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calculate a series of originator profits and unmeasured costs (OPUCs) for the period 1994 to 2012, and show that these OPUCs increased significantly between 2008 and 2012. They also evaluate the extent to which some commonly cited factors, such as changes in loan putback risk, mortgage servicing rights values, and pipeline hedging costs, contributed to the rise in OPUCs. Although some costs of mortgage origination may have risen in recent years, a large component of the rise in OPUCs remains unexplained, pointing to increased profitability of originations. The authors conclude by discussing possible drivers of the rise in profitability, such as capacity constraints and originators' pricing power resulting from borrowers' switching costs.

41 Precarious Slopes? The Great Recession, Federal Stimulus, and New Jersey Schools

Rajashri Chakrabarti and Sarah Sutherland

While only a sparse literature investigates the impact of the Great Recession on various sectors of the economy, there is *virtually no* research on the effect on schools. This article starts to fill the void. The authors make use of rich panel data and a trend-shift analysis to study how New Jersey school finances were affected by the onset of the recession and the federal stimulus that followed. Their results show strong evidence of downward shifts in total school funding and expenditures, relative to trend, following the recession. Support of more than $2 billion in American Recovery and Reinvestment Act funding seems to provide a cushion in 2010: While funding and expenditures still fall relative to pre-recession levels, they decline less than in 2009. The infusion of federal funding coincides with significant cuts in state and local support, and the authors mark sharp changes in New Jersey's relative reliance on the three sources of aid. An examination of the compositional shift in expenditures suggests that the stimulus may have prevented declines in categories linked most closely to instruction. Still, budgetary stress seems to have led to sizable layoffs of nontenured teachers, resulting in an increase in median teacher salary and median experience level. Furthermore, high-poverty and urban school districts were found to sustain larger resource declines than more affluent and less populated districts did in the post-recession era. The study's findings offer valuable insight into school finances during recessions and can serve as a guide to aid future policy decisions.

67 The Financial Market Effect of Central Bank Minutes

Carlo Rosa

The influence of the Federal Reserve's unanticipated target rate decisions on U.S. asset prices has been the subject of numerous studies. More recently, researchers have looked at the asset price response to statements issued by the Federal Open Market Committee (FOMC). Yet, despite a vast and growing body of evidence on the financial market effect of monetary news released on FOMC meeting days, little is known about the real-time response of U.S. asset prices to the information contained in central bank minutes. This article fills the gap by using a novel, high-frequency data set to examine the effect of the FOMC minutes release on U.S. asset prices—Treasury rates, stock prices, and U.S. dollar exchange rates. The author shows that the release significantly affects the volatility of U.S. asset prices and their trading volume. The magnitude of the effects is economically and statistically significant, and it is similar in magnitude to the Institute for Supply Management manufacturing index release, although smaller than that of the FOMC statement and nonfarm payrolls releases. The asset price response to the minutes, however, has declined in recent years, suggesting that the FOMC has become more transparent by releasing information in a timelier manner.

Zoltan Pozsar, Tobias Adrian, Adam Ashcraft, and Hayley Boesky

Shadow Banking

- Shadow banks are financial intermediaries that conduct maturity, credit, and liquidity transformation without explicit access to central bank liquidity or public sector credit guarantees.
- The banks have played a key role in the market-based financial system, particularly in the run-up to the financial crisis.
- This study describes the institutional features of shadow banks, their economic roles, and their relation to traditional banks.
- The authors suggest that increased capital and liquidity standards for depository institutions and insurance companies will likely heighten the returns to shadow banking activity.
- Shadow banking, in some form or another, is therefore expected to be an important part of the financial system for the foreseeable future.

1. Introduction

Shadow banking activities consist of credit, maturity, and liquidity transformation that take place without direct and explicit access to public sources of liquidity or credit backstops. These activities are conducted by specialized financial intermediaries called shadow banks, which are bound together along an intermediation chain known as the shadow banking system (see "The Shadow Banking System" Online Appendix).[1]

In the shadow banking system, credit is intermediated through a wide range of securitization and secured funding techniques, including asset-backed commercial paper (CP), asset-backed securities (ABS), collateralized debt obligations (CDOs), and repurchase agreements (repos). While we believe the term "shadow banking," coined by McCulley (2007), to be a somewhat pejorative name for such a large and important part of the financial system, we have adopted it for use here.

Prior to the 2007-09 financial crisis, the shadow banking system provided credit by issuing liquid, short-term liabilities against risky, long-term, and often opaque assets. The large amounts of credit intermediation provided by the shadow banking system contributed to asset price appreciation in residential and commercial real estate markets prior to the financial crisis and to the expansion of credit more generally.

[1] This article is complemented by a series of online appendixes (listed in the box on the next page).

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Online Appendixes

These appendixes, which depict graphically the processes described in the article, offer a comprehensive look at the shadow banking system and its many components.

Map: The Shadow Banking System
www.newyorkfed.org/research/economists/adrian/1306adri_map.pdf

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The funding of credit through the shadow banking system significantly reduced the cost of borrowing during the run-up to the financial crisis, at the expense of increasing the volatility of the cost of credit through the cycle.

In particular, credit intermediaries' reliance on short-term liabilities to fund illiquid long-term assets is an inherently fragile activity that can make the shadow banking system prone to runs.[2] During the financial crisis, the system came under severe strain, and many parts of it collapsed. The emergence of shadow banking thus shifted the systemic risk-return trade-off toward cheaper credit intermediation during booms, at the cost of more severe crises and more expensive intermediation during downturns.

Shadow banks conduct credit, maturity, and liquidity transformation much like traditional banks do. However, what distinguishes shadow banks is their lack of access to public sources of liquidity, such as the Federal Reserve's discount window, or to public sources of insurance, such as that provided by the Federal Deposit Insurance Corporation (FDIC). Because the failure of credit intermediaries can have large, adverse effects on the real economy (see Bernanke [1983] and Ashcraft [2005]), governments have chosen to shield the traditional banking system from the risks inherent in maturity transformation by granting them access to backstop liquidity in the form of discount window lending and by providing a credit put to depositors in the form of deposit insurance.

In contrast to traditional banking's public sector guarantees, the shadow banking system, prior to the onset of the financial crisis, was presumed to be safe, owing to liquidity backstops in the form of contingent lines of credit and tail-risk insurance in the form of wraps and guarantees. The credit lines and tail-risk insurance filled a backstop role for shadow banks (much like the role discount window and deposit insurance play for the commercial banking sector), but they were provided by the private, not the public, sector. These forms of liquidity and credit insurance provided by the private sector, particularly commercial banks and insurance companies, allowed shadow banks to perform credit, liquidity, and maturity transformation by issuing highly rated and liquid short-term liabilities. However, these guarantees also acted to transfer systemic risk between the core financial institutions and the shadow banks.

As the solvency of the providers of private sector puts came into question (even if in some cases it was perfectly satisfactory), the confidence that underpinned the stability of the shadow banking system vanished. The run on the system,

[2] Diamond and Dybvig (1983) initiated a large literature on bank runs modeled as multiple equilibria. Morris and Shin (2004) provide a model of funding fragility with a unique equilibrium in a setting with higher-order beliefs.

which began in the summer of 2007 and peaked following the failure of Lehman Brothers in September 2008, was curbed only after the creation of a series of official liquidity facilities and credit guarantees that replaced private sector guarantees entirely. In the interim, a large portion of the shadow banking system collapsed, and several shadow intermediation activities disappeared entirely.

The assets and liabilities that collateralized and funded the shadow banking system were the product of a range of securitization and secured lending techniques. Securitization refers to the pooling of mortgages, loans, receivables, and other financial cash flows into securities that are tranched according to credit and liquidity characteristics. Secured lending refers to lending transactions that are secured by collateral, particularly securities, loan, or mortgage collateral.

Securitization-based credit intermediation potentially increases the efficiency of credit intermediation. However, it also creates agency problems that do not exist when these activities are conducted within a bank. Indeed, Ashcraft and Schuermann (2008) document seven agency problems that arise in the securitization markets. If these agency problems are not adequately mitigated, the financial system is prone to excessive lowering of underwriting standards and to overly aggressive structuring of securities.

The failure of private sector guarantees to support the shadow banking system occurred mainly because the relevant parties—credit rating agencies, risk managers, investors, and regulators—underestimated the aggregate risk and asset price correlations. Specifically, the market did not correctly price for the fact that valuations of highly rated structured securities become much more correlated in extreme environments than during normal times. In a major systemic event, the price behavior of diverse assets becomes highly correlated, as investors and levered institutions are forced to shed assets in order to generate the liquidity necessary to meet margin calls (see Coval, Jurek, and Stafford [2009]).

Correlations can also increase because of mark-to-market leverage constraints that result in "fire sales" (see Adrian and Shin [2010a] and Geanakoplos [2010]). The underestimation of correlations enabled financial institutions to hold insufficient amounts of capital against the puts that underpinned the stability of the shadow banking system, which made these puts unduly cheap to sell (see Gennaioli, Shleifer, and Vishny [forthcoming] for a model of the link between shadow banking and neglected risk). As investors also overestimated the value of private credit and liquidity enhancement purchased through these puts, the result was an excess supply of credit. In addition, the likely underpricing of public sector liquidity and credit puts would have provided further incentives for risk-taking behavior.

The emergency liquidity facilities launched by the Federal Reserve and the guarantee schemes created by other government agencies during the financial crisis were direct responses to the liquidity and capital shortfalls of shadow banks. For example, the Commercial Paper Funding Facility (CPFF) provided emergency lending to issuers of commercial paper, the Primary Dealer Credit Facility supplied a backstop for repo market borrowers, and the Term Asset-Backed Securities Loan Facility (TALF) offered ABS to investors at "haircuts" below those available in times of market distress. All three facilities directly provided liquidity support to shadow banking activities or entities, effectively offering a backstop for credit intermediation by the shadow banking system and for traditional banks as a result of their exposure to shadow banks.

Overviews of the shadow banking system are provided by Pozsar (2008) and Adrian and Shin (2009). Pozsar catalogues different types of shadow banks and describes the asset and funding flows within the shadow banking system. Adrian and Shin focus on the role of security brokers and dealers in the shadow banking system, and discuss implications for financial regulation. Our contribution with this article is to focus on institutional details of the system, complementing a rapidly growing literature on its collapse. As such, our study is primarily descriptive and focuses on funding flows in a somewhat mechanical manner. We believe that an understanding of the "plumbing" of the shadow banking system is an important underpinning for any study of systemic interlinkages within the financial system.

The next section defines shadow banking and estimates its size. Section 3 discusses the seven steps of the shadow credit intermediation process. In section 4, we describe the interaction of the shadow banking system with institutions such as bank holding companies and broker-dealers. Section 5 offers thoughts on the future of shadow banking.

2. What Is Shadow Credit Intermediation?

2.1 Defining Shadow Banking

In the traditional banking system, credit intermediation between savers and borrowers occurs in a single entity. Savers entrust their money to banks in the form of deposits, which the institutions use to fund the extension of loans to borrowers. Banks furthermore issue debt and equity to capitalize their intermediation activities. Relative to direct lending (that is, savers lending directly to borrowers), banks issue safe, demandable deposits, thus removing the need for savers to monitor the risk-taking behavior of these institutions.

Credit intermediation, the subset of financial intermediation that involves borrowing and lending through

credit instruments, consists of credit, maturity, and liquidity transformation. Credit transformation refers to the enhancement of the credit quality of debt issued by the intermediary through the use of priority of claims. For example, the credit quality of senior deposits is better than the credit quality of the underlying loan portfolio, owing to the presence of more junior claims. Maturity transformation refers to the use of short-term deposits to fund long-term loans, which creates liquidity for the saver but exposes the intermediary to rollover and duration-mismatch risks. Liquidity transformation refers to the use of liquid instruments to fund illiquid assets. For example, a pool of illiquid whole loans might trade at a lower price than a liquid rated security secured by the same loan pool, as certification by a credible rating agency would reduce information asymmetries between borrowers and savers.

Credit intermediation is frequently enhanced through the use of third-party liquidity and credit guarantees, generally in the form of liquidity or credit put options. A liquidity put option supplied by the private sector is typically provided in the form of contingent lines of credit by the commercial banking sector. Private sector credit put options are provided in the form of wraps, guarantees, or credit default swaps (CDS) by insurance companies or banks. Liquidity and credit puts provided by the public sector consist of discount window access and deposit insurance. We call financial intermediation activities with public sector guarantees "officially enhanced."

Table 1 lays out the framework by which we analyze official enhancements.[3] Official enhancements to credit intermediation can be classified into four categories, depending on whether they are direct or indirect and explicit or implicit.

1. A liability with direct official enhancement must reside on a financial institution's balance sheet, while off-balance-sheet liabilities of financial institutions are indirectly enhanced by the public sector. Activities with direct and explicit official enhancement include on-balance-sheet funding of depository institutions, insurance policies and annuity contracts, liabilities of most pension funds, and debt guaranteed through public sector lending programs.[4]
2. Activities with direct and implicit official enhancement include debt issued or guaranteed by the government-sponsored enterprises (GSEs), which benefit from an implicit credit put to the taxpayer.
3. Liabilities with indirect official enhancement generally include the off-balance-sheet activities of depository institutions, such as unfunded credit card loan commitments and lines of credit to conduits.
4. Activities with indirect and implicit official enhancement include asset management activities, such as bank-affiliated hedge funds and money market mutual funds (MMMFs) as well as the securities lending activities of custodian banks. While financial intermediary liabilities with an explicit enhancement benefit from official sector puts, liabilities enhanced with an implicit credit put option might not benefit from such enhancements ex post.

Finally, some activities do not benefit from any form of official enhancement and are said to be unenhanced. An example is guarantees made by monoline insurance companies. In addition, the securities lending activities of insurance companies, pension funds, and certain asset managers do not benefit from access to official liquidity.

We define shadow credit intermediation to include all credit intermediation activities that are implicitly enhanced, indirectly enhanced, or unenhanced by official guarantees.

2.2 Sizing the Shadow Banking System

Before describing the shadow intermediation process in detail, we provide a gauge for measuring the size of shadow banking activity. The chart shows two measures of the shadow banking system, net and gross, both computed from the Federal Reserve's "Flow of Funds" data. The gross measure sums all liabilities recorded in the Flow of Funds that relate to securitization activity: mortgage-backed securities (MBS), ABS, and other GSE liabilities, as well as all short-term money market transactions that are not backstopped by deposit insurance: repos, commercial paper, and other MMMF liabilities. The net measure attempts to remove the double-counting.

We should point out that these measures are imperfect for several reasons. First, the Flow of Funds data do not cover the transactions of all shadow banking entities (see Eichner, Kohn, and Palumbo [2010] for data limitations of the Flow of Funds in detecting the imbalances that built up prior to the financial crisis).

Second, we are not providing a measure of the shadow banks' net supply of credit to the real economy. In fact, the gross number sums up all shadow banking liabilities, irrespective of double-counting. The gross number should not be interpreted as a proxy for the net supply of credit by shadow banks, but rather as the total balance-sheet capacity allocated to shadow banking activities. The net measure mitigates the second problem by netting the money market funding of ABS

[3] A formal analysis of deposit insurance was conducted by Merton (1977) and Merton and Bodie (1993).

[4] Depository institutions, including commercial banks, thrifts, credit unions, federal savings banks, and industrial loan companies, benefit from federal deposit insurance and access to official liquidity backstops provided by the discount window. Insurance companies benefit from guarantees provided by state guaranty associations. Defined-benefit private pensions benefit from insurance provided by the Pension Benefit Guaranty Corporation and public pensions benefit from implicit insurance provided by their state, municipal, or federal sponsors. The Small Business Administration, the U.S. Department of Education, and the Federal Housing Administration each operate programs that provide explicit credit enhancement to private lending.

