Cantillon effects in the market for art

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Abstract

The paper introduces and tests the theory of Cantillon effects, the quantity of money effects on asset prices, using an art index frequently used by cultural economists for annual art prices on the London art market from 1830 to 2007. The empirical analysis is divided into two periods, pre-World War One (the classical gold standard) and post-World War Two (the 'post-war' central banking period). Correlation analysis shows that the long-term relationship between art prices and money supply is highly significant for both the classical gold standard and post-war periods, however comovement analysis shows that only for the post-war central banking period are short-term relationships statistically significant. Using time-series data and least squares regression corrected for heteroskedasticity we cannot, however, conclude statistically that money supply "Granger causes" art prices. Using VAR log likelihood we find statistically that the most likely effect of money supply changes on art (asset) prices changes appear between the first and second years. This lagtime is consistent with previous literature on output price changes, however, unlike money supply effects on output prices, our analysis shows that effects on asset (art) prices do not rapidly dissipate after the period of the most likely effects. This continued and perhaps cumulative effect of money supply changes on asset price might in turn help explain asset bubbles during times of expansionary monetary policy with quantitative easing.

JEL Classification E31, B53, C20, Z11

Keywords Monetary history, Cantillon effects, Art prices, Asset bubbles

1 Introduction

This paper introduces the use of time-series econometrics for an analysis of "Cantillon effects" on asset prices, specifically, on the price of art. We begin with a theoretical foundation.

If we view the classical equation of exchange,

$$MV = PQ \tag{1}$$

We find that money supply in an economy (M) multiplied by the velocity of money (V) equals the price of the goods produced in an economy (P) multiplied by the quantity of the goods produced (Q).

However it might be said that this equation lacks an explanation of economic causality. Some economists (e.g., Hume, Wicksell, Marx and the Real Business Cycle school[1]) have written that money is endogenous, where the money demands of the real economy (PQ) determine the money supply and the velocity of money (MV) which gives us a causality,

$$PQ \Rightarrow MV \tag{2}$$

Whereas other economists (e.g., Keynes and Monetarists) write that money is exogenous, which gives us a causality,

$$MV \Rightarrow PQ \tag{3}$$

Even other economists disaggregate the classical equation of exchange and view the effects of money policy changes on relative prices, in other words, "Q" is disaggregated into different sectors, most fundamentally for the Austrian School, between consumption and intermediate goods.[2] Agricultural economists (Bessler

[1] The presentation of differing takes on the classical equation of exchange is adapted from Taylor (2004).

[2] In econometrics work to-date Austrian School economists (Mulligan 2006, Bismans and Mougeot 2009)) have used interest rates, not money supply, to measure monetary policy effects on relative output (disaggregated "Q") prices. Sechrest in an unpublished 2004 paper uses

1984, Devadoss and Meyers 1987) have used money supply changes to analyze relative price effects on agricultural versus industrial goods.

1.1 What this paper adds to the literature

What we are concerned with in this research is not exogenous money's effects on the relative prices of output, but money's effect on asset prices. Can a change in money supply by itself explain the change in asset value? The effect of the growth of money supply on relative asset prices is what is known as Cantillon effects[3].

In this paper, specifically, we are looking at the effect of the money supply on the price of art. In this we build upon (and use the art index dataset provided by) Goetzmann, Renneboog & Spaenjers (2010), who evaluate the effect of equity markets and top incomes (including a measure of inequality) on the price of art in the London market between 1830 and 2007. However though for our project we are to evaluate Cantillon effects (quantity of money effects), not wealth or income effects, on the price of art.

This project might be seen as an exercise in the *longe durée*. Again, visiting the exogenous equation of exchange (3), we can view the economic causal chain of a change in the money supply. First an increase in money supply (M) is expected (by Keynesians) to increase output, then later with rational expectations, output prices increase (Monetarists believe that there is no output effect from a money supply growth, and that prices are effected directly). Finally, after any output (Q)

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money supply to measure price effects on indexes comprised of both output (CPI and PPI) and asset prices (DJIA and urban real estate) combined, but my literature review to-date has not shown any econometrics research, Austrian School or otherwise, purely on Cantillon effects on asset (not output) prices alone.

Orthodox literature, focuses on central bank interest rate policy effects, not 'hidden' money supply policy effects, on the economy. See for example the review article Blinder, Ehrmann, Fratzcherr, De Haan and Jansen (2008) on central bank (meaning exogenous causality of money supply on the economy) communication as a "toolkit" in monetary policy-setting.

[3] Cantillon effects are named after economist Richard Cantillon (1680-1734) one of the first articulators of the classical equation of exchange, which is also referred to (very appropriately in our case) as the quantity theory of money. The use of "Cantillon effects" in relation to art is also appropriate in that Cantillon was one of the first, if not the first, economist to focus on subjective utility as the source of value, after all, beauty is in the eye of the beholder.

and output price (P) effects are realized in the economy, it is asset (not output) prices which are effected by an increase in the money supply.

