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Robert E. Hall

Working Paper 18370
http://www.nber.org/papers/w18370

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 2012

The Hoover Institution supported this research. It is part of the National Bureau of Economic Research's Economic Fluctuations and Growth Program. I am grateful to Mark Bils, Valerie Ramey, Julio Rotemberg, and Michael Woodford for valuable comments. The views expressed herein are those of the author and do not necessarily reflect the views of the National Bureau of Economic Research.

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The Cyclical Response of Advertising Refutes Counter-Cyclical Profit Margins in Favor of Product-Market Frictions

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NBER Working Paper No. 18370
September 2012
JEL No. D43,E12,E32

## ABSTRACT

According to the standard model, advertising is remarkably sensitive to profit margins. Firms advertise to stimulate demand for their products. They advertise high-margin products aggressively and low-margin ones hardly at all. In macroeconomics, variations in profit margins over the business cycle have a key role. A widening of margins can explain the rise in unemployment in recessions. A higher margin implies a lower real wage. A variety of models ranging from Keynesian to search-and-matching map a decline in wages to higher unemployment. But a rise in profit margins should expand advertising by a lot. Really a lot. Advertising should be highly counter-cyclical. Instead, it is somewhat pro-cyclical. The ratio of advertising spending to private GDP falls when the economy contracts. I show that wages do decline in recessions. The labor share of income falls. On the other hand, the behavior of advertising refutes the hypothesis that profit margins rise. Hence there must be another factor that lowers the wage without raising profit margins. The only influence that fits the facts is a rise in a product-market friction that has the same effect as an increase in sales taxes.

Robert E. Hall
Hoover Institution
Stanford University
Stanford, CA 94305-6010
and NBER
rehall@gmail.com

**Theorem:** Let $R$ be the ratio of advertising expenditure to the value of output. Let $-\epsilon$ be the residual elasticity of demand. Let $m$ be an exogenous shift in the profit margin. Then the elasticity of $R$ with respect to $m$ is $\epsilon - 1$, which is a really big number.

After proving this theorem, which is a direct implication of the standard model of advertising, I dwell on its implications for an important issue in macroeconomics, the role of shifts in the profit margin. The basic idea is simple. In a slump, firms do not cut prices in answer to disappointing sales. If their costs are lower—because they have moved down their upward-sloping short-run marginal costs curves or because flexible-price factor markets now have lower prices—their profit margins are higher. The theorem says that they should expand advertising by substantial amounts. Consider the middle-of-the-road value for the typical residual elasticity of demand of 6, so that the ratio of price over marginal cost is 6/(6-1) = 1.2 The ratio of advertising spending to GDP should rise by 5 times the proportional increase in that ratio. Advertising should be highly counter-cyclical. Firms should expand advertising aggressively in a slump.

In fact, advertising is pro-cyclical. I show that the ratio of advertising to GDP *falls* by about one percent for each percentage point of extra unemployment. Far from boosting advertising to recover business lost in a slump, firms cut advertising by even more than their loss of sales. The key finding, however, is that advertising is *not* highly counter-cyclical. I would have written this paper even if I had found advertising to be non-cyclical or mildly counter-cyclical.

The thrust of standard advertising theory is that advertising should rise and fall in proportion to sales. The formula for the ratio is remarkably simple; it is the elasticity of sales with respect to advertising effort divided by the residual elasticity of demand. If the two elasticities are constants not influenced by the factors causing a slump, then advertising will be a constant fraction of sales. Macroeconomics has brought into play a mechanism not usually considered in advertising theory, namely that profit margins widen in slumps. That widening should result in a splurge of advertising in slumps.

The question at this point is what other factor could be operating to alter the standard property that implies that advertising should be neither pro-cyclical (as it actually is) nor counter-cyclical (as the widening-margin model implies). In my baseline model, I include a friction that has the effect on a firm that a sales tax would. I call this a product-market

friction.

The paper studies two key variables: (1) the ratio of advertising spending to revenue, and (2) the ratio of labor compensation to revenue (the labor share). Both the profit-margin shock and the product-market friction affect these variables. The elasticity of the advertising ratio with respect to the profit-margin shock is $\epsilon - 1$, a number around 5. The elasticities of the advertising ratio with respect to the product-market friction and of the labor share with respect to both shocks are all $-1$. The fact that the profit-margin shock has a large effect on the advertising ratio has a neat implication. Consider the ratio of the advertising variable to the labor share. One fact is that the elasticity of that ratio with respect to the product-market friction is zero, because the friction has the same effect on numerator and denominator. The second fact is that the elasticity of the ratio with respect to the profit-margin shock is the residual elasticity of demand, $\epsilon$, say 6. These facts provide a clean identification of the role of the profit-margin shock. That shock should have a big positive effect on advertising in recessions, under the view that profit-margins increase in recessions. A regression of the ratio of the advertising/sales variable to the labor share on unemployment should have a big positive coefficient that arises entirely from the margin effect and not at all from the product-market friction. In reality, the regression coefficient is somewhat negative and the confidence interval around it excludes any big positive effect. The finding casts serious doubt on the counter-cyclical profit-margin hypothesis

On the other hand, the product-market friction emerges as a fully consistent idea about the character of slumps. It says that rising frictions in recessions lower advertising and the labor share about equally, leaving the ratio of the two variables close to non-cyclical. I avoid speculation in this paper about the nature of the friction.

I consider a number of potential variations around the basic specification in the paper. The first is to follow an important branch of the advertising literature and treat advertising expenditure as a form of investment. Because investment in, say, plant and equipment is quite pro-cyclical, this consideration might explain the findings despite a counter-cyclical margin—the pro-cyclical effect from investment might be swamping the large counter-cyclical effect of the margin changes. But a reformulation of the model using standard investment theory shows otherwise. A key factor in this finding is the high depreciation rate of advertising. A consensus of research on advertising is that around 60 percent of the effect of earlier advertising dissipates each year.