Table 1

The Topology of Pre-Crisis Shadow Banking Activities and Liabilities

Increasingly "Shadow" Credit Intermediation Activities ⟶

	Direct Public Enhancement		Indirect Public Enhancement		
Institution	Explicit	Implicit	Explicit	Implicit	Unenhanced
Depository institutions	Insured deposits		Credit lines to shadow banks	Trust activities Tri-party clearing Asset management Affiliate borrowing	
Commercial banks, clearing banks, ILCs	Nondeposit liabilities				
Federal loan programs DoE, SBA, and FHA credit puts	Loan guarantees				
Government-sponsored enterprises Fannie Mae, Freddie Mac, FHLBs		Agency debt	Agency MBS		
Insurance companies	Annuity liabilities Insurance policies				Securities lending CDS protection sold
Pension funds	Unfunded liabilities				Securities lending
Diversified broker-dealers Investment bank holding companies	Brokered deposits (ILCs)		CP	Tri-party repo	MTNs Prime brokerage customer balances Liquidity puts (ABS, TOB, VRDO, ARS)
Mortgage insurers					Financial guarantees
Monoline insurers					Financial guarantees CDS protection sold on CDOs Asset management (GICs, SIVs, conduits)
Shadow banks					
Finance companies (stand-alones, captives)	Brokered deposits (ILCs)		CP ABCP		Team ABS, MTNs Extendible ABCP
Single-seller conduits			ABCP	Extendible ABCP	Extendible ABCP
Multiseller conduits			ABCP		
Hybrid conduits			ABCP	Extendible ABCP	Extendible ABCP
TRS/repo conduits			ABCP		
Securities arbitrage conduits			ABCP	Extendible ABCP	Extendible ABCP
Structured investment vehicles (SIVs)			ABCP	MTNs, capital notes	Extendible ABCP
Limited-purpose finance companies			ABCP Bilateral repo		MTNs, capital notes Bilateral repo
Credit hedge funds (stand-alones)			Bilateral repo		Bilateral repo
Money market intermediaries Shadow bank "depositors"					
Money market mutual funds					$1 NAV
Overnight sweep agreements					$1 NAV
Cash "plus" funds					$1 NAV

Table 1 (continued)
The Topology of Pre-Crisis Shadow Banking Activities and Liabilities
Increasingly "Shadow" Credit Intermediation Activities ⟶

	Direct Public Enhancement		Indirect Public Enhancement		
Institution	Explicit	Implicit	Explicit	Implicit	Unenhanced
Enhanced cash funds					$1 NAV
Ultra-short bond funds					$1 NAV
Local government investment pools (LGIPs)					$1 NAV
Securities lenders					$1 NAV
European banks					
Landesbanks, etc.	State guarantees	ABCP	Credit lines to shadow banks		

Source: Pozsar et al. (2012).

and MBS. As such, it is closer to a measure of the net supply of credit provided by shadow banking activities, but it is still not a perfect measure.

Third, many of the securitized assets are held on the balance sheets of traditional depository and insurance institutions or supported off their balance sheets through backup liquidity and credit derivative or reinsurance contracts. The holding of shadow liabilities by institutions inside the government safety net makes it difficult to draw bright lines between traditional and shadow credit intermediation, prompting us to classify the latter at the instrument level and not the institution level.

As shown in the chart on the next page, the gross measure of shadow bank liabilities grew to nearly $22 trillion in June 2007. For comparison, we also plot total traditional banking liabilities, which were around $14 trillion in 2007.[5] The size of the shadow banking system has contracted substantially since the peak in 2007, while total liabilities of the traditional banking sector have continued to grow throughout the crisis.

The government's liquidity facilities and guarantee schemes introduced in the summer of 2007 helped ease the $5 trillion contraction in the size of the shadow banking system, thereby protecting the broader economy from a collapse in the supply of credit as the financial crisis unfolded. These programs were only temporary in nature; however, given the still-significant size of the shadow banking system and its exposure to runs by wholesale funding providers, one open question is the extent to which some shadow banking activities should have more permanent access to official backstops and receive more oversight.

[5] Adrian and Shin (2010b) and Brunnermeier (2009) provide complementary overviews of the financial system in light of the financial crisis.

3. The Shadow Credit Intermediation Process

The shadow banking system is organized around securitization and wholesale funding. Loans, leases, and mortgages are securitized and thus become tradable instruments. Funding is conducted in capital markets through instruments such as commercial paper and repos. Savers hold money market balances instead of deposits with banks.

Like traditional banks, shadow banks conduct financial intermediation. However, unlike in the traditional banking system, where credit intermediation is performed "under one roof"—that of a bank—in the shadow banking system it is performed through a chain of nonbank financial intermediaries in a multistep process. These steps entail the "vertical slicing" of traditional banks' credit intermediation process and include 1) loan origination, 2) loan warehousing, 3) ABS issuance, 4) ABS warehousing, 5) ABS CDO issuance, 6) ABS "intermediation," and 7) wholesale funding. The shadow banking system performs these steps of intermediation in a strict, sequential order. Each step is handled by a specific type of shadow bank and through a specific funding technique.

Each of the seven steps of credit intermediation consists of a shadow banking activity, some of which is conducted by specialized shadow banking institutions while others by traditional financial intermediaries such as commercial banks or insurance companies. The seven steps of shadow bank intermediation are as follows:

1. Loan origination (such as auto loans and leases, nonconforming mortgages) is performed by finance companies that are funded through CP and medium-term notes (MTNs).

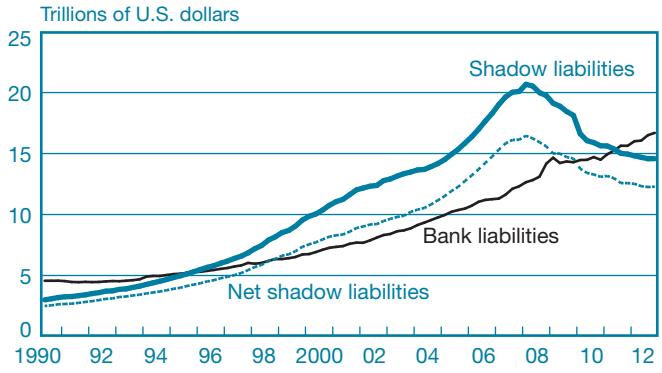
2. Loan warehousing is conducted by single- and multi-seller conduits and is funded through asset-backed commercial paper (ABCP).
3. The pooling and structuring of loans into term asset-backed securities are conducted by broker-dealers' ABS syndicate desks.
4. ABS warehousing is facilitated through trading books and is funded through repurchase agreements, total return swaps, or hybrid and repo conduits.
5. The pooling and structuring of ABS into CDOs are also conducted by broker-dealers' ABS syndicate desks.
6. ABS intermediation is performed by limited-purpose finance companies, structured investment vehicles (SIVs), securities arbitrage conduits, and credit hedge funds, which are funded in a variety of ways including, for example, repos, ABCP, MTNs, bonds, and capital notes.
7. The funding of all of the above activities and entities is conducted in wholesale funding markets by funding providers such as regulated and unregulated money market intermediaries (for example, 2(a)-7 money market funds and enhanced cash funds, respectively) and direct money market investors (such as securities lenders). In addition to these *cash* investors—which fund shadow banks through short-term repo, CP, and ABCP instuments—fixed-income mutual funds, pension funds, and insurance companies fund shadow banks by investing in their longer-term MTNs and bonds.

Shadow credit intermediation performs an economic role similar to that of traditional banks' credit intermediation. The shadow banking system decomposes the simple process of retail-deposit-funded, hold-to-maturity lending conducted by banks into a more complex, wholesale-funded, securitization-based lending process. Through this intermediation process, the shadow banking system transforms risky, long-term loans (subprime mortgages, for example) into seemingly credit-risk-free, short-term, money-like instruments, ending in wholesale funding through stable net asset value shares issued by 2(a)-7 MMMFs that require daily liquidity. This crucial point is illustrated by the first and last links in the diagram, which depicts the asset and funding flows of the shadow banking system's credit intermediation process. The intermediation steps of the shadow banking system are illustrated in Table 2.

Importantly, not all intermediation chains involve all seven steps, and some might involve even more. For example, an intermediation chain might stop at step 2 if a pool of prime auto loans is sold by a captive finance company to a bank-sponsored multiseller conduit for term warehousing purposes. In another example, ABS CDOs could be further repackaged into a CDO squared, which would lengthen the intermediation chain to eight steps. Typically, the poorer an underlying loan pool's quality at the beginning of the chain (for example, a pool of subprime mortgages originated in California in 2006), the longer the credit intermediation chain will be to allow shadow credit intermediation to transform long-term, risky, and opaque assets into short-term and less risky highly rated assets that can be used as collateral in short-term money markets.

As a rule-of-thumb, the intermediation of low-quality long-term loans (nonconforming mortgages) involved all seven or more steps, whereas the intermediation of high-quality short- to medium-term loans (credit card and auto loans) involved usually three steps and rarely more. The intermediation chain always starts with origination and ends with wholesale funding, and each shadow bank appears only once in the process.

Shadow Bank Liabilities versus Traditional Bank Liabilities



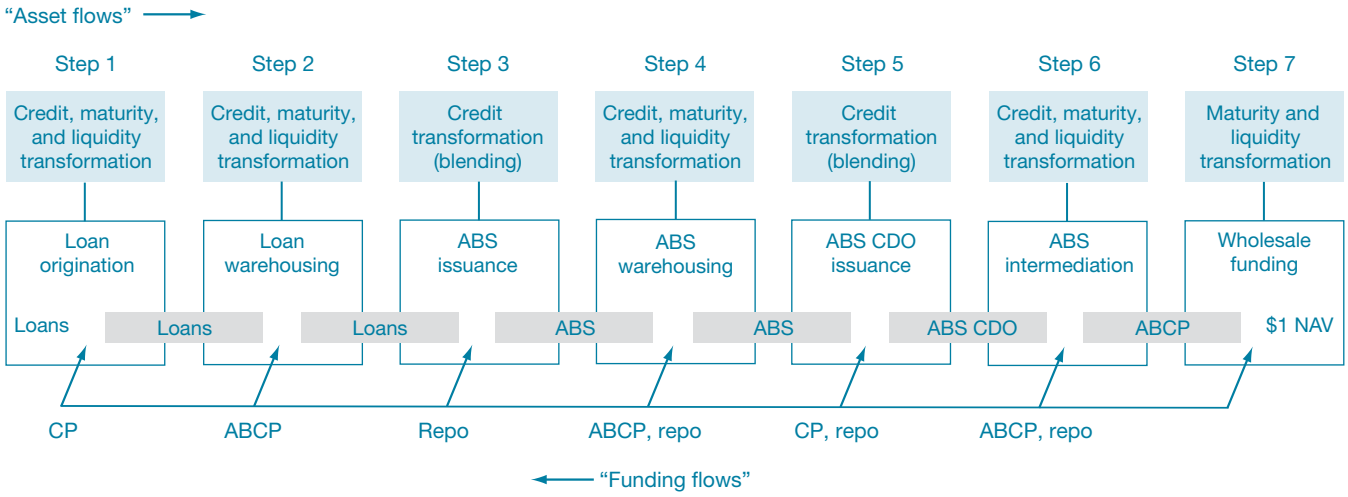
Sources: Board of Governors of the Federal Reserve System, "Flow of Funds Accounts of the United States" (as of 2011:Q3); Federal Reserve Bank of New York.

4. The Shadow Banking System

We identify three subgroups of the shadow banking system: 1) the government-sponsored shadow banking subsystem, 2) the "internal" shadow banking subsystem, and 3) the "external" shadow banking subsystem. We also discuss the liquidity backstops that were put in place during the financial crisis.

The Shadow Credit Intermediation Process

The shadow credit intermediation process consists of distinct steps. A credit intermediation chain, depending on the type and quality of credit involved, may entail as few as three steps and as many as seven or more. The shadow banking system conducts these steps in a string-sequential order. Each step is handled by specific types of financial entities, funded by specific types of liabilities.



Source: Pozsar et al. (2012).

4.1 The Government-Sponsored Shadow Banking Subsystem

The seeds of the shadow banking system were sown nearly eighty years ago with the creation of government-sponsored enterprises, which include the Federal Home Loan Bank (FHLB) system in 1932, the Federal National Mortgage Association (Fannie Mae) in 1938, the Government National Mortgage Association (Ginnie Mae) in 1968, and the Federal Home Loan Mortgage Corporation (Freddie Mac) in 1970. Each of these institutions is perceived by the marketplace to be a shadow bank given that its liabilities are implicitly guaranteed by U.S. taxpayers. The GSEs have had a large influence on the way in which the financial system is funded and conducts credit transformation. Arguably, they were the first providers of term warehousing of loans and invented the originate-to-distribute model of securitized credit intermediation.

GSEs largely securitize their loan and mortgage portfolios in pools of mortgage-backed securities, which are referred to as agency MBS. These MBS pass interest payments and principal payments through to the MBS holder, but the credit risk is retained by the GSEs. Agency MBS thus incorporate interest rate and prepayment risk, but not the default risk of individual borrowers. Freddie Mac issued the first pass-through certificate in 1971, while the first pass-through MBS were issued by Ginnie Mae in 1970 and Fannie Mae in 1981.

The MBS that are retained by the GSEs are funded with a maturity mismatch. Unlike banks, however, the GSEs are funded not through deposits but through the capital markets, where they issue short- and long-term agency debt securities. These securities are bought by money market investors and real-money investors such as fixed-income mutual funds. The funding functions performed by the GSEs on behalf of banks and the way GSEs are funded are the models for wholesale funding markets (see Table 3 and Online Appendix 1).

The GSEs have embodied five intermediation techniques:

1. term loan warehousing provided to banks by the FHLBs,
2. credit risk transfer and transformation through credit insurance provided by the GSEs,
3. originate-to-distribute securitization functions provided for banks by the GSEs,
4. maturity transformation conducted through the GSE-retained portfolios, and
5. pass-through MBS funding of mortgage credit.

Over the past thirty years, these techniques were developed by dealers, banks, and the GSEs and became the foundation for the securitization process of shadow credit intermediation. The adaptation of these techniques fundamentally changed the bank-based, originate-to-hold credit intermediation process and gave rise to the securitization-based, originate-to-distribute credit intermediation process.

The government-sponsored shadow banking subsystem is not involved in loan origination, only in loan processing and funding.[6] These entities qualify as shadow banks to the extent

Table 2

Examples of the Steps, Entities, and Funding Techniques of the Shadow Credit Intermediation Process

Step	Function	Shadow Banks	Shadow Banks' Funding Techniques
1	Loan origination	Finance companies	CP, MTNs, bonds
2	Loan warehousing	Single- and multiseller conduits	**ABCP**
3	ABS issuance	SPVs, structured by broker-dealers	**ABS**
4	ABS warehousing	Hybrid, TRS/repo conduits, broker-dealers' trading books	**ABCP**, repo
5	ABS CDO issuance	SPVs, structured by broker-dealers	**ABS CDOs, CDO-squareds**
6	ABS intermediation	LPFCs, SIVs, securities arbitrage conduits, credit hedge funds	**ABCP**, MTNs, repo
7	Wholesale funding	2(a)-7 MMMFs, enhanced cash funds, securities lenders, etc.	$1 NAV shares (shadow bank "deposits")

Source: Pozsar et al. (2012).

Notes: Entries in bold denote securitized funding techniques. Securitized funding techniques are *not* synonymous with secured funding.

Table 3

Examples of the Steps, Entities, and Funding Techniques of the GSE Credit Intermediation Process

Step	Function	Shadow Banks	Shadow Banks' Funding Techniques
1	Mortgage origination	Commercial banks	Deposits, CP, MTNs, bonds
2	Mortgage warehousing	FHLBs	Agency debt, discount notes
3	ABS issuance	Fannie Mae, Freddie Mac through TBA market	**Agency MBS (pass-through)**
4	ABS warehousing	Broker-dealers' trading books	**ABCP**, repo
5	ABS CDO issuance	Broker-dealer agency MBS desks	**CMOs (resecuritizations)**
6	ABS intermediation	GSE retained portfolios	Agency debt, discount notes
7	Wholesale funding	2(a)-7 MMMFs, enhanced cash funds, securities lenders	$1 NAV shares (GSE "deposits")

Source: Pozsar et al. (2012).

