

# research review



Issue No. 15, January 2011 - June 2011

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# research review

**Issue no. 15, January 2011 – June 2011**

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# Public Policy Discussion Papers

p-11-1

## The 2009 Survey of Consumer Payment Choice

by Kevin Foster, Erik Meijer, Scott Schuh, and Michael A. Zabek

complete text: <http://www.bostonfed.org/economic/ppdp/2011/ppdp1101.htm>

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### Motivation for the Research

The 2009 *Survey of Consumer Payments Choice* (SCPC) is the second in a series of annual studies conducted by the Federal Reserve Bank of Boston to estimate and examine the cash and noncash payment behavior of U.S. consumers. Produced by the Boston Fed's Consumer Payments Research Center (CPRC), the SCPC is an effort to develop nationally representative, high-quality, timely, comprehensive, and publicly available data on consumer payment behavior. The survey measures the adoption and use of nine common methods, or payment "instruments" by which U.S. consumers initiate payment. It also measures related consumer banking and payment practices. Together, the two surveys (2009 and 2008) measure changes in consumer payment choices over time. The primary purpose of this paper, like that of its predecessor, is to publish and document the aggregate statistics obtained from the 2009 SCPC and compare these results with those from the revised 2008 SCPC. This paper's secondary purpose is to provide a high-level, nontechnical interpretation of the key results for general readership.

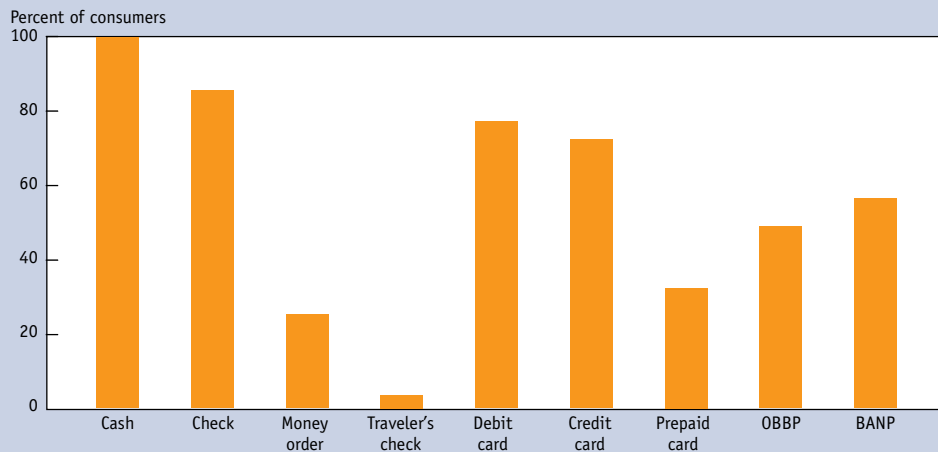
### Research Approach

The paper presents tables displaying estimates of adoption rates, incidence of use, and number of payments per month by U.S. consumers for nine common payment instruments—cash, checks, money orders, traveler's checks, debit cards, credit cards, prepaid cards, online banking bill payments, and bank account number payments. It also presents a wide range of estimates of consumer activity related to banking, cash management, and payments, along with a rich set of consumer characteristics. In the discussion portion, the paper discusses the most salient facts for 2009, provides an economic assessment of how the results fit into the long-run transformation of consumer payments over the last three decades from paper-based instruments to payment cards and electronic payments, and offers an economic interpretation of the annual change in consumer payment behavior during 2008–2009.

The surveys are conducted during the last four months of each year, beginning in 2008. In 2009, the RAND Corporation again administered the Internet-based SCPC as a module of the American Life Panel (ALP), but this time to a sample of 2,173 U.S. consumers—more than twice as many as in 2008. Survey responses were weighted to match national population estimates from the U.S. Census Bureau's *Current Population Survey*. Almost 40 percent of the 2009 SCPC respondents also took the 2008 SCPC, and these continuing SCPC participants are being used to begin to construct a longitudinal panel of consumers for research purposes.

Survey responses were reviewed and tabulated by the CPRC in consultation with RAND. To the extent possible, the CPRC verified the average survey responses, and in some cases the response distributions, by comparing them with actual transactions data from depository institutions and payments companies (where available) or with other consumer payment surveys. A very small number of outlying responses were replaced with values representing the mean responses of consumers with similar demographic characteristics.

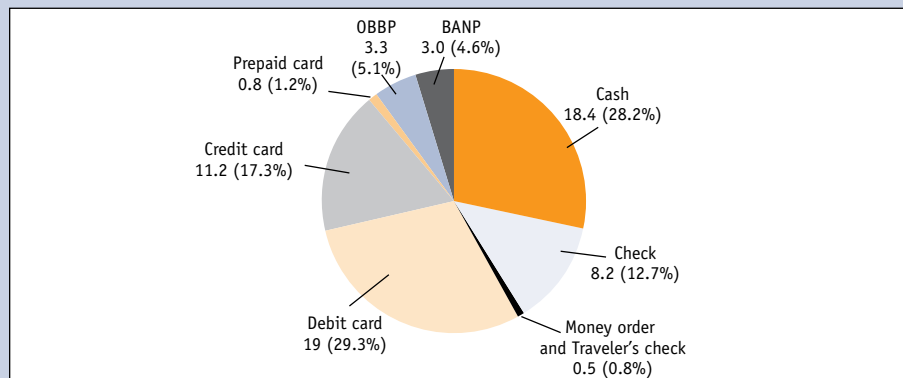
## Adoption of Payment Instruments, 2009



Sources: 2009 Survey of Consumer Payment Choice, Table 4.

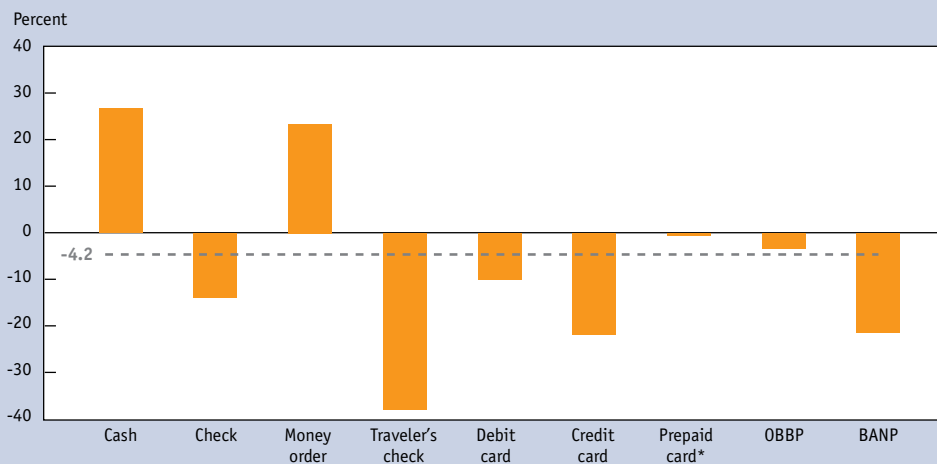
Note: Cash adoption is 100 percent by assumption; estimated cash adoption is 99.8 percent.

## Number of Payments per Month per Consumer, 2009



Source: 2009 Survey of Consumer Payment Choice, Table 20.

## Growth in Number of Payments per Month, from 2008 to 2009



Source: 2009 Survey of Consumer Payment Choice, Table 20.

Notes: \*The percentage change of prepaid card use is based on adopters only. The dashed line represents the growth rate of total consumer payments, across all instruments.

## Key Findings

- The average consumer held 5.0 payment instruments and used 3.8 of them during a typical month. Both numbers are slightly lower than in 2008 (5.1 and 4.2, respectively), yet these results still reflect broad diversity in consumer adoption of payment instruments associated with the long-run transformation from paper instruments to cards and electronic payments.
- Compared with 2008, in 2009 fewer consumers held debit and credit cards: 77.0 percent had a debit card (down from 80.2 percent) and 72.2 percent had a credit card (down from 78.3 percent). Electronic payment instruments were also popular—48.8 percent had set up online banking bill payment and 56.3 percent had used bank account number payments—but these percentages are also lower than in 2008 (down 3.7 percent and 17.0 percent, respectively). The noncash payment instrument still held by the most consumers was checks (85.4 percent).
- The average U.S. consumer (meaning average in terms of the statistic being discussed) made 64.5 payments in a typical month. Debit cards were the most commonly used payment instrument (19.0 payments per month) and cash the second most (18.4). Credit cards (11.2) and checks (8.2) were also commonly used. Most of the remaining payments were made by electronic means, and a small number were made by other methods.
- The time that elapsed between the 2008 and 2009 surveys includes the trough of the latest recession, which was severe. During this time, total consumer payments per month declined by 4.2 percent and consumers shifted toward making more payments by cash and close cash substitutes. Cash payments increased by 26.9 percent; cash holdings and total monthly withdrawals of the average consumer also increased similarly (26.5 percent and 29.2 percent, respectively). At the same time, consumers reduced their payments by credit card (21.9 percent), bank account number (26.1 percent), check (14.0 percent), and even debit card (10.0 percent).
- Several factors likely played a role in the shift of consumer payments back toward cash and related instruments. Weaker economic conditions probably encouraged a shift away from credit card payments, for both supply and demand reasons, and perhaps toward substituting cash payments because paying with cash helps some consumers cut costs and improve budgeting. However, changes in government regulations toward credit and debit cards and bank pricing of payment card services during 2008–2009 also may have contributed to this shift. Consumers' assessments of the security of electronic payments worsened too and may have played a role in the shift back to cash and near-cash payment methods.
- At this time, it is very difficult to assess how much each factor contributed to the shift back toward cash, and whether the shift will be transitory or permanent. However, the fact that consumers continue to tend to rate cash highest in virtually every payment characteristic (acceptance, convenience, cost, and security) suggests that consumer demand for cash is unlikely to disappear any time soon.
- Nevertheless, signs of the ongoing long-term transformation of payments from paper instruments to cards and electronic methods remain evident. About one in three consumers (32.3 percent) had at least one of the many forms of prepaid card, and nearly as many (30.0 percent) had a nonbank payment account, such as PayPal or Google Checkout. Mobile payments also gained a foothold in the United States, with 3.0 percent of consumers having made one in the past 12 months.

## Implications

As the result of a long-term trend away from using cash and checks, consumers employed a wide variety of payment instruments and relied less on traditional paper instruments in 2009 than in the past. However, this trend was interrupted to some extent during and following the recent financial crisis and recession (2008–2009), as the 2009 results show consumers increased their use of cash

in 2009 over 2008 for their monthly payment activities. It remains to be seen whether this shift was merely a reflection of the cyclical downturn, whether it was related to long-lasting changes in consumer perceptions, or whether it was related to policy interventions in payment card markets.

By 2009, consumers were beginning to make significant use of emerging payments technologies such as mobile phones, and the pace of innovation in payments markets is likely to remain high. The Boston Fed's CPRC welcomes collaborators in developing future versions of the SCPC and research partners to join in its broader research program of studying consumer payment behavior.

