the inflation hypothesis. However, instead of inflation causing a decline in purchasing power, it is a decline in the value of the dollar (from excess inflation [relative to other nations] among other factors). To examine this theory, we used the Trade Weighted Exchange Index. This index from FRED includes currencies from the Euro Area, Canada, Japan, United Kingdom, Switzerland, Australia, and Sweden. The index is the dollar against the currencies in this basket, or US$/basket, such that high values for the index mean a relatively strong (or high value) dollar, and low values for the index mean a weak dollar.

Figure 6 shows the logarithm of the real gold price and the value of the dollar. To some degree it resembles the gold and real interest rate graph only it is much smoother. Throughout the entire period (although less so from 1990 to 1997) the gold price and the dollar exhibit an inverse relationship. For example, from 1978 to 1982, the dollar falls and gold rises, from 1982 to 1987, the dollar rises and gold falls. Peaks seem to match up very closely with troughs, and even smaller dollar movements such as those that occurred in 1982-1983 are matched inversely by gold price movements. This graphical analysis suggests gold has a very strong relationship with the value of the dollar.

The simple linear regression confirms this. We used the difference in the dollar value from one month to the next as the independent variable. The coefficient is -7.4. It has a t-statistic of -4.71 and an R-squared of .057. A rise of one unit (because the index oscillates around a base value of 100 this is approximately a one percent rise) in the value of the dollar decreases the real price of gold by $7.40. Put it into the current price level of gold, which is about 800 dollars per Trojan ounce, this amount is approximately one percent, which can be considered economically significant.

A graph of real interest rates and the dollar shows the relationship discussed above. They move pretty well together with real interest rates being a slight lead. However, in 1997, the relationship breaks when the value of the dollar increases significantly. The cause of this decoupling of dollar value to real interest rates was the Asian financial crisis in 1997 after the Thai government could not defend the baht and maintain its peg to the dollar. As Asian currencies crashed, the relative value of the dollar increased thus resulting in the mountain top shown in the graph. As of about 2006, the real interest rate and dollar relationship seems to have been restored.

5.4 Gold as a Currency

To summarize, the dollar destruction hypothesis stands. Gold has unique features in comparison to other commodities. From its physical properties, gold is largely unproductive except in minor mechanical manufacturing and dentistry. One main demand of gold is in jewelry, which largely will be passed down from generation to generation. It is so durable to the point that gold mined each year adds (2,000 to 3,000 tons) very little to the existing stockpile (approximately 150,000 tons). Furthermore, from the little gold demand data available (from the World Gold Council), gold demand, and no sector of gold demand (jewelry, investment & ETF, etc) appear to have any effect on gold prices. Preliminary research shows all coefficients to be statistically insignificant for the short sample period for which data is available, 2001-2008.

Perhaps more important, gold has played a role as universal means of exchange through most of human history. Thus, it makes sense to think of gold as another currency. Along this line of thinking, gold value is simply relative to other currencies, and thus the gold price in real dollars should have an inverse relationship to the value of the dollar. Because high real interest rates increase the value of a currency, high interest rates should also in the shortest term have an

inverse relationship with gold (and in the longer term increase gold monthly returns) and this is what we find.

5.4.1 Gold Specific Price Movement

To further examine the idea of gold being more of a currency than a commodity, we regressed gold returns on the CRB index (differenced) and stored the residuals. We then regressed these residuals on the one-period lagged residual (to correct for serial correlation) and also the same factors mentioned earlier in the paper to see if the effects of interest rates, industrial production, inflation, and so on, were affecting commodities in general or were specific to gold prices. If coefficients showed up with significant relationships to the residuals, then we could conclude there is some component of gold price movement that cannot be captured by the general movement of commodities. The results are reported in Table 2 below. The first column of numbers shows the coefficients for many simple linear regressions, and the next column shows the coefficients for a single multiple linear regression.

The coefficients do not mean much, but the significance for the multiple linear regression is close to our previous results. The dollar appears to have an affect on gold prices that is outside its affect on commodities in general. This would suggest gold is more of a currency than other commodities. In the multiple linear model, consumer expectations is also significant. In our previous results, it was nearly significant, so this is not a real clash. The only real change is that real interest rates no longer show up as significant and the p-value of .34 is quite large. It is possible inflation expectations are taking away from some of this relationship as discussed before, or it may just be that real interest rates affects gold in the same way as they do other commodities. They are all assets after all which must earn some rate of return.

The simple linear regressions in Table 2 all show up with statistically significant coefficients (with the exception of volatility), so there is not much to infer here other than individually, the relationship between these factors and gold prices is not fully accounted for in general commodity price movement.

6. Multiple Linear Regression Models

We now do several multiple linear regressions to see the *ceteris paribus* effects of the above-mentioned factors. Model 1 incorporates all the independent variables from the simple linear regressions earlier. The results are shown in Table 1. The coefficients of independent variables in Model 1 are similar to those in the simple linear regressions, showing the correlations between independent variables are not large.