Notes: Entries in bold denote securitized funding techniques. Securitized funding techniques are *not* synonymous with secured funding.

that they are involved in the traditional bank activities of credit, maturity, and liquidity transformation, but without actually being chartered as banks and without having meaningful access to a lender of last resort and an explicit insurance of their liabilities by the federal government.[7]

4.2 The "Internal" Shadow Banking Subsystem

The development of the GSEs' activities has been mirrored by the development of a full-fledged shadow banking system. In recent decades, the largest banks were transformed from low-return-on-equity (RoE) utilities, originating loans and holding and funding them until maturity, to high-RoE entities that developed shadow banking activities in order to increase profitability. The largest banks and dealers played a central role in the development of shadow banking activities, particularly in the origination, warehousing, securitizing, and funding of credit. As a result, the nature of banking changed from a credit-risk-intensive, deposit-funded, spread-based business to a less credit-risk-intensive, wholesale-funded process subject to run risk.

The vertical and horizontal slicing of credit intermediation uses a range of off-balance-sheet securitization and asset management techniques, which enable banks to conduct lending with less capital than if they had retained loans on their balance sheets (Table 4). This process enhances the RoE of banks—or, more precisely, the RoE of their holding companies.

Shadow banking activities of bank holding companies (BHCs) are conducted off balance sheet through various subsidiaries. BHCs: 1) originate loans in their bank or finance company subsidiaries, 2) warehouse and accumulate loans in off-balance-sheet conduits that are managed by their broker-dealer subsidiaries, with funding through wholesale funding markets and liquidity enhancements by bank subsidiaries, 3) securitize loans through their broker-dealer subsidiaries by transferring them from the conduit into bankruptcy-remote

[6] By design, GSEs are prohibited from loan origination. They create a secondary market for mortgages to facilitate their funding.

[7] Note that Fannie Mae and Freddie Mac had some explicit backstops from the U.S. Treasury in the form of credit lines prior to their conservatorship in 2008. However, these liquidity backstops were very small compared with the size of the agencies' balance sheets.

Table 4
Examples of the Steps, Entities, and Funding Techniques of the FHC Credit Intermediation Process

Step	Function	Shadow Banks	Shadow Banks' Funding Techniques
1	Loan origination	Commercial bank subsidiary	Deposits, CP, MTNs, bonds
2	Loan warehousing	Single- and multi-seller conduits	**ABCP**
3	ABS issuance	SPVs, structured by broker-dealer subsidiary	**ABS**
4	ABS warehousing	Hybrid, TRS/repo conduits, broker-dealers' trading books	**ABCP**, repo
5	ABS CDO issuance	SPVs, structured by broker-dealer subsidiary	**ABS CDOs, CDO-squareds**
6	ABS intermediation	SIVs, internal credit hedge funds (asset management)	**ABCP**, MTNs, capital notes, repo
7	Wholesale funding	2(a)-7 MMMFs, enhanced cash funds, securities lending subsidiary	$1 NAV shares (shadow bank "deposits")

Source: Pozsar et al. (2012).

Notes: Entries in bold denote securitized funding techniques. Securitized funding techniques are *not* synonymous with secured funding.

special-purpose vehicles, and 4) fund the safest tranches of structured credit assets in off-balance-sheet ABS intermediaries (such as SIVs) that are managed from the asset management subsidiary of the holding company and are funded through wholesale funding markets with backstops by the bank subsidiaries (see Online Appendix 2).

This process highlights three important aspects of the changed nature of lending in the U.S. financial system, especially for residential and commercial mortgage credit. First, the process of lending and the uninterrupted flow of credit to the real economy no longer rely only on banks, but on a process that spans a network of banks, broker-dealers, asset managers, and shadow banks funded through wholesale funding and capital markets globally.

Second, bank subsidiaries' only direct involvement in the shadow credit intermediation process is at the loan origination level. The indirect involvement of commercial bank subsidiaries is broader, however, as the banks act as lenders to other subsidiaries and off-balance-sheet vehicles involved in the warehousing and processing of loans, as well as the distribution and funding of structured credit securities. Even though a BHC's credit intermediation process depends on at least four entities other than the bank, only the bank subsidiary of a BHC has access to the Federal Reserve's discount window and the benefits of deposit insurance.

Third, securitization techniques have increased the implicit leverage of bank holding companies, sometimes called "capital efficiency." As the financial crisis of 2007-09 showed, however, the capital efficiency of the process is highly dependent on liquid wholesale funding and debt capital markets globally. The exposure of BHCs to shadow bank entities increases the effective leverage of the BHC, even though that might not be obvious from looking at the balance sheet because much shadow banking activity is designed to be conducted off balance sheet. The implicit leverage in turn exposes BHCs to credit and liquidity risk and represents an important source of systemic risk.

This interpretation of the workings of BHCs is different from the one emphasizing the benefits of BHCs as "financial supermarkets." According to that widely held view, the diversification of the holding companies' revenues through broker-dealer and asset management activities makes the banking business more stable, as the holding companies' banks, if need be, could be supported by net income from other operations during times of credit loss. In our interpretation, the broker-dealer and asset management activities are not parallel, but instead are serial and complementary activities to BHCs' banking activities.

4.3 The "External" Shadow Banking Subsystem

Similar to the "internal" shadow banking subsystem, the "external" version is a global network of balance sheets. The origination, warehousing, and securitization of loans are conducted mainly from the United States, but the funding and maturity transformation of structured credit assets are conducted from the United States, Europe, and offshore financial centers. While the internal subsystem is designed primarily to raise the profitability of BHCs by increasing their effective leverage through off-balance-sheet entities and activities, the external subsystem has resulted from vertical integration and the exploitation of gains from specialization.

The external shadow banking subsystem is defined by 1) the credit intermediation process of diversified broker-dealers, 2) the credit intermediation process of independent, nonbank specialist intermediaries, and 3) the credit puts provided by private credit-risk repositories.

Table 5

Examples of the Steps, Entities, and Funding Techniques of the DBD Credit Intermediation Process

Step	Function	Shadow Banks	Shadow Banks' Funding Techniques
1	Loan origination	Finance company subsidiary	CP, MTNs, bonds
2	Loan warehousing	Single- and multi-seller conduits	**ABCP**
3	ABS issuance	SPVs, structured by broker-dealer subsidiary	**ABS**
4	ABS warehousing	Hybrid, TRS/repo conduits, broker-dealers' trading books	**ABCP**, repo
5	ABS CDO issuance	SPVs, structured by broker-dealer subsidiary	**ABS CDOs, CDO-squareds**
6	ABS intermediation	Internal credit hedge funds, proprietary trading desks	Repo
7	Wholesale funding	2(a)-7 MMMFs, enhanced cash funds, securities lending subsidiary	$1 NAV shares (shadow bank "deposits")

Source: Pozsar et al. (2012).

Notes: Entries in bold denote securitized funding techniques. Securitized funding techniques are *not* synonymous with secured funding.

The Credit-Intermediation Process of Diversified Broker-Dealers

We refer to the stand-alone investment banks as they existed prior to 2008 as diversified broker-dealers (DBDs). DBDs vertically integrate their securitization businesses (from origination to funding), lending platforms, and asset management units. The credit intermediation process of DBDs is similar to that of financial holding companies (FHCs; Table 5).

The diversified broker-dealers are distinguished by the fact that they do not own commercial bank subsidiaries. Some of the major stand-alone investment banks did, however, own industrial loan company (ILC) subsidiaries. However, owning an ILC did not require the holding company to turn into a bank holding company. Since running one's own loan warehouses (single- or multiseller loan conduits) requires large bank subsidiaries to fund the contingent liquidity backstops that enhance the ABCP issued by the conduits, broker-dealers typically outsourced these warehousing functions to BHCs with large deposit bases or to independent multiseller conduits.

At the end of their intermediation chains, DBDs do not operate securities arbitrage conduits or SIVs. Instead, the dealers run internal credit hedge funds, fund trading books, and fund repo conduits. The intermediation process of DBDs tends to rely more on repo funding than that of FHCs, which rely on CP, ABCP, MTNs, and repos. The subsidiaries of DBDs do not have direct access to public sources of credit or liquidity backstops. It should be noted that the credit intermediation processes described here are the simplest and shortest forms of the intermediation chains that run through FHCs and DBDs. In practice, these processes are often elongated by additional steps involved in the warehousing, processing, and distribution of unsold ABS into ABS CDOs (see Online Appendix 3).

The Independent-Specialists-Based Credit Intermediation Process

The credit intermediation process that runs through a network of independent specialists is the same as those of FHCs and DBDs and results in the same credit intermediation functions as those performed by traditional banks. The independent-specialists-based intermediation process includes the following types of entities: stand-alone and captive finance companies on the loan origination side;[8] independent multiseller conduits on the loan warehousing side; and limited-purpose finance companies, independent SIVs, and credit hedge funds on the ABS intermediation side (Table 6).

There are three key differences between the independent-specialists-based credit intermediation process and those of BHCs and DBDs. First and foremost, on the origination side, the three processes intermediate different types of credit. The BHC and DBD processes originate some combination of both conforming and nonconforming mortgages, as well as commercial mortgages, leveraged loans, and credit card loans. In contrast, the independent-specialists-based process tends to specialize in the origination of auto and equipment loans and leases, middle-market loans, franchise loans, and more esoteric loans. The obvious exceptions to this are stand-alone nonconforming mortgage finance companies, which have become largely extinct since the crisis.

The independent-specialists-based credit intermediation process is based on an "originate-to-fund" model (again, with the exception of the now extinct stand-alone mortgage finance companies), as opposed to the mostly originate-to-distribute model of the

[8] Captive finance companies are finance companies that are owned by nonfinancial corporations, typically manufacturing firms or homebuilders. They are used to provide vendor financing to the clients of their parents and benefit from cross-guarantees. Stand-alone finance companies, as the name suggests, stand on their own and are not subsidiaries of any corporate entity.

Table 6

Examples of the Steps, Entities, and Funding Techniques of the Independent-Specialists-Based Credit Intermediation Process

Step	Function	Shadow Banks	Shadow Banks' Funding Techniques
1	Loan origination	Stand-alone and captive finance companies	CP, MTNs, bonds
2	Loan warehousing	FHC-sponsored and independent multiseller conduits	**ABCP**
3	ABS issuance	SPVs, structured by broker-dealers	**ABS**
4	ABS warehousing		**ABCP**, repo
5	ABS CDO issuance		**ABS CDOs, CDO-squareds**
6	ABS intermediation	LPFCs, independent SIVs, independent credit hedge funds	**ABCP**, MTNs, capital notes, repo
7	Wholesale funding	2(a)-7 MMMFs, enhanced cash funds, securities lenders	$1 NAV shares (shadow bank "deposits")

Source: Pozsar et al. (2012).

Notes: Entries in bold denote securitized funding techniques. Securitized funding techniques are *not* synonymous with secured funding.

government-sponsored shadow banking subsystem and the credit intermediation processes of BHCs and DBDs.

While the GSE, BHC, and DBD credit intermediation processes depend heavily on liquid capital markets for their ability to fund, securitize, and distribute loans, independent specialists' seamless functioning is also exposed to the ability of DBDs and FHCs to perform their functions as gatekeepers to capital markets and lenders of last resort, respectively. This in turn represents an extra layer of fragility in the structure of the independent-specialists-based credit intermediation process, as failure by FHCs and DBDs to perform these functions in times of systemic stress runs the risk of paralyzing and disabling the process (see Rajan [2005]).

Indeed, this fragility became apparent during the financial crisis of 2007-09, as the independent-specialists-based process broke down and with it the flow of corresponding types of credit to the real economy. Online Appendix 4 describes the relative extent to which specialist loan originators (captive and independent finance companies) relied on BHCs and DBDs as their ABS underwriters and gatekeepers to capital markets.

Private Credit-Risk Repositories

The shadow credit intermediation processes of independent specialists, BHCs, and DBDs rely heavily on private credit-risk repositories (see Online Appendix 5). Private risk repositories specialize in providing credit transformation services in the shadow banking system, and include mortgage insurers, monoline insurers, diversified insurance companies, and credit hedge funds. These entities facilitate the securitization process by providing tail-risk insurance for structured credit products in various forms. For example, insurance companies might offer CDS written on mezzanine tranches of ABS, thus enhancing credit ratings at the resecuritization stage of the shadow bank intermediation chain (step 5). By providing such tail-risk insurance, the private credit-risk repositories change the pricing of tail risk and ultimately affect the supply of credit to the real economy.

Different credit-risk repositories correspond to specific stages of the shadow credit intermediation process. As such, mortgage insurers specialize in insuring or wrapping whole mortgage loans; monoline insurers, which are bond insurance companies, specialize in wrapping ABS tranches (or the loans backing specific ABS tranches), and diversified insurance companies and credit hedge funds take on the risks of ABS CDO tranches through CDS.[9]

Effectively, the various forms of credit put options provided by private risk repositories absorb tail risk from loan pools, turning the enhanced securities into less risky ones (at least from the perspective of investors prior to the crisis). This in turn means that any liability issued against these assets is perceived to be less risky as well. Such credit puts provided by risk repositories to the shadow banking system thus play a role analogous to FDIC insurance for the commercial banking system.

The perceived credit-risk-free nature of traditional bank and shadow bank liabilities stems from two very different sources. In the case of traditional banks' insured liabilities (deposits), the credit quality is driven by the counterparty: the U.S. taxpayer. As a result, insured depositors do not need to examine a bank's creditworthiness before depositing money—it is the regulator that performs the due diligence. In the case of shadow bank liabilities such as repos or ABCP, perceived credit

[9] CDS were also used for hedging warehouse and counterparty exposures. For example, a broker-dealer with a large exposure to subprime MBS that it warehoused for an ABS CDO deal in the making could purchase CDS protection on its MBS warehouse. In turn, the broker-dealer could also purchase protection (a counterparty hedge) from a credit hedge fund or credit derivative product company on the counterparty providing the CDS protection on subprime MBS.

quality is based on the credit enhancements achieved through private credit-risk repositories. Credit rating agencies, in turn, perform the due diligence on behalf of the ultimate investors.

The credit puts of private credit-risk repositories also perform a function similar to that of the wraps provided by Fannie Mae and Freddie Mac on conforming mortgage pools, as these government-sponsored, public credit-risk repositories allow senior mortgage tranches to achieve AAA ratings by removing credit risk.[10]

4.4 The "Parallel" Banking System

Many "internal" and "external" shadow banks existed in a form that was possible only because of the special circumstances in the run-up to the financial crisis. Some of these circumstances were economic in nature and some were due to regulatory and risk management failures. However, there are also examples of shadow banks that had competitive advantages relative to traditional banks. These shadow banks were driven not by regulatory arbitrage, but by gains from specialization as a "parallel" banking system. Most of these entities were found in the "external" shadow banking subsystem.

These entities include nonbank finance companies, which can be more efficient than traditional banks because of specialization and economies of scale in the origination, servicing, structuring, trading, and funding of loans to both bankable and nonbankable credits.[11] For example, finance companies have traditionally served subprime credit card or auto loan customers, as well as low-rated corporate credits such as the commercial airlines, none of which are served by banks. Furthermore, some ABS intermediaries could fund highly rated structured credit assets at a lower cost and at lower levels of leverage than banks could with high-return-on-equity targets.

Over the last thirty years, a number of activities have been pushed out of banks and into the parallel banking system. It remains an open question whether the parallel banking system will ever remain stable through credit cycles in the absence of official credit and liquidity puts. If the answer is no, then there are questions about whether such puts and the associated prudential controls should be extended to parallel banks or, alternatively, whether parallel banking activity should be severely restricted. (A spectrum of shadow banking activities by type is described in Online Appendix 6.)