I also consider a model extended to include other cyclical shifts. These are (1) productivity shocks, (2) measurement error in the labor share, (3) measurement error in the capital share, and (4) measurement error in the price of advertising. I show that productivity and capital measurement errors have no effect on the measured values of the variables I study. Of course, they do affect other variables—the point is that they drop out of the ratios I consider. A measurement error in the labor share—an idea I take seriously—could not explain the failure to find large counter-cyclical movements of the advertising/sales ratio without invoking improbably cyclical swings in the error. Measurement error in the price of advertising could conceal part of its counter-cyclical movements but would have to be implausibly large to overturn the basic conclusion of the paper. The most likely form of such an error would come from failing to consider the investment component of advertising, a topic I consider separately with negative conclusions.

# 1 Related Research

## 1.1 Cyclical behavior of advertising

Kaldor (1950) noted the positive correlation of advertising and the business cycle and Blank (1962) and Yang (1964) documented the correlation, without theoretical interpretation. Bils (1989), Table 1, presents regressions of the rate of change of real advertising expenditures on the rate of change of real GDP. A coefficient greater than one would indicate pro-cyclical movements as that term is used in this paper. He uses data for the U.S. and Britain. In all cases the coefficients are positive and for more recent U.S. data and all British data, they exceed one. The model in the paper implies counter-cyclical market power for reasons similar to Edmond and Veldkamp (2009), discussed below, but Bils interprets the model as pointing toward pro-cyclical advertising.

## 1.2 The level of market power

Positive advertising expenditure proves the existence of market power, for there is no incentive to advertise in perfectly competitive markets. Still, there is remarkably little consensus on the extent of market power in the U.S. economy. The most recent survey of the subject appears to be Bresnahan (1989). His summary, in Table 17.1, reports residual elasticities in the range from 1.14 to 40, for industries from coffee roasting to banking. Many subsequent

studies, mainly for consumer packaged goods, have appeared since the publication of Bresnahan's survey. I am not aware of any attempt to distill a national average from studies for individual products. Hausman, Leonard and Zona (1994), for example, study the demand for beer and find residual elasticities (holding the prices of competing beers constant) in the range from 3.5 to 5.9. Most research does not try to reconcile residual elasticities estimated from demand equations with data on price/marginal cost ratios from producers, though Bresnahan discusses this topic extensively.

## 1.3 Cyclical changes in market power

Macroeconomics has spawned a large literature on counter-cyclical market power. Bils (1987) launched the modern literature that studies cyclical variation in the labor share. My interpretation of that literature is that it measures not variations in profit margins but rather in the labor share, because these are not the same thing in the presence of the product-market friction that I consider. Bils made important adjustments based on cyclical variations in the incidence of overtime wages. Rotemberg and Woodford (1999) embraced Bils's adjustments in a survey chapter that explains how New Keynesian models explain cyclical variations in output and employment through variations in market power resulting from sticky prices and flexible cost. Nekarda and Ramey (2010) and Nekarda and Ramey (2011) challenge the findings of counter-cyclical market power in favor of cyclically constant markups resulting from Bils's overstatement of the incidence and magnitude of overtime premiums.

Bils and Kahn (2000) argue that marginal cost is pro-cyclical because firms internalize the fluctuations in the disamenity of work effort of their employees. In slumps, the marginal disamenity of effort is low, because effort itself is low. In an expansion, as effort rises, its marginal burden on workers rises and marginal cost of production rises accordingly, even if cash payments to workers do not rise in proportion to the marginal burden. They use this hypothesis to explain the otherwise puzzling behavior of inventory investment. Firms allow inventory levels to decline persistently below normal during booms and above normal in slumps, which would only make sense if marginal production costs are high in booms and low in slumps.

Chevalier and Scharfstein (1996) develop and estimate a model in which capital-market frictions influence pricing decisions at the retail level. In slumps, firms that are financially constrained disinvest in customers by setting prices at higher than normal margins over

marginal cost.

Edmond and Veldkamp (2009) look at the issues of market power from the consumer's perspective. They find that rising dispersion of income distribution lowers residual elasticities in slumps. Firms respond by setting prices further above marginal cost.

The literature on cyclical changes in market power is complementary to the ideas in this paper. In many of the accounts in the existing literature, the question becomes acute: Why does advertising not expand in slumps when the residual elasticity falls?

### 1.4 Cyclical fluctuations in product-market friction

I am not aware of any work on this topic.

## 2 Theory

Suppose that the residual demand facing a firm is a constant-elastic function of the firm's price $p$, the average $\bar{p}$ of its rivals' prices, its own advertising $A$, and the average of its rivals' advertising $\bar{A}$, with elasticities $-\epsilon$, $\bar{\epsilon}$, $\alpha$, and $-\bar{\alpha}$. A multiplicative factor $x$ shifts demand. The marginal cost of production is $c$ and the cost of a unit of advertising is $\kappa$. Although customers pay $p$ for each unit of output, the firm receives only $p/f$, where $f$ is a product-market friction or wedge factor that depresses the price the firm receives. The factor $f$ may be a bit above 1. The firm's objective is

$$\max_{p,A} \left( \frac{p}{f} - c \right) x\, p^{-\epsilon}\, \bar{p}^{\,\bar{\epsilon}} A^{\alpha} \bar{A}^{\,-\bar{\alpha}} - \kappa A. \tag{1}$$

The profit-maximizing price is

$$p^* = \frac{\epsilon}{\epsilon - 1}\, f\, c \tag{2}$$

and in symmetric equilibrium, $\bar{p} = p$ and $\bar{A} = A$. For some reason—possibly price stickiness—the firm actually sets the price

$$p = m\, p^*. \tag{3}$$

The factor $m$ may be a bit above or a bit below 1.

Equation (2) and equation (3) imply

$$p = m\, f\, \frac{\epsilon}{\epsilon - 1}\, c. \tag{4}$$

The variable part of the markup of price $p$ over marginal cost $c$ is the product of the two shocks, $m\, f$. I call $m$ the *profit-margin shock* because $m$ raises price relative to cost. If

$m > 1$, the firm keeps the added profit. The profit-margin shock has implications stressed in Rotemberg and Woodford (1992) and is the way that sticky prices affect real allocations, as those authors explain. On the other hand, the friction $f$ also appears in equation (1), where it has the effect of taking away the margin increase from the firm, so an increase in $f$ does not raise profit. Consequently, the two shocks have quite different effects. Later in the paper I will demonstrate that authors thinking they are measuring the profit-margin shock $m$ by studying labor's share of total cost are actually measuring the compound shock $m\,f$.