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## **Adopting, Using, and Discarding Paper and Electronic Payment Instruments: Variation by Age and Race**

by *Ronald J. Mann*

complete text: <http://www.bostonfed.org/economic/ppdp/2011/ppdp1102.htm>  
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### **Motivation for the Research**

The most important development in payments during the last half century has been the steady shift from paper to electronic payments. The increased use of credit cards has made retail payments much more efficient, especially for those seeking to make purchases with borrowed funds (Evans and Schmalensee 2005; Mann 2006). More recently, the shift from checks to debit cards has lowered the transaction costs of processing payments and accelerated the clearing process (Evans and Schmalensee 2005). More generally, the shift away from cash to more sophisticated payment instruments has facilitated a change in the way that households hold their assets—from cash (vulnerable to loss or theft and bearing no interest) to assets that are much safer and much more likely to produce a return for those that hold them. Unfortunately, the limitations of existing survey instruments have made it difficult to understand the details of the ongoing evolution from paper to electronic payment instruments. This paper analyzes data from the Federal Reserve Bank of Boston's 2008 *Survey of Consumer Payment Choice* (SCPC), the first publicly available, nationally representative survey with comprehensive and detailed information about consumers' payment choices.

### **Research Approach**

Using data from the SCPC, this paper discusses the adoption, use, and discarding of various common payment instruments. The survey instrument includes detailed questions about the adoption, use, and discarding of nine different payment instruments: cash, checks, money orders, traveler's checks, debit cards, credit cards, prepaid cards, online-banking bill payment (OBBP), and electronic bank account deductions (EBAD). For purposes of the SCPC, OBBP includes transactions in which a bill payment is made directly from a bank account without using a check or a debit card, and is initiated by a consumer using the bank's online banking bill pay application. EBAD, by contrast, involves an electronic payment in which the consumer provides a bank account number and routing information to a third party that uses the information to obtain funds without the use of a check. Transactions processed by an intermediary (such as PayPal) are treated as made by the underlying payment system that the intermediary accesses (usually credit card, debit card, or EBAD). The survey also includes questions about which payment instruments are used for which types of transactions (paying bills, retail purchases, online purchases, and services). Finally, of particular interest to scholars interested in understanding the development and success of emerging payment instruments, the survey asks a set of detailed questions about the importance consumers attribute to various characteristics of payments (ease of acquisition, acceptance, timing, cost, security, and so on).

The author first briefly discusses the SCPC—how it was conducted, what it includes and how it compares with the Federal Reserve's *Survey of Consumer Finances* (SCF), a triennial nationally

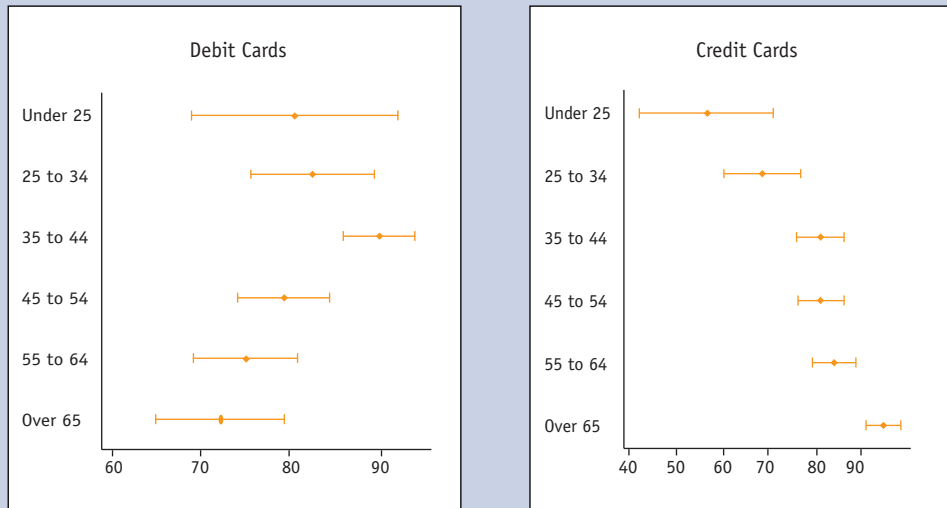
## Adoption of Payment Instruments by Race



Source: 2008 Survey of Consumer Payment Choice.

Notes: Graphs show weighted mean percentage of consumers adopting the listed instrument with 5% confidence intervals. N ranges from 977 to 1002.

## Adoption of Payment Cards by Age



Source: 2008 Survey of Consumer Payment Choice.

Notes: Graphs show weighted mean percentage of consumers adopting the listed instrument with 95% confidence intervals. N = 1001 (Debit Cards), 1000 (Credit Cards).

representative survey of the balance sheet, pension, income, and other demographic characteristics of U.S. families that has been conducted since 1983. The author uses summary descriptive data, simple cross tabulations, and multivariate analysis to examine the adoption of the various payment instruments, estimate the significance of the demographic data and reasons consumers gave for their



payments decisions, and document the relevance of demographic variation. Next, the author assesses the success of the various payment instruments—how often they are used and how often consumers decide to stop or limit their use, again employing both descriptive data and multivariate analysis—before moving on to examine the most novel findings from the SCPC: data about which payment instruments are used for which types of payments.

### **Key Findings**

- In terms of income, the most useful variable to compare, the SCPC and the SCF distributions appear sufficiently similar to validate exploring the SCPC data, particularly across the interior part of the income distribution. There is some divergence at the tails, which is not surprising, given that the SCPC is a consumer-level survey while the SCF collects information at the household level, and given the differences in timing—the last SCF was administered in 2007 and the SCPC discussed in this paper was administered in 2008.
- The rapid rise of debit cards—rarely used just 15 years ago—has led to their adoption by even more consumers than those who use credit cards. This is particularly surprising given the first-mover advantage the existing payment systems had when debit cards first became generally available. A big part of the explanation lies in the ability of MasterCard and Visa to leverage their existing credit card networks to accelerate the market deployment of debit cards. Similarly, the burgeoning use of ACH transactions has pushed EBAD into the top tier of payment instruments. Recognizing that this is a payment system that makes sense only for consumers who have bank accounts, an adoption rate of 73.4 percent reflects a remarkably high level of penetration. In contrast, the low levels of use of money orders and traveler's checks document the marginalization of these once systemically important instruments by the rise of the payment card.
- The 2008 SCPC displays robust evidence of significant age- and race-related differences in payments choices. The data suggest that the range of payment instruments adopted and regularly used by blacks is narrower than that of whites, presumably because of relatively limited access to financial institutions. With regard to age, the analysis documents pervasive and complex age-related patterns at every step of the decisions to adopt, use, and discard payments. Blacks are significantly less likely to use checks, credit cards, stored value cards, and OBBP than whites; the multivariate analysis suggests that this difference is strongly associated with fewer blacks than whites having checking accounts. Consumers who are 45 years old and older appear significantly less likely than younger adults to use debit cards and OBBP, even controlling for race, household status, income, and education. On the contrary, the age-related effect on credit card use is particularly noteworthy in light of the persistent efforts of credit card issuers to market their products to college students. Checking use, once controls are included, is not nearly so age-sensitive as debit card and OBBP use: variations in race, household status, income, and education largely explain the limited variation in access to checking accounts at various ages.
- Among the attributes of payment instruments, consumers care most about security: this property is selected by most respondents as the most important attribute of a payment instrument and by fewer than 1 percent as the least important. Close behind security is ease of use, which is selected by almost as many consumers as the most important attribute and rarely selected as the least important. Conversely, consumers appear to care little about the difficulties of acquiring and setting up an instrument and about how widely it is accepted. This last finding suggests that consumers are much more interested in a simple payment experience, even if it requires carrying multiple instruments for different purposes.

### **Implications**

Much more work remains to be done to understand the underlying causes of the demographic variations documented in this paper. For example, the paper documents substantial and significant age

effects related to payment methods, but does not undertake to determine whether the effects relate to age—the position in the consumer’s life course—or whether they are instead cohort effects—differences in payments choices that depend on the nature of the payments institutions during the early, formative adult years of the life course for each generation of consumers. Although the different payment options that become available as later cohorts enter the mainstream economy make cohort effects plausible, there are strong arguments to support a timeless life-course effect. Most obviously, whatever else has changed about financial services in the last three decades, it remains true that younger Americans have less access to mainstream financial services than those farther along the life course.

p-11-3

## **Oil and the Macroeconomy in a Changing World: A Conference Summary**

*by Christopher L. Foote and Jane S. Little*

complete text: <http://www.bostonfed.org/economic/ppdp/2011/ppdp1103.htm>

e-mail: [chris.foote@bos.frb.org](mailto:chris.foote@bos.frb.org)

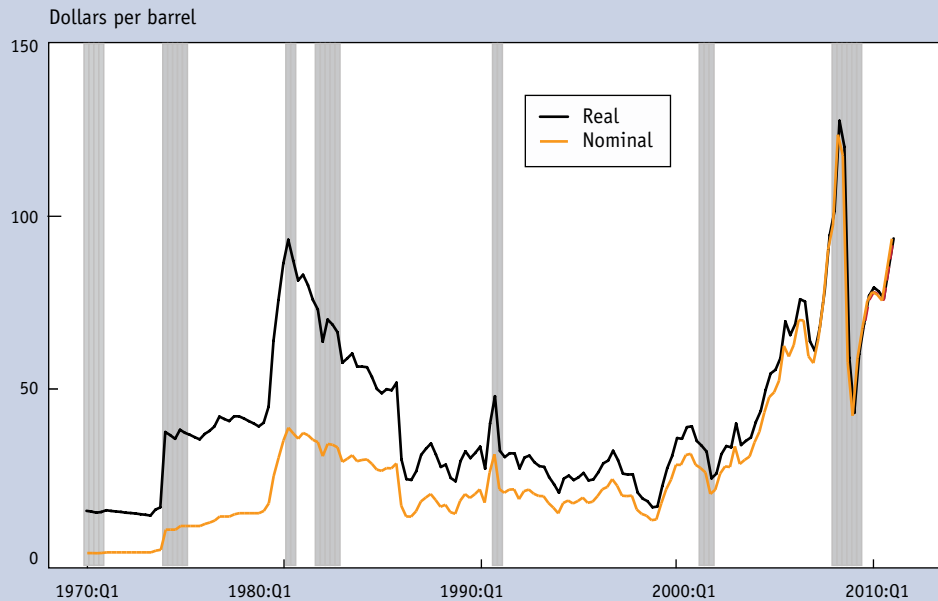
### **Motivation for the Research**

Oil prices have gyrated significantly over the past decade, and analysis of oil-price movements is once again an important feature of economic policy discussions. A barrel of West Texas Intermediate crude oil sold for just under \$30 in early 2001. After a dip during the 2001 recession, oil prices began a sustained increase that approached \$75 per barrel by mid-2006. Soon after, the price increase accelerated, with prices topping out at more than \$145 per barrel in July 2008. Then, the onset of the Great Recession helped send prices sharply lower, as a barrel of oil averaged about \$43 in 2009:Q1. The global economic recovery, combined with concern over potential supply disruptions in Libya and other oil producers, sent prices higher again this year. Oil prices breached the \$100 mark in March and rose to \$112 in April, before falling back to about \$100 in early May. Price movements like these have long been of interest to economic policymakers. Rising oil prices have typically preceded recessions, an empirical regularity that has remained consistent since it was formally documented in Hamilton (1983). Yet the economic effects of oil prices are hard to explain in simple economic models because oil-based products account for a small share of consumer and business spending. Moreover, the reasons behind oil price movements have often baffled observers. Rising demand from emerging markets like India and China might have accounted for \$145 oil in July of 2008—but what about the collapse in prices over the subsequent seven months? Could oil-market “fundamentals” be behind both movements or did a speculative boom-bust cycle in the oil market also play a role?