[10] Credit wraps come in different forms and guarantee the timely payment of principal and interest on an underlying debt obligation.

[11] Carey, Post, and Sharpe (1998) document the specialization of finance companies and their servicing of riskier borrowers.

4.5 Backstopping the Shadow Banking System

The Federal Reserve's 13(3) emergency lending facilities that followed the bankruptcy of Lehman Brothers amount to a backstop for all the functional steps involved in the shadow credit intermediation process. The facilities introduced during the crisis were an explicit recognition of the need to channel emergency funds into internal, external, and government-sponsored shadow banking subsystems. (To read about a pre- and postcrisis backstop for shadow banks, see Online Appendixes 7 and 8.)

As such, the CPFF was a backstop for the CP and ABCP issuance of loan originators and loan warehouses, respectively (steps 1 and 2 of the shadow credit intermediation process); the TALF was a backstop for ABS issuance (step 3); Maiden Lane LLC was a backstop for Bear Stearns' ABS warehouse, while the Term Securities Lending Facility (TSLF) was a means to improve the average quality of broker-dealers' securities warehouses by swapping ABS for Treasury securities (step 4); Maiden Lane III LLC was a backstop for AIG-Financial Products' credit puts on ABS CDOs (step 5); and the Term Auction Facility (TAF) and foreign exchange swaps with other central banks were meant to facilitate the "onboarding" and on-balance-sheet dollar funding of the ABS portfolios of formerly off-balance-sheet ABS intermediaries—mainly SIVs and securities arbitrage conduits (step 6).[12]

The Primary Dealer Credit Facility (PDCF) was a backstop for the funding of diversified broker-dealers through the tri-party repo system. The Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF) and the Money Market Investor Funding Facility (MMIFF) served as liquidity backstops for regulated and unregulated money market intermediaries, respectively (step 7). The FDIC's Temporary Liquidity Guarantee Program, which covered various bank and nonbank financial institutions' senior unsecured debt and corporations' non-interest-bearing deposit transaction accounts, regardless of dollar amount, was another emergency backstop, as was the U.S. Treasury Department's temporary guarantee program of retail and institutional money market mutual funds.

Upon the complete rollout of the liquidity facilities and guarantee schemes, the shadow banking system was fully embraced by official credit and liquidity puts and became fully backstopped, just like the traditional banking system. As a result, the adverse effect on real economic activity from the collapse of the shadow banking system was mitigated.

[12] The CPFF is documented in detail by Adrian, Marchioni, and Kimbrough (2011); the TSLF is described by Fleming, Hrung, and Keane (2009); the TALF is described by Campbell et al. (2011) and Ashcraft, Malz, and Pozsar (2012); the PDCF is discussed by Adrian, Burke, and McAndrews (2009); the TAF is documented by Armantier, Krieger, and McAndrews (2008).

5. Conclusion

We document the specialized financial institutions of the shadow banking system and argue that these credit intermediaries played a quantitatively important role in the run-up to the financial crisis. Shadow credit intermediation includes three broad types of activities differentiated by their strength of official enhancement: implicitly enhanced, indirectly enhanced, and unenhanced.

The shadow banking system has three subsystems that intermediate different types of credit in fundamentally different ways. The government-sponsored shadow banking subsystem refers to credit intermediation activities funded through the sale of agency debt and MBS, which mainly include conforming residential and commercial mortgages. The "internal" shadow banking subsystem refers to the credit intermediation process of a global network of banks, finance companies, broker-dealers, and asset managers and their on- and off-balance-sheet activities—all under the umbrella of financial holding companies. Finally, the "external" shadow banking subsystem refers to the credit intermediation process of diversified broker-dealers and a global network of independent, nonbank financial specialists that includes captive and stand-alone finance companies, limited-purpose finance companies, and asset managers.

While much of the current and future reform efforts are focused on remediating the excesses of the recent credit bubble, we note that increased capital and liquidity standards for depository institutions and insurance companies are likely to increase the returns to shadow banking activity. For example, as pointed out in Pozsar (2011), the reform effort has done little to address the tendency of large institutional cash pools to form outside the banking system. Thus, we expect shadow banking to be a significant part of the financial system, although almost certainly in a different form, for the foreseeable future.

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The Rising Gap between Primary and Secondary Mortgage Rates

- While the primary-secondary mortgage rate spread is a closely tracked series, it is an imperfect measure of the pass-through between secondary-market valuations and primary-market borrowing costs.
- This study tracks cash flows during and after the mortgage origination and securitization process to determine how many dollars (per $100 loan) are absorbed by originators, either to cover costs or as originator profits.
- The authors calculate a series of originator profits and unmeasured costs (OPUCs) for the period 1994-2012, and show that these OPUCs increased significantly between 2008 and 2012.
- Although some mortgage origination costs may have risen, a large component of the rise in OPUCs remains unexplained by cost increases alone, pointing to increased profitability of originators.

1. Introduction

The vast majority of mortgage loans in the United States are securitized in the form of agency mortgage-backed securities (MBS). Principal and interest payments on these securities are passed through to investors and are guaranteed by the government-sponsored enterprises (GSEs) Fannie Mae or Freddie Mac or by the government organization Ginnie Mae.[1] Thus, investors in these securities are not subject to loan-specific credit risk; they face only interest rate and prepayment risk—the risk that borrowers may refinance the loan when rates are low.[2]

In the primary mortgage market, lenders make loans to borrowers at a certain interest rate, whereas in the secondary market, lenders securitize these loans into MBS and sell them to investors. When thinking about the relationship between these two markets, policymakers and market commentators usually pay close attention to the "primary-secondary spread." This spread is calculated as the difference between an average

[1] Fannie Mae is the Federal National Mortgage Association (or FNMA); Freddie Mac is the Federal Home Loan Mortgage Corporation (FHLMC; also FGLMC); Ginnie Mae is the Government National Mortgage Association (GNMA).

[2] They also face the risk that borrowers prepay at lower-than-expected speeds when interest rates rise.

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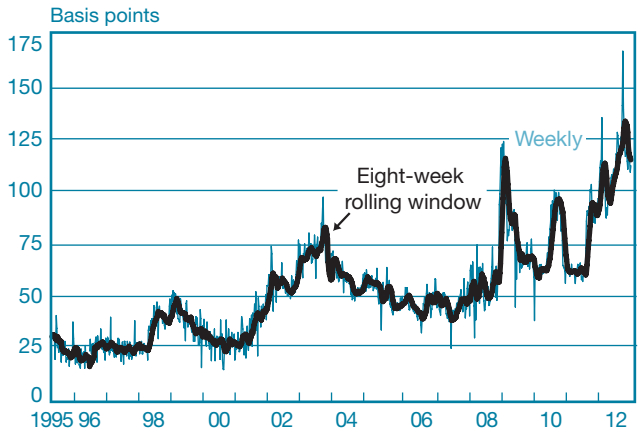
Chart 1
The Primary-Secondary Spread



Sources: Bloomberg L.P.; Freddie Mac.

Chart 2
Back-of-the-Envelope Calculation of the Net Market Value of a Thirty-Year Fixed-Rate Mortgage Securitized in an Agency MBS

Sources: JPMorgan Chase; Freddie Mac; Fannie Mae; authors' calculations.

Notes: The chart shows the interpolated value of a mortgage-backed security (MBS) with coupon ($r_{primary}$ – g-fee) minus 100. The line reflects an eight-week rolling window average; the calculation uses back-month MBS prices.

mortgage interest rate (usually coming from the Freddie Mac Primary Mortgage Market Survey) and a representative yield on newly issued agency MBS—the "current-coupon rate."

Chart 1 shows a time series of the primary-secondary spread through the end of 2012. The spread was relatively stable from 1995 to 2000, at about 30 basis points; it subsequently widened to about 50 basis points through early 2008, but then reached more than 100 basis points in early 2009 and during 2012. Following the September 2012 Federal Open Market Committee announcement of additional MBS purchases, the spread temporarily rose to more than 150 basis points—a historical high that attracted much attention from policymakers and commentators at the time.

While the primary-secondary spread is a closely watched series, it is an imperfect proxy for the degree to which secondary-market movements are reflected in mortgage borrowing costs (the "pass-through") since, among other things, the secondary yield is not directly observed, but model-determined, and thus subject to model misspecification. Furthermore, mortgage market pass-through depends on the evolution of the GSEs' guarantee fees (or "g-fees," the price the GSEs charge for insuring the loan) as well as on mortgage originators' margins. To understand changes in the extent of pass-through over time, it is useful to track the two components separately. While g-fee changes are easily observable, we argue that originator margins are best studied by tracking the different cash flows during and after the origination process, rather than by looking at the primary-secondary spread (even after netting out g-fees). Indeed, since originators are selling the loans, their margin depends on the price at which they can sell them, rather than the interest rate on the security into which they sell the loans.

To get a sense of what lenders earn from selling loans, we first consider a simple "back-of-the-envelope" calculation. We track the secondary-market value of the typical offered mortgage loan (according to the Freddie Mac survey) over time, assuming that the lender securitizes and sells the loan as an agency MBS. To do so, we first deduct the g-fee from the loan's interest stream. We then compute the value of the remaining interest stream by interpolating MBS prices across coupons and subtracting the loan amount of $100.[3] Chart 2 shows that the approximate net market value of a mortgage grew from less than 100 basis points (or $1 per $100 loan) before 2009 to more than 350 basis points in the second half of 2012. Taken literally, the chart implies that lender costs (other than the g-fee), lender profits, or a combination of the two must have increased by 300 basis points, or a factor of four, in five years.

In this article, we first present a more detailed calculation of originator profits and costs, and then attempt to explain their rise by considering a number of possible factors

[3] For instance, assume that the mortgage note rate is 3.75 percent and the g-fee is 50 basis points, such that the remaining interest stream is 3.25 percent. Assuming that the 3.0 percent MBS trades at 102 and the 3.5 percent MBS trades at 104.5, the approximate market value of this mortgage in an MBS pool would then be simply the average of the two prices, 103.25, or 3.25 net of the loan principal.

affecting them. In section 2, we begin with a general discussion of the mortgage origination and securitization process, and how originator profits are determined. Here, we include a detailed discussion of the valuation of revenues from servicing and points as well as costs from g-fees, based on standard industry methods. Next, in section 3 we use these methods to derive a time series of average originator profits and unmeasured costs (OPUCs) for the period 1994-2012, which largely reflects the time-series pattern of Chart 2. We then compare OPUCs and the primary-secondary spread as measures of mortgage market pass-through. Finally, in section 4 we turn to possible explanations for the increase in OPUCs, including putback risk, changes in the valuation of mortgage servicing rights, pipeline hedging costs, capacity constraints, market concentration, and streamline refinancing programs. While some of the costs faced by originators may have risen over the period 2008-12, we conclude that a large component of the rise in OPUCs remains unexplained by cost increases alone, suggesting that originators' profits likely increased over this period. We then discuss possible sources of the rise in profitability. Capacity constraints likely played a significant role in enabling originator profits, especially during the early stages of refinancing waves. Pricing power coming from refinancing borrowers' switching costs could have been another factor sustaining originator profits.[4]

2. Measuring the Profitability of Mortgage Originations

2.1 The Origination and Securitization Process

The mortgage origination process begins when a borrower seeks a quote for a loan, either to purchase a home or to refinance an existing mortgage. Based on the borrower's credit score, stated income, loan amount, and expected loan-to-value (LTV) ratio, an originator offers the borrower a combination of an interest rate and an estimate of the amount of money the borrower will need to provide up front to close the loan.[5] For example, for a borrower who wants a $300,000, thirty-year fixed-rate mortgage, the originator may offer a 3.75 interest rate, known as the "note rate," with the borrower paying $3,000 (or 1.0 percent) in closing costs. If the borrower and originator agree on the terms, then the originator will typically guarantee these terms for a "lock-in period" of between thirty and ninety days, and the borrower will officially apply for the loan.

During the lock-in period, the originator processes the loan application, performing such steps as verifying the borrower's income and the home appraisal. Based on the results of this process, borrowers may ultimately not qualify for the loan, or for the rate that the originator initially offered. In addition, borrowers have the option to turn down the loan offer, for example, because another originator may have offered better loan terms. As a result, many loan applications do not result in closed loans. These "fall-outs" fluctuate over time and present a risk for originators, as we discuss in more detail in section 4.

Originators have a variety of alternatives to fund loans: they can securitize them in the private-label MBS market or in an agency MBS, sell them as whole loans, or keep them on their balance sheets. In the following discussion, we focus on loans that are "conforming" (meaning that they fulfill criteria based on loan amount and credit quality, so that they are eligible for securitization by the GSEs), and assume securitization in an agency MBS, meaning that this option either dominates or is equally profitable to the originator's alternatives.[6,7]

[4] Importantly, this article focuses on longer-term changes in the level of originator profits and costs, rather than on the high-frequency pass-through of changes in MBS valuations to the primary mortgage market.

[5] Throughout this article, we use the terms "lender" or "originator" somewhat imprecisely, as they lump together different origination channels that in practice operate quite differently. Currently, the most popular origination channel is the "retail channel" (for example, large commercial banks that lend directly), which accounts for about 60 percent of loan originations, up from around 40 percent over the period 2000-06 (source: *Inside Mortgage Finance*). The alternative "wholesale" channel consists of brokers and "correspondent" lenders. Brokers have relationships with different lenders that fund their loans, and account for about 10 percent of originations. Correspondent lenders account for 30 percent of originations, and are typically small independent mortgage banks that have credit lines from and sell loans (usually including servicing rights) to larger "aggregator" or "sponsor" banks. Our discussion in this section applies most directly to retail loans.

[6] The fraction of mortgages that are not securitized into agency MBS has steadily decreased in recent years, according to *Inside Mortgage Finance:* while the estimated securitization rate for conforming loans ranged from 74 to 82 percent over the period 2003-06, it has varied between 87 and 98 percent since then (the 2011 value was 93 percent). The private-label MBS market has effectively been shut down since mid-2007, with the exception of a few deals involving loans with amounts exceeding the agency conforming loan limits ("jumbo" loans).

[7] Our discussion throughout this article applies directly to conventional mortgages securitized by the GSEs Fannie Mae and Freddie Mac; the process of originating Federal Housing Administration (FHA) loans and securitizing them through Ginnie Mae is similar, but with some differences (such as insurance premia) that we do not cover here.

A key feature of an agency MBS is that principal and interest payments for these securities are guaranteed by the GSEs.[8] The GSEs charge a monthly flow payment, the g-fee, which is a fixed fraction of the loan balance. Flow g-fees do not depend on loan characteristics but may differ across loan originators. Until 2012, flow g-fees averaged approximately 20 basis points per year, but during 2012 they rose to about 40 basis points, reflecting a Congressionally mandated 10-basis-point increase to fund the 2012 payroll tax reduction and another 10-basis-point increase mandated by the Federal Housing Finance Agency (FHFA). As we discuss below, originators can convert all or part of the flow g-fee into an up-front premium by "buying down" the g-fee. Alternatively, they can increase the flow g-fee and receive an up-front transfer from the GSE by "buying up" the g-fee.

Since 2007, the GSEs have also been charging a separate up-front premium due upon delivery of the loan, known as the loan-level price adjustment (LLPA).[9] The LLPA contains a fixed charge for all loans (currently 25 basis points) known as an adverse-market delivery charge, as well as additional loan-specific charges that depend on loan characteristics such as the term of the loan, the LTV, and the borrower's FICO score. For instance, as of early 2013, the LLPA for a borrower with a FICO score of 730 and an LTV of 80 was 50 basis points (for a thirty-year fixed-rate loan; the charge is waived for loans with a term of fifteen or fewer years). Together with the 25-basis-point adverse-market delivery charge, this implies that the loan originator pays an up-front fee equal to 0.75 percent of the loan amount. Thus, the total up-front transfer between the originator and GSE consists of the LLPA plus or minus potential g-fee buy-ups or buy-downs, which can be either positive or negative. For simplicity, our discussion assumes that the transfer from the originator to the GSE is positive and refers to it as an "up-front insurance premium" (UIP).