Model 3 is slightly more restrictive, limiting the regression to only the best fear indicator, inflation indicator, and market indicator as defined by highest significance from the simple linear regression. All of the independent variables from the dollar destruction section are included. The results once again remain unchanged except for slight changes in the magnitudes of the coefficients. None of these multiple linear regression models are particularly interesting however, prompted by McCown and Zimmerman's (2006) finding that inflation is not a factor in the short term but in the long term, we applied our same models to annual frequency. The results shown in Table 1 are different. Tables 1 also compares Model 2 for monthly and annual frequencies, along with Model 3 for monthly and annual frequencies.

Previous research says inflation becomes significant over longer periods of time. To explain this, we can consider how we think about gold. When gold demand is broken down, only 15% is investment demand, the rest is jewelry consumption, industrial and dental (http://www.research.gold.org/supply_demand/). If we think about gold as a good or production

input, rather than money, it is not far fetched to assume its price over time should rise along with the general rise in prices. The Consumer Price Index is derived the change in prices of a basket of goods, maybe computers, refrigerators, bread. If you throw gold into that list, it should rise along with everything else over longer frequencies. Nonetheless, in shorter time frames, the 15% of gold demand that is investment is moving the price all over the place as it considers factors such as the value of the dollar and real interest rates.

To explain the insignificance of expected inflation (which is counter-intuitive by earlier analysis), we need to think about inflation, real interest rates, and the value of the dollar together. As we have said earlier, they are intertwined. Regressing the difference in the dollar value on real interest rates yields a coefficient of 1.06 with a p-value of .0571 and an R-squared of .12. Regressing the difference in real interest rates from one period to the next on the logarithm on inflation yields a coefficient of 1.22 with a p-value of .008 and R-squared on .224. If inflation is perceived to be increasing, people can reasonably understand interest rates will rise. If real interest rates rise, it can be believed the value of the dollar will increase. Both increases in real interest rates and increases in the value of the dollar lead to drops in the gold price. Although a higher interest rate may lead to higher gold returns in the future, this multiple linear regression is contemporaneous and thus does not capture this effect. Instead, we probably get a lower coefficient on expected inflation due to people anticipating the effects such inflation will have on real interest rates and eventually the dollar.

7. A Semi-Structural VAR Model

In the previous section, we showed very roughly the correlation between macroeconomic factors of interest. The above-mentioned multiple linear regression models are not proper for investigating the responses of gold price to changes in those macroeconomic aggregates and vice

versa as there is consensus among economists that the price of gold is endogenous. Nevertheless, we are interested in which factors drove up the real price of gold and their relative contribution in different times of history. In order to do so, we perform impulse response functions, variance decomposition (VDC) and historical decomposition (HDC) of the real price of gold using a semi-structural vector auto-regression (VAR) model.

7.1. Methodology

VAR allows us to examine the dynamics between variables in the models with the presence of movements of other variables. The power of a structural VAR is that it can give us mutually independent shocks (structural shocks) which enable us to track how the cumulative effect of one given shock alone on the price of gold. Also, we can identify the contribution of one shock in the price movement of gold at given points in history. We first estimate the reduced form VAR using the least squares method. Then, we orthogonalize the reduced-form errors in VAR using Cholesky decomposition to get the structural errors. By orthogonalization we actually assume a particular chained relationship, which must be an economically sensible framework. We will defend the structure and assumptions of the model below. For the purpose of this study, we use a semi-structural VAR model because we cannot specify all the structural shocks under the recursive structure. For instance, it is impossible to set apart the influence of real exchange rate *per se* on real price of gold as we know the real exchange rate is endogenous, therefore, any thought of "exchange market shock" cannot be structural.

Given the fitted structural VAR model, we can readily obtain the impulse responses of the return of gold to the specified structural shocks. Furthermore, we can compare the contributions of different structural shocks to variability of return of gold, as measured by the prediction mean squared error. It is meaningful to point out that this kind of forecasting variance

decomposition (VDC) is retrospective conclusion; it can only depict the average of a certain sample period. Alternatively, based on impulse response functions, we could put ourselves into certain points in history and computer the cumulative influence of certain structural shocks on return of gold until that time. This is historical decomposition (VDC).

7.2. A semi-structural VAR model

My semi-structural VAR model consists of five monthly series:

$y_t = (indpro_t, \pi_t, r_t^{ante}, e_t^r, P_t^{rg})$, where $indpro_t$ is the US Industrial Production Index, π_t refers to U.S. inflation measured by percentage change of CPI from 12 months ago, r_t^{ante} denotes the expected (ex ante) real long-term interest rate we discussed earlier, e_t^r defers to the real exchange rate between U.S. dollar and a basket of major currencies, for which we use "Price-adjusted Trade Weighted Exchange Index" constructed by Federal Reserve Board, and lastly, P_t^{rg} is the real price of gold. Both P_t^{rg} and $indpro_t$ are logged. The sample period is January 1973 to October 2008. In estimating the model, I allow lags of up to two years (24 lags, as our data is monthly).

7.3. Identifying Assumptions

The reduced-form VAR is:

$$y_t = \alpha + \sum_{i=1}^{24} A_i y_{t-i} + \varepsilon_t$$

The structural VAR model is:

$$B_0 y_t = \alpha' + \sum_{i=1}^{24} B_i y_{t-i} + u_t ,$$

where u_t is mutually uncorrelated.