The purpose of this project then is to "cut to the chase" so to speak and determine the lag-time effects of money supply on asset prices, in our case, the price of art. Art is an appropriate case study for Cantillon effects, because unlike, for example, the housing market or energy market, the art market is relatively free of government intervention, and as a purely consumption good (or investment good, depending on your view) without causality in the chain of production, or for the most part excluded from national output/income accounts[4], it is again for the most part free from the debate over the many competing interpretations and heretofore empirical applications surrounding the classical equation of exchange.

1.2 Some discussion on Cantillon effects

The temporal effects of 'quantitative easing' (money supply growth) has become conventional wisdom. More exogenous central bank money in an economy directly, albeit temporarily, increases the stock market prices and devalues the currency of a country which rapidly increases its money supply.

> But in November Naota Kan, who has since become Japan's finance minister, made what he proudly call his "deflationary declaration", urging the BOJ to redouble its efforts to combat falling prices. Days later the BOJ offered ¥10 trillion ($112 billion) of virtually interest-free liquidity to the banking system to fight deflation….As the yen came off its high, investors piled into shares. But since then the yen has rebounded with barely a squeak from the BOJ (*Economist* 2010).[5]

[4] This is true for our art index methodology because the Goetzmann et al 2010 art index is based on 1,336 repeated sales from the period 1830-2007, sales of work that did not add to the computation of GDP for the year of the repeated sale. Therefore the "Q" value in the classical equation of exchange is missing altogether from the economic causal chain on output ("PQ"), thus an increase in monetary aggregates might therefore be expected to influence directly the price of art. It should be noted that the Cantillon effects an art prices using this methodology will necessarily overstate the quantity of money effects on art prices in that the repeated sales methodology necessarily limits the supply of art under-study, yet to-date, art economists have in general preferred repeated sales indexes over hedonic models.

[5] The yen's revaluation was due of course to the fact that the nearly $800 billion American stimulus package, as well as the massive bank and non-bank bailouts occurring simultaneously,

Callahan and Garrison (2003) take a medium-period view and use monetary expansion to help explain the dot-com bubble, investment in high-tech companies listed on the NASDAQ, between 1996 and 1998.

> We believe that events comprising the dot-com boom and bust can be illuminated by tracing the Cantillon effects as new money made its way from the Federal Reserve, through the banking system, and finally to the dot-com start-ups (68).
>
> As a result, after increasing at a rate of less than 2.5 percent during the first three years of the Clinton administration, MZM (money zero maturity[6]) increased over the next three years (1996-1998) at an annualized rate of over 10%, rising during the last half of 1998 at a binge rate of almost 15 percent (81).

In our *longe durée* analysis, we are using Cantillon effects not to look at investment bubbles or short term macro-economic adjustments but something of a more lasting premise. Can exogenous money over time help explain the price of something which has value for the ages[7]? The microeconomic theoretical foundation behind the idea of Cantillon effects is that as the money supply increases it is seen that assets become less expensive relative to consumption goods, and therefore time-preferences are elongated causing the value (price) of assets, in this case, fine art, to increase.

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lead to greater expectations of dollar depreciation against the yen, and as therefore investors fled the dollar for the yen and other assets such as gold and the Euro (€).

[6] Callahan and Garrison (2003) use MZM rather than the more orthodox M1 for their definition of the money supply as the MZM monetary aggregate includes non-bank money market funds. This measure of money supply ("M" in the classical equation) may be a more valid measure of money's effect on the economy, however it was not until the 1980s that money market funds became a significant portion of the money supply. Therefore for our analysis covering 1830 through 2007 we will use M1 for our definition of the money supply for *long durée* consistency in measurement. The M1 definition of money supply follows Devadoss and Meyers 1987.

[7] Substantial research has been conducted into art as an investment relative to equities, Goetzmann et al (2010) do a fine survey of this literature. For our purposes here though, we are looking at the Cantillon effects on art as being something of intrinsic value (e.g., what Throsby 2001 might define as *symbolic value*). A work of art does not go bankrupt nor does it get bailed-out depending on the political winds of the day. Again this project is of the *longe durée* method where we are concerned with "what determines the variations in art returns [prices, sic] over time" (Goetzmann et al 2010, 13), with our conjecture being that it is monetary aggregates over time which influence art prices over time.

2. Data

The art index proxy for London art prices, 1830 to 2007, comes from Goetzmann et al 2010, and is based upon an index that has been used by many of the leading cultural economists in their work on returns to art relative to other investments. The art index used in this project has been updated in Goetzmann et al 2010[8] for error correction, contemporary art (1960s onward), and includes a more recent methodology for inflation indexing.

The sterling money supply data, 1830 to 2007, is from the Global Financial Data database[9] and a validation against 1996 data by the present author shows that that the long-term data series is similar to the "National Definition" of M1 reported for the years 1986-2006.[10] All data are based on the GBP (£), indexed to 1 for 1830, allowing consistency with the Goetzmann et al (2010) art index.