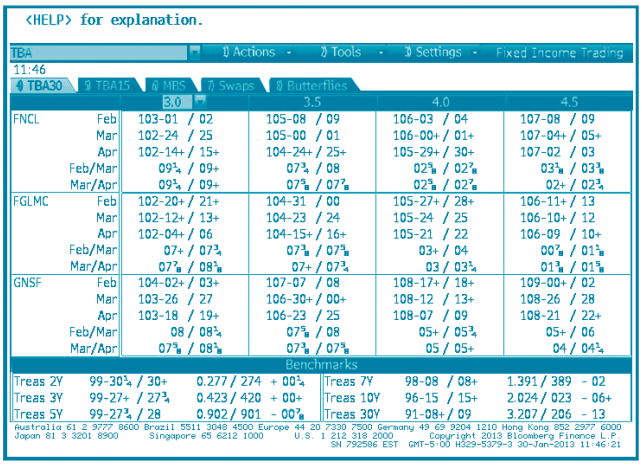
Once an originator chooses to securitize the loan in an agency MBS pool, it can select from different coupon rates, which typically vary by 50-basis-point increments. The note rate on the mortgage, for example, 3.75 percent, is always higher than the coupon rate on an agency MBS, for example, 3.0 percent. Who receives the residual 75-basis-point interest flow? Assuming the originator does not buy up or down the g-fee, approximately 40 basis points go to the GSEs (as of early 2013), leaving 35 basis points of "servicing income." The GSEs require the servicer to collect at least 25 basis points in servicing income, known as "base servicing." Base servicing is tied to the right

[8] If the loan is found to violate the representations and warranties made by the seller to the GSEs, the GSEs may put the loan back to the seller.

[9] LLPA is the official term used by Fannie Mae; Freddie Mac calls the corresponding premium "postsettlement delivery fee." The respective fee grids can be found at www.fanniemae.com/content/pricing/llpa-matrix.pdf and www.freddiemac.com/singlefamily/pdf/ex19.pdf.

Exhibit 1

Example of a TBA Price Screen



Source: Bloomberg L.P.

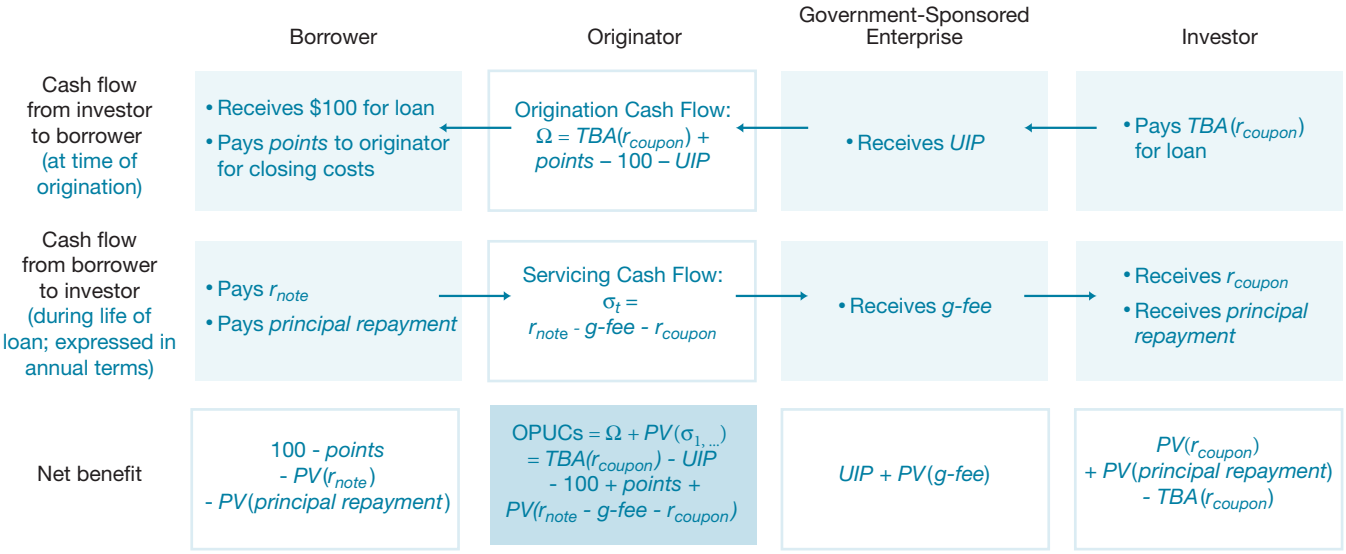
Notes: Prices are quoted in ticks, which represent 1/32nd of a dollar; for instance, 103-01 means 103 plus 1/32 = $103.03125 per $100 par value. The "+" sign represents half a tick (or 1/64). Quotes to the left of the "/" are bids, while those to the right are asks (or offers).

and obligation to service the loan (which involves, for instance, collecting payments from the borrower) and can be seized by the guaranteeing GSE if the servicer becomes insolvent. Servicing income in excess of 25 basis points—10 basis points in this example—is known as "excess servicing," and is a pure interest flow. One might surmise here that a loan in a 3.0 percent pool must have a rate of 3.65 percent or higher (3.0 plus 40 basis points for the g-fee plus 25 basis points for base servicing), but recall from above that the originator can buy down the g-fee so, in fact, the minimum note rate in a 3.0 percent pool is 3.25 percent. In practice, for a mortgage of a given note rate, originators compare the profitability of pooling it in different coupons, as described below.

Originators typically sell agency loans in the so-called TBA (to-be-announced) market. The TBA market is a forward market in which investors trade promises to deliver agency MBS at fixed dates one, two, or three calendar months in the future. For concreteness, Exhibit 1 displays TBA prices from Bloomberg at 11:45 a.m. on January 30, 2013. At this time, investors will pay 102 14+/32≈102.45 for a 3.0 percent Fannie Mae (here denoted FNCL) MBS for April settlement. To understand the role of the TBA market, suppose that Bank A expects to have $100 million of 3.5 percent note rate mortgages available for delivery in April. In order to hedge its interest rate risk, Bank A will then sell $100 million par of 3.0 percent pools "forward" in the TBA market at a price of $102.45 per $100 par, to be delivered on the standard settlement day in April. Over the following weeks,

Exhibit 2

Mortgage Loan Securitized in an Agency MBS and Sold in TBA Market: The Money Trail



Note: $TBA(r_{coupon})$ is the price of a mortgage-backed security (MBS) with coupon rate r_{coupon} in the "to-be-announced" market; *UIP* is up-front insurance premium (consisting of loan-level price adjustments plus or minus potential g-fee buy-ups or buy-downs); *PV* is present value.

Bank A assembles a pool of loans to be put in the security and delivers the loans to Fannie Mae, which then exchanges the loans for an MBS. This MBS is then delivered by Bank A on the contractual settlement day to the investor who currently owns the TBA forward contract in exchange for the promised $102.45 million. A key feature of a TBA trade is that at the time of trade, the seller does not specify which pools of loans it will deliver to the buyer—this information is "announced" only shortly before the trade settles. As a consequence, market participants generally price TBA contracts under the assumption that sellers will deliver the least valuable—or "cheapest-to-deliver"—pools at settlement.[10]

2.2 How Does an Originator Make Money on the Transaction?

A mortgage loan involves an initial cash flow at origination from investors to the borrower, and subsequent cash flows from the borrower to investors as the borrower repays the loan principal and interest. Exhibit 2 maps these cash flows for a mortgage loan securitized in a Fannie Mae MBS and sold in the TBA market. The top panel shows the origination cash flow, which involves the investor paying price $TBA(r_{coupon})$ to the originator in exchange for an MBS with coupon rate r_{coupon}.

[10] See Vickery and Wright (2013) for an overview of the TBA market.

From the investor's payment, an originator funds the loan and pays any *UIP* to Fannie Mae.[11] Together with points received from the borrower, the cash flow to the originator when the loan is made equals:

$$\Omega \equiv \text{Origination cash flow} = TBA(r_{coupon}) + points - 100 - UIP. \quad (1)$$

Through the life of the loan (middle panel of Exhibit 2), a borrower pays the note rate, r_{note}, from which Fannie Mae deducts the *g-fee* and the investor gets r_{coupon}, leaving servicing cash flow to the originator equal to:

$$\sigma_t \equiv \text{servicing cash flow}_t = r_{note} - g\text{-}fee - r_{coupon}. \quad (2)$$

Originator profits per loan are the sum of profits at origination (equation 1) and the present value (*PV*) of the servicing cash flow (equation 2) less all marginal costs (other than the *g-fee*) of originating and servicing the loan, which we call "unmeasured costs." Thus,

$$\text{originator profits} = \Omega + PV(\sigma_1, \sigma_2, \ldots) - \text{unmeasured costs}. \quad (3)$$

[11] Here and below, "originator" refers to all actors in the origination and servicing process, that is, if a loan is originated through a third-party mortgage broker, for instance, the broker will earn part of the value.

In our empirical exercise below, we study the sum of profits and unmeasured costs, which is what we can observe:

$$\text{originator profits and unmeasured costs (OPUCs)} = \Omega + PV(\sigma_1, \sigma_2, \ldots). \quad (4)$$

In later sections of the article, we attempt to assess to what extent changes in unmeasured costs can explain fluctuations in OPUCs.

We next consider a specific transaction to illustrate how the computations in Exhibit 2 are done in practice. Consider a loan of size $100 with a note rate of 3.75 percent locked in on January 30 for sixty days by a borrower with a FICO score of 730 and an LTV ratio of 80. The borrower agrees to pay 1 point to the originator for the closing, and the originator sells the loan into a TBA security with a 3.0 percent coupon for April settlement to allow sixty days for closing. Assuming the loan closes, how high are the OPUCs?

Computing the net revenue at origination, Ω, is relatively straightforward. According to Exhibit 1, investors pay $102.45 for every $100 of principal in a TBA security with a 3.0 percent coupon. As discussed earlier, the up-front insurance premium from the LLPA (and assuming no g-fee buy-up/-down) at the time was 0.75 percent of the loan (or 0.75 points). The originator collects 1 point from the borrower, remitting $100 for the loan, yielding Ω = 2.7 points.

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Valuing the stream of servicing income after origination, (σ_1, σ_2, ...), is more complicated. For now, we assume that the originator does not buy up or down the g-fee—a decision that we will revisit below. This means that from the borrower's interest flow of 3.75 percent, the GSEs collect 40 basis points, while the investors get 3.0 percent, leaving 35 basis points in flow servicing income, σ_t, decomposed into 25 basis points of base servicing and 10 basis points of excess servicing. There are a number of alternative ways to determine the present value of these flow payments:

IO Strip Prices or Coupon Swaps

Servicing income can be thought of as an interest-only (IO) strip, which is a security that pays a flow of interest payments, but no principal payments, to investors as long as a loan is active.[12] The main driver of the valuation of an IO strip is the duration of the loan—an IO strip is far more valuable if one expects the borrower to prepay in five years as opposed to one year; as in the latter case, interest payments accrue for a much shorter time period. One simple way to value IO strips is to construct them from TBA securities through coupon swaps. For example, going long on a 3.5 percent MBS and short on a 3.0 percent MBS generates interest cash flows of 50 basis points with prepayment properties that correspond roughly to loans in 3.0 and 3.5 pools. According to Exhibit 1, that 50-basis-point IO strip for April settlement would cost 2 11/32 (104 25+/32 minus 102 14+/32) ≈ 2.34. Since our originator has only 35 basis points of servicing, the coupon swap method would value servicing rights at 35/50 × 2.34 ≈ 1.6, resulting in OPUCs of 2.7 + 1.6 = 4.3 points.[13]

This method ignores the fact that base servicing generates other revenues, such as float income, in addition to the IO strip. To account for this additional value, it is often assumed that the base servicing is worth more than the present value of the IO strip. Assuming that base servicing is worth, for example, 25 percent more than excess servicing would yield a PV of servicing income of (25 × 1.25 + 10)/50 × 2.34 ≈ 1.9, so that OPUCs would equal 2.7 + 1.9 = 4.6 points.

Another shortcoming of the coupon swap method is that the coupon swap reflects differences in assumed loan characteristics across coupons. For example, TBA prices may reflect the fact that higher coupons are older securities having different prepayment characteristics. These differences will distort the valuations of interest streams from the coupon swaps.[14]

Constant Servicing Multiples

An alternative method for valuing servicing flows is to use fixed accounting multiples that reflect historical valuations of

[12] Another way to describe an IO strip is as an annuity with duration equal to the life of the loan.

[13] This is the method implicitly used in the back-of-the-envelope calculation in Chart 2, except that there we ignored points paid by the borrower.

[14] As an illustration, a 50-basis-point IO strip from a new 4.0 percent loan may not be worth as much as the price difference between the 3.5 and the 4.0 TBAs suggests, because the 4.0 TBAs may consist of loans that are older or credit impaired and thus prepay more slowly.

servicing. In the industry, the base servicing multiple is often assumed to be 5*x*, meaning that the present value of 25 basis points equals 1.25, while excess servicing is assumed to be valued at 4*x*, so that the value of the excess servicing in our example is 0.40. Using these servicing multiples, we see that the servicing income in our example is worth 1.65, meaning that OPUCs for this loan would be 2.7 + 1.65 = 4.35 points.

Buy-ups

As mentioned above, originators can convert the g-fee into an up-front premium, or vice versa, using buy-ups and buy-downs. A buy-up means that the flow g-fee increases, but to compensate, the GSE will reduce the UIP (or, in case it is negative, transfer money to the originator upon delivery of the loan). Thus, buying up the g-fee is a way to reduce the flow servicing income and increase income at the time of origination.

The GSEs offer a buy-up multiple, which is communicated to originators (but not otherwise publicly known), and varies over time, presumably with the level of the coupon swap. If, for example, the buy-up multiple is 3*x*, then a 10-basis-point increase in the g-fee reduces UIP by 30 basis points, lowering σ_t by 0.1 and raising Ω by 0.3. Note that only excess servicing, σ_t, -0.25, can be "monetized" this way, while 25 basis points of base servicing still need to be retained and valued by the originator. If we assume a base servicing multiple of 5*x*, as above, then buying up the g-fee by 10 basis points would lead to OPUCs of 3.0 + 1.25 = 4.25.

The buy-up multiple provides a lower bound on the valuation of excess servicing—the originator (or some other servicer) may value it at a higher multiple; but if it does not, it can sell its excess servicing to the GSEs. To what extent originators want to take advantage of this option depends on a number of factors. For example, as we discuss in section 4.1, the upcoming implementation of Basel III rules may require banks to hold additional capital against mortgage servicing assets, which may lower their effective valuation of servicing income. By buying up the g-fee, these banks can turn servicing cash flows that are subject to additional regulatory capital charges into cash. Another potential factor is the originator's beliefs about the prepayment properties of a pool of loans. For example, if a lender believes that the expected lifetime of a pool is shorter than average, it may choose to buy up the g-fee.

Market Prices of Servicing Rights

Finally, there is an active market for trading servicing rights, which can be sold by originators at origination or well afterward. One can use market prices to value servicing rights, but since not all servicing rights change hands, it is difficult to know whether the ones that trade are systematically more or less valuable than the ones that originators hold.

2.3 Best Execution

Lenders can decide to securitize a loan into securities having different coupons, which involves different origination and servicing cash flows. The strategy that maximizes OPUCs is known in the industry as "best (or optimal) execution."[15]

Thus far, we have assumed that the originator securitizes the loan in a 3.0 coupon. However, since the note rate is 3.75, the originator could alternatively sell it in a 3.5 coupon.[16] Given that the originator must retain 25-basis-point base servicing, such a choice would require buying down the entire 40-basis-point g-fee, meaning that instead of any flow payment to the GSE, the originator pays the full insurance premium up front. Exactly like the buy-up multiple discussed above, the GSEs also offer a (higher) buy-down multiple, which determines the cost of this up-front payment.