By some algebra, we can show that $\alpha = B_0^{-1}\alpha'$, $A_i = B_0^{-1}B_i$ and $\varepsilon_t = B_0^{-1}u_t$. It follows that we can use Cholesky decomposition to transform the variance-covariance matrix of the reduced-form errors $\sum \varepsilon_t$ into that of structural error $\sum u_t$. Specifically,

$$\varepsilon_t = \begin{bmatrix} \varepsilon_t^{indpro} \\ \varepsilon_t^{\pi} \\ \varepsilon_t^{r(ante)} \\ \varepsilon_t^{exchange} \\ \varepsilon_t^{rgp} \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{52} & a_{44} & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \begin{bmatrix} u_t^1 \\ u_t^2 \\ u_t^3 \\ u_t^4 \\ u_t^5 \end{bmatrix}$$

We can name a few of the orthogonalized shocks, namely, u_t^1, u_t^3 and u_t^5. u_t^1, which is only related to the change of US industrial production, is referred to as the aggregate demand shock for industrial commodities (aggregate demand shock for short). As commonly postulated, the Federal Reserve bases their targeted interest rate on real economic activity and inflation. u_t^3 is likely represents monetary policy shocks that affect the *ex ante* real long-term interest rate (10-year Treasury bond in this case). u_t^5 reflects innovations other than aggregate demand shocks, monetary policy shocks and some other unspecified shocks underlying inflation and exchange rate that can affect the real gold returns. Presumably it could contain many components. But as I will argue below, the behavior and timing of the estimated shocks were consistent with what the safe haven hypothesis would have predicted. So we name this to be "gold-specific demand shock". By the above specification, we impose the following assumptions:

First, we assume that fluctuations in real economic activity, for which US industrial production is an index, can affect inflation, exchange rate, ex ante real interest rate and the return of gold in the same month, but not vice versa. This is very reasonable as manufacturing production tends to behave sticky or sluggish.

Second, we hypothesize that the monetary policy shock and the "residual" structural shock affecting the exchange rate and the gold-specific demand shock will not affect inflation, at least not in the same month. The empirical evidence for this is vague, so we believe that it is acceptable to add this assumption in constructing the model.

Third, we impose the restriction that the gold-specific demand shock and the underlying but unspecified structural shock on exchange rate won't affect the ex ante real interest rate at least in the same month. How the exchange rate and the Fed-monitored T-bond rate interact empirically is an intriguing issue. So this assumption is debatable, but nevertheless, one can hardly rule out this assumption as being one reasonable alternative. Also, we exclude the possibility that gold-specific demand shock can affect exchange rate of US dollar against major currencies, which is not a big matter to our topic.

Lastly, we implicitly postulate that there is no gold supply shock in our model. The rationale for this is that gold is an extremely durable asset. The amount of newly-extracted gold each year is negligible comparing to the stock of gold worldwide, and therefore will hardly affect the price. But we fully understand that this assumption is somewhat presumptuous in the sense that the price of gold is determined mainly by the amount of gold on open market. The change in central bank gold reserves is potentially a huge influence on gold price. But to get an accurate measure and timing of these actions is not easy. There is little research looking into this field, we will try to take this factor into account in our future drafts of this paper.

7.4.1. How Gold Returns Respond to the Specified Shocks

Figure 7 plots the impulse responses of real price of gold to unit structural shocks. Figure 8 plots the cumulative impulse responses of real price of gold to unit structural shocks.

An unexpected aggregate demand expansion of industrial commodities, which often associates with global economic expansion, will cause gold returns to fluctuate in the first twenty months; mostly it will drag it downwards. After twenty months, the expansion will lift gold returns, but very modestly. From the cumulative graph, we can see an aggregate demand shock will lower gold returns. This pattern seems to verify the story of negative beta asset, which claims the movement of gold price is in the opposite direction to most other commodities. But notice the magnitude of the effect is not very noticeable, even in the starting months. Without the bootstrap confidence intervals, we can not judge whether it contradicts the zero-beta asset conclusion stated earlier.

An unanticipated monetary expansion will have a similar effect on gold returns as the aggregate demand shock does: it will modestly disturb gold returns. The effect will diminish after about twenty months. Cumulatively, a positive monetary policy shock (loosening the money supply) will lower gold returns, which is consistent with the economic theory such as Capital Asset Pricing Model: the monetary expansion will lower the return of Treasury securities. In equilibrium, gold should also have lower returns, but in the short-term, there is an expected substitution effect, driving gold returns up and down. Again, the monetary policy shocks are of a very modest magnitude.

The gold-specific demand shock will have an immediate significant positive effect on gold returns, but that effect diminishes very quickly, within two or three months. This resembles the sensitive and ever-changing sentiment in the financial market and its effect on gold returns. The historical decomposition will give additional evidence that this shock is likely to be the precautionary demand shock.