## 2.1 Advertising

The first-order condition for advertising is

$$\frac{\alpha}{A}\,Q\,\left(\frac{p}{f}-c\right)=\kappa. \tag{5}$$

Rearranging and dividing both sides by $p$ yields an expression for the ratio of advertising expenditure to revenue:

$$\frac{\kappa A}{pQ}=\alpha\frac{p/f-c}{p}. \tag{6}$$

Substituting for $p$ from equation (3) and for $p^*$ from equation (2) restates the right-hand side in terms of exogenous influences:

$$R=\frac{\kappa A}{pQ}=\alpha\frac{(m-1)\epsilon+1}{f\;m\;\epsilon} \tag{7}$$

Absent the special influences captured by $f$ and $m$, that is, with $f = m = 1$, the advertising/revenue ratio is

$$R=\frac{\alpha}{\epsilon}, \tag{8}$$

a standard result in the advertising literature, first derived by Dorfman and Steiner (1954). See Bagwell (2007) for an impressively complete review of the literature on the economics of advertising.

From these equations, two useful results follow:

**Proposition Rm:** The elasticity of the advertising ratio $R$ with respect to the profit-margin shock $m$ at the point $f = m = 1$ is $\epsilon - 1$.

**Proposition Rf:** The elasticity of the advertising ratio with respect to the friction $f$ is $-1$.

Proposition Rm is the centerpiece of the paper—advertising is highly sensitive to the profit-margin shock. If markups rise in a slump, firms should aggressively increase efforts to

attract new customers and retain existing ones, because selling to them has become more profitable.

## 2.2 Labor share

The second measure of interest is the labor share

$$\lambda = \frac{W}{pQ}. \tag{9}$$

Here $W$ is the firm's total wage bill including all forms of compensation. Under the assumptions of Cobb-Douglas technology with labor elasticity $\gamma$ and cost minimization, the wage bill is $\gamma\ c\ Q$, so

$$\lambda = \frac{\gamma\ c\ Q}{pQ} = \gamma \frac{\epsilon - 1}{\epsilon} \frac{1}{f\ m} \tag{10}$$

Two additional results then follow immediately:

**Proposition $\lambda$m:** The elasticity of the labor share $\lambda$ with respect to the profit-margin shock $m$ is $-1$.

**Proposition $\lambda$f:** The elasticity of the labor share with respect to the friction $f$ is $-1$.

## 2.3 Effects of shifts of demand

Next I assume that $m$ is a decreasing function $m(x)$ of the demand shift $x$—higher demand lowers the actual price $p$ relative to the ideal price $p^*$, a key feature of the New Keynesian model. I also assume the same property for $f$: It is a decreasing function $f(x)$ of the demand shift—higher demand reduces the product-market friction that $f(x)$ embodies. The elasticities of the two functions with respect to $x$ are $-\chi_m$ and $-\chi_f$.

The elasticities of the two measures with respect to the demand shift are

$$\text{Elasticity of } R = \chi_f - (\epsilon - 1)\chi_m \tag{11}$$

and

$$\text{Elasticity of } \lambda = \chi_f + \chi_m \tag{12}$$

An interesting implication that I will exploit shortly is

$$\text{Elasticity of } R/\lambda = -\epsilon\chi_m \tag{13}$$

I think of the demand shift as an unobserved variable. I entertain the hypothesis that the semi-elasticity of $x$ with respect to $u$ is minus one. In other words, a one percentage-point decrease in unemployment signals a one-percent increase in product demand. This hypothesis simplifies the explanation of the results. It has almost no role in the substance of the empirical findings.

Then

$$\beta = -\text{Semi-elasticity of } R \text{ with respect to } u = \chi_f - (\epsilon - 1)\ \chi_m \tag{14}$$

and

$$\psi = -\text{Semi-elasticity of } \lambda \text{ with respect to } u = \chi_f + \ \chi_m \tag{15}$$

Given estimates of the two semi-elasticities, and prior knowledge of the absolute value of the residual demand facing the typical firm, $\epsilon$, the implied values of the absolute values of elasticities of the margin shift $\chi_m$ and the friction $\chi_f$ are

$$\chi_m = \frac{\psi - \beta}{\epsilon} \tag{16}$$

and

$$\chi_f = \frac{(\epsilon - 1)\psi + \beta}{\epsilon}. \tag{17}$$

# 3 Cyclical Movements of the Ratio of Advertising to GDP

## 3.1 Time-Series Data on Advertising

For many years, Robert J. Coen of the ad agency Erickson-McCann published a compilation of data on advertising expenditure. I was unable to find any surviving original copy of his data. Douglas Galbi posted a copy of Coen's estimates through 2007 in his blog, along with estimates for early years from other sources. Galbi also provides links to Coen's data sources, but the only one still active is for the data on newspapers. Further information about the sources appears in the appendix.

For 2005 through 2010, the Census Bureau has published revenue data for NAICS industry 51, the information sector, which includes the advertising industries. I define advertising as the sum of newspapers, magazines, broadcasting, and Internet. In the three years that the Census figures overlap Coen's, the latter is 1.38 times the former. I take the figures for 2008 through 2010 to be this factor times the Census figure.

I am continuing to explore alternative data sources for advertising spending, at the aggregate and industry levels. The Internal Revenue Service publishes data for corporate advertising deductions for recent years and possibly for earlier years, but only on paper.

Figure 1 shows the ratio of advertising spending to private GDP, stated as an index, with vertical bars shaded in proportion to the unemployment rate.