Using the prices in Exhibit 1, we note that the price of a 3.5 TBA coupon is 104 24+/32=104.77, meaning that changing coupons would increase loan sale revenues by 2.32 points. If we assume the buy-down multiple equals 7, then UIP would increase by 2.8 points relative to the 3.0 coupon case. Ω is thus equal to 2.22, or 0.48 less than it would be for the 3.0 coupon case. Meanwhile, servicing income is now simply σ_t = 0.25, as the flow g-fee has been bought down to zero, and with an assumed base servicing multiple of 5*x*, OPUCs for this execution would equal 2.22 + 1.25 = 3.47.

Comparing this OPUC value with the "constant servicing multiples" case above, we see that pooling into the 3.0 coupon would generate higher OPUCs than the 3.5 coupon and thus would be best execution for a mortgage with the 3.75 percent note rate.

However, this conclusion is sensitive to a number of assumptions—in particular, the valuation of excess servicing and the buy-down multiple.[17] As shown in Table 1, pooling in the higher coupon becomes more attractive as the buy-down multiple decreases or the excess servicing multiple decreases.

[15] See Bhattacharya, Berliner, and Fabozzi (2008) for an extensive discussion of pooling economics and mortgage pricing that also includes nonagency securitizations.

[16] The originator could also place the loan in a 2.5 percent or lower coupon—the only restriction is that the note rate cannot be more than 250 basis points above the coupon.

[17] As base servicing always needs to be retained, its valuation does not affect best execution—it shifts OPUCs up or down equally for all coupons.

Table 1

Dependence of Best Execution on Excess Servicing and Buy-Down Multiples

Excess Servicing Multiple	Buy-Down Multiple	OPUCs(3.0) (Points)	OPUCs(3.5) (Points)
4*x*	7*x*	4.35	3.47
4*x*	5*x*	4.35	4.27
3*x*	5*x*	4.25	4.27

Sources: Bloomberg L.P.; authors' calculations.
Note: OPUCs are originator profits and unmeasured costs.

2.4 Rate Sheets and Borrower Choice

Until now, we have taken the borrower choice as given—the borrower pays 1 point at origination and is offered a note rate of 3.75. However, from our OPUC calculations, it is clear that there are other combinations of note rate and points that would be equally profitable for the originator. For example, if the borrower paid a note rate of 4.0 instead, and the originator still pooled the loan into a 3.0 coupon, then excess servicing would increase by 25 basis points, leading to 1 point higher revenue under an excess servicing multiple of 4*x*. Therefore, the originator could maintain its profit margin by offering the borrower a combination of 0 points at closing and a note rate of 4.0.[18]

Indeed, originators offer borrowers precisely these sorts of alternatives between closing costs and rates. Table 2 shows part of a rate sheet provided by a bank to a loan officer on January 30, 2013.[19] The entries in the table are "discount points," which are points paid by the borrower at closing to lower the note rate on the loan. For example, assume that the total closing fees the originator would charge the borrower without any discount points would equal 1.58 points—sometimes referred to as "origination points." These fees include application processing costs, compensation for the loan officer, and also the LLPA (0.75 points in our example), which is usually charged directly to the borrower.

Our baseline borrower has a sixty-day lock-in period and a note rate of 3.75 percent; accordingly, based on the rate sheet, the borrower is contributing -0.581 discount points. This means that the bank is actually paying the borrower cash up front (often referred to as a "rebate"), which reduces closing costs from 1.58 points to the 1 point assumed throughout the example. If the borrower wanted a lower note rate, for example, 3.5 percent, then the closing costs would rise by 1.044 – (-0.581) = 1.625, or from 1 to 2.625 points. Alternatively, by choosing a rate of 4.125 percent, the borrower could get a rebate of 1.581 points and would pay nothing at closing.

As shown in the rate sheet, there is no single "mortgage rate." Rather, a large number of different note rates are available to borrowers on any given day, typically in increments of 0.125.[20] Originators simply change the number of discount points offered for the different note rates one or more times a day, reflecting secondary-market valuations (TBA prices), servicing valuations, and GSE buy-up/buy-down multiples.[21]

Table 2

Example of a Mortgage Rate Sheet

	Lock-in Period		
Note Rate	Fifteen Days	Thirty Days	Sixty Days
4.750	(3.956)	(3.831)	(3.706)
4.625	(3.831)	(3.706)	(3.581)
4.500	(3.706)	(3.581)	(3.456)
4.375	(3.331)	(3.206)	(3.081)
4.250	(3.081)	(2.956)	(2.831)
4.125	(1.831)	(1.706)	(1.581)
4.000	(1.456)	(1.331)	(1.206)
3.875	(1.081)	(0.956)	(0.831)
3.750	(0.831)	(0.706)	(0.581)
3.625	(0.081)	0.044	0.169
3.500	0.794	0.919	1.044
3.375	1.669	1.794	1.919
3.250	2.544	2.669	2.794
3.125	3.919	4.044	4.169

Source: www.53.com/wholesale-mortgage/wholesale-rate-sheets.html on January 30, 2013.

Notes: Figures are in percentage points of the loan amount. Loan type is a thirty-year fixed-rate loan. Column 1 shows the annual interest rate to be paid by the borrower over the life of the loan. Columns 2-4 show the points the borrower needs to pay up front to obtain the interest rate in column 1, for different lock-in periods. Parentheses denote negative figures.

[18] In fact, the 4.0 note rate might increase the profit margin, because it would potentially alter the best-execution coupon.

[19] Actual sample rate sheets can be found, for instance, at www.53.com/wholesale-mortgage/wholesale-rate-sheets.html. Most lenders do not make their rate sheets available to the public.

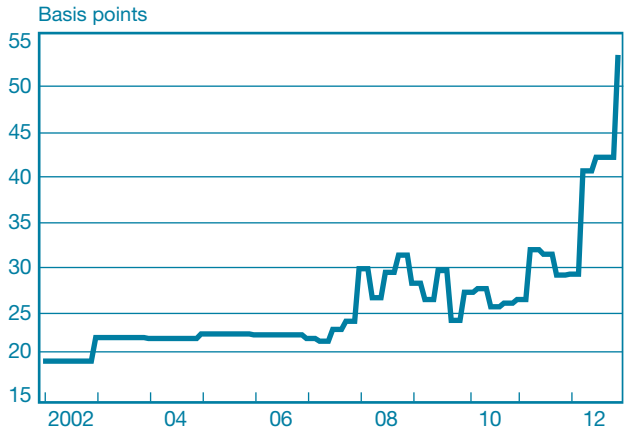
[20] That said, banks will often quote a headline mortgage rate, which is generally the lowest rate such that the number of discount points required from the borrower is "reasonable" (this rate is sometimes referred to as the "best-execution" rate for the borrower, not to be confused with the originator's best execution). In the example rate sheet, this rate would likely be 3.75 or 3.625, as going below 3.625 requires significant additional points from the borrower.

[21] The set of available note rates on a given day generally depends on which MBS coupons are actively traded in the secondary market.

2.5 Summary: Trade-offs, Trade-offs Everywhere

As shown in the preceding discussion, the different actors in the origination and securitization process have a number of trade-offs available to them. Borrowers can decide between paying more points up front and paying a higher interest rate later. Originators can choose between different coupons into which to pool a loan, which imply different origination and servicing cash flows; in addition, as part of this decision, originators can choose whether to pay the GSE insurance premium up front or as a flow. Finally, investors can choose to invest in securities with different coupons, with higher coupons requiring a larger initial outlay, but subsequently generating higher flow payments. Investor demand for different coupons, which reflects their prepayment and interest rate projections, ultimately affects originators' best-execution strategies and thus the point-rate grid offered to borrowers.

Chart 3
Average Effective Guarantee Fee



Source: Fannie Mae SEC Forms 10-K and 10-Q, various issues through 2012:Q4.

3. Measuring OPUCs over Time

Our goal in this section is to derive an empirical measure of average OPUCs (equation 4) for thirty-year fixed-rate mortgages for the period 1994 to 2012. To do so, we need to make a number of assumptions.

First, rather than valuing each possible loan note rate, we value a hypothetical mortgage having a note rate equal to the survey rate from Freddie Mac's Primary Mortgage Market Survey, at weekly frequency. We also use the weekly time series of average points paid from the same survey.

Second, rather than accounting separately for LLPAs and the flow g-fee, we use an "effective" g-fee, which assumes that LLPAs are paid over the life of the loan, as reported in Fannie Mae's Securities and Exchange Commission Form10-Q filings. The average size of the effective g-fee is shown in Chart 3. In our calculations, we incorporate anticipated changes in g-fees. In particular, the 10-basis-point increases that came into effect on April 1, 2012, and December 1, 2012, are assumed in our calculations to apply to loans originated January 1 and September 1, respectively, which is right after the increases were announced.

Third, as explained above, we need to value the servicing income flow. The coupon swap method has the advantage of being based on current market prices that reflect changes in the duration of the cash flows. But, as mentioned earlier, the coupon swap may also reflect differences in assumed loan characteristics across coupons; therefore, it may be a poor proxy for the value of an interest strip from a new loan.

To circumvent this issue, and also for the sake of simplicity, our baseline calculations use fixed multiples of 5*x* for base servicing, 4*x* for excess servicing, and 7*x* for buy-downs.[22] These are commonly assumed values in industry publications. Later, we explore the sensitivity of OPUCs to alternative assumptions.

Finally, we do a best-execution calculation, considering three different *TBA* coupons (using back-month prices) into which the mortgage could potentially be pooled.[23] The highest coupon is set such that it requires the originator to buy down some or all of the *g-fee* up front, while instead, for the other two possible coupon options, the originator retains positive excess servicing because the loan's interest payment is more than sufficient to cover the *g-fee* and base servicing.[24] The best execution among the three options determines our OPUC value for the week in question. Before turning to the weekly OPUC time series, we report in Table 3 a detailed OPUC calculation on a given day. We can infer, from the bottom of the table, that the mid-coupon execution is optimal in this example.

[22] We assume the buy-up multiple to be smaller than 4*x*, such that, in our calculations, buy-ups are never used.

[23] The use of back- rather than front-month TBA price contracts reflects the originators' desire to hedge price movements during the lock-in period, as discussed in more detail in section 4.

[24] Depending on the mortgage rate, pooling into the highest candidate coupon may not actually be a possibility—as explained, the mortgage rate needs to exceed the coupon rate by at least 25 basis points.

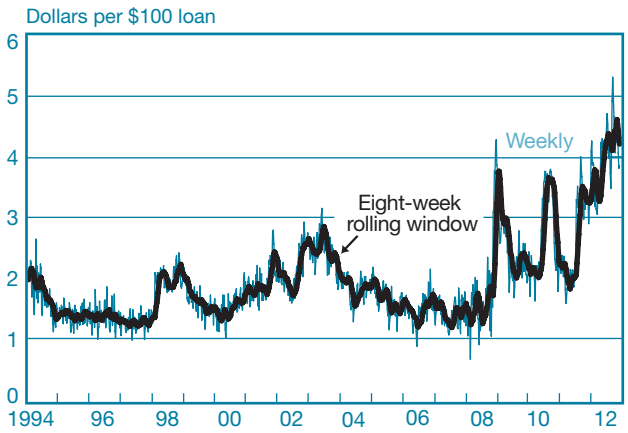
Table 3
Example of OPUCs Best-Execution Calculation

TBA Coupon (Percent)	3.5	4.0	4.5	(1)
Coupon-independent inputs (percent)				
Mortgage rate	4.78	4.78	4.78	**(2)**
Points	0.7	0.7	0.7	**(3)**
Effective g-fee	0.261	0.261	0.261	**(4)**
Base servicing	0.25	0.25	0.25	**(5)**
Excess servicing	0.769	0.269	-0.231	**(6)** = **(2)** − **(1)** − **(4)** − **(5)**
Coupon-specific inputs (dollars per par value)				
TBA price (back-month)	97.55	99.95	101.67	**(7)**
Value of base servicing	1.25	1.25	1.25	**(10)** = 5 × **(5)**
Value of excess servicing	3.08	1.08		**(11)** = 4 × **(6)** if **(6)** > 0
G-fee buy-down			-1.62	**(12)** = 7 × **(6)** if **(6)** < 0
Revenues from TBA sale less payout to borrower	-1.75	0.65	2.37	**(13)** = **(7)** − (100 − **(3)**)
Value of servicing net of g-fee	4.33	2.33	-0.37	**(14)** = **(10)** + **(11)** + **(12)**
OPUCs				
By coupon	2.58	2.98	2.00	**(15)** = **(13)** + **(14)**
Best-execution		2.98		**(16)** = max**(15)** if **(2)** − **(1)** > .25

Source: Authors' calculations.

Note: Calculation is for April 30, 2009. OPUCs are originator profits and unmeasured costs; TBA is "to-be-announced."

Chart 4
Originator Profits and Unmeasured Costs, 1994-2012



Sources: JPMorgan Chase; Freddie Mac; Fannie Mae; authors' calculations.

3.1 Results

The weekly OPUC series over the period 1994 to 2012 is shown in Chart 4. The series averaged about $1.50 between 1994 and 2001, then temporarily increased to the $2.00-$3.00 range over 2002-03, before declining again and remaining below $2.00 for most of the period 2005-08. The OPUC measure jumped dramatically to more than $3.50 in early 2009 and then again in mid-2010. Most notably, however, it increased further over 2012, and reached highs of more than $5 per $100 loan in the second half of the year, before declining again toward the end of 2012.

As shown in the back-of-the-envelope calculation in Chart 2, the higher valuation of loans in the MBS market is the main driver of the increase in OPUCs toward the end of our sample period. Relative to that figure, the increase in OPUCs over 2009-12 in Chart 4 is less dramatic; this is because the earlier calculation implicitly valued servicing through coupon swaps, which were very low in early 2009 but relatively high since 2010. In contrast, in Chart 4 we have

assumed constant multiples.[25] As we discuss in more detail below, servicing right valuations appear to have declined, rather than increased, over the past few years, supporting the use of fixed multiples rather than coupon swaps.

When interpreting the OPUC series, it is important to keep in mind a few notes. First, the measure uses data on thirty-year conventional fixed-rate mortgage loans only and therefore bears no direct information on other common types of loans, such as fifteen-year fixed-rate mortgages, adjustable-rate mortgages, Federal Housing Administration loans, or jumbos.

Second, since the measure uses survey rates/points and average g-fees, our OPUC series is an average industry measure rather than an originator-specific one. In addition, rates and points may be subject to measurement error that could distort the OPUC measure at high frequency, although this should not have much effect on low-frequency trends.

Third, the measure is a lower bound to the actual industry OPUCs, as it uses TBA prices to value loans, while originators may have more profitable options available. Indeed, as noted in section 2, about 10 percent of conforming loans are held on balance sheet, implying that originators find it more (or equally) profitable not to securitize these loans. In addition, a significant fraction of agency loans is securitized in specified MBS pools that trade at a premium, or pay-up, to TBAs. In fact, the fraction of mortgages sold into the non-TBA market appears to have increased substantially in 2012, relative to earlier years. Table 4 shows an estimate of pools that are being issued as specified ("spec") pools, rather than TBA pools.[26] Over the first ten months of 2012, only about 60 percent (value-weighted) of all pools were issued to be traded in the TBA market, while the rest were issued as spec pools. The increase in spec-pool issuance is due in part to Making House Affordable (MHA) loans originated under the Home Affordable Refinance Program (HARP), which account for about 20 percent of all issuance and typically trade at significant pay-ups to TBAs, owing to their lower expected prepayment speeds. For example, over the second half of 2012, Fannie 3.5 and 4 MHA pools with LTVs above 100 traded on average about 1 1/2 and 3 1/2 points higher than corresponding TBAs. Low-loan-balance pools, the second largest spec-pool type, received similarly high pay-ups.