7.4.2. Contribution of Each Shock to the Variability of Return of Gold

As shown in Table 2, the variability of return of gold is overwhelmingly determined by the unspecified shock relating to exchange rate. In the first ten phases, that unspecified shock accounts for over 90% of the variation. The aggregate demand shock, monetary policy shock and gold-specific demand shock each contribute 3% or so. As forecasting steps increase, the aggregate demand shock plays a bigger role. If we use 200 as a proxy for infinity, u_4^t still contributes over 62% of the variation. The share of the aggregate demand shock is nearly 21%, the monetary policy shock, 3.5%, the gold-specific demand shock, 4%. This variance decomposition (VDC) table (Table 2) verifies the concurrent correlations we observed in the in simple linear regressions: the fear premium and aggregate demand can explain little of the movement of real gold price.

7.4.3. The Cumulative Effect of the Specified Shocks on the Return of Gold

Figure 9 is the historical decomposition of return of real gold. The figure shows that the specified structural shocks could not explain the average movement of real gold price at monthly level that well. There is some evidence that the spikes of real gold price in 1980 are only related to gold-specific demand shock, raising the possibility that the gold-specific demand shock is the "fear" precautionary demand shock. The spike in 1983 can be tracked to both gold-specific demand shock and aggregate demand shock. The downward trending real gold price in 1990s is mostly related to aggregate demand shocks among the three. And the recent boom in gold price since 2005 until the outbreak of the recent recession is related to both aggregate demand and gold-specific demand.

8. Conclusion

This paper reexamines several commonly-held opinions about gold price movements. We consider safe haven, inflation hedge, and dollar destruction hypotheses. The safe haven

hypothesis claims that gold returns will increase as fear increases. We use three alternative measures of fear: volatility in the S&P 500 Index, the consumer expectation in Michigan Survey of Consumers and Moody's Baa and Aaa bond premium. Gold returns do not have significant correlation with any of these measures. Related to safe haven hypothesis is the idea of gold being a negative-beta asset. We tested this hypothesis with S&P 500 returns, U.S. Industrial Production and Kilian's Dry Cargo Index and rejected it in favor of the zero-beta asset alternative. The inflation hedge hypothesis postulates the negative correlation between expected inflation and the return of gold. Our analysis disproves that hypothesis for shorter term frequencies. We find a very significant relationship between the price movement of gold, real interest rates and the exchange rate, suggesting a close relationship between gold and the value of U.S. dollar. The multiple linear regressions verify these findings.

The decomposition of gold price under a semi-structural VAR model shows that aggregate demand shocks, monetary demand shocks, and precautionary demand shocks have only a modest influence on the price of gold. The unspecified structural shock underlying exchange rates is the driving force of the gold price.

The central message of the paper is that gold's relationships with fear and inflation are not what most people believe. We should not regard gold as a mysterious asset that is immune to fluctuations and behaves uniquely on the market. Rather, we should regard it as another currency, whose value is a reflection of the value of the U.S. dollar and U.S. monetary policy.

References

1- Ang, A., Bekaert, G., and Wei, M. (2007) "Do Macro Variables, Asset Market, or Survey Forecast Inflation Better?", *Journal of Monetary Economics*, 54 (2007) 1163-1212.

2- Atkeson, A. and Ohanian, L.E. (2001) "Are Philips Curves Useful for Forecasting Inflation?", *Federal Reserve Bank of Minneapolis Quarterly Review,* Vol.25, No.1, Winter 2001, pp.2-11.

3- Barsky, R., Summers, L. (1988) "Gibson's Paradox and the Gold Standard", *Journal of Political Economy*, Vol. 96, No.3. (Jun., 1988), pp. 528-550.

4- Baur, D.G. and Lucey, B.M. (2007) "Is Gold a Hedge or a Safe Haven? An Analysis of Stocks, Bonds and Gold", SSRN Working Paper Series, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=952289

5- Culter, D.M., Poterba, J.M. and Summers, L.H. (1989) "What Moves Stock Prices?", *The Journal of Portfolio Management,* Vol. 15, No. 3, pp. 4-12, (Spring 1989).

6- Jastram, R.W. *The Golden Constant: The English & American Experience, 1560-1976*, Wiley Press, 1977.

7- Kilian, L. (2007) **"**Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market", forthcoming: *American Economic Review*. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=975262

8- McCown, J., Zimmerman, J. (2006) "Is Gold a Zero-Beta Asset? Analysis of the Investment Potential of Precious Metals", SSRN Working Paper Series, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=920496

9- Stock J. and Watson M., (1999) "Forecasting Inflation", *Journal of Monetary Economics*, 44 (1999) 293-335.