## 3.2 Specification

I form

$$R = \frac{\kappa A}{pQ} \tag{18}$$

as the ratio of advertising expenditure to private nominal GDP. The ratio has substantial low-frequency variation resembling the variation of the price/dividend ratio in the stock market. I model the low-frequency variation in a number of ways. The first is as a highly serially correlated additive term:

$$\log R_t = \omega_R - \beta u_t + q_{R,t}. \tag{19}$$

Here $\omega_R$ is a constant and the coefficient $\beta$ on unemployment $u_t$ estimates the semi-elasticity derived in the previous section,

$$\beta = \chi_f - (1 - \epsilon)\, \chi_m \tag{20}$$

and the slow-moving component $q_t$ is

$$q_t = \tau_R t + \frac{1}{1 - \rho L}\, \eta_t, \tag{21}$$

where $L$ is the lag operator and $\eta$ is a white-noise innovation. The specification also includes a time trend, $\tau_R t$

The second and third models take the slow-moving component to be a filtered version of $R_t$, say $\bar{R}_t$, and estimate

$$\log(R_t/\bar{R}_t) = \omega_R + \beta u_t. \tag{22}$$

The filter absorbs any trend in $R_t$, so I do not include an explicit trend. I also omit the trend if the estimated value of $\rho$ exceeds one in the AR specification, in which case I estimate using first differences, constraining $\rho = 1$.

For the filters, I use Hodrick-Prescott with smoothing parameter 6.25 and a bandpass filter that passes cycle periods of 2 through 8 years.

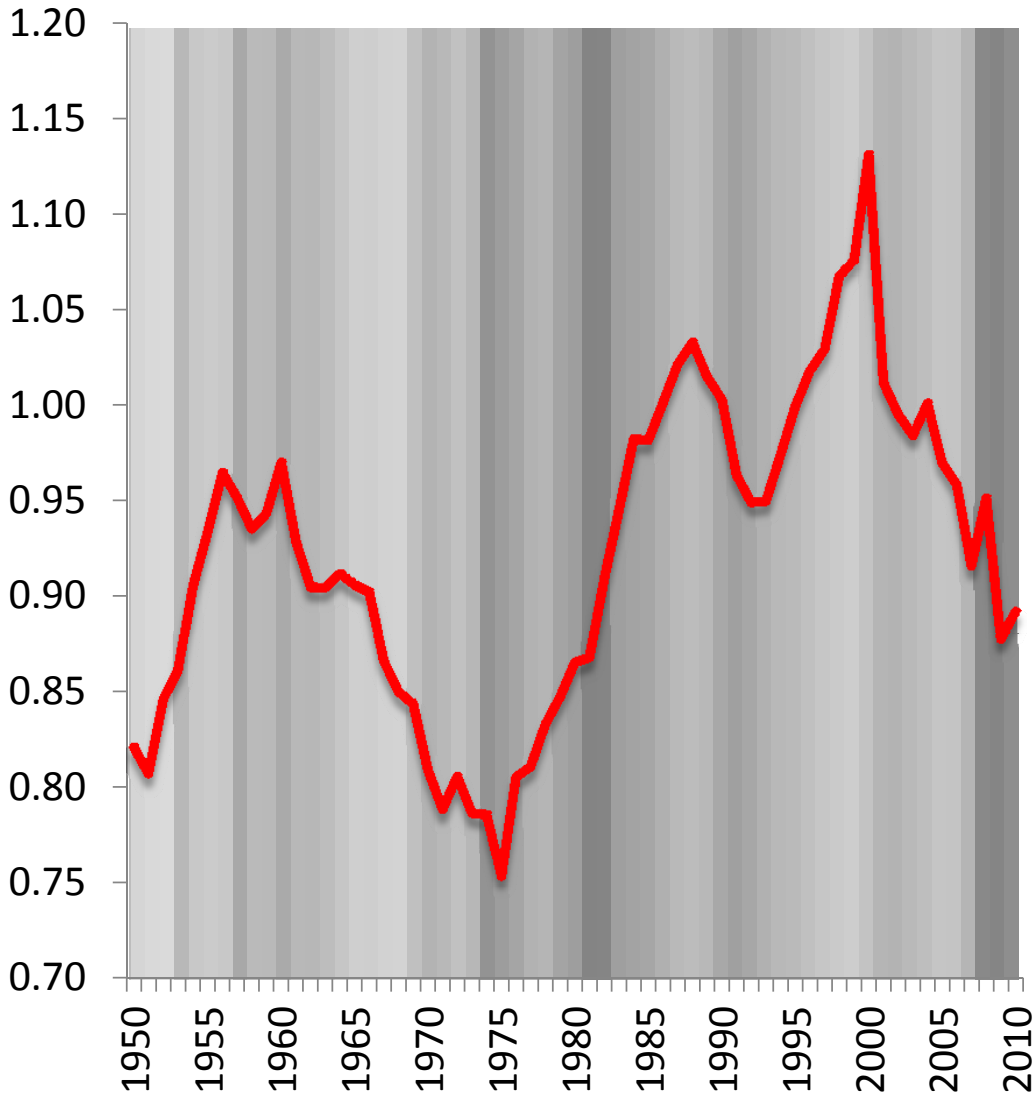


Figure 1: Index of the Ratio of Advertising Spending to Private GDP, with Shading in Proportion to the Unemployment Rate

| *Left-hand variable* | *Coefficients and standard errors* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Minus unemployment* | | *Trend* | | *Autoregressive term* | | *Constant* | |
| Log of all types of advertising/GDP | 0.97 | (0.39) | 0.000 | (0.004) | 0.93 | (0.05) | 0.00 | (0.07) |
| HP cycle component | 0.41 | (0.23) | - | - | - | - | 0.02 | (0.01) |
| Bandpass cycle component | 0.36 | (0.16) | - | - | - | - | 0.02 | (0.01) |
| TV ads | 0.40 | (0.71) | 0.014 | (0.002) | 0.71 | (0.03) | 0.01 | (0.06) |
| Radio ads | 0.37 | (0.55) | 0.008 | (0.002) | 0.81 | (0.04) | -0.01 | (0.05) |
| Newspaper ads | 1.19 | (0.51) | - | - | - | - | -0.01 | (0.01) |
| Direct mail | -0.42 | (0.49) | 0.011 | (0.008) | 0.96 | (0.04) | -0.07 | (0.15) |
| Other advertising | 1.74 | (0.54) | -0.011 | (0.001) | 0.77 | (0.08) | 0.06 | (0.05) |

Table 1: Results for the Advertising/GDP Ratio

## 3.3 Results

The data run from 1950 through 2010. In addition to total advertising, I also estimate equations for the major components: TV, radio, newspapers, direct mail, and other. Table 1 shows the results. In all cases but one, the estimated cyclical response—the coefficient on minus unemployment—is positive, generally statistically unambiguously positive. The relationship is much stronger for the AR specification of the low-frequency component—the HP and bandpass filters plainly absorb a good deal of the variation in the advertising/GDP ratio that would otherwise be associated with unemployment.