The higher valuation of loans in the MBS market is the main driver of the increase in OPUCs toward the end of our sample period.

Table 4

Issuance of Various GSE Thirty-Year Fixed-Rate Pool Types, January–October 2012

Pool Type	Balance (Millions of Dollars)	Loan Count	Balance (Percent)	Count (Percent)
TBA	379,763	1,347,516	59	46
MHA[a]	124,779	559,180	20	19
Loan balance[b]	97,161	867,628	15	30
Other specified[c]	36,588	138,735	6	5
Total	638,292	2,913,059	100	100

Sources: Fannie Mae; Freddie Mac; 1010data; Amherst Securities.

Note: GSE is government-sponsored enterprise. TBA is "to-be-announced." MHA is the Making Home Affordable program.

[a]Includes pools that are 100 percent refi with 80<Orig LTV≤105, and pools with loans >105 LTV.
[b]Includes pools that contain only loans with balances less than or equal to $175,000.
[c]Includes 100 percent investor, NY, TX, PR, low FICO pools, and "mutt" pools (variety of specified loan types). Excludes GSE pool types that are jumbo, FH reinstated, co-op, FHA/VA, IO, relo, and assumable.

3.2 OPUCs, the Primary-Secondary Spread, and Pass-Through

In assessing the extent to which secondary-market movements pass through to mortgage loan rates, most commentators focus on the primary-secondary spread—the difference between primary mortgage rates and the yield on MBS securities implied by TBA prices. As shown in Chart 1, the spread reached record-high levels over the course of 2012, suggesting that declines in primary mortgage rates did not keep pace with those on secondary rates. For example, while the primary-secondary spread averaged 73 basis points in 2011, the corresponding number was 113 basis points in 2012.

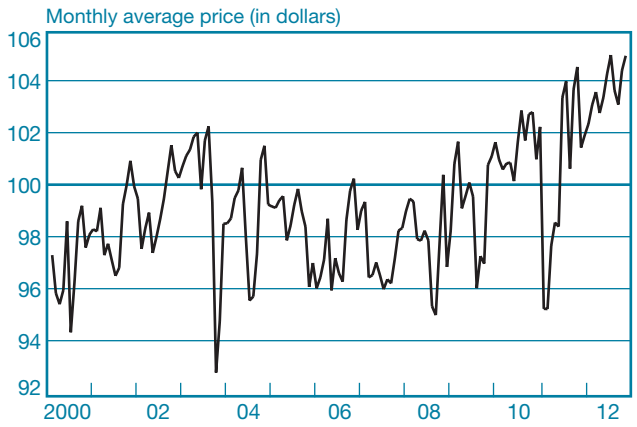
While the primary-secondary spread is a closely tracked series, it is an imperfect measure of the pass-through between secondary-market valuations and primary-market borrowing costs for several reasons.

[25] Another difference is that we take changes in points paid by borrowers into account, but this matters relatively little (the average amount of points paid by borrowers was relatively stable, between 0.4 and 0.8 over the period 2006-12).

[26] We do not know with certainty whether a pool is ultimately traded in the TBA market or as a specified pool; we simply assume that pools that strictly adhere to certain specified pool criteria are also subsequently traded as such.

Chart 5

Price of Lowest Fannie Mae TBA Thirty-Year Coupon with Sizable Issuance



Source: eMBS; JPMorgan Chase.

Notes: TBA is "to-be-announced." "Sizable issuance" means that the coupon accounts for at least 10 percent of total issuance in that month.

First, the yield on any MBS is not directly observable, because the timing of cash flows depends on prepayments. Therefore, the calculation of the yield is based on the MBS price and cash flow projections from a prepayment model, which itself uses as inputs projections of conditioning variables (for example, interest rates and house prices). In addition, for TBA contracts, the projected cash flows and the yield also depend on the characteristics of the assumed cheapest-to-deliver pool. The resulting yield is thus subject to errors due to model misspecification.

Second, the primary-secondary spread typically relies on the theoretical construct of a "current coupon MBS." The current coupon is a hypothetical TBA security that trades at par and has a yield meant to be representative of those on newly issued securities.[27] Historically, this par contract has usually fallen between two other actively traded TBA coupons; however, in recent times, even the lowest coupon with nontrivial issuance has generally traded significantly above par (Chart 5). As a result, the current coupon rate is obtained as an extrapolation from market prices, rather than a less error-prone interpolation between two traded points.[28] Importantly, the impact of potential prepayment model misspecification on yields is amplified when the security trades significantly above (or below) par because the yield on the security depends on the timing of the amortization of the bond premium.

A better way to think about pass-through is to look directly at what happens with the money paid by an investor in the secondary market—does it go to borrowers, originators, or the GSEs (either up front, or through equivalent flow payments)? The purpose of the OPUC measure is to track how many dollars (per $100 loan) get absorbed by originators, either to cover costs other than the g-fee, or as originator profits.[29] G-fees also contribute to the overall cost of mortgage credit intermediation—increasing these fees means that less money goes to borrowers (or equivalently, that they need to pay a higher rate). So, full pass-through of secondary-market movements to borrowers would require OPUCs and g-fees to remain constant (or, alternatively, a rise in g-fees would need to be offset by a decrease in OPUCs).

In panel A of Chart 6, we conduct a counterfactual exercise in which we compute a hypothetical survey note rate during 2012, assuming that either the OPUCs only (dark blue line), or both the OPUCs and the g-fee (light blue line), had stayed at their average levels in 2011:Q4.[30] The comparison of the light blue line with the black line, the actual realized mortgage rate, shows that had the cost of mortgage intermediation stayed constant relative to 2011:Q4, mortgage rates during 2012 would at times have been substantially lower, with a maximum gap between the two rates of 55 basis points in early October 2012.

Comparing the black line with the dark blue line (holding only OPUCs fixed but letting g-fees increase), we note that over most of 2012, much of the gap between the actual and counterfactual rate derives from the rise in OPUCs.

[27] An alternative is to calculate the yield on a particular security, which may trade at a pay-up to the cheapest-to-deliver security. However, such a calculation is still subject to other model misspecification and would not be representative of the broad array of newly issued securities.

[28] Additionally, the current coupon is typically based on front-month contract prices, while a more accurate measure would use back-month contracts, because loans that rate-lock today are typically packaged into TBAs at least two months forward.

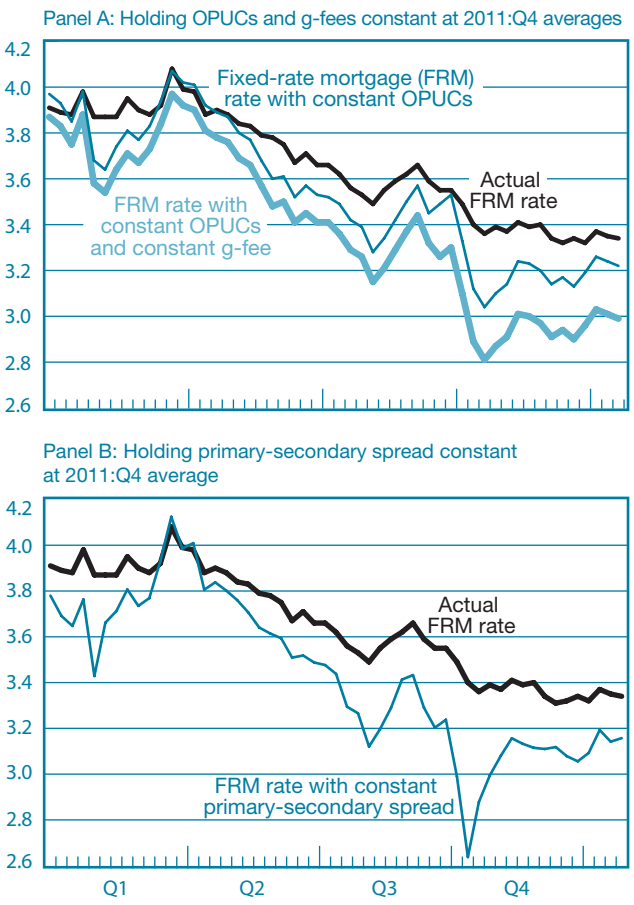
[29] It is important to keep in mind that changes in the secondary yield, even if correctly measured, do not necessarily translate one-to-one into changes in originator margins, which are determined by the TBA prices of different coupons (which in turn determine optimal execution), and also by points paid by the borrower. The primary-secondary spread, even net of g-fees, is thus at best an imprecise measure of originator margins and profitability.

[30] The effective g-fee in our calculation for 2011:Q4 is 28.8 basis points, which then increases to 38.9 basis points for the period January-March 2012 (as the announced increase effective April 1, 2012, is assumed to already be relevant for loans originated at that point), 40.3 basis points for the period April-June 2012, 41.8 basis points for July and August, and then increases by another 10 basis points, to 51.8 basis points, for the rest of 2012 as the December 1 g-fee increase becomes relevant to pricing.

Chart 6

Counterfactual Paths of Mortgage Rates over 2012

Percent



Sources: Bloomberg L.P.; Freddie Mac; authors' calculations.

Note: OPUCs are originator profits and unmeasured costs.

Additionally, it is apparent that in times when rates are stable or increasing, the counterfactual rate with constant OPUCs tends to be close to the actual rate, and most of the gap between the black and the light blue lines comes from the higher g-fees (this is the case, for instance, toward the end of the year). It is during times when rates fall (secondary-market prices increase) that actual rates do not fall as much as they would with constant OPUCs. As we discuss later, this is consistent with originators having limited capacity, which means they can keep rates relatively high and make extra profits. That said, one should not necessarily interpret the counterfactual rate series as indicating "where rates should have been," as this would require a judgment regarding the "right" level of OPUCs. Here, we took the average over 2011:Q4 as our baseline, but if instead we took a lower value, such as the average OPUCs over all of 2011, the dark blue and light blue lines would be significantly lower.

In panel B of Chart 6, we conduct a similar counterfactual rate analysis, but using the primary-secondary spread as the measure of the cost of mortgage intermediation. Holding this spread (measured as the Freddie Mac survey rate minus the Bloomberg current coupon yield) constant, we again get a hypothetical mortgage rate under full pass-through. As shown in panel B, while the overall pattern is similar to the counterfactual rate with constant OPUCs and g-fees in panel A, the series in panel B is more volatile, with the gap between the counterfactual and actual rate spiking at 75 basis points in late September 2012. This volatility of the counterfactual rate and the presence of such large spikes illustrate the imperfect nature of the primary-secondary spread as a pass-through measure.

Over most of 2012, much of the gap between the actual and counterfactual rate derives from the rise in OPUCs.

4. Potential Explanations for the Rise in Costs or Profits

The rest of the article explores in more detail factors that may have driven the observed increase in OPUCs over the period 2008-12. On the cost side, we focus on changes in pipeline hedging costs, putback risk, and possible declines in the valuation of mortgage servicing rights. We also briefly discuss changes in loan production expenses. On the profit side, we focus on potential increases in originators' pricing power due to capacity constraints, industry concentration, or switching costs for refinancers.

4.1 Costs

Loan Putbacks

Originators pay g-fees to the GSEs as an insurance premium; in exchange, the GSEs pay the principal and interest of the loan in full to investors when the borrower is delinquent.

However, mortgage originators or servicers are obligated to repurchase nonperforming or defaulted loans under certain conditions, for example, when the GSEs establish that the loan did not meet their original underwriting or eligibility requirements, that is, if the loan representations and warranties are flawed.[31] The repurchase requests have increased rapidly since the 2008 financial crisis and have been the source of disputes between originators and GSEs. The increased risk to originators that the loan may ultimately be put back to them has been cited as a source of higher costs and thus OPUCs.

How can we assess the magnitude of the contribution of putback costs to OPUCs? To do so, one needs to imagine a stress scenario—not a modal one—with a corresponding default rate, and then assume fractions of putback attempts by the GSEs, putback success, and loss-given-defaults for servicers/lenders forced to repurchase the delinquent loan.

The increased risk to originators that the loan may ultimately be put back to them has been cited as a source of higher costs and thus OPUCs.

To construct a ballpark estimate of the possible putback cost on new loans, we start from the experience of agency loans originated during the period 2005-08. Based on a random 20 percent sample of conventional first-lien fixed-rate loans originated during that period in the servicing data set of LPS Applied Analytics, we find that about 16.5 percent of GSE-securitized mortgages (value-weighted) have become sixty-or-more days delinquent at least once, and 11.5 percent of them have ended in foreclosure.[32] Importantly, these vintages include a substantial population of borrowers with relatively low FICO scores, undocumented income or assets, or a combination of these factors. For instance, the median FICO score was around 735, while the 25th percentile was at 690. In 2012, however, the corresponding values on non-HARP loans were around 770 and 735, respectively.[33]

To account for the tighter underwriting standards on new loans, we focus on the performance of GSE-securitized loans from the 2005-08 vintages with origination FICO of at least 720 and full documentation. Among those, "only" about 8.8 percent have become sixty-or-more days delinquent, and 5.5 percent have ended in foreclosure. Thus, because of today's more stringent underwriting guidelines for agency loans, our expectation in a stress scenario would be for delinquencies, and hence potential putbacks, to be roughly half as large, relative to those experienced by the 2005-08 vintages. Furthermore, we would expect the frequency of putback attempts to be roughly half as large for loans with full documentation as for the overall population of delinquent loans.

We obtain an estimate of the fraction of loans that the GSEs could attempt to force the lender to repurchase from Fannie Mae's 2012:Q3 Form 10-Q, which states (on page 72) that as of 2012:Q3, about 3 percent of loans from the 2005-08 vintages have been subject to repurchase requests (compared with only 0.25 percent of loans originated after 2008). Thus, given that repurchase requests are issued primarily conditional on a delinquency, we would anticipate repurchase requests in a stress scenario to be about one-quarter (0.5 delinquency rate × 0.5 putback rate) as high as those recorded on the 2005-08 vintage, or about 0.75 percent.[34]

Based on repurchase disclosure data collected from the GSEs,[35] it appears that about 50 percent of requests ultimately lead to buybacks of the loan. Furthermore, if we assume a 50 percent loss-given-default (which seems on the high side), this would generate an expected loss to the lender/servicer of:

$$0.75 \text{ percent} \times 0.5 \times 0.5 = 19 \text{ basis points}$$

This estimate, which we think of as being conservative (given the unlikely repetition at this point of large house price declines experienced by the 2005-08 vintages), would imply a putback cost of 19 cents per $100 loan. This cost is modest relative to the widening in OPUCs experienced over the period 2008-12.[36] That said, perhaps the "true" cost of putback risk comes from originators trying to avoid putbacks in the first place by spending significantly more resources on underwriting new loans or on defending against putback

[31] It is also possible that originators need to repurchase incorrectly underwritten loans prior to a loan becoming delinquent. However, the repurchase of nondelinquent loans is likely less costly to originators. The rest of this section therefore focuses on repurchases of delinquent loans.

[32] These statistics are as of November 2012.

[33] Origination LTVs have not changed as dramatically: in 2012, approximately 16 percent of non-HARP loans had an LTV at origination above 80; this is only slightly lower than during the period 2005-08. However, the fraction of loans with second liens was likely higher during the boom period. Also, in 2012 there are no non-HARP Freddie Mac loans with incomplete documentation (this is not disclosed in the Fannie Mae data, but is likely similar).

[34] Without the assumption that full-documentation loans are less likely to be put back, the expected putback rate would be 1.5 percent, resulting in an expected loss of 37.5 basis points.

[35] Source: *Inside Mortgage Finance*.

[36] Furthermore, the FHFA introduced a new representation and warrant framework for loans delivered to the GSEs after January 2013 that relieves lenders of repurchase exposure under certain conditions (for example, if the loan was current for three years). This policy change should further reduce the expected putback cost going forward.

claims. Furthermore, the remaining risk on older vintages is larger than on new loans, and many active lenders are also still subject to lawsuits on nonagency loans made during the boom. It is unclear, however, why these claims on vintage loans should affect the cost of new originations.

Mortgage Servicing Rights Values

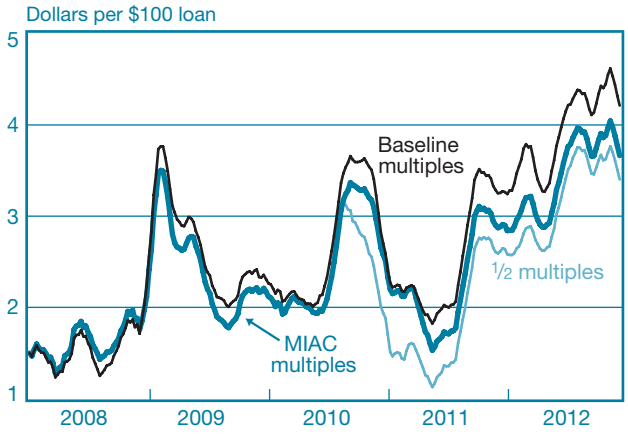
The baseline OPUC calculation assumes constant servicing multiples throughout the sample of 5*x* for base servicing and 4*x* for excess servicing flows. While these are commonly assumed levels, according to market reports, mortgage servicing right (MSR) valuations have declined over the past few years. In this section, we study the sensitivity of OPUCs to alternative multiple assumptions.

We obtain a time series of normal (or base) servicing multiples for production agency MBS coupons from the company Mortgage Industry Advisory Corporation (MIAC).[37] These multiples declined from about 5*x* in early 2008 to about 3.25*x* in November 2012.[38] To evaluate the impact on OPUCs, we repeat our earlier calculation using the MIAC base multiples.[39] The results are shown in Chart 7. Comparing the black (baseline) and dark blue (MIAC) lines, we see that the lower multiple values reduce OPUCs by about sixty cents at the end of 2012, a somewhat significant impact.

Some commentators have attributed the decline in multiples to a new regulatory treatment of MSRs under the 2010 Basel III accord. While the three U.S. federal banking regulatory agencies released notices of proposed rulemaking to implement the accord on June 12, 2012, the introduction of the new rules, originally set for January 2013, has been postponed. Under the June 2012 proposal, concentrated MSR investment will be penalized and will generally receive a higher risk weighting.[40] The long phase-in period for these rules makes it unclear how much the expected tighter regulatory treatment is already affecting MSR multiples. Nonetheless, in order to assess an upper-bound impact on OPUCs, we consider here a more stressed scenario than implied by the MIAC multiples. In this scenario, our baseline multiples are halved starting (for simplicity) with the disclosure by the Basel Committee of the capital rules in July 2010.[41] The resulting eight-week-rolling OPUC series is also depicted in Chart 7. As shown in the chart, following a halving of the MSR multiples, the implied OPUC declines are significant, but still not sufficient to explain the historically high OPUC levels in 2012.

We conclude that lower multiples, while having a sizable impact on OPUCs, can only partially offset their increase over the past few years.

Chart 7
Sensitivity of OPUCs to Alternative Assumptions about Mortgage Servicing Right Multiples



Sources: JPMorgan Chase; Freddie Mac; Fannie Mae; MIAC; authors' calculations.

Notes: The data reflect an eight-week rolling window. MIAC is the Mortgage Industry Advisory Corporation.

[37] These multiples come from MIAC's "Generic Servicing Assets" portfolio and are based on transaction values of brokered bulk MSR deals, surveys of market participants, and a pricing model.

[38] Key drivers of servicing right valuations are expected mortgage prepayments—lower interest rates mean a higher likelihood that the servicing flow will stop due to an early principal payment—and, in the case of base servicing, varying operating costs in servicing the loan, for example, when loans become delinquent. Another important component is the magnitude of the float interest income earned, for instance, on escrow accounts.

[39] We assume a 20 percent discount for excess servicing and keep the g-fee buy-down multiple unchanged at 7*x*. Also, as our MIAC series ends in November 2012, we assume that the multiple in December is identical to that in November.

[40] MSRs will be computed toward Tier 1 equity only up to 10 percent of their value, and risk-weighted at 250 percent, with the rest being deducted from Tier 1 equity. This treatment is significantly more stringent than the status quo that risk-weights the MSRs at 100 percent and limits MSRs to 50 percent of Tier 1 capital of banks (100 percent for savings and loans).

[41] In this alternative scenario, base servicing is now valued at 2.5*x*, while excess servicing is valued at 2*x*. (The GSE buy-down multiple is assumed to stay at 7*x*.) The optimal execution in this exercise again takes into account the lower levels of the multiples.

Pipeline Hedging Costs

For loans that are securitized in MBS, the "mortgage pipeline" is the channel through which an originator's loan commitment, or rate-lock, is ultimately delivered into a security or terminated with a denial or withdrawal of the application. The originators' commitment starts with a rate-lock that typically ranges between thirty and ninety days. This time window appears to have increased significantly in recent years. For example, the time from application to funding for refinancing applications increased from about thirty days in late 2008 to more than fifty days in late 2012 (as shown graphically in section 4.2 below).

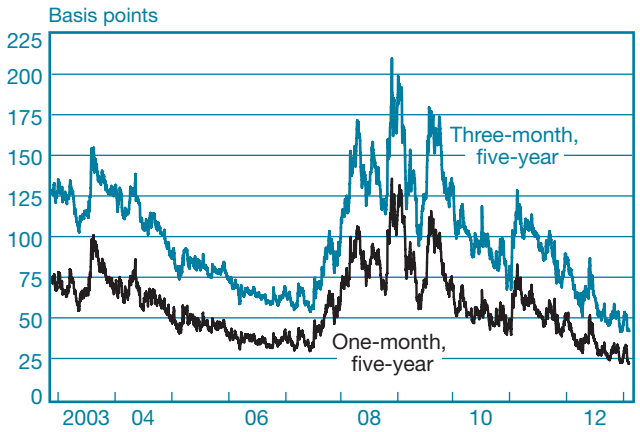
Originators face two sources of risk while the loan is in the pipeline: changes in the prospective value of the loan due to interest rate fluctuations and movements in the fraction of rate-locks that do not ultimately lead to loan originations, referred to as "fallouts."

The first risk—potential changes in the value of the loan due to interest rate movements—can be hedged by selling TBA contracts: at the time of the loan commitment, originators who are long a mortgage loan at the time of the rate-lock can offset the position by selling the yet-to-be-originated loan forward in the TBA market. The calculation in section 3 already takes into account these hedging costs: when computing the OPUC measure, we use the back-month TBA contract price that settles on average about forty-five days following the transaction. To the extent that originators may have been able to sell into the front-month TBA market when the length of the pipeline was shorter, our calculations may understate OPUCs for earlier years by the price difference, or "drop," between the two contract prices. Yet, this drop is typically only about 20 basis points in price space. We conclude that the lengthening of the pipeline does not appear to have had a significant economic impact on the cost of price hedging, and thus the rise in OPUCs experienced over the period 2008-12.

Originators face two sources of risk while the loan is in the pipeline: changes in the prospective value of the loan due to interest rate fluctuations and movements in the fraction of rate-locks that do not ultimately lead to loan originations, referred to as "fallouts."

The second risk is due to movements in the fallout rate. As discussed in section 2, borrowers' terminations may occur involuntarily (if they do not ultimately qualify for the loan or rate offer) or voluntarily. Except for changes in lending standards and house prices, fluctuations in involuntary terminations are largely driven by idiosyncratic factors that are diversified for originators with large-enough portfolios. Movements in voluntary terminations, on the other hand, are mostly due to primary rate dynamics: following the initial rate-lock, mortgage rates may fall, prompting borrowers to pursue a lower rate loan with either the same or a different lender. Common ways to hedge this risk are to dynamically delta-hedge the position using TBAs, using mortgage options or swap options, or a combination of these (or other) strategies.[42] To illustrate, we now consider a hedging example using at-the-money swaptions to gauge the magnitude and time-series pattern of the interest rate hedging cost.

Chart 8
Swaption Price Premia



Source: JPMorgan Chase.

Based on market reports and data from the Mortgage Bankers Association (MBA), normal fallout rates average about 30 percent, and we assume that an originator hedges as much using swaptions. Chart 8 shows the price premium in basis points for swaptions on a five-year swap rate with expirations of one and three months. Conditional on a 30 percent hedging strategy, the cost of protection, when using a three-month expiration, would be about 0.3 x 40 basis points = 12 basis points, or a 12 cent impact on OPUCs. The extension in the length of the pipeline, which may have led originators to go from one-month to three-month expiration, also had a rather small impact on OPUCs.

[42] Correspondent lenders, or small lenders that sell whole loans to the GSEs, can manage the fallout risk by entering into "best-effort" locks with the buyer of the loan. Under this arrangement, the originator does not need to pay a fine for not delivering a mortgage that does not close, unlike under "mandatory delivery." To compensate, the price offered by the buyer of the loan is lower. Thus, in a sense, "best-effort" commitments allow (small) originators to "outsource" the hedging of fallout risk.

More generally and beyond our specific example, implied volatility and option price premia have declined significantly since the fall of 2008, reflecting the lower rate volatility environment. While we do not explicitly consider other, more complex hedging strategies, the lower volatility environment has likely also lowered the cost of these strategies. This is in contrast with the rise in OPUCs over this period. In sum, changing hedging costs does not appear to account for a significant portion of the rise in OPUCs, and at least the cost of hedging fallout risk may in fact have declined during the period 2009-12.

Other Loan Production Expenses

A final possible cost-side explanation for the increase in OPUCs is that other loan production expenses, including costs related to the underwriting of loans and to finding borrowers (sales commissions, advertising, and so on) have increased substantially over the past few years. While it is difficult to obtain a variable loan cost series that can be easily mapped into the OPUC measure, the MBA collects in its Quarterly Mortgage Bankers Performance Report survey information on total loan production expenses that include both fixed and variable costs, such as commissions, compensation, occupancy and equipment, and other production expenses and corporate allocations. With the caveat that the sample of respondents is composed of small- and medium-sized independent mortgage companies, the data indicate a modest increase in loan production expenses over the past few years and a fairly stable pattern of these expenses. For example, total loan production expenses averaged $4,717 per loan in 2008, and $5,163 per loan in 2012:Q3.[43] This modest increase appears unlikely to explain the more than doubling in OPUCs over the period 2008-12.

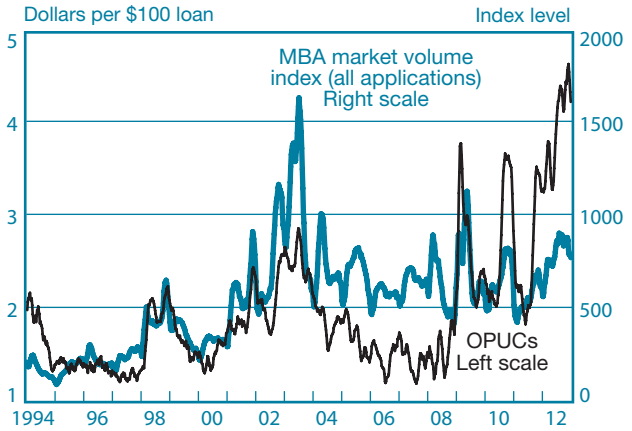
4.2 Industry Dynamics and Originators' Profits

The discussion in the previous subsection appears to indicate that the higher OPUCs on regular agency-securitized loans over the period 2008-12 were not likely driven exclusively, or even mostly, by increases in costs. As a result, the rise in OPUCs during this time could reflect an increase in profits. If so, what are the potential driving forces behind such an increase?

[43] Source: Mortgage Bankers Association, *Press Release Performance Report*, various issues. The numbers cited are gross expenses, not including any revenue such as loan origination fees or other underwriting, processing, or administrative fees.

Chart 9

Originator Profits and Unmeasured Costs (OPUCs) and MBA Application Index



Sources: JPMorgan Chase; Freddie Mac; Fannie Mae; Mortgage Bankers Association (MBA); authors' calculations.

Note: The lines reflect eight-week rolling window averages.

Capacity Constraints

An often-made argument is that capacity constraints in the mortgage origination business have been particularly tight in recent years, and that these constraints become binding when the application volume increases significantly, usually due to a refinancing wave. As a result, originators do not lower rates as much as they would without these constraints, in order to curb the excess flow of applications.

Chart 9 provides some long-horizon evidence on the potential importance of capacity constraints for profits, by plotting our OPUC measure against the MBA application index (including both purchase and refinancing applications). The chart shows that the two series correlate quite strongly: Whenever the MBA application index increases, OPUCs tend to increase, and vice-versa.[44]

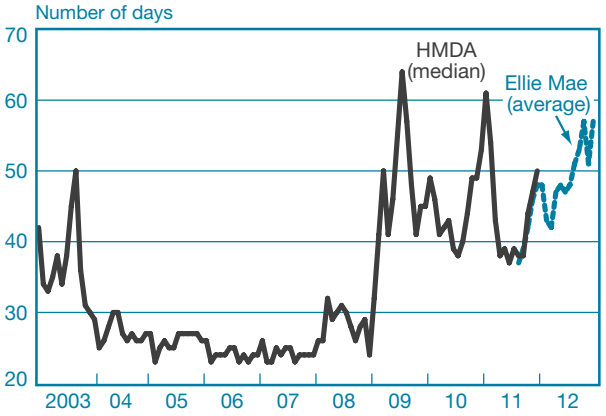
This correlation suggests that capacity constraints play an important role in generating the higher OPUCs. That said, mortgage applications (and other measures of demand and origination activity, such as MBS issuance) were at higher levels in the past, without OPUCs being as high as they were in 2012.

Chart 10 shows some more direct evidence on the potential importance of capacity constraints, by depicting the number of days it takes from the initiation of a refinancing application to the funding of the loan. The chart is based on data from the

[44] Over the period 2004-08, the relationship between the two series appears weaker than elsewhere—OPUCs appear to be on a downward trend over much of that time, even when applications increase.

Chart 10

Time from Refinancing Application to Funding (by Month in Which a Loan Is Funded)



Sources: HMDA (January 2003 to December 2011); Ellie Mae (August 2011 to December 2012).

Notes: HMDA is the Home Mortgage Disclosure Act. HMDA data are restricted to first-lien mortgages for owner-occupants of one-to-four-unit houses or condos.

Home Mortgage Disclosure Act (HMDA), which was available only through 2011 at the time of this writing, and from the Ellie Mae *Origination Insight Report*, which is only available since August 2011.[45] It shows that the median (HMDA) or average (Ellie Mae) number of days it takes for an application to be processed and funded has been substantially higher since 2009 than it was in prior years.[46] The processing time moves in response to the MBA application volume shown earlier; for instance, it reached its maximum after the refinancing wave of early 2009 and increased from less than forty days in mid-2011 to more than fifty-five days by October 2012, as refinancing accelerated over this period. However, to the extent that the HMDA and Ellie Mae data are comparable, it does not appear that it took substantially longer to originate a refinancing loan in 2012 than it did in early 2009, making it difficult to explain the full rise in OPUCs through capacity constraints.[47]

A final interesting question is how rigid capacity constraints may be. Current originators can add staff, but it takes time to train new hires. New originators can enter the market, but entry requires federal and/or state licensing and approval from Fannie Mae, Freddie Mac, and Ginnie Mae to fully participate in the origination process. To the extent that training may take longer than in the past, or that approval delays for new entrants are longer (as anecdotally reported), the speed of capacity expansion may have declined compared with earlier episodes.[48] Another potentially important factor is that the share of third-party originations (by brokers or correspondent lenders) has decreased significantly in recent years (as discussed in footnote 5). Third-party originators may, in the past, have acted as a rapid way to adjust capacity, especially during refinancing waves. In sum, while capacity constraints likely contributed to the rise in OPUCs in recent years, it is unlikely that they were the only source of this rise.

Market Concentration

A second popular explanation for the higher profits in the mortgage origination business is that the market is highly concentrated. It is well known that the mortgage market