### **Research Approach**

To help answer such questions, the Federal Reserve Bank of Boston held an interactive symposium, “Oil and the Macroeconomy in a Changing World,” on June 9, 2010. The conference gathered scientific experts, market participants, business leaders, academics, and policymakers for discussions that covered many facets of the oil market. Among other topics, participants debated the likely short- and long-run outlooks for oil supply and demand, the best ways to model oil prices, the reasons for oil’s outsized effect on GDP, and the effect that potential climate-change legislation might have on the oil market. The symposium was “presentation-based,” in that no formal papers were delivered. Rather, each session featured an expert presentation on a particular topic, followed by remarks from a discussant and then an open conversation among all attendees. This paper summarizes the conference by outlining four crosscutting themes that recurred throughout the day and then presenting synopses of the individual sessions that addressed the following topics: explaining the historical course of oil prices, the supply of oil, the demand for oil, the future of climate change

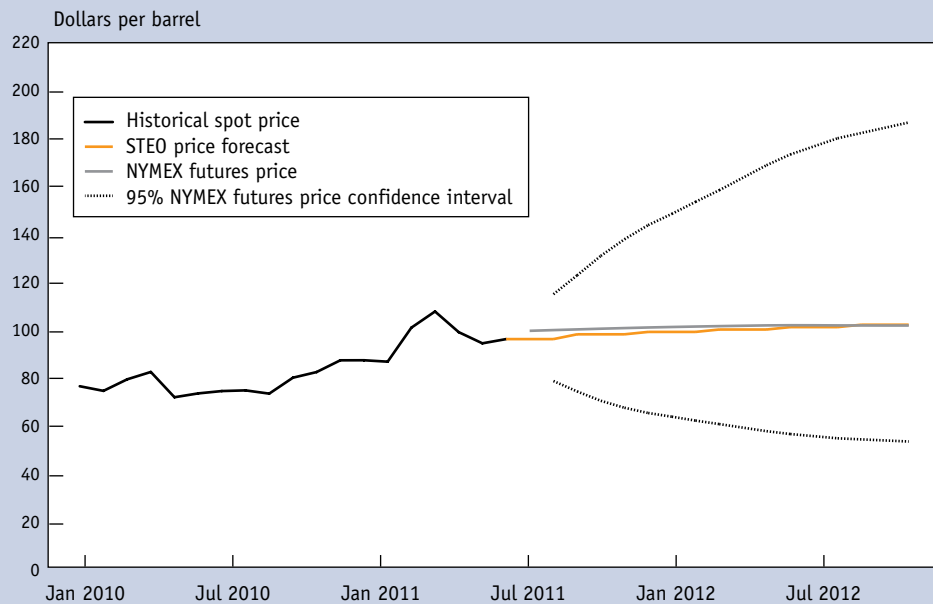
## Nominal and Real Prices of West Texas Intermediate Crude Oil 1970:Q1 to 2011:Q1



Sources: *Wall Street Journal*, Bureau of Economic Analysis, and National Bureau of Economic Research.

Notes: Posted prices are used prior to 1982. The GDP is used to transform the nominal oil price into a real price (2011:Q1 dollars)

## Oil Price Forecast of the Energy Information Administration, as of May 2011



Source: Energy Information Administration, May 2011 *Short-Term Energy Outlook*.

Notes: Forecast respond to the price of a barrel of light, sweet crude in current dollars. Confidence intervals are derived from options-market information for the five trading days ending May 5, 2011. Intervals are not calculated for months with sparse trading in "near-the-money" options contracts.

policy, financial innovation and oil markets, modeling oil prices, and the macroeconomic effects of oil price shocks.

### **Key Points**

- High oil prices are probably here to stay. Although the real price of oil trended lower in the decades following the 1970s' oil shocks, conference participants generally believed that a similar decline is unlikely to occur after recent oil price increases. The 1980s' price decline was very much due to the way advanced economies responded to higher oil prices at the time, but similar responses along either the demand or supply margins are less likely today.
- Predictions for oil prices are uncertain at all time horizons. The prediction that oil prices will remain high represents the best educated guess about the future and is not a statement of fact. Indeed, as the conference title suggests, today's oil market operates in a rapidly changing world, so any predictions about this market are highly uncertain. Much of this uncertainty stems from the close relationship between oil and the transportation sector. In the short run, the lack of alternatives to oil as a source of transportation energy mean that large changes in oil prices are required to restore equilibrium when oil supply is disrupted or when oil demand increases. Because oil markets are forward-looking, prices typically rise even when the world's spare oil-production capacity starts to run low.
- There is little consensus on whether the "financialization" of oil has affected prices. Taken together, economic and political uncertainties in the global oil market provide a framework for explaining the oil price gyrations of recent years. Economic models can explain how long-lasting changes in oil demand, arising from emerging countries like China or India, could have big effects on oil prices if the world's access to spare capacity is limited. But some conference participants were unwilling to ascribe all of the recent volatility of oil prices to fundamental forces. Financial speculation in oil markets could have contributed to oil price hikes in the 2000s by driving prices higher in a classic asset-market bubble.
- Oil prices still have sizable effects on the global and domestic economy. While there was substantial disagreement about financial speculation in oil markets, there was general consensus that oil prices have significant effects on the wider economy. Higher oil prices can slow GDP growth in many ways. On the demand side, higher oil prices force U.S. consumers to remit more of their income abroad to pay for oil imports, leaving less income to be spent on domestically produced goods and services. Higher prices may also heighten economic uncertainty, causing consumers to delay big-ticket, energy-intensive purchases like automobiles. Additionally, if oil price increases turn out to be permanent, they can engender substantial reallocations of production away from oil-intensive uses. This reallocation can absorb resources that otherwise could have been used to produce output.

### **Implications**

Surprisingly, the conference participants devoted relatively little attention to how rising oil prices affect inflation and inflation expectations—an issue of key importance to monetary policymakers in 2008 and again in mid-2011. This silence likely attests to the participants' confidence that this impact will remain quite limited as long as the monetary authority has credibility and inflation expectations remain anchored. Indeed, one presenter argued that the Federal Reserve has created a "reservoir of anti-inflation credibility" that allows it to delay raising interest rates when an oil shock produces a gap between core and total inflation. He contended that a credible Fed can avoid raising interest rates and aggravating the negative impact of an oil price increase on output and employment without risking an increase in inflation expectations as long as people believe that the Fed is committed to maintaining a low but stable inflation rate over the long term. As Boston Fed President Eric Rosengren pointed out in a recent speech, this high-credibility scenario describes the

prevailing experience since the mid-1980s (Rosengren 2011). However, in the low-transparency, low-credibility world of the 1970s and early 1980s, oil shocks did lead to a rise in inflation expectations, wage pressures, and a period of high core, as well as total, inflation. Thus, even though current medium-to-long-term inflation expectations remain well anchored, Rosengren argued that the Fed must continue to monitor inflation dynamics very closely to make sure that inflation expectations do not become unmoored as they did in the 1970s. In this context, additional research to improve economists' understanding of the nonlinearities and asymmetries in the relationship between oil prices and inflation dynamics could be very useful.

## Working Papers

w-11-1

### **Real Output of Bank Services: What Counts Is What Banks Do, Not What They Own**

*by Robert Inklaar and J. Christina Wang*

complete text: <http://www.bostonfed.org/economic/wp/wp2011/wp1101.htm>

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#### **Motivation for the Research**

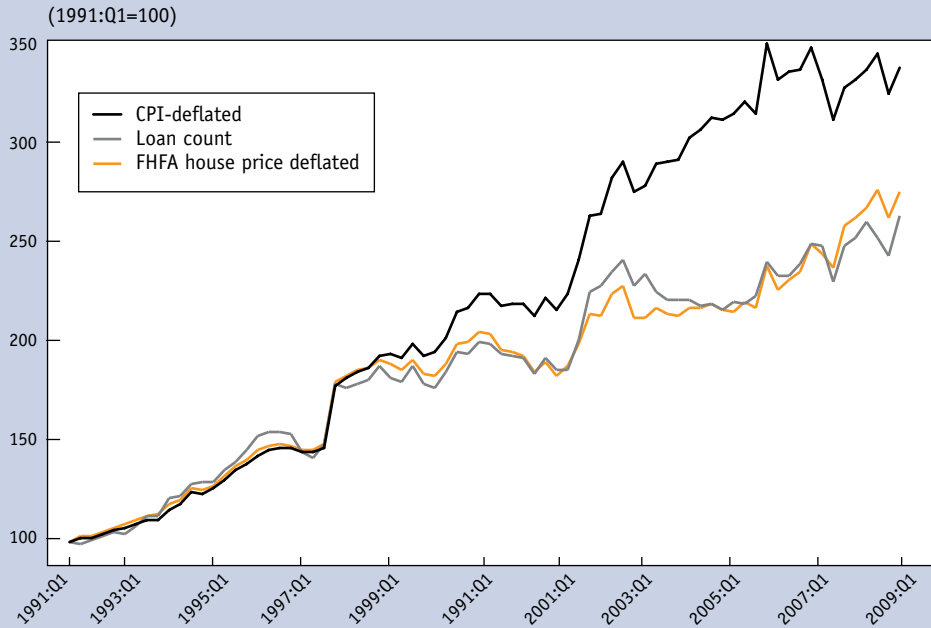
How to measure bank output has long been a difficult and sometimes contentious topic that has yet to see a consensus resolution. Achieving the right output measure for bank services has become more important in the aftermath of the recent devastating financial crisis, as the role of financial firms has come under intense scrutiny. One of the questions attracting greater attention concerns how much banks have truly contributed to the real economy in terms of the services they provide. This paper focuses on the methodological question of how to measure the real value of these services.

#### **Research Approach**

The authors construct model-based output measures for banking services and compare these with alternative measures commonly used by statistical agencies. The underlying banking model is built on theories of financial intermediation and asset pricing. Its central premise is that bank output should be measured in terms of indexes of quality-adjusted counts of different categories of banking transactions. This approach amounts to assuming that each transaction within a suitably defined category, such as a conforming mortgage loan origination or a deposit withdrawal, represents a constant flow of services over time.