I take the coefficient in the upper left-hand corner of Table 1 as the basic result—an added point of unemployment lowers the advertising ratio by just under one percent.

I reiterate that the finding that advertising is pro-cyclical is not central to the point of the paper. Rather, the key finding is that advertising is not strongly counter-cyclical, as it would be if the profit margin were counter-cyclical. The findings in Table 1 are not dispositive on the unimportance of fluctuations in the profit margin, however, because there is a possibility that a strongly pro-cyclical effect from the product-market friction is masking a counter-cyclical effect from the margin. To deal with this issue, I turn to a study of the cyclical movement of the labor share.

# 4 Cyclical Movements of the Labor Share

## 4.1 Data

The Bureau of Labor Statistics publishes a quarterly series for the labor share of non-financial corporations at bls.gov/lpc, series PRS88003173, running from 1947 through the first quarter of 2012. The limitation to corporations is desirable because there is no reliable basis for dividing proprietary income into labor and capital components.

## 4.2 Specification

The labor share rises briefly but sharply at the beginning of a contraction, apparently because of labor hoarding. Similarly, it falls at the beginning of expansions, possibly because more intense work effort is the initial response to an increase in demand. To account for these transitory dynamics, I use the following specification:

$$\log \lambda_t = \omega_\lambda - \psi u_t + \theta \left[ u_t - \frac{1}{N}(u_{t-1} + \cdots + u_{t-N}) \right] + q_{\lambda,t}. \tag{23}$$

Here the coefficient $\psi$ on unemployment $u_t$ estimates the semi-elasticity derived earlier,

$$\psi = \chi_f + \chi_m \; ; \tag{24}$$

$\theta$ is the coefficient of the term for labor-hoarding dynamics, $\omega_\lambda$ is a constant, and $q_{\lambda,t}$ is a slow-moving component of the labor share arising from other sources. I use the same three specifications for $q_t$ as for the advertising/GDP ratio, $R$.

## 4.3 Results

Table 2 shows the results of estimating the three specifications of the equation for the labor share. The transitory part of the specification uses $N = 4$ lagged quarters of unemployment. The top line uses the AR(1) specification of the slow-moving component. It finds that the labor share is pro-cyclical, with a semi-elasticity of about 0.5. That estimate is reasonably precise, with a standard error a bit below 0.2. The estimate confirms the presence of a transitory component in the opposite direction. The immediate response of the share to an increase in unemployment—the difference between the first and second coefficient—is actually negative.

The second and third lines in Table 2 use filtering methods on the share to account for its slower movements. They find semi-elasticities about half as large. The reported standard

| *Left-hand variable* | *Coefficients and standard errors* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Minus unemployment* | | *Departure of unemployment from recent past* | | *Autoregressive term* | | *Constant* | |
| Log labor share | 0.53 | (0.18) | 1.20 | (0.17) | 0.956 | (0.019) | 0.062 | (0.015) |
| HP cycle component | 0.23 | (0.06) | 1.44 | (0.14) | - | - | 0.013 | (0.004) |
| Bandpass cycle component | 0.23 | (0.06) | 1.38 | (0.13) | - | - | 0.012 | (0.004) |

Table 2: Results for Labor Share

error is probably an overstatement of the reliability, as it does not account for the preliminary filtering.

# 5 Implications

The purpose of this research is to uncover $\chi_m$, the elasticity of the profit margin with respect to the demand shift, and $\chi_f$, the elasticity of the product-market friction with respect to that shift. Recall that these are

$$\chi_m = \frac{\psi - \beta}{\epsilon} \tag{25}$$

and

$$\chi_f = \frac{(\epsilon - 1)\psi + \beta}{\epsilon}. \tag{26}$$

In addition to the two estimated parameters $\psi$ and $\beta$, these equations contain the residual elasticity of demand $\epsilon$. As I noted earlier, though market power is an important topic in many branches of applied microeconomics and is the subject of a large literature, the results of empirical research are inconclusive. Research has concentrated on packaged consumer goods and thus left most components of final goods untouched. That said, most economists would probably place the typical value of the residual elasticity of demand in the range from 3 to 20, corresponding to profit margins of 33 down to 5 percent of price. Figure 2 shows the values of $\chi_m$ and $\chi_f$ over this range of residual elasticities. All the values of $\chi_m$ are slightly negative.