2.1 Data bifurcation

In Figure 1 we find a graph of the art index and the GBP (£) from 1830 to 2007. We see a clear disharmony in the data during the war years and the Interwar period, 1914 to 1945. It is clear that Great Britain used war finance, a monetary policy without concern towards 'stabilization', beginning in 1914. Wandschneider (2008) finds that the Interwar "Gold Exchange" period was one of instability due to the lack of international political will for a rationally functioning gold standard, despite (or because of) Britain's attempt to return to the classical gold standard by fixing the pound to its pre-war parity. "Nevertheless the system could not repeat the classical gold standard's success, and its problems soon became apparent" (Wandschneider 2008, 154).

We also see a return to war finance and/or a reaction to international "gold exchange" instability (e.g., rapid money supply growth) in the UK leading up to and during the Second World War. Therefore, because of the historically extreme variability of the British pound during the war and Interwar years, we have decided

[8] Christophe Spaenjers sent via email the present author the art index used in Goetzmann et al 2010 on 2/10/10.

[9] www.globalfinancialdata.com, data series MSGBRMO, accessed and downloaded 2/12/10.

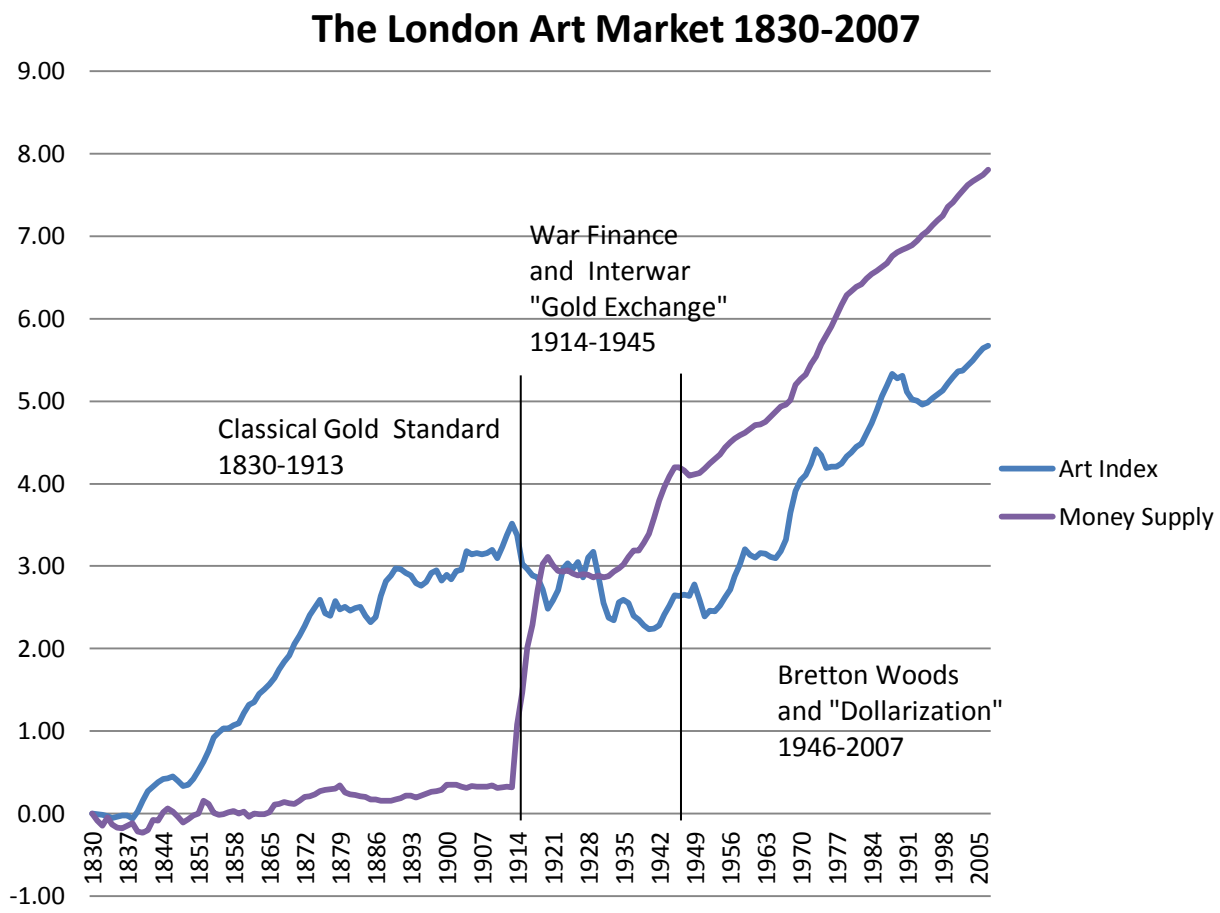
[10] Data series MAUKM1NNNM, accessed and downloaded 2/12/10.

to exclude the period 1914 to 1945 from our analysis of Cantillon effects on the price of art in the London market.

The post-war period of the Bretton Woods gold standard and the subsequent "dollarization" of the international economy (most fundamentally after the Nixon administration pulled out of the Bretton Woods agreement in 1971) provides a more coherent GBP (£) monetary base in which to conduct our analysis for the modern period compared to the instable war and Interwar years. Therefore the data and related historical events suggest that our time-series econometrics be bifurcated into two distinct periods, a relatively stable Classical Gold Standard period, 1830 to 1913, and a post-war period, 1946 to 2007, which has had a more rapid growth in the quantity of money.[11] It will be interesting to test empirically the differing Cantillon effects of these two distinctly differing periods in monetary history.