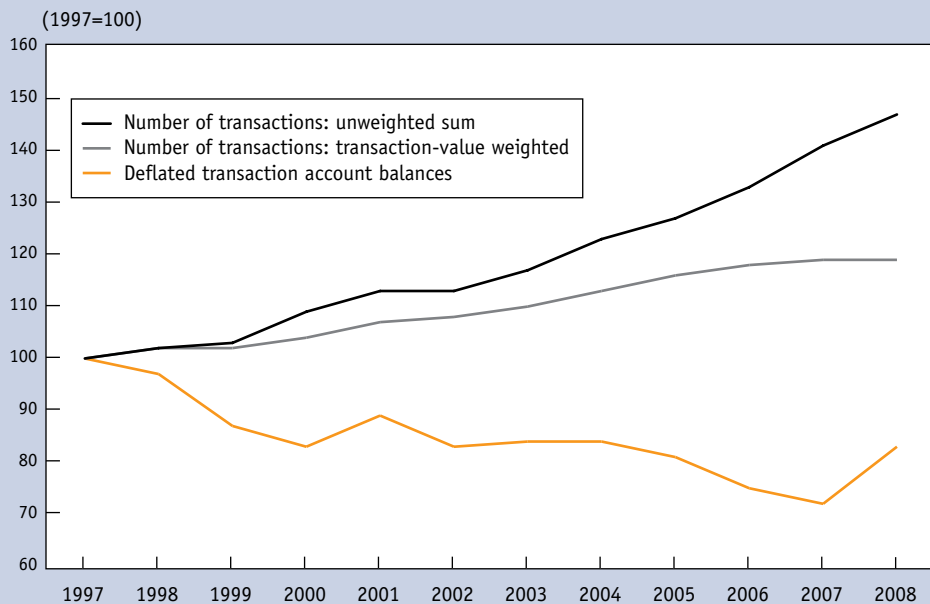
The authors contrast their model-based output measures derived from activity counts with measures based on outstanding balances of loans and deposits deflated by a general price index—such measures are used by statistical agencies in many countries. Effectively, this latter approach assumes that every (real) currency unit such as the euro or U.S. dollar corresponds to a constant flow of services over time. However, assuming such fixed proportionality between outstanding balances and service flows requires restrictive assumptions. In contrast, counting activities always yields the right output measure in theory. In practice, adequate quality adjustment is difficult because of the lack of relevant detailed data. Nevertheless, the authors map the theoretical concepts to the best available data, encompassing three categories of bank services—commercial and industrial loans, residential real estate loans, and transaction services associated with deposit accounts. They contend that these activity-count-based measures using available data, albeit with imperfect quality adjustment, still constitute an improvement over deflated balances because of the conceptual advantage gained by measuring banks' activities more correctly.

### Output Indexes for U.S. Residential Mortgage Services: Loan Counts, CPI-Deflated Balances, and House Price-Deflated Balances, 1991:Q1-2009:Q4



Sources: Federal Financial Institutional Examination Council Call Reports, Bureau of Labor Statistics, and Federal Housing Finance Agency.  
Note: The house price index used is the equal-weighted index published by the FHFA.

### Output Indexes for U.S. Deposit Services: Deflated Balances Versus Alternative Transaction Counts, 1997-2008



Sources: Federal Financial Institutional Examination Council Call Reports and Bank for International Settlements.

### Key Findings

- The output indexes based on activity counts of the three types of banking services exhibit notably different trends from output indexes based on deflated balances. Moreover, the bias of the deflated-balance series varies across types of bank services, countries, and over time. These findings imply that deflated balances are unlikely to be a valid proxy for true bank output because the conditions needed are too restrictive to be satisfied in practice.
- The conceptually sound, activity-count measure can be implemented only imprecisely at present because of data limitations.

### Implications

The paper's findings have important implications for cross-country growth comparisons. In the United States, official statistics have so far been based on the activity-count approach, while the European statistics rely almost entirely on the deflated-balance approach. Following the authors' reasoning, the official estimate of European bank output growth is most likely biased relative to that of the United States, although the direction and size of the overall bias is unclear given the paper's finding of biases in both directions. More accurate estimates await additional data needed to conduct a similar comparison for the other types of loan and deposit services.

The paper's proposal for an activity-count measure of bank output can also have implications for productivity estimates over the past decade or so. In particular, if bank output has been overestimated because of inflated asset valuations (and hence balances), it would call for revisiting estimates of the U.S. productivity revival that began in the mid-1990s, because the financial services industry accounts for a nontrivial fraction of the productivity gains. Furthermore, growing interest has been expressed in discussions of financial regulatory reform to separate banks' utilities-like function from their risk-taking function. The estimates in this study can be viewed as a first attempt to gauge the contribution of the utilities-like functions of banking to growth that is minimally contaminated by the risky returns earned by banks or by asset inflation.

w-11-2

## Explaining Gender-Specific Racial Differences in Obesity Using Biased Self-Reports of Food Intake and Physical Activity

by Mary A. Burke and Frank W. Heiland

complete text: <http://www.bostonfed.org/economic/wp/wp2011/wp1102.pdf>

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### Motivation for the Research

Since the late 1970s obesity has been significantly more prevalent among nonHispanic African-American women (henceforth "black women") than among nonHispanic white American women (henceforth "white women"). According to the National Health and Nutrition Examination Surveys (NHANES), in the 1976–1980 period the obesity rate among black women was 15.6 percentage points higher than among white women. In the 1988–1994 period, this same gap went up slightly, to 15.8 percentage points and by the 2003–2006 period had widened to 21.8 percentage points. Surprisingly, obesity rates of American men measured in the same surveys are not consistently higher among blacks than among whites, although a small but significant gap of 3.3 percentage points appears in the 2003–2006 data. While policymakers and researchers from a broad set of disciplines have long been aware of these patterns, systematic research into the causes has been relatively scarce and the facts underlying the disparities remain poorly understood. An editorial in the April 2009 issue of the *American Journal of Clinical Nutrition* draws attention to the higher obesity rate among

black American women and argues that a greater understanding of disparities in obesity risk is critical for designing appropriate policy interventions.

### **Research Approach**

The authors use data from the NHANES 1999–2006 surveys to perform a gender-specific multivariate analysis of obesity and body mass index (BMI) in order to determine the extent to which variation in relevant behaviors—including food intake, physical activity, and smoking—contribute to gender-specific racial differences in outcomes. BMI is the ratio of weight, measured in kilograms, to squared height, measured in meters, and the CDC defines obesity as a BMI value of 30 or more. The authors' analysis focuses primarily on the discrepancies between nonHispanic whites and non-Hispanic blacks. Combining the estimated effects of behaviors on BMI in the multivariate analysis with the demographic patterns in the behaviors themselves yields a quantitative estimate of the extent to which these behaviors can account for the black-white BMI gap among women.

NHANES is a nationally representative set of cross-sectional studies conducted by the Centers for Disease Control (CDC) that include height, weight, and other physical features measured by trained examiners, as well as information regarding the subjects' demographic, socioeconomic, behavioral, and health characteristics obtained through in-person interviews. While NHANES contains data on subjects of all ages, the current study deals only with individuals between 20 and 65 years of age, in order to properly control for differences in the age distribution across demographic groups and survey periods. The analysis incorporates a new method of addressing measurement error in self-reported behaviors and is informed by a conceptual model of BMI based on biological and economic principles. To the best of the authors' knowledge, no previous study has identified the contribution to obesity of behavior patterns categorized along racial and gender lines using a nationally representative dataset such as NHANES.

The NHANES data contain weight and height values measured by trained examiners, and therefore the BMI values computed from these data are not subject to self-reporting bias. Of necessity, however, the NHANES data on food intake and physical activity are self-reported and as such are subject to biases arising for a variety of reasons, such as individuals' forgetting to report certain food items or deliberately failing to report them based on fear of social disapproval.

The NHANES data are used to estimate the basal metabolic rate (BMR) for each individual, which is the daily caloric expenditure required to maintain basic bodily functions, such as breathing, while in a resting (not sleeping) and fasting state. In turn, the authors use the estimated BMR values to construct two ratios: the physical activity level (PAL), defined as the ratio of total daily energy expenditure to the BMR, measured in kilocalories, and the energy intake ratio, defined as the ratio of daily energy intake (kilocalories consumed) to the BMR. These ratios are then used to construct a key control variable, described below, that assists in mitigating measurement error in self-reported behaviors.

To control for the potential biases present in self-reported behaviors, the authors employ two rigorous and complementary strategies to mitigate measurement error for these two behaviors. First they identify self-reports of food intake that appear questionable in relation to the reported physical activity level and exclude these observations from the regression. Second, because the exclusion criterion has relatively low sensitivity when using single-day food intake data, they construct a continuous proxy for joint measurement error in self-reported food intake relative to physical activity and add this as a control variable in some models. Termed “EI-check,” short for “energy-intake check,” this error proxy, which is constructed by dividing the energy-intake ratio by the PAL, helps to correct for residual underreporting bias as well as classical attenuation bias. The authors perform an empirical analysis that describes raw differences in food intake, physical activity levels, and smoking behavior by race and sex. Then they estimate models of BMI and obesity status separately for men



and women as functions of these behavioral measures. Eight different models based on different covariates are constructed, and EI-check is included in some of these models.

The authors' use of objectively measured height and weight values to compute BMI, coupled with their more rigorous error mitigation methods when compared with studies using self-reported behavioral data, yields some important insights. After eliminating highly implausible observations and proxying for remaining measurement error with EI-check, they achieve large increases in the explanatory power of caloric intake and physical activity and the ability of these two factors to account for gender-specific racial differences in mean BMI and obesity. While behavioral differences are merely proximate to differences in BMI and obesity—that is, one would ultimately like to understand the causes of the behavioral differences—identifying the behavioral patterns that bear on the racial and gender specificity of obesity helps pinpoint appropriately targeted policy interventions.

### **Key Findings**

- Among women, lower levels of physical activity in both work-related and leisure-time pursuits contribute significantly to black women's higher mean BMI and greater obesity prevalence. In addition, modestly higher caloric intake among black women also contributes significantly to their higher mean BMI and higher obesity rate. However, these significant effects of behaviors emerge only in models that control for measurement error using the methods described above, indicating that self-reporting errors are significant and that the controls are essential to the analysis. In particular, including EI-check significantly strengthens the effects that caloric intake and physical activity exert on BMI, thereby enabling behaviors to account for a greater portion of the black-white obesity gap than is obtained in models that omit EI-check.
- In the NHANES 1999–2006 data, the authors' most comprehensive empirical model can account for roughly half of the black-white female BMI gap, or 2.1 BMI units. Roughly 0.51 BMI units of the gap are accounted for by the 34-calorie-per-day gap in mean caloric intake between black women and white women, while lower levels of physical activity among black women (across various indicators) jointly account for about 1.03 BMI units. The lower average value of EI-check among black women (indicating possibly a stronger tendency to underreport food intake and/or overreport physical activity) accounts for 0.57 BMI units, which means that a significant portion of the BMI gap may be due to racial differences in caloric intake and physical activity that are obscured by measurement error. (The authors caution that they cannot neatly separate the contribution of measurement error in caloric intake from measurement error in physical activity, nor can they rule out the possibility that EI-check may proxy in part for unmeasured variation in basal metabolism.)
- The effects of smoking on BMI and obesity risk generally become smaller and/or lose significance when EI-check is included. Theoretically, smoking has no direct effect on BMI when perfect measures of caloric intake and expenditure are available, but empirically smoking may proxy for unmeasured variation in food intake and energy expenditure. By including EI-check as a proxy for measurement error, smoking's proxy effect is apparently reduced.
- Failing to address self-reporting bias in behaviors could lead to the mistaken conclusion that individual behaviors explain only a modest portion of the difference in mean BMI between black women and white women and that unalterable differences in basal metabolism must therefore explain the outcomes.