Figures:

Figure 1: Real Gold Price 1978-2008

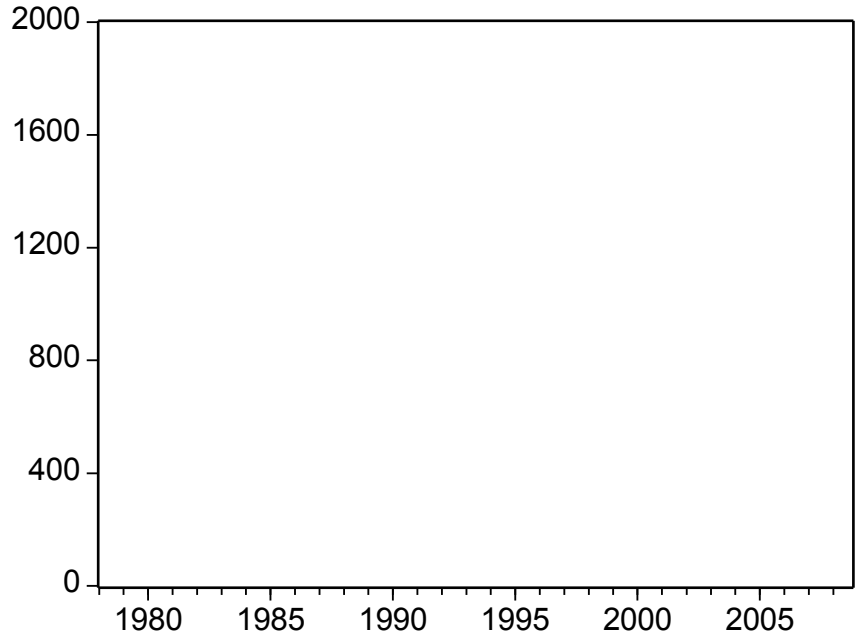

Figure 2: Monthly Gold Returns 1978-2008

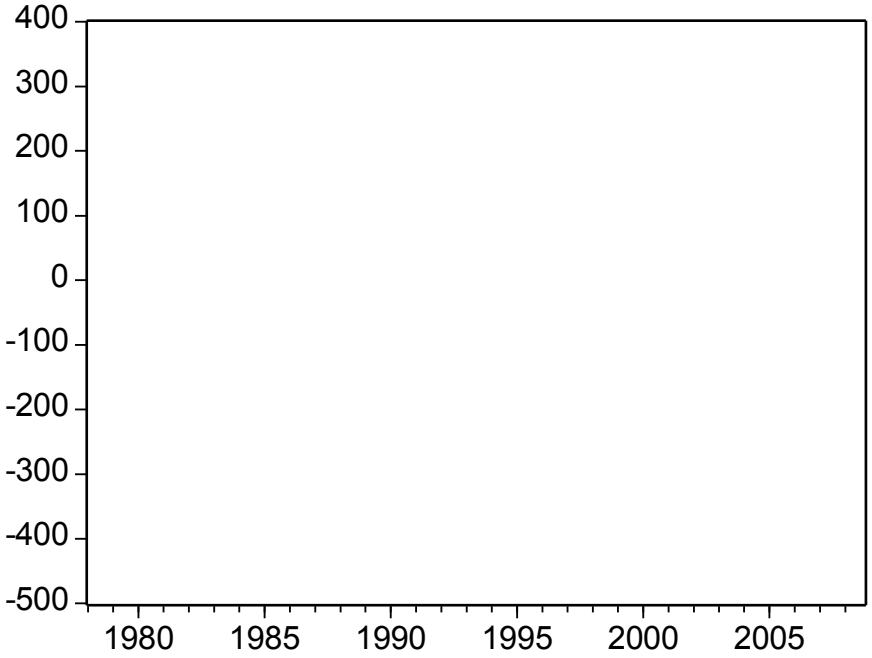

Figure 3: Gold & Volatility

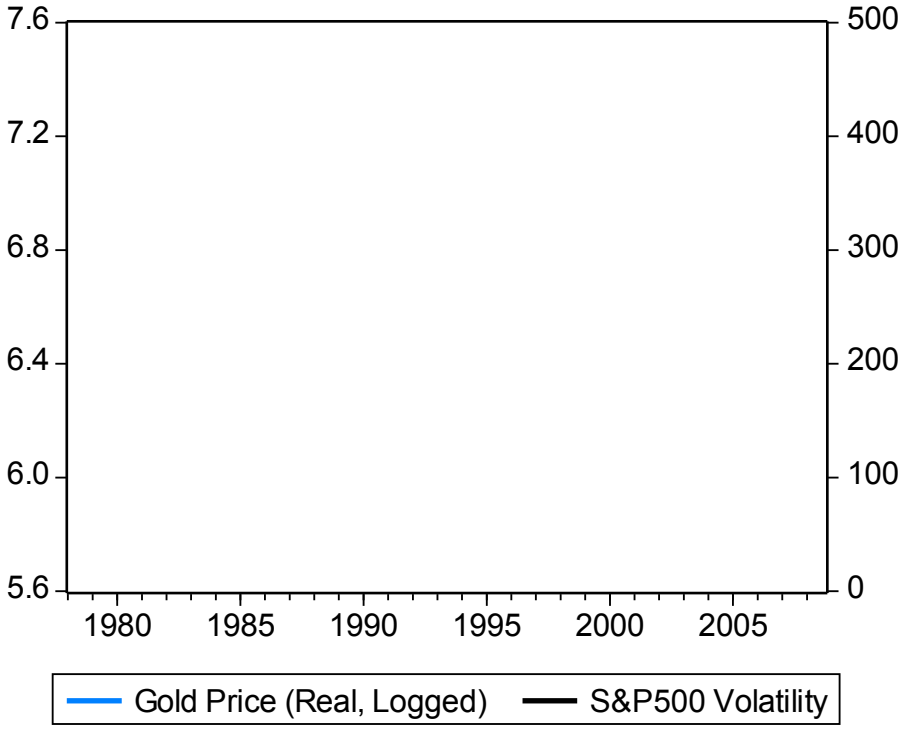

Figure 4: Zero-Beta Asset

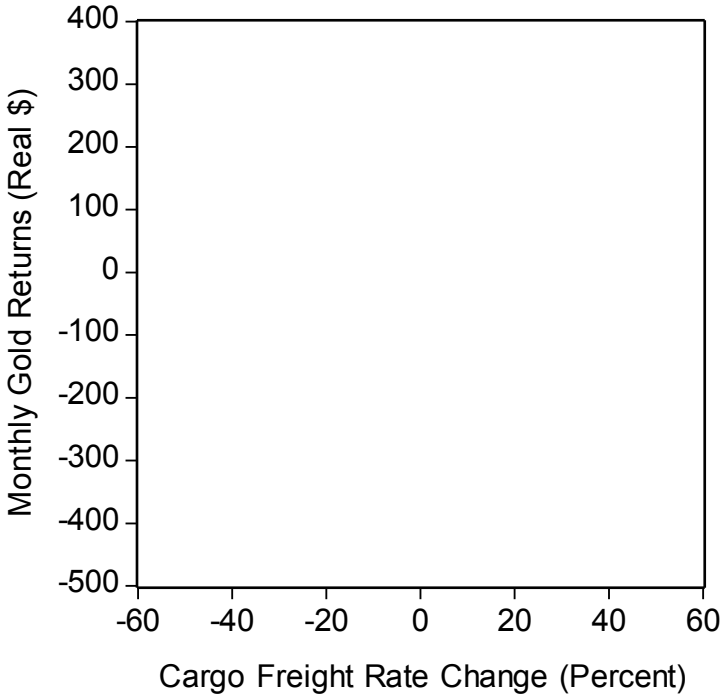

Figure 5: Gold & Real Interest Rates

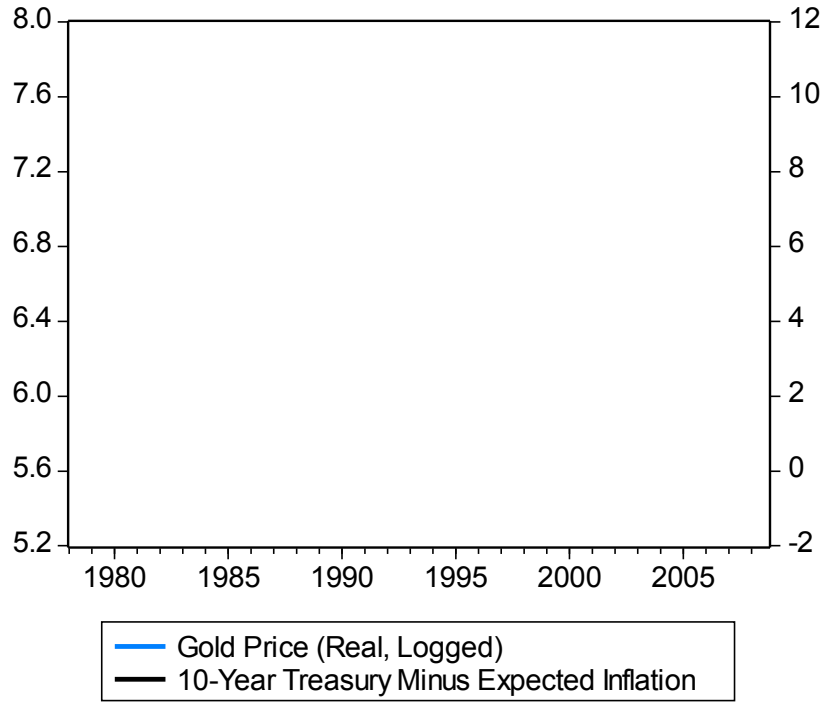

Figure 6: Gold & The Dollar

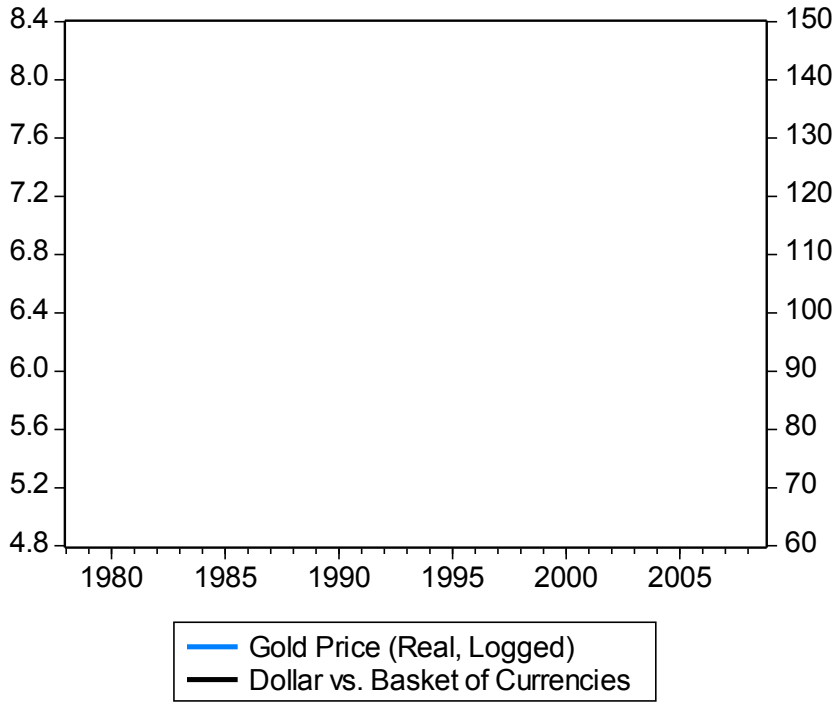

Table 1 Multiple Linear Regressions

	Model 1		Model 2		Model 3	
	Monthly	Annual	Monthly	Annual	Monthly	Annual
Volatility	-0.01	.14	.00	.11	-	-