[11] For more information on the Classical Gold Standard see Bardo & Schwartz (1984), on the Interwar Years see Eichengreen (1992) and the post-war years Samuelson (2008).

Fig. 1



For our analysis then we have reconfigured our time-series data into two differing datasets to account for the two distinct time-periods in economic history for monetary policy, the Classical Gold Standard (1830-1913) and the post-war period (1946-2007), normalizing and indexing the second period, like the first period, to allow for consistent analysis. Eventhough Bretton Woods was agreed to in 1944 we are not starting our analysis until 1946 to allow the relationships between variables to be established after an initial "start-up" period. This is not a problem for the gold standard as it grew spontaneously through the development of trade during the medieval period of history. Figures 2 and 3 respectively show the graphs of the normalized log data of the art index and the money supply for each period. Figure 2 confirms that the money supply grew less rapidly under the gold standard, and as relative to the price of art, while Figure 2 shows an almost consistent increase in the money supply in the post-war period.

Fig. 2

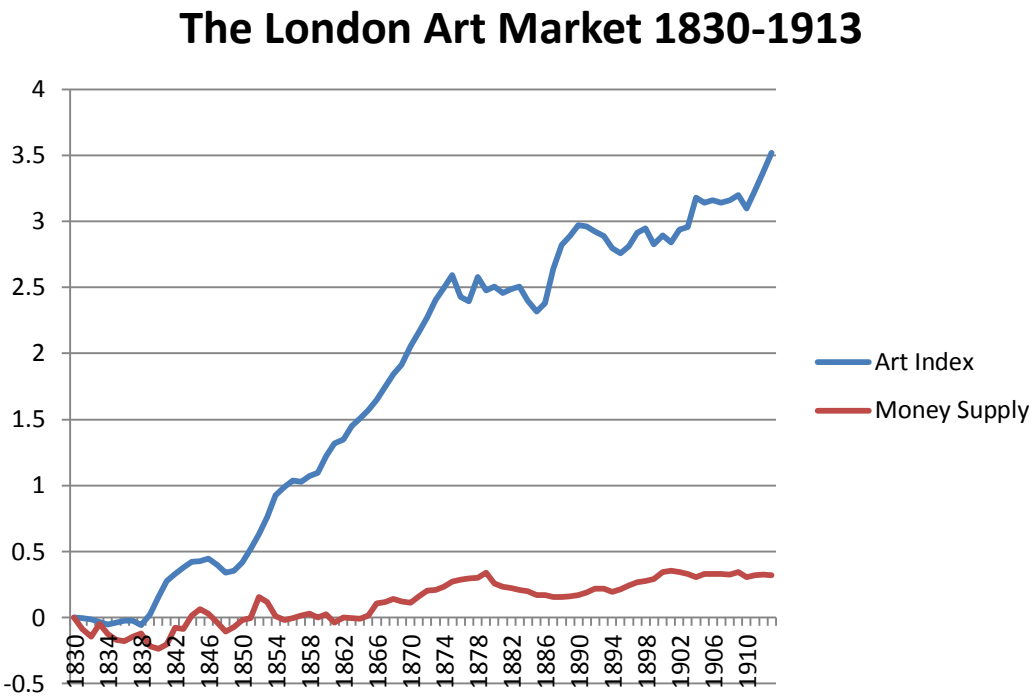
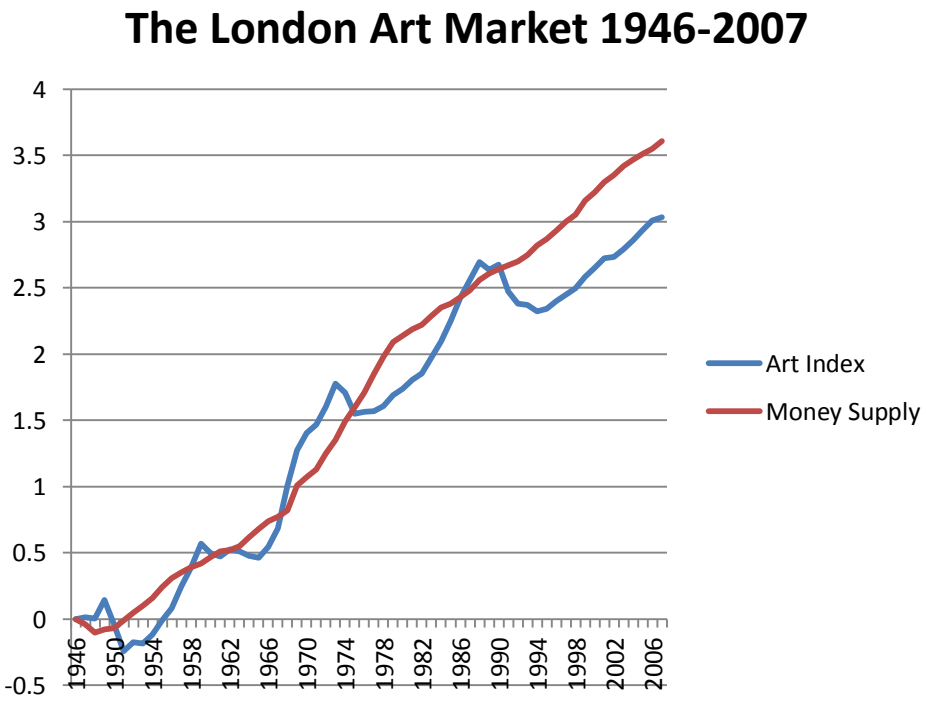

The London Art Market 1830-1913
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
1830
1834
1838
1842
1846
1850
1854
1858
1862
1866
1870
1874
1878
1882
1886
1890
1894
1898
1902
1906
1910
Art Index
Money Supply

Fig. 3


The London Art Market 1946-2007
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
1946
1950
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
2002
2006
Art Index
Money Supply

3 Empirical Results

Our general model is as follows,

$$y_t = b_0 + \sum_{i=1}^{T} b_{1i} y_{t-1} + \sum_{i=1}^{T} b_{2i} z_{t-1} + \epsilon_t, \text{ for } t = 1, \ldots, T. \quad (4)$$

Where T = 84 for the period 1830-1913 and T = 62 for the period 1946-2007, *y* is the art index for a given year, *z* is the indexed money supply for a given year, b_1 is the coefficient for effects of past art prices on current art prices, b_2 is the coefficient for effects of prior-period money supply on the current year art price, and ϵ is white noise. As a robustness check for our regressions we introduce a control variable, the level of equity prices in London during the same periods as proxied by the Financial Times Stock Index "All-Shares" (FTSE).[12]

In Table 1 we find that the money supply grew at an average annual rate of less than 0.5% during the gold standard while it grew at an average annual rate of almost 6% during the post-war period. [13] The returns to art averaged 4.2% under the gold standard, with a standard deviation of 8%, while in the post-war period the returns to art were greater at almost 5%, but with, as expected under risk-return investment theory, a higher standard deviation of around 10%.[14] Interestingly, we find that money supply growth outpaced the real returns to art in the later period as opposed to the earlier period where the real returns to art outpaced the money supply growth by a factor of 10. Note as well that the money supply decreased by as much as 11% in one year during the gold standard, and at most 6% during the post-war (central banking) period, showing the anti-deflationary ("stability") mandate of central bank officials in the post-war years. We find that the returns to the FTSE average less than 1% per year during the gold standard, making art a

[12] Global Financial Data series, _FTASD, downloaded 4/20/10.

[13] The econometrics package used for all empirical analysis is Gretl, by Allin Cottrell and Riccardo "Jack" Luchetti, available through the Free Software Foundation, http://www.gnu.org.

[14] Goetzmann et al 2010 find a 3.20% return to art and a standard deviation of around 11% for the entire period 1830-2007, but it should be kept in mind that this includes the instable world war and interwar periods (1914-1945), *a priori* excluded from our analysis. The authors also find an average return to equity of 6.74% over the entire period, with a standard deviation of 15.57%.

better investment over the long-term than equities in the period of stable currency. During the post-war years the art index increased approximately 5%, the money supply approximately 6% and the equity index approximately 7% on average per year. The trade-off to the 2% higher growth in value per year in equities over art in the post-war was a standard deviation more than 2 times as great (10% versus 22%).

Table 1 Descriptive Statistics

	Mean	Min.	Max.	Std. Dev.
1830-1913 (T = 81)				
ΔLnArt	0.0420	-0.1600	0.2600	0.0800
ΔLnM1	0.0041	-0.1100	0.1600	0.0456
ΔLnFTSE	0.0042	-0.2528	0.1990	0.0847
1946-2007 (T = 58)				
ΔLnArt	0.0497	-0.2012	0.3247	0.1005
ΔLnM1	0.0592	-0.0600	0.1900	0.0394
ΔLnFTSE	0.0692	-0.8100	0.8600	0.2180

3.1 Test for relationships between money supply and art prices

In Table 2 we find the pair-wise correlations between art prices, money supply and equity prices for each period under study. These correlations quantify statistically the long-term *relationship*s between these variables absent any indication of causality, all of the correlations are highly statistically significant. We find that these correlations, for both time-periods, exhibit the positive coefficients that we would expect *a priori* based on the theory of Cantillon effects on asset prices. We find for the 1830-1913 period that the art price is most highly correlated with the contemporaneous money supply whereas for the 1946-2007 period the first and second lags of money supply are most highly correlated with the art prices.

However we also can be skeptical of these results as the high degree of correlation and the high statistical significance of these correlation coefficients imply that there is serial correlation in the data, that it is not necessary the relationships between variables which is being captured in the statistical analysis

but the fact that the variables are moving together over time whether or not there is a relationship between them. This finding needs to be kept in mind when we do our regression analysis to test for causation later in the paper in order to avoid 'spurious' regressions.

Tables 2 Correlations

	Art	M1	M1_1	M1_2	M1_3	FTSE	FTSE_1	FTSE_2	FTSE_3
1830-1913									
Art	1	0.876	0.783	0.734	0.707	0.819	0.803	0.786	0.769
M1		1	0.845	0.7690	0.7370	0.812	0.787	0.781	0.783
M1_1			1	0.882	0.815	0.672	0.833	0.804	0.791
M1_2				1	0.904	0.615	0.724	0.849	0.821
M1_3					1	0.577	0.673	0.759	0.864
FTSE						1	0.897	0.812	0.738
FTSE_1							1	0.909	0.832
FTSE_2								1	0.918
FTSE_3									1
1946-2007									
Art	1	0.952	0.953	0.954	0.954	0.894	0.881	0.878	0.866
M1		1	0.999	0.9990	0.9980	0.954	0.952	0.949	0.948
M1_1			1	0.999	0.999	0.952	0.95	0.946	0.945
M1_2				1	0.999	0.952	0.947	0.944	0.942
M1_3					1	0.953	0.947	0.941	0.939
FTSE						1	0.984	0.959	0.931
FTSE_1							1	0.983	0.955
FTSE_2								1	0.982
FTSE_3									1

Notes: Table represents pair-wise correlations of each horizontal and vertical variable. Each correlation is significant at the 1% level. *Art* is the art index, *M1* is the money supply in (billions of) pound sterling, and *FTSE* is the equities index. Both the art and the equity indexes were re-normalized for the 1946-2007 period. *M1_1*, for example, represents the money supply lagged one year.

Following Goetzmann et al (2010) we conduct a comovement analysis, see Table 3, to determine the "short-term", year-to-year, relationships between the variables, to supplement the "long-term" correlations used above. We use first differences (Δ) in each variable to capture the year-to-year differences in the short-term analysis, although do not extend the analysis to lagged first differences beyond a single period following McCallum (2010) who recommends a one-lag model in case of "serious" autoregression.

Table 3 Comovement analysis

	1	2	3	4	5	6
	ΔArt	ΔArt	ΔArt	ΔArt	ΔArt	ΔArt
1830-1913						
ΔM1	0.025				0.22	0.027
	(1.514)				(1.520)	(1.524)
ΔM1_1		-0.03				-0.050
		(1.512)				
ΔFTSE			0.009			-0.003
			(1.512)			
ΔFTSE_1				0.022	0.022	0.028
				(1.520)		
1946-2007						
ΔM1	0.005 ***				0.004 ***	.005 *
	(1.135)				(1.073)	(1.051)
ΔM1_1		0.004 ***				-0.001
		(1.235)				
ΔFTSE			0.006			-0.002
			(1.030)			
ΔFTSE_1				0.014	0.01 *	0.012
				(0.996)		

Notes: Comovement regressions use OLS and Newey-West (HAC) standard errors. ***, **, and * indicate significance of the regression coefficient at the 1%, 5% and 10% level, respectively.

The only significant results we obtain from the comovement analysis is for the post-war period where we find that both current period money supply changes and lagged money supply changes show statistically significant coefficients relating money supply changes to art price changes. However it should be noted that these coefficients themselves may be too small to be of any economic significance. [15] We also find in the robustness check model (Column 5) that for the post-war period both contemporaneous money supply changes and lagged equity price changes move together at a statistical significant level with art price changes.

[15] See McCloskey (1998) for a discussion on economic significance in relation to statistical significance, e.g., here we might be satisfied *a priori* economically that the signs of the coefficients are economically relevant, that indeed there is a positive correlation (relationship) in the long-run between lagged money supply and art (asset) price, however statistically significant or not.

All regressions except Column 4, the regression of changes in lagged equity prices on changes in art prices, have a Durbin-Watson statistic for autocorrelation of greater than 1, following McCallum (2010), "The argument is that any investigator with even minimal training in econometrics would/should not conclude a time-series regression study with (e.g.) a Durbin-Watson statistic of less than 1.0" (6). It is also surprising to see a negative coefficient in Column 2 for the lagged effects of a change in money supply on a change in art prices for the 1830-1913 period although statistically significant. In summary we can ascertain from the comovement analysis that the short-term relationships between money supply and art prices are significant only in post-war period, when the money supply was increasing at more than 10 times the rate of the gold standard period. We note too from the correlation analysis found in Table 2 showing the long-term relationships between the variables that the correlation are higher for the post-war period than for the gold standard period. These initial results show that Cantillon effects appear to be greater in periods of an increasing money supply for both long-term and short-term relationships.

3.2 Test for causality between money supply and art prices

In the analysis above we focused on the statistical and economic *relationships* between money supply and art price (asset price) changes. In this section we are concerned not just with relationships but with *causality* and test the Granger causality of the money supply on the price of art using the general model in (4) discussed above. In addition we check the robustness of the model specification and results by including the FTSE as an additional regressor for a control variable, giving the "robustness check" model,

$$y_t = b_0 + \sum_{i=1}^{T} b_{1i} y_{t-1} + \sum_{i=1}^{T} b_{2i} z_{t-1} + \sum_{i=1}^{T} b_{1i} \alpha_{t-1} + \epsilon_{t,}, \text{ for } t = 1, \ldots, T. \qquad (5)$$

Where α is the FTSE index normalized to 1 at the beginning of both historical periods.[16]

[16] It should be noted that there may be a specification problem in the robustness check model in that under the theory of Cantillon effects we would expect that it is money supply changes which would cause the equity (asset) price changes, not that a change in equity prices would cause a

For the regressions we use the level data of the art and FTSE indexes, with the indexes as stated reset for each period. The money supply data is GBP (£) outstanding in billions (e.g., a data point of *20* would mean 20 billion pounds of M1 money supply). Following McCallum (2010) we use a least squares regression, with independent variables of a one-period lag per our general and robustness check models, and correct for heteroskedasticity to cleanse the error terms of autocorrelation which as noted in Table 2 we highly-suspect. We observe the results in Table 4 below where we fail to find Granger causality of money supply effects on the art price; none of the money supply coefficients are statistically significant for either the 1830-1913 or the 1946-2007 periods. This finding of Granger non-causality is counterintuitive to the findings in the comovement analysis found in Table 3 which indicate statistically significant relationships between changes in these variables for the post-war period. The robustness check for misspecification also proves inconclusive. For the 1830-1913 period including the lagged FTSE as an explanatory variable does change the coefficient of money supply effects to positive as expected under Cantillon effects, however, the remain statistically insignificant.

We note for the 1830-1913 period that the coefficients of the lagged art prices on current art prices are greater than 1, and statistically significant, indicating an 'explosive' time series and thus perhaps suggesting that our model for regression analysis is misspecified. However here we are following the result obtained by Perron (1989) who shows that most macroeconomic time-series are "trend stationary", including the money stock and common stock prices, when the series are detrended to account for exogenous shocks. There was a financial crisis in 1873, the "Panic of 1873", which may account for what appears to be the long memory of the art time-series. Given that the standard deviation of the art index is very similar to that of the equity index for the same period, we believe this provides the rationale for accepting the regression results based on Perron's analysis. The financial crisis may also be the reason for the persistent autocorrelation in the regression residuals even after correction for heteroskedasticity as witnessed by the high Durbin-Watson statistic in both the general and robustness check models for the 1830-1913 period.

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change in art prices. However in using an equity measure as a control variable we are following Goetzmann et al (2010). We do test the aforementioned Cantillon effect later in the paper.

Table 4 Regression analysis of Art as dependent variable

	Constant	Art_{t-1}	$M1_{t-1}$	$FTSE_{t-1}$
1830-1913				
General Model	0.193	1.060	-0.009	
T = 84		(***)		
Adj. R^2 = 0.987				
d-w = 1.537				
Robustness Check	0.199	1.056	0.004	0.014
T = 84		(***)		
Adj. R^2 = 0.987				
durbin's h = 1.400				
1946-2007				
General Model	2.235	0.943	0.001	
T = 62	(**)	(***)		
Adj. R^2 = 0.996				
durbin's h = 3.980				
Robustness Check	1.803	0.978	0.001	-0.001
T = 62		(***)		
Adj. R^2 = 0.996				
durbin's h = 3.787				

Notes: Least squares regression with heteroskedastic-corrected error terms. ***, **, and * indicate significance of the regression coefficient at the 1%, 5% and 10% level, respectively.

In the spirit of Cantillon effects, we run another regression following the general form of the regression model to analyze the money supply effects on equity prices, using instead of the art index the FTSE index as the dependent variable, and with the lagged regressors the FTSE index and the money supply. Here we are checking to see if money supply changes Granger cause equity price changes. Again the results are inclusive showing that only lagged FTSE values Granger-cause current period FTSE values. We find that that coefficient for the post-war period lagged money supply is positive as expected given the significance of the comovements, however statistically insignificant, not allowing rejection of the null hypothesis of Granger non-causality between the money supply and equity price.

Table 5 Regression analysis with FTSE as dependent variable

	Constant	$FTSE_{t-1}$	$M1_{t-1}$
1830-1913			
	2.563	0.982	-0.083
T = 84		(***)	
Adj. R^2 = 0.953			
Durbin's h = 0.153			
1946-2007			
	1.434	0.967	0.004
T = 62		(**)	
Adj. R^2 = 0.943			
Durbin's h = 2.587			

Notes: Least squares regression with heteroskedastic-corrected error terms. ***, **, and * indicate significance of the regression coefficient at the 1%, 5% and 10% level, respectively.

3.3 Lagtime Analysis

In this final analytical section we follow the work of Bessler (1984) and Devadoss & Meyers (1987) who find that the most likely lag effects of money supply changes on *output* prices are 13 and 14 months, respectively. For our analysis of Cantillon effects we would like to know what the mostly-likely lagtime of a money supply change on *asset* (not output) prices are and compare our results with the previous findings money supply's effect on output prices. To this end we use the same methodology as Bessler and Devadoss & Meyers to make the results comparable, however these authors use monthly data and only cover the post-war central baking period whereas we are using yearly data and also include analysis of the gold standard period. As discussed above the correlation analysis of long-term relationships are that for the 1830 – 1913 period it appears that effects appear within the first year, whereas for the 1946-2007 period effects appear during the second and third years. The comovement analysis of short-terms relationships shows again for the gold standard under a steady money supply that changes appear within the first year (but this is inconclusive as the results are not statistically significant, and perhaps this might mean that Cantillon effects only appear when money supply is increasing at a relatively "high" rate historically) and for the post-war period the results appear during the first and second year, findings which are statistically significant.

Following Bessler and Devadoss & Meyers we use a VAR log likelihood model with the natural logs of the variables to estimate the most likely lagtimes. Results are found in Table 6 and show that for both the 1830-1913 and 1947-2007 periods the most likely lag effect is during the second year, meaning between 13 and 24 months. This finding is similar to that of the Bessler and Devadoss & Meyers findings showing a 13 and 14 month lag of money supply on output prices. However we would expect under the theory of Cantillon effects that asset prices effects would take longer than output price effects, therefore the finding of a most likely lagtime of between one and two years is consistent *a priori*.

Table 6 VAR System Log Likelihood Ratio Test for Lagtimes

Lags	Loglik	AIC	BIC
1830-1913			
1	83.18703	-2.110185	-2.018182
2	85.68235	-2.149536*	-2.026865*
3	85.7666	-2.125437	-1.972099
4	86.76375	-2.125362	-1.941356
5	86.81364	-2.100359	-1.885686
6	86.91812	-2.076793	-1.831452
7	89.10214	-2.107951	-1.831943
8	89.37293	-2.088761	-1.782086
1946-2007			
1	53.92625	-1.886157	-1.775658
2	65.95571	-2.294656*	-2.147324*
3	66.25091	-2.268552	-2.084387
4	66.58107	-2.243743	-2.022745
5	66.71588	-2.211699	-1.953868
6	66.7168	-2.174696	-1.880032
7	67.86268	-2.180099	-1.848602
8	67.93534	-2.145753	-1.777423

Notes: Both the Akaike (AIC) and Schwartz's(BIC) information criteria show that the most-likely lag length for the effect of LnM1 as exogenous variable on LnArt as endogenous variable is the second period (e.g., between the first and second year**).**

What is unique about our finding on lagtime effects on asset (art) prices is that, unlike money effects on output prices, the effects do not seem dissipate rapidly after the period of the most-likely effect. In other words, money supply effects on

asset prices seem to be longer lasting than money supply effects on output prices. Both Bessler (1984) and Devadoss & Meyers (1987) find that output price effects are temporary and insignificant after the most likely lag; this is consistent with monetary "stimulus". Callahan & Garrison (2003) write, "The duration of the seemingly positive but temporary effects of monetary stimulation – the "overheating" [of *output* and then *output* prices, but not *asset* prices, author] - is believed to be roughly 18 months" (77). However what we find from the results shown in Table 6 is that money supply effects on asset price do not rapidly dissipate after the most likely maximum effect period, and that these effects continue on in both periods of monetary history. This can be seen from the Akaike Information Criteria (AIC) which remain below -2 (negative two) for 6 years after the most likely lag period of the second year for both 1830-1913 and 1946-2007.

This interpretation makes sense according to Callahan and Garrison (2003) who state, "During what we roughly designate as "the boom", from June 1995 to march 2000, MZM [the money supply] grew 52 percent, well ahead of real GDP growth of 22 percent". This might be interpreted as stating that money supply effects over a given period effect both output and asset prices, in this case it appears that 30% (52%-22%) of the money growth went to the boom in dot-com assets whereas 22 percent went towards temporal effects on output. From our lagtime analysis as found in Table 6 it appears that the money effect on (art) asset price is almost immediate (one to two years, e.g., approximately the same time-lag as output price) as well as long-lasting.

4 Concluding Discussion

In this paper we have used the theory of Cantillon effects in an attempt to help explain asset prices over time based on changes in money supply over time in the London market for art. In doing so we have used two distinct periods in economic history, the Classical Gold Standard period (1830 -1913) when the real art price grew at an annual average of around 4% while the money supply at less than 1% and the post-war period (1946-2007) which saw an average real art price increase of around 5% whereas the money supply increased at around 6%. We were able to show that for both periods the art price and the money supply were positively correlated at a statistically significant level, whereas only for the post-war period were comovements, short-term relationships, found to be statistically significant. However an attempt at using least squares regression analysis corrected for

autocorrelation to prove Granger causality was not able to reject the null hypothesis of no causation despite statistically significant short-term comovements in the post-war central banking period.

A level-VAR log likelihood regression showed that the most likely lagtime for money supply's effects on art (asset) prices was between one and two years, which is consistent with previous findings using the same methodology on money supply changes on output prices. Tellingly though for our analysis of Cantillon effects it appears that *asset* price effects do not dissipate rapidly as do money supply effects on *output* prices. Finally it appears given the inconclusive causality tests for effects of money supply on art price that, of course, it takes more than money supply changes to effect art prices. We did find however though that it appears asset prices change during the same time interval as output prices (one to two years) after a change in money supply. This might in turn help to explain asset bubbles after a money supply increase.

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