### **Implications**

This analysis contributes to the debate concerning the contribution that individual behaviors versus metabolic endowments make to observed demographic patterns in obesity—since variations not explained by chosen behaviors must be attributable to such innate endowments, barring the

imperfections of the empirical estimation. While an analysis of proximate causes raises the question of why such individual and gender-specific behaviors differ, for policy purposes it may be easier to target behaviors rather than the underlying causes of such behaviors. The fact that behaviors related to diet and physical activity levels can account for a significant portion of the obesity gap between black women and white women is important from a policy viewpoint. While wholesale behavioral change is difficult to effect, the authors' findings suggest that a combination of modest but sustained adjustments on both sides of the energy balance equation may go a long way towards closing the BMI and obesity gaps between black women and white women. For example, these results imply that a relatively small daily intake reduction on the order of 50 calories could reduce relative obesity risk among black women by 10 percent. While black women engage in significantly less leisure-time physical activity than white women, interventions aimed at increasing black women's leisure-time activity address only one portion of overall physical activity. The authors' findings indicate that increasing physical activity among normal daily activities may have a significant impact on BMI and obesity risk. Thus, if leisure time is scarce, a more effective policy might aim at increasingly physical activity during the workday for those required to spend extended periods in a seated position.

w-11-3

## **Estimation of Forward-Looking Relationships in Closed Form: An Application to the New Keynesian Phillips Curve**

*by Michelle L. Barnes, Fabia Gumbau-Brisa, Denny Lie, and Giovanni P. Olivei*

complete text: <http://www.bostonfed.org/economic/wp/wp2011/wp1103.htm>

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### **Motivation for the Research**

Modern macroeconomic models have an important forward-looking dimension, with current variables depending, among other factors, on expected future economic conditions. Estimation of these intertemporal relationships is often carried out with the relationships expressed in Euler-equation form. In this form, a variable typically depends on its expected future and past performance, as well as its driving process. For example, an aggregate supply relationship in Euler form can be expressed as a hybrid Phillips curve where inflation is a function of expected future (next-period) inflation, past inflation, and marginal costs (the driving process).

In a limited-information estimation framework, the crucial issue is how to use the available data to properly identify the role of the forward-looking elements. Consider a two-stage estimation procedure where expectations are constructed first by means of a simple unrestricted linear projection on past data, and then substituted into the dynamic relationship of interest. At this point, it is important to distinguish between two polar approaches to estimation. At one extreme, expectations are left unconstrained. In particular, the projections are taken as the only information available on expectations and the econometrician directly estimates an Euler equation (in practice, a difference equation). At the other extreme, the evolution of expectations is itself constrained to obey the Euler equation. This latter approach restricts the expected value of the variable of interest to be governed by the same Euler equation one period forward. Taking into account this fact introduces expectations regarding the variable of interest shifted two periods forward, which in turn are governed by the Euler equation two periods forward, and so on. This recursive procedure constrains the evolution of expectations to be model-consistent ad infinitum. A particular application of this approach is the estimation of a model's closed form. A closed-form solution to the Euler equation embeds by construction all model-based restrictions on the evolution of expectations. For simplicity, we refer to model estimates based on a closed-form solution as CF estimates, and to those based on the unrestricted Euler equation as DE (difference equation) estimates.

The CF estimates are of particular interest because they can be thought of as the limiting case in which all model restrictions on the forward-looking part of the model are imposed at the estimation stage. However, one can think of intermediate cases between the DE and the CF estimates where model-consistency of expectations is imposed only for a finite number of periods. In other words, the iteration described above when imposing model discipline on expectations is not carried out ad infinitum as in the closed form. These intermediate cases are especially relevant as they allow one to assess the extent of model discipline that is needed to obtain estimates that are close to the CF specification's results. In addition, these cases are particularly convenient when the closed form of an Euler equation is difficult to compute.

In this paper the authors analyze the differences that arise from estimating a forward-looking relationship when different degrees of model discipline are imposed on expectations. The forward-looking relationship considered in the paper is a New Keynesian Phillips Curve (NKPC) with time-varying trend inflation. Of particular interest is the contrast of results when the NKPC is expressed in its DE form versus the CF representation.

There is now a large literature on estimating NKPC models. The forward-looking component in the NKPC is usually derived from a micro-founded problem in which firms cannot reset prices optimally in every period (Calvo 1983) or face convex adjustment costs (Rotemberg 1982). Firms then take into account not only current market conditions, but also expected future conditions when setting prices optimally. This mechanism alone provides no role for lagged inflation in the NKPC. But in actual data, inflation can be highly persistent, and purely forward-looking versions of the NKPC often fit the data worse than "hybrid" versions where current inflation depends not just on expected future inflation, but also on its own previous path. The dependence on past inflation is frequently introduced through some ad hoc pricing mechanism (for example, indexation or "rule-of-thumb" price setters). For many purposes this is unsatisfactory, as the mechanism lacks microfoundations, though sluggish nominal adjustment has been related to learning and information processing constraints. The work by Cogley and Sbordone (2008) explores the possibility that the persistence in the inflation process is due to a time-varying inflation target rather than to some ad hoc element in firms' price-setting decisions. There is considerable evidence that the Federal Reserve's inflation target has not remained constant over time (Ireland 2007), and this raises the possibility that variations in the target are an important source of inflation persistence. The empirical findings in Cogley and Sbordone do indeed favor a purely forward-looking Phillips curve where inflation persistence results entirely from a time-varying inflation target. These findings, therefore, are consistent with a price-setting framework that does not rely on ad hoc, backward-looking price adjustment.

A purely forward-looking NKPC has important implications for inflation dynamics. As long as the inflation target is not moving, inflation is as persistent as its driving process. For example, consider a situation in which real marginal costs drop below their steady-state level and are expected to revert to the steady state in one year. Inflation then drops immediately and returns to its target level in one year, in sync with real marginal costs. The same is true for a markup shock: a one-period markup shock has only a one-period effect on inflation. Instead, when inflation is not purely forward-looking, the adjustment of inflation to movements in real marginal costs or to markup shocks is slower. A one-period negative markup shock, for example, results in lower current inflation and, given the dependence of inflation on its own past path, this lowers inflation in the next period. Indeed, inflation converges only asymptotically to the target, despite the one-time shock. These differences in inflation dynamics can have substantial implications for the design of optimal monetary policy. In the current U.S. economic environment in which real marginal costs are well below normal and are expected to increase only gradually, the difference in the projected path of inflation can be large. In this situation, the extent of monetary policy accommodation is critically dependent on the degree of backward-looking behavior that characterizes inflation. In the purely forward-looking NKPC, the

decline in inflation may well be modest, but when inflation is not purely forward-looking the pull of depressed marginal costs on inflation can be significant.

### **Research Approach**

To explain the differences in the estimates, the authors start from a first-stage estimation where expectations of the variable of interest are generated by means of some forecasting rule. This forecasting rule is the same unconstrained reduced form for all specifications that they consider (DE, CF and all intermediate cases). The first stage is estimated as an unconstrained vector autoregression. Given the estimated forecasting rule, the second stage uses minimum-distance methods to estimate the deep parameters of the intertemporal relationship of interest. Since the first-stage estimates are the same across all specifications, this two-step estimation isolates the impact on the estimates from adding restrictions to the way expectations enter the relationship at hand.

When the first-stage reduced form is identical to the “true” data-generating process, the DE and the CF specifications (and all the intermediate cases) estimated in the second stage should be the same. Yet it is fair to assume that any unconstrained reduced form for the “true” process underlying the actual data is bound to be, at best, an approximation. In this case, the DE and CF specifications (and all the intermediate ones) are not equivalent. The way these specifications differ is that the DE form does not exploit model restrictions on expectations. Instead, all other specifications impose at least some model discipline on expectations. The authors show that these restrictions are equivalent to appending additional moment conditions to the DE specification. As long as the dynamic relationship they are estimating provides an accurate description of the data, placing these additional constraints results in more precise estimates. In this respect, the paper links the estimation problem of Euler equations to the literature on the gains in efficiency that result from adding model constraints to minimum distance estimators (Kodde, Palm, and Pfann 1990; Hayashi 2000, ch. 3). This issue has already been explored in seminal work by Hansen and Sargent (1982). The authors’ analytical approach, however, is novel in that it shows how model discipline can always be imposed through re-weighting of the very same cross-equation restrictions that characterize the unstructured minimum-distance problem for the DE case. Thus, the econometrician can require any degree of model consistency between (and including) the two polar cases without changing the dimension of the minimum-distance problem.

For the estimation on actual data, the authors use a NKPC with time-varying coefficients to account for changes in the inflation trend. Using this model, Cogley and Sbordone (2008) report DE estimates that imply that the NKPC is purely forward-looking, with no role for lagged inflation in explaining inflation dynamics.

The authors of this paper describe the DE, CF, and intermediate specifications in the context of a simple NKPC model and discuss the two-stage estimation procedure. They then provide an explanation for the gain in efficiency from estimating specifications that impose model-consistent constraints on expectations and provide some Monte Carlo evidence. Next, they consider a NKPC model that allows for time-varying trend inflation, compare estimates from the different specifications using actual U.S. data, and draw conclusions based on these exercises.

### **Key Findings**

- Estimation of forward-looking models via limited information methods can differ substantially when the model is expressed in Euler equation (DE) form rather than in closed form (CF). The reason for the difference in estimates is that the closed form imposes model-consistent restrictions on expectations that are not explicitly imposed in the DE form.
- The addition of model-consistent constraints (which do not necessarily hold in the DE form) yields more efficient and less biased estimates. On actual data, moving from the DE specification (Cogley and Sbordone 2008) to the CF version of the NKPC leads to substantially

different results concerning the importance of lagged inflation in the NKPC. The estimated role for backward-looking indexation goes from zero in some DE specifications to almost one using the CF specification. This implies that the NKPC assigns similar weights to lagged inflation and to expected future inflation. The estimation of the closed form suggests that accounting for time-varying trend inflation in the NKPC does not explain away inflation inertia. In addition, the CF specification implies that prices are re-optimized much less frequently than what is suggested by the DE form (approximately 12 months versus 4 months).

- Overall, the authors' results underscore that U.S. inflation persistence within a widely used NKPC framework cannot be explained entirely by time-varying trend inflation and the persistence of the driving process. In particular, lagged inflation contributes importantly to inflation dynamics. These findings apply not only to the full 1960-to-2003 sample period, but also to the post-1983 sample.