Consumer Expectations	-.21	-.67	-.18	-.42	-.20	-.16
`Bond Premium	6.81	19.48	3.05	-.08	-	-
`Inflation Expectation	-2.58	-9.04	.50	.79	-.43	2.87
Real Interest Rate	-4.43**	-6.92**	--3.27**	-3.21	-3.01**	-2.52*
~Dollar Value	-5.98**	0.00	-6.07**	-.25	-6.21**	-.45
S&P 500	0.80	3.14	.71	4.58	-	-
~Industrial Production	.52	1.36	.64	.30	.26	.00
Cargo Freight Rate	-.19	-0.29	-	-	-	-
Intercept	30.52	68.20	25.97	39.48	27.59	18.68
R-square	0.08	0.50	0.07	0.36	0.07	0.25
No. of Observations	359	29	363	30	363	30
The dependent variable is monthly/annual gold return						
**p-value < .05, *p-value < .1						
` = logged, ~ = differenced						

Table 2 Multiple Linear Regression

	Simple Linear Regressions	Multiple Linear Regression
Volatility	.0004	-
Consumer Expectations	-.0503**	-.03809*
`Bond Premium	.0211**	-
`Inflation Expectation	.0126*	.0030
Real Interest Rate	-.0025**	.0011
~Dollar Value	-.0064**	.0059**
S&P 500	-	-
~Industrial Production	-.0084**	-.0044
Cargo Freight Rate	.0001	-
Intercept	-	.1752
R-square	-	.92
No. of Observations	363 or 367	363
The dependent variable is the residual of monthly gold returns regressed on the change in the CRB Index		
**p-value < .05, *p-value < .1		
` = logged, ~ = differenced		