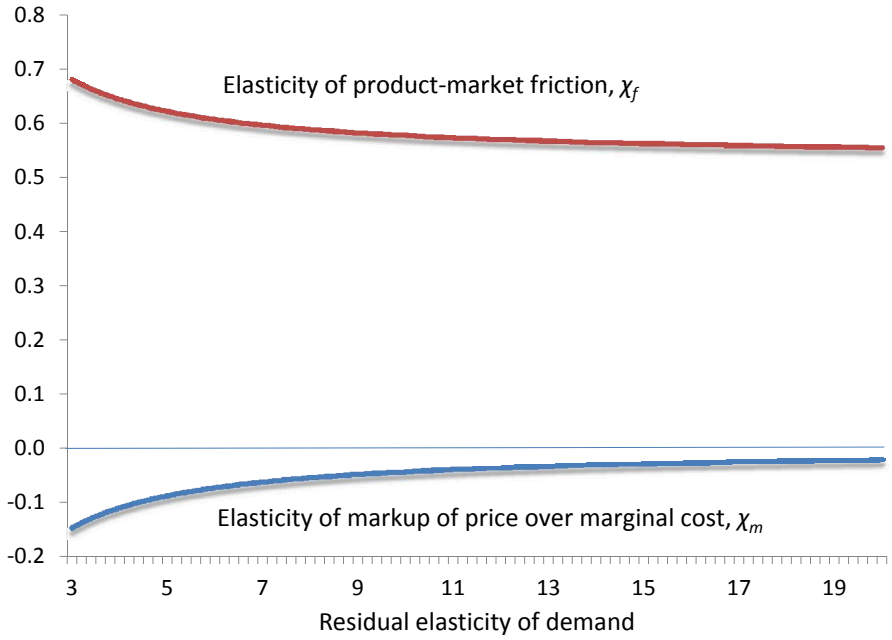


Figure 2: Elasticities Implied by Estimated Coefficients

## 5.1 Testing the hypothesis of no profit-margin shock

The difference between equation (19) and equation (23) is

$$\log R_t - \log \lambda_t = \omega_R - \omega_\lambda + (\psi - \beta)u_t - \theta(u_t - u_{t-1}) + q_{R,t} - q_{\lambda,t}. \tag{27}$$

Because I am limited to annual data, I simplify the labor-hoarding term controlled by $\theta$ in this equation relative to equation (23). The coefficient on the current level of unemployment is

$$\psi - \beta = \epsilon\, \chi_m. \tag{28}$$

The results for this regression appear below in Table 4. The estimate of $\epsilon\, \chi_m$ is $-0.32$ with a standard error of 0.53. The $p$ value for the hypothesis that $\chi_m = 0$ is 0.27 on a one-tailed basis (the interest here is only in positive values of $\chi_m$). Note that the test is unambiguously a test about $\chi_m$ because the residual elasticity of demand $\epsilon$ must exceed one. The evidence against a more than slightly positive value of $\chi_m$ is fairly strong.

Table 3 provides information about the strength of the evidence about the value of the elasticity $\chi_m$ of the margin shock $m$ with respect to the demand shift $x$. The left column gives alternative hypothetical values of the product, $\epsilon\chi_m$, starting at the top with the standard null hypothesis of zero. The next column is the corresponding $t$ statistic and to its right is

| | | | Value of $\chi_m$ | | |
|---|---|---|---|---|---|
| | | | Residual elasticity of demand | | |
| $\epsilon\chi_m$ | $t$ | $p$ value | $\epsilon$=3 | $\epsilon$=6 | $\epsilon$=20 |
| 0.0 | -0.60 | 0.277 | 0.00 | 0.00 | 0.00 |
| 0.2 | -0.97 | 0.168 | 0.07 | 0.03 | 0.01 |
| 0.4 | -1.35 | 0.092 | 0.13 | 0.07 | 0.02 |
| 0.6 | -1.72 | 0.045 | 0.20 | 0.10 | 0.03 |
| 0.8 | -2.10 | 0.020 | 0.27 | 0.13 | 0.04 |
| 1.0 | -2.47 | 0.008 | 0.33 | 0.17 | 0.05 |
| 1.2 | -2.85 | 0.003 | 0.40 | 0.20 | 0.06 |
| 1.4 | -3.22 | 0.001 | 0.47 | 0.23 | 0.07 |

Table 3: $p$ Values for Various Values of the Residual Elasticity and Elasticity of the Margin Shock

the $p$ value for the statistic. The three columns on the right give the value of $\chi_m$ for the value of $\epsilon$ at the head of the column. For example, the fourth line of the table considers the hypothesis that $\epsilon\chi_m = 0.6$ when the point estimate is $\epsilon\chi_m = -0.32$ with a standard error of 0.53. The $t$-statistic is $-1.72$ with a $p$ value of 0.045, suggesting fairly strong rejection. If market power is high, with a residual elasticity of 3, the rejected value of the elasticity of the margin shock is 0.20. With moderate market power ($\epsilon = 6$), the rejected value is 0.10, and with low market power ($\epsilon = 20$), the rejected value is 0.03.

A related issue is testing the same hypothesis under the assumption that, as Nekarda and Ramey (2010) and Nekarda and Ramey (2011) find, the labor share is constant over the cycle. These authors, along with most of their predecessors, frame the question as the cyclical behavior of the markup ratio, so that it might appear that they estimate the demand elasticity of the profit margin, $\chi_m$, rather than the cyclical movements captured by $\psi$, in the notation of this paper. However, the earlier literature does not consider the cyclical role of the product friction $f$ introduced in this paper. Hence it is appropriate to consider their results as bearing on the labor share rather than the profit margin. Equation (12) in Nekarda and Ramey (2010) describes the relation between the labor share and the markup ratio. The variable considered in their work and in much of the earlier work is the reciprocal of the labor share, adjusted for overtime wages and for the elasticity of substitution. The latter

adjustment has an effect only if the technology is not Cobb-Douglas. Their equation (13) is close to the one in this paper, except that the cycle indicator is not based on unemployment.

Recall that $\psi = \chi_f + \chi_m$, so the cyclical movement of the labor share is the sum of the effects from the product-market friction $f$ and the profit-margin shock $m$. If $\psi = 0$, either both of these effects are zero or one of them is negative. Further, in that case, $\beta = -\epsilon\chi_m$. The finding of a positive $\beta$ is strong evidence against a positive value of $\chi_m$. The one-tailed $p$ value for the hypothesis that $\chi_m$ is zero, against positive values, is 0.0075. The $p$ values for $\chi_m = 0.2$ and 0.4 are 0.0019 and 0.0004. The test is conditional on the assumption that $\psi = 0$ is more powerful than in Table 3, where $\psi$ is estimated, because of the reduction in the sampling variation in estimating $\psi - \beta$. The standard error of the estimate of $\beta$ is 0.39 while the standard error of $\psi - \beta$ is 0.53.

## 5.2 Conclusion about the role of profit-margin shocks and product-market frictions

The finding points in the direction that $\chi_m$ is close to zero. Sticky prices are not an important factor in pricing. The suggestion that the data do not support the sticky-price hypothesis is not new. But the companion finding is new—that the data strongly support the hypothesis that firms encounter some kind of friction during slumps that makes them behave as if they were paying a higher tax on their output.

It is beyond the scope of the paper to describe the general-equilibrium implications of these conclusions. I will mention that a variety of macro models focus ultimately on the movements of the labor wedge. I define the wedge here as the ratio of the labor share to the Cobb-Douglas elasticity $\gamma$. Its value is

$$\frac{\lambda}{\gamma} = \frac{\epsilon - 1}{\epsilon} \frac{1}{f\ m}. \tag{29}$$

The elasticities of the wedge with respect to $f$ and $m$ are both $-1$. From Figure 2, it appears that reasonable values for the elasticity of the product-market friction $f$ with respect to the demand shock is 0.6 and the elasticity of the margin shock is zero. Thus a recession generates a substantial decline in the real wage. In Hall (2009) I describe a framework where that decline brings a substantial rise in unemployment, with perhaps 2 points of unemployment rise per percentage point decline in the real wage. Relatively few macro models have established a direct link to unemployment, but many, including the widely applied New Keynesian models, link real wage reductions to declines in employment.

# 6 Advertising as Investment

One reason that advertising is pro-cyclical is that advertising is an investment that has a lasting effect on demand, extending beyond the period of the expenditure itself. Other types of investment—inventories and plant-equipment in particular—are quite pro-cyclical, in the sense used in this paper, that the ratio of expenditure to revenue declines in a recession. In this section, I investigate whether the investment character of advertising is concealing a counter-cyclical movement of advertising spending driven by counter-cyclical margins.

The empirical literature on the effects of advertising has reached a reasonably strong consensus that most of the effect of advertising on sales occurs within a year—see Bagwell (2007), pages 1726 to 1728, for cites, and Corrado, Hulten and Sichel (2009) for a recent quantification and additional cites. The latter paper places the annual depreciation rate of advertising capital at 60 percent.

Nerlove and Arrow (1962) developed the theory of investment in depreciable advertising along the same lines as Jorgenson's (1963) famous model of investment in plant and equipment. The stock of advertising, $A_t$, evolves according to

$$A_t = a_t + (1 - \delta)A_{t-1}. \tag{30}$$

Here $a_t$ is purchases of new advertising and $\delta$ is the rate of depreciation.

The price of a unit of advertising—now thought of as the services of a unit of a stock of advertising over one year—is

$$\kappa_t = \frac{r + \delta}{1 + r}\, p_t. \tag{31}$$

Here $r$ is the annual real interest rate, $\delta$ is the annual rate of depreciation, and $p$ is the price of investment in advertising, which I take to be the price of goods and services in general. Notice that this formula is $\kappa_t = p_t$ if there is complete depreciation within a year: $\delta = 1$.

The ratio of advertising expenditure to revenue is $\frac{\kappa_t A_t}{p_t Q_t}$. To form this ratio from the data, I calculate the advertising stock $A_t$ from the recursion, equation (30), using data on $a_t$ formed as the Coen data on advertising expenditure deflated by the price index for private GDP, starting in 1929. I calculate $\kappa$ using $\delta = 0.6$ and $r = 0.05$.

Using this version of the advertising/private GDP ratio in the specification in the first column in Table 1 yields a coefficient of $\beta = 0.20$ with a standard error of 0.29. The $p$ value for the null hypothesis that advertising is a constant share of revenue and is thus noncyclical, against the alternative that it is pro-cyclical, is 0.25, moderately persuasive evidence in favor

| *Left-hand variable* | *Coefficients and standard errors* | | | |
|---|---|---|---|---|
| | *Minus unemployment* | *Change in unemployment* | *Autoregressive term* | *Constant* |
| Difference between log of advertising/GDP and log of labor share | 0.32<br>(0.53) | -0.92<br>(0.39) | 0.93<br>(0.04) | -4.66<br>(0.07) |
| Difference between log of advertising capital cost/GDP and log of labor share | 0.33<br>(0.40) | 0.04<br>(0.29) | 0.96<br>(0.03) | -4.63<br>(0.10) |

Table 4: Regression Results for $R/\lambda$

of pro-cyclicality. A specification that includes lagged unemployment finds a coefficient on that variable of 0.81 with a standard error of 0.27. The $p$ value for the same hypothesis is then 0.0023, strong evidence of pro-cyclicality.

Table 4 shows the regression results for the original specification where $\log(R/\lambda)$ is the left-hand variable and the second row shows the results for the model reformulated to treat advertising spending as investment. The estimates of $\psi - \beta$, the coefficient of minus unemployment, are almost the same. The only important difference is that the second coefficient, for the transitory term $\theta(u_t - u_{t-1})$, becomes almost zero in the investment case. That term enters the equation from the labor share. It disappears when the investment dynamics appear in the advertising ratio.

I repeated the calculations relating to the hypothesis tests about the value of $\epsilon\chi_m$ shown in Table 3 for the investment version of the model. They are similar but somewhat stronger in rejecting reasonable value of the key elasticity $\chi_m$ of the margin shock with respect to demand. For example, in the earlier table, the $p$ value for the hypothesis that $\epsilon\chi_m = 0.6$ against higher values had a $p$ value of 0.045, fairly strong evidence against the alternative hypothesis that, for example, $\chi_m$ exceeded 0.1 because $\epsilon = 6$. In the investment version of the test, the $p$ value is 0.011, much stronger evidence against a value of $\chi_m$ as high as 0.10.

# 7 Other Influences

To this point, the paper has compared two forces that affect the advertising/sales ratio $R$ and the labor share $\lambda$. These are the margin shock $m$ and the product-market friction $f$. The evidence favors a small role for the margin shock and a correspondingly large role for the

friction. A rise in the friction during slumps explains both the decline in $R$ during slumps and the decline in $\lambda$. A natural question is whether other influences could have the same effect. In this section I argue that the set of other influences is quite limited.

To consider the effects of other shocks, I extend the model to include the following:

- A Hicks-neutral productivity shock, $h$
- A labor wedge or measurement error, $f_L$
- A capital wedge or measurement error, $f_K$
- An advertising wedge or measurement error, $f_A$

For clarity, I refer to the product-market shock $f$ as $f_Q$ in this section. For the three new $f$ factors, I assume that the firm pays an amount per unit that is the factor times the reported price; for example, the firm pays an actual wage bill of $f_L W$ when the reported wage bill is $W$. Marginal cost $c$ is now a function of $h$, $f_L$ and $f_K$. But in the derivation of the advertising spending/revenue ratio $R$, leading up to equation (7), neither $c$ nor its determinants makes their way into $R$. The new factor $f_A$ does affect the ratio in the extended model:

$$R = \frac{\kappa A}{pQ} = \frac{\alpha}{f_A \, f_Q \, m} \, \frac{(m-1)\epsilon + 1}{\epsilon} \tag{32}$$

From the derivation of equation (10), it is apparent that only the labor wedge $f_L$ enters the formula for the labor share $\lambda$:

$$\lambda = \frac{W}{pQ} = \frac{1}{f_L \, f_Q \, m} \, \gamma \, \frac{\epsilon - 1}{\epsilon} \tag{33}$$

The appendix contains complete derivations for $R$ and $\lambda$.

These conclusions follow:

- The Hicks-neutral productivity shock $h$ and the capital wedge or measurement error $f_K$ affect neither the advertising/sales ratio $R$ nor the labor share $\lambda$.
- The new shocks affect $R$ and $\lambda$ with elasticities of $-1$; the margin shock $m$ is the only shock that has a high elasticity.
- The advertising wedge or measurement error, $f_A$, lowers $R$ in the same way that $f_Q$ does.

- The labor wedge or measurement error, $f_L$, lowers $\lambda$ in the same way that $f_Q$ does.
- Equal values of $f_A$ and $f_L$ have the same effect as $f_Q$ of the same value.

The relation between the estimated coefficients $\beta$ and $\psi$ becomes:

$$\beta = -\text{Semi-elasticity of } R \text{ with respect to } u = \chi_Q + \chi_A - (\epsilon - 1)\,\chi_m \tag{34}$$

$$\psi = -\text{Semi-elasticity of } \lambda \text{ with respect to } u = \chi_Q + \chi_L + \chi_m \tag{35}$$

The first of these equations is an obstacle to an interpretation of the evidence within the extended model. Suppose first that the value of $\beta$ is 1.0, in line with the estimates in Table 1 and that $\epsilon = 6$, an intermediate value. Then equation (34) implies

$$\chi_m = \frac{\chi_A + \chi_Q - 1}{5}. \tag{36}$$

Recall that $\chi_A$ is the negative of the elasticity of the measurement error in the advertising price $\kappa$ with respect to the demand shift. The actual price is $f_A$ times the reported price. Measured spending is pro-cyclical, as the positive value of $\beta$ demonstrates. To sustain the hypothesis of an important counter-cyclical movement of the profit margin, the error $f_A$ must be counter-cyclical; that is, $\chi_A$ must be positive.

If the elasticity $\chi_A$ is bounded by 1.0, the addition of $\chi_A$ adds at most 0.2 to the implied elasticity of the profit-margin shock with respect to demand. The extended model is not successful in identifying a plausible source of variation that overcomes the high elasticity of advertising with respect to the profit margin. Imputing a substantial counter-cyclical error in measuring the price of advertising goes only part of the way to making sense of the lack of the strongly counter-cyclical movement of advertising compelled by the hypothesis of counter-cyclical fluctuations in profit margins.

The only plausible source of measurement error, to my knowledge, is the one considered in the previous section, based on the hypothesis that advertisement is a form of investment. That hypothesis did reduce the measured pro-cyclicality of advertising, but not by enough to make fluctuations in the markup $m$ an important source of movements in the advertising/revenue ratio $R$ and the labor share $\lambda$.

# 8 Concluding Remarks

Macroeconomists have become fond of invoking rising profit margins to explain the many puzzles of slumps. I think it will be important for these model-builders to bring the behavior of advertising into the variables under consideration. It's hard to overcome the implication that advertising is really, really sensitive to profit margins. The obvious conclusion from the failure of advertising to explode in recessions is that profit margins remain about the same when the economy contracts.

If so, we need to redouble efforts to track down the sources of poor economic performance in long-lasting slumps.

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# A Full Derivation for Advertising

Optimal price:

$$p^* = \frac{\epsilon}{\epsilon - 1} f_Q c \tag{37}$$

Actual price:

$$p = m p^* \tag{38}$$

First-order condition for advertising:

$$\frac{\alpha}{A} Q \left( \frac{p}{f_Q} - c \right) = f_A \kappa \tag{39}$$

From above,

$$c = \frac{\epsilon - 1}{\epsilon} \frac{p}{m f_Q} \tag{40}$$

The first-order condition becomes

$$\frac{\alpha}{A} \frac{pQ}{f_Q} \frac{(m-1)\epsilon + 1}{\epsilon m} = f_A \kappa \tag{41}$$

and, finally,

$$R = \frac{\kappa A}{pQ} = \frac{\alpha}{f_A f_Q m} \frac{(m-1)\epsilon + 1}{\epsilon} \tag{42}$$

# B Full Derivation for Labor Share

With cost minimization and Cobb-Douglas technology, labor cost is a fixed share $\gamma$ of total cost:

$$\frac{f_L W}{cQ} = \gamma \tag{43}$$

Substitute for $c$:

$$f_L f_A m \frac{\epsilon}{\epsilon - 1} \frac{W}{pQ} = \gamma \tag{44}$$

so

$$\lambda = \frac{W}{pQ} = \frac{1}{f_L f_Q m} \gamma \frac{\epsilon - 1}{\epsilon} \tag{45}$$

# C Data Sources

| *Type of advertising* | *Source* | *Years* | *Reference* |
|---|---|---|---|
| Newspapers | Newspaper Association of America | 1950-2011 | http://www.naa.org/Trends-and-Numbers/Advertising-Expenditures/Annual-All-Categories.aspx |
| All types | Douglas Galbi | 1900-2007 | http://purplemotes.net/2008/09/14/us-advertising-expenditure-data/ |
| All types | Census Bureau | 1994-2004 | http://www.census.gov/prod/www/abs/bus-services.html |
| | | 2005-2010 | http://www.census.gov/services/index.html |

Table 5: Sources for Advertising Data