### **Implications**

A desirable property of the authors' framework is that imposing additional model-consistent restrictions on the DE form does not increase the scale of the estimation problem. While these restrictions can be interpreted as additional moment conditions, the number of cross-equation restrictions is always the same, regardless of how much model discipline the econometrician is willing to impose explicitly. This is especially useful when estimating forward-looking Euler equations in a limited-information framework, as model-consistent expectations are an essential element of these models (Hansen and Sargent 1982).

Whether inflation exhibits autonomous inertia has important implications for the dynamics of inflation. It is therefore important to approach the estimation of the NKPC using methods that take the forward-looking nature of the model as seriously as possible. The inflation model estimated here is used simply as a tool to illustrate the importance of imposing model discipline on expectations in estimation settings that do not necessarily require it. This widely used model assumes autonomous inflation inertia rather than deriving it from microfoundations, the lack of which does not mean that one can a priori reject inertia as a feature of the data. Moreover, "indexation" might just help to capture more complex structural behavior such as the impact of learning on pricing (Gumbau-Brisa 2005). For the period the authors consider, the findings indicate that autonomous inertia is a relevant feature of the inflation process and highlight the need for better microfoundations. In this respect it should also be noted that the authors' estimates question the relevance of marginal costs (as proxied by the labor share) as the driving process for inflation. The current economic environment may provide an important test of the model as a whole and of the relevance of autonomous inertia when inflation is very low.

w-11-4

## **A Response to Cogley and Sbordone's Comment on "Closed-Form Estimates of the New Keynesian Phillips Curve with Time-Varying Trend Inflation"\***

*by Fabià Gumbau-Brisa, Denny Lie, and Giovanni P. Olivei*

complete text: <http://www.bostonfed.org/economic/wp/wp2011/wp1104.htm>

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### **Motivation for the Research**

In their 2010 comment (henceforth referred to here as CS10), Cogley and Sbordone argue the following: (1) that estimates in a paper by Barnes, Gumbau-Brisa, Lie, and Olivei, (henceforth BGLO09, current version BGLO11) are not entirely closed form, and hence are arbitrary; (2) that

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\*The current version is titled "Estimation of Forward-Looking Relationships in Closed Form: An Application to the New Keynesian Phillips Curve" and is summarized in the immediately preceding executive summary (w-11-3).

the authors of BGLO09 cannot guarantee that their estimates are valid while Cogley and Sbordone's estimates in their 2008 paper (henceforth CS08) always are; and (3) that the estimates in CS08, in terms of goodness of fit, are just as good as other, much different estimates in BGLO09.

### **Research Approach**

Although this paper notes that all of the CS10 issues are addressed in the current version of the paper (BGLO11), this paper provides a point-by-point response, framing the discussion as a series of replies to the points made in CS10. This paper begins with a general discussion of the efficiency gains to be had by imposing model-consistent restrictions on expectations that a difference equation specification does not exploit, and notes that the authors' empirical applications produce very different New Keynesian Phillips Curve (NKPC) estimates from the ones reported in CS08. The authors (BGLO) employ a number of different specifications to show that the estimates do not change meaningfully when considering the exact closed form.

### **Key Findings**

- The exact closed-form estimates are virtually the same as the estimates based on the “quasi” closed form.
- The estimates in BGLO09 (including the exact closed-form estimates) generally satisfy the necessary and sufficient conditions for the validity of the two-stage estimation framework. These conditions guarantee determinacy and the proper specification of the first-stage VAR (vector autoregression) expectations.
- These necessary and sufficient conditions are often not satisfied in CS08. This indicates a violation of Cogley and Sbordone's own critical assumption that expectations can be estimated from a finite-order VAR with serially uncorrelated errors.
- The goodness of fit exercise in CS08 and CS10 is misleading, as it almost reduces to fitting expected inflation with expected inflation itself. This paper provides more credible goodness of fit comparisons, which show that the BGLO09 estimates outperform the CS08 estimates.

### **Implications**

The authors show that imposing model-consistent constraints on the evolution of expectations yields strikingly different estimates for the NKPC deep structural parameters from the ones reported in CS08. In this reply to CS10, the authors illustrate that the CS10 criticism is misplaced and, if anything, highlights flaws and inconsistencies in CS08. BGLO conclude that the claim in CS10 that the BGLO09 estimates are not believable because they are not derived from an exact closed-form solution is unfounded, and they provide exact closed-form estimates, showing that the findings do not change in any relevant way. Moreover, and contrary to the CS10 claim, BGLO show that their estimates are consistent with the assumptions needed to derive the closed form. In this respect, Cogley and Sbordone's comment is self-defeating when it recognizes that the estimates in CS08 indicate that the inflation process is likely to be sunspot-driven over most of the sample. The problem with this finding, which is not an issue for BGLO's estimates, is that the presence of indeterminacy invalidates the VAR used in the first stage to generate expectations. Such a VAR is typically not consistent with an indeterminate equilibrium, unless one makes stringent additional (and questionable) assumptions. The only model solution that does not present these issues is estimated in CS08, whose results, instead, indicate that the reduced-form representation of CS08 is different from the VAR used to form expectations. This is a troubling inconsistency when estimating a structural forward-looking relationship.

In this reply BGLO also highlight flaws in the comparison of model fit made in CS08 and provide an alternative goodness of fit comparison. In particular, BGLO show that the fit of the CS08 model is poor: there is little to suggest that real marginal costs are an important driver for inflation—at least when marginal costs are proxied by the labor share. Still, the only estimates from BGLO09 that Co-

gley and Sbordone are willing to discuss provide a sizable model fit improvement, in a mean-squared error sense, over their own estimates reported in CS08. These estimates question CS08's claim that "when drift in trend inflation is taken into account, a purely forward-looking version of the model fits the data well, and there is no need for backward-looking components" (CS08, p. 2101). In this paper BGLO consider a wide array of different specifications, and all of them, aside from the particular difference equation specification considered in CS08, overwhelmingly point to the presence of inflation persistence that is not captured by the model. As a result, using the language of the NKPC model, BGLO find an important role for indexation in explaining inflation dynamics.

The authors conclude by touching briefly on two additional points. First, BGLO09 devotes considerable discussion to a set of estimates that is never mentioned in Cogley and Sbordone's comment. These estimates explicitly require expectations to be consistent with the NKPC, but only for a few quarters out instead of the entire future. The estimates are based on specifications that, very much like the NKPC estimated in CS08, are also difference equations themselves, yet they provide overwhelming support to BGLO's closed-form and exact closed-form estimates. Such difference-equation estimates pose an important challenge to CS10, as none of the objections raised against BGLO's closed-form estimates would apply to these specifications in any event. Second, if CS08's estimates were robust, the point in time from which expectations are taken should not matter much. However, this is not the case.

w-11-5

## **Self-Employment in the Global Economy**

*by Federico Díez and Ali Ozdagli*

complete text: <http://www.bostonfed.org/economic/wp/wp2011/wp1105.htm>

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### **Motivation for the Research**

Nearly one of nine workers in the United States is self-employed (Hipple 2010). The rate of self-employment in most of the developed countries is around 10 percent, and the figures are even higher for developing countries. Moreover, self-employment is often used as a measure of entrepreneurship (see Parker 2009). Given the substantial share of self-employment and the importance that entrepreneurs play in contributing to economic activity, coupled with the fact that the world is becoming increasingly interconnected, it is important to understand the effects of trade on the rate of self-employment. Yet self-employment is a phenomenon that has mostly been overlooked in the international economics literature.

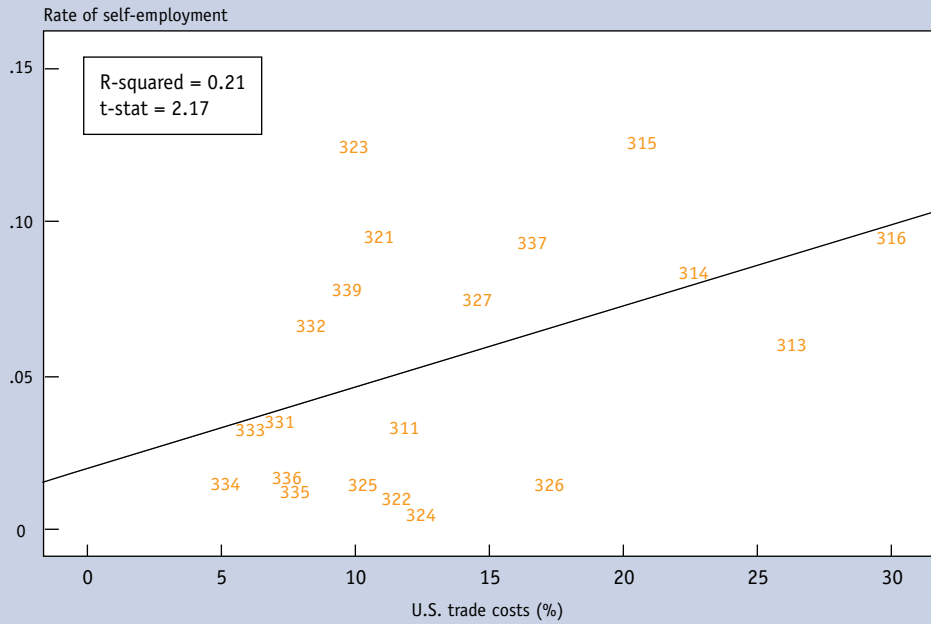
### **Research Approach**

The authors develop a model where heterogeneous agents self-select into being either self-employed workers or employees, in the spirit of Lucas (1978). (Lucas's model, similarly, has heterogeneous agents who self-select into the same two categories, with the self-employed workers varying in ability levels while the employees are homogeneous in ability.) This, in turn, translates into intra-industry firm heterogeneity, as in Melitz (2003). Self-employed agents (firms) can also decide to enter into the export markets, subject to fixed and variable trade costs. The model yields three predictions that are then tested against U.S. 3-digit NAICS manufacturing data from the Bureau of Labor Statistics for the period 2000–2010 and found to hold.

### **Key Findings**

- Industries with higher domestic trade costs will have higher rates of self-employment.
- Higher foreign trade costs also result in higher self-employment in the domestic economy.
- The rates of self-employment and of exporting firms are negatively related.

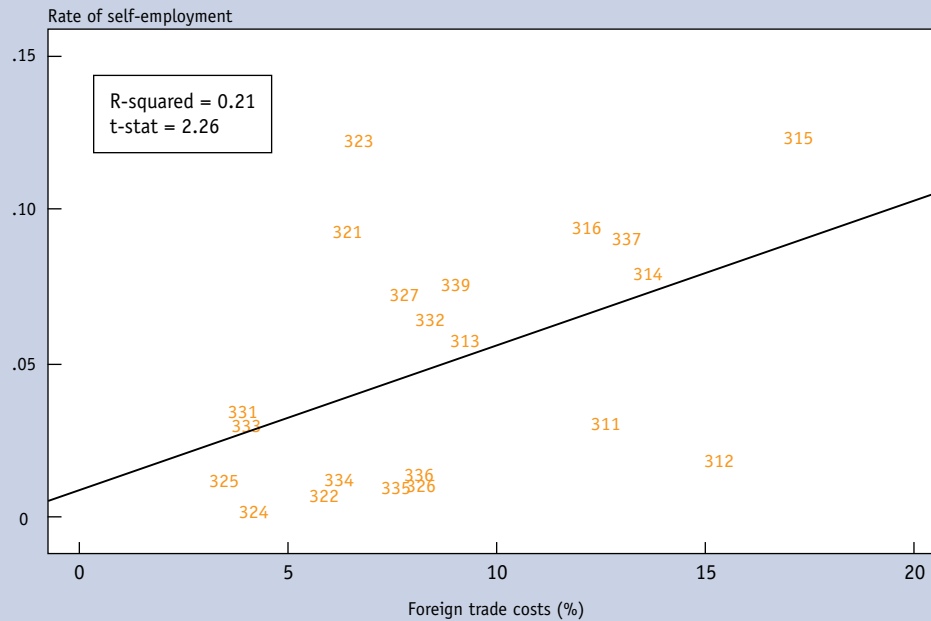
## Rate of Self-Employment and U.S. Trade Costs



Source: U.S. Bureau of Labor Statistics

Notes: "Rate of self-employment" is the ratio of self-employed workers to total employment in the industry. "U.S. trade costs" is the openness measure discussed in the main text. Data are for 2010.

## Rate of Self-Employment and Foreign Trade Costs

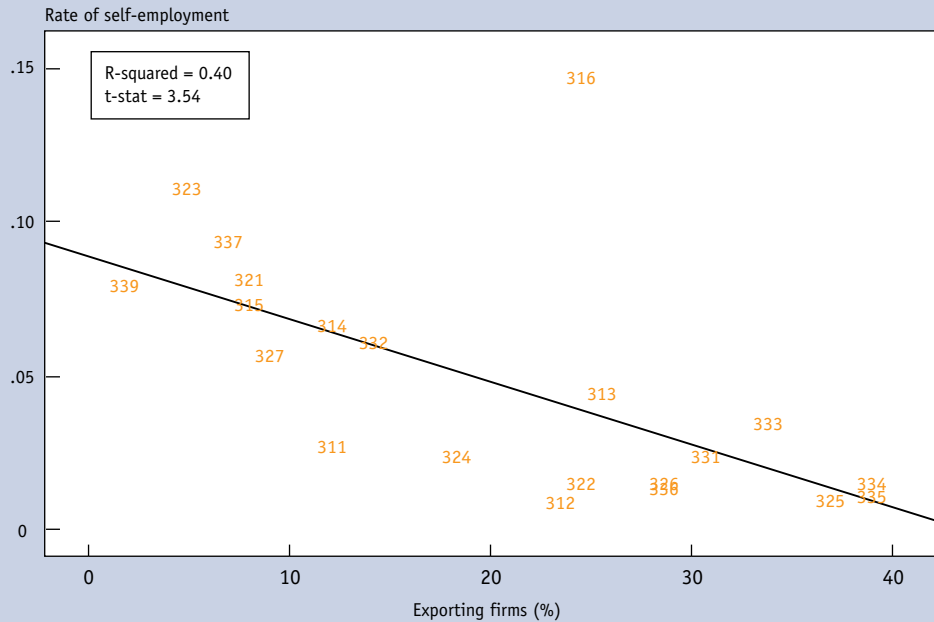


Source: U.S. Bureau of Labor Statistics

Notes: "Rate of self-employment" is the ratio of self-employed workers to total employment in the industry. "Foreign trade costs" is the openness measure discussed in the main text. Data are for 2010.



## Rate of Self-Employment and Share of Exporters



Source: U.S. Bureau of Labor Statistics

Note: "Rate of self-employment" is the ratio of self-employed workers to total employment in the industry in 2002. "Exporting firms (%)" is the share of firms within an industry that were exporters in 2002.

### Industry Codes for Figure and Figures on Previous Page

NAICS	Industry
311	Food Manufacturing
312	Beverage and Tobacco Product Manufacturing
313	Textile Mills
314	Textile Product Mills
315	Apparel Manufacturing
316	Leather and Allied Product Manufacturing
321	Wood Product Manufacturing
322	Paper Manufacturing
323	Printing and Related Support Activities
324	Petroleum and Coal Products Manufacturing
325	Chemical Manufacturing
326	Plastics and Rubber Products Manufacturing
327	Nonmetallic Mineral Product Manufacturing
331	Primary Metal Manufacturing
332	Fabricated Metal Product Manufacturing
333	Machinery Manufacturing
334	Computer and Electronic Product Manufacturing
335	Electrical Equipment, Appliances, and Components
336	Transportation Equipment Manufacturing
337	Furniture and Related Product Manufacturing
339	Miscellaneous Manufacturing

### Implications

It is interesting to compare the message of this paper with Lucas's (1978) final remarks. On the one hand, Lucas's ultimate message is that, under Gibrat's law and an elasticity of technical substitution less than unity, the managerial ability cutoff increases with the capital-labor ratio of the economy. Since the capital per capita indeed increases through time, one would expect the share of self-employed workers to decrease with time. On the other hand, if we think that the world is becoming in-

creasingly interconnected through international trade, then the authors' model predicts that the rate of self-employment will decrease through time. Thus, the authors' model delivers exactly the same prediction as Lucas (1978) does—the share of employees is increasing and the share of self-employed (entrepreneurs) has been decreasing over time in recent years—but for a very different reason.

## Public Policy Briefs

b-11-1

### Do Commodity Price Spikes Cause Long-Term Inflation?

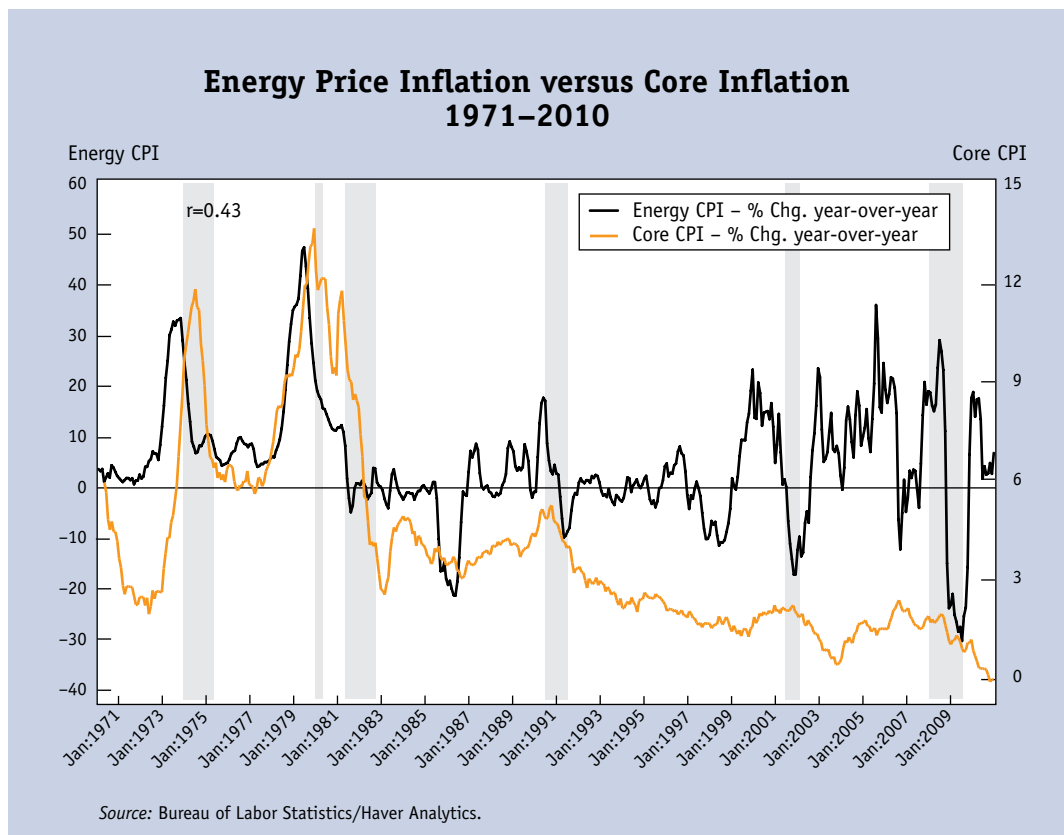
by Geoffrey M. B. Tootell

complete text: <http://www.bostonfed.org/economic/ppb/2011/ppb111.htm>

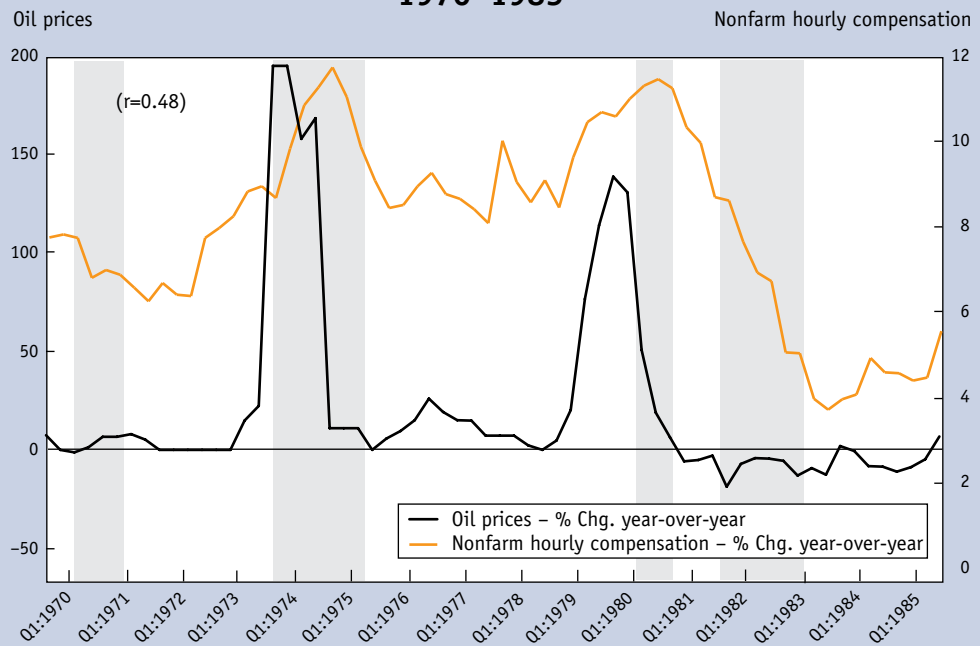
email: [geoff.tootell@bos.frb.org](mailto:geoff.tootell@bos.frb.org)

#### Motivation for the Research

Commodity prices often rebound as a recovery takes hold, and these rebounds usually raise fears of inflation. The current recovery is no exception. Recent press accounts are filled with warnings that the acceleration of commodity prices over the past few quarters will cause a more general and permanent increase in core inflation, defined as the rate of inflation on goods other than food and energy. How should central banks respond to rising commodity prices? Certainly, rising relative prices, particularly for goods produced abroad, are painful. Unfortunately, central banks have little control over relative prices. If, however, these commodity price increases do begin to consistently elevate core inflation, central banks should react. Given the possible policy implications of a relationship between oil prices and trend inflation, this brief examines the evidence of such a relationship.

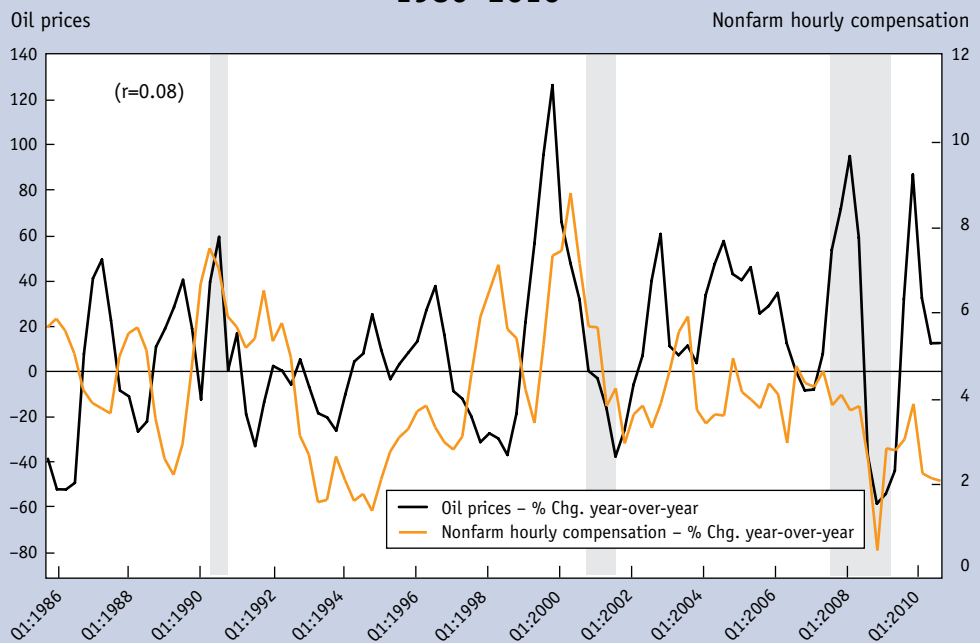


## The Wage-Price Spiral 1970–1985



Source: Bureau of Labor Statistics/Haver Analytics.

## The Nonexistent Wage-Price Spiral 1986–2010



Source: Bureau of Labor Statistics/Haver Analytics.

## Research Approach

The author explores both theory and evidence to determine whether changes in commodity prices affect long-run inflation. He begins by noting that relative prices are determined by the supplies and demands of various goods in the economy and that although these prices can change in response to changes in these demands or supplies, once these prices reach their new equilibrium levels they should stabilize. Once relative prices stabilize, inflation should settle back to its original rate. To get a permanent increase in inflation from a change in the relative price of commodities, notably from the price of oil, requires further assumptions about inflation dynamics. One such assumption is that these relative price changes become embedded in people's expectations of the prices of nonenergy goods.

Next, the author examines the correlation between commodity prices and core inflation. He then narrows his focus to explore econometrically one channel—wages—through which a temporary increase in the price of oil may have become embedded in inflation expectations and, thus, inflation. The author first estimates various specifications of a price inflation equation, with the degree of resource slack, inflation expectations, and the change in the relative price of oil as explanatory variables. Then he estimates a reduced-form wage equation in which the aggregate wage depends on a lag of the unemployment rate, an inflation expectations term, a commodity price inflation term, and the lag of labor productivity growth. Finally, he performs robustness checks.

## Key Findings

- Over the past 40 years, the correlation between core inflation and oil price inflation is fairly high. Yet the estimated effect of commodity prices on core inflation depends critically on the sample period selected. Since the 1970s these two measures seem to be only very loosely related; the strong association between the two in the 1970s seems to be an anomaly. The likely explanation is that the temporary increase in the relative price of oil became embedded in inflation expectations during that decade.
- Commodity prices may have sparked a wage-price spiral in the 1970s. However, since then, even significant fluctuations in commodity prices have had little effect on wage inflation.

## Implications

Neither theory nor evidence supports the notion that commodity price changes necessarily affect the long-run inflation rate. In the 1970s there appears to have been some effect on wages, but it is not evident in the latter sample period. Although commodity price inflation will affect total inflation in the short run, it does not appear to have affected core inflation, and thus total inflation, in the long run, at least since the 1970s.

Going forward, to determine whether the current U.S. economy is in a situation like that of the 1970s or one more akin to the post-1985 period, the response of wages to oil and food price increases should be monitored closely.

# The Estimated Macroeconomic Effects of the Federal Reserve's Large-Scale Treasury Purchase Program

by Jeffrey C. Fuhrer and Giovanni P. Olivei

complete text: <http://www.bostonfed.org/economic/ppb/2011/ppb112.htm>

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## Motivation for the Research

In early November 2010, the Federal Open Market Committee (FOMC) announced it would purchase up to \$600 billion in Treasury securities by June 30, 2011. This plan for a second round of quantitative easing, dubbed “QE2” by the media, was designed to influence interest rates in order to help achieve the Fed’s dual mandate for guiding inflation and employment toward socially desirable levels. Yet since the plan was announced, other events occurred that could plausibly affect U.S. Treasury yields—most notably discussion of whether to extend the Bush tax cuts, longer-run fiscal issues facing the United States, Japan’s earthquake and nuclear crises, and the possibility of a European sovereign debt crisis. Because these actual and potential events could make U.S. Treasuries more or less attractive to investors (tax cuts and fiscal issues would tend to make Treasuries less attractive), it is difficult to distinguish clearly the effects of the Fed’s large-scale purchase program from other factors influencing the market for Treasuries. However, gauging the effect of the Fed’s policy action is crucial for assessing the likely progress this program has had on improving the outlook for employment and inflation in the United States, information that will inform other choices and decisions regarding the current conduct of U.S. economic policy.

## Research Approach

The authors employ a set of models to try isolating the effects that the large-scale Treasury purchase program may have on interest rates, real spending (GDP), and the employment rate. For gauging the response of interest rates to an exogenous purchase, they rely on estimates by Gagnon et al. (2010) and Hamilton and Wu (2011). For measuring the lagged effect that lower interest rates may have on real spending, the authors average the multipliers used in a variety of different models of the U.S. economy—among these are a largely unstructured vector autoregression, the Federal Reserve Bank of Boston’s model, and the Federal Reserve Board’s FRB/US model. Taken together, these various models approximately span the range of estimates for U.S. macroeconomic models in current use. Individually, the models differ in estimating how a 1 percentage point change in the long-term nominal interest rate affects real GDP.

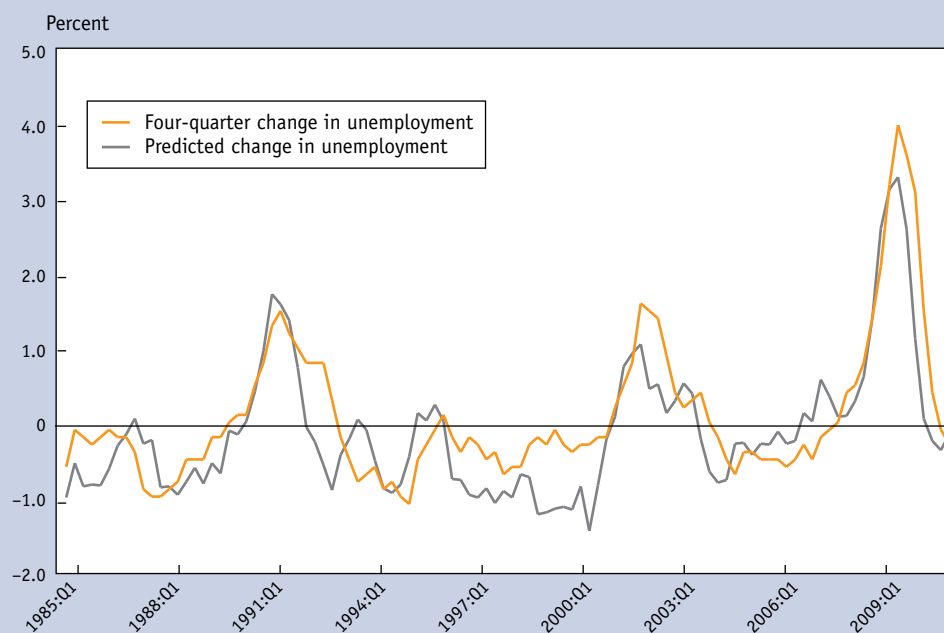
The vector autoregression model estimates that after eight quarters (two years), a persistent decline of 100 basis points in the 10-year Treasury yield generates an increase in GDP of 2.65 percent. The Boston Fed’s model tracks the interest rate channel more precisely than the vector autoregression and finds that after eight quarters, the GDP multiplier is 2.5 for every 1 percentage point decline in the 10-year Treasury rate. The FRB/US model has a GDP multiplier closer to 4.0.

To estimate how changes in GDP translate to employment, the authors use an Okun’s Law relationship that links GDP growth to changes in the unemployment rate. A widely accepted Okun’s Law rule of thumb holds that annual GDP growth that exceeds potential growth by 1 percentage point lowers unemployment by about 0.5 (one-half) percentage point.

## Key Findings

- Using the estimates from Gagnon et al. (2010) and Hamilton and Wu (2011), the authors calculate that the FOMC’s \$600 billion Treasury purchase program should lower the 10-year Treasury yield by 20 or 30 basis points. The authors view this response as influencing the interest rates on other

## Predictions of an Okun's Law Rule of Thumb



Sources: Bureau of Labor Statistics; fitted value depends on real GDP growth (BEA); authors' calculations.

assets of similar risk and duration, and consider these complementary movements when assessing the spending effects from these large-scale asset purchases, as reported below.

- The authors take an average of the multipliers employed in the various models of the U.S. economy; this result implies that the FOMC purchases can be expected to raise real GDP by 60 to 90 basis points. The Boston Fed model suggests that it will take two years for this lagged effect to be fully realized in the U.S. economy.
- To illustrate the strong correlation between GDP growth and changes in the unemployment rate, the figure plots a simple Okun's Law relationship over the past 25 years. Combining this relationship with the estimated GDP effects reported above implies that the U.S. unemployment rate will decline 30 to 45 basis points over the two-year period that it takes the spending rate change to feed through the entire economy. This translates into 700,000 new jobs in a labor force of 150 million people.

### Implications

Since this brief was posted in late April 2011 and the FOMC program ended in June, other factors have come into play—such as the contentious negotiations for raising the U.S. debt ceiling and renewed worries about European sovereign debt—that likely have some short-term implications for the U.S. Treasury market and hence the short-term path of the U.S. economy. While the estimates of the FOMC's \$600 billion Treasury purchase program are necessarily uncertain, given both the rarity of this type of intervention and the multitude of potential endogenous and exogenous influences on Treasury yields, this exercise nonetheless offers a basis for gauging the program's eventual effect on the U.S. economy. In turn, these estimates can serve as a plausible benchmark for the effects of asset purchase programs and can inform additional FOMC policy actions.

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