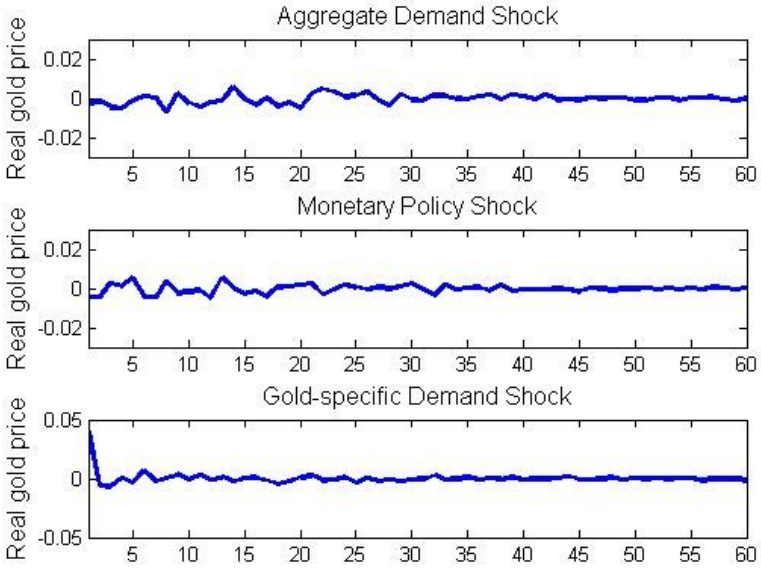

Figure 7

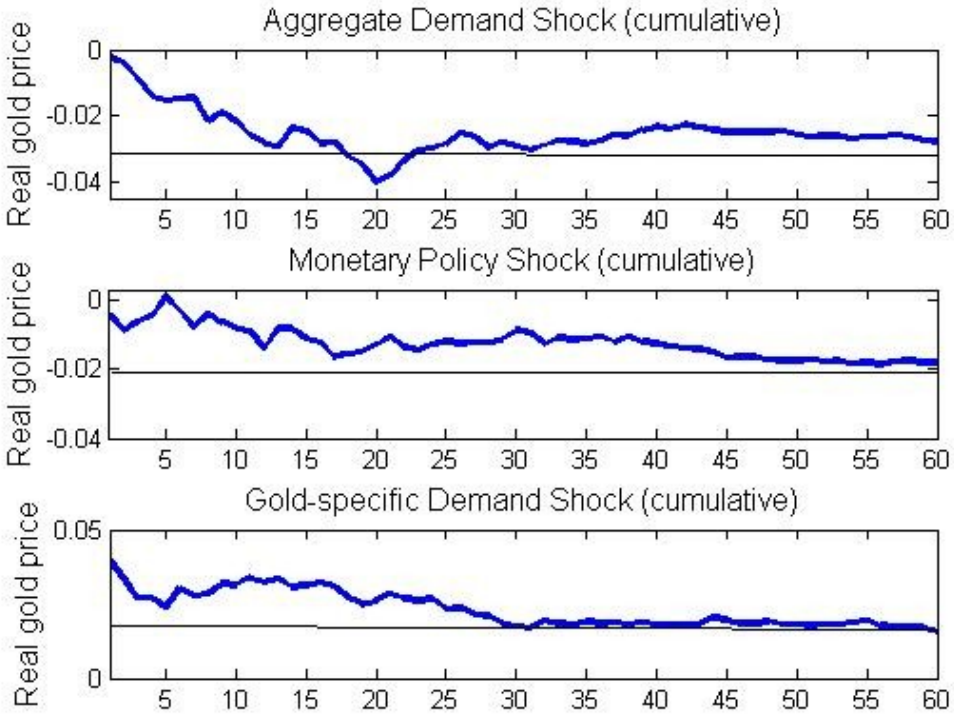

Figure 8

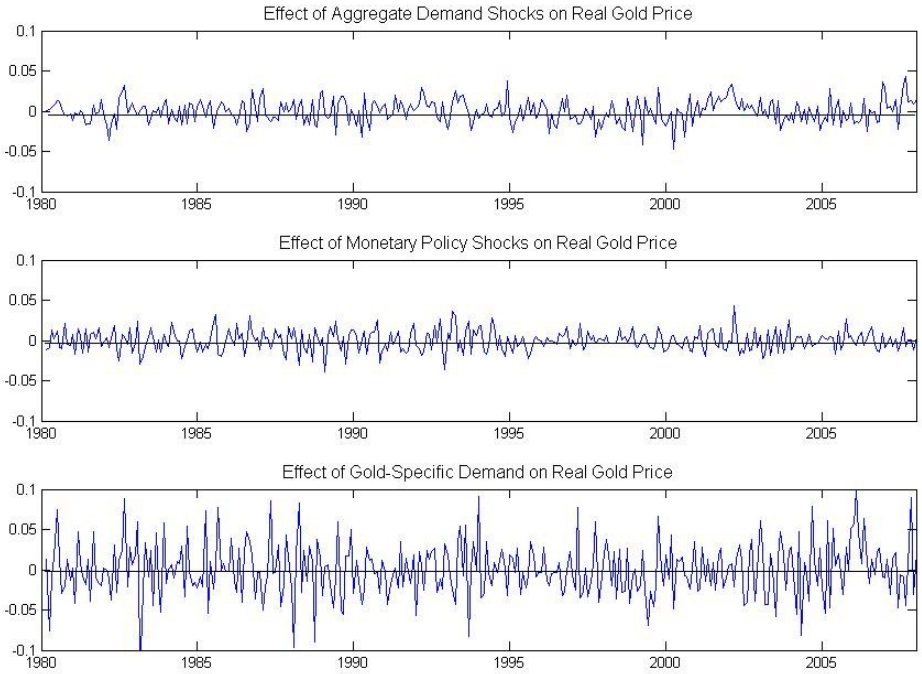

Figure 9

Table 2: Variance Decomposition of the Real Gold Price

Period	u_1^t	u_2^t	u_3^t	u_4^t	u_5^t
1	2.2618	0.1557	1.5417	95.5197	0.5211
2	2.0475	0.069	3.8326	92.5343	1.5165
3	1.2933	0.0563	5.4692	91.9857	1.1955
4	1.0228	0.042	5.2007	92.6111	1.1234
5	0.9499	0.0955	4.8305	92.8185	1.3055
6	0.8465	0.0862	4.4274	92.8748	1.7652
7	0.8856	0.0797	4.3709	92.59	2.0738
8	1.2453	0.1921	4.0017	92.2523	2.3086
9	2.0181	0.4615	3.6406	91.4627	2.4171
10	2.963	0.5185	3.4111	90.2403	2.8671
11	4.0143	0.5785	3.2515	89.3537	2.802
12	4.696	0.6195	3.0013	88.9245	2.7587
13	5.2791	0.5658	2.809	88.4875	2.8585
14	5.6233	0.5172	2.6542	88.3023	2.903
15	5.8706	0.4769	2.5837	87.9841	3.0847
16	6.2469	0.4386	2.6315	87.4267	3.2563
17	6.975	0.4077	2.6965	86.5813	3.3394
18	7.9203	0.3876	2.7583	85.4925	3.4413
19	9.3305	0.3658	2.7672	84.2324	3.3041
20	10.8913	0.3469	2.6977	82.8997	3.1644
50	20.0083	1.9262	2.6079	72.7334	2.7242
100	19.9422	8.5212	3.1065	64.4125	4.0175
200	20.91	9.2381	3.4905	62.2001	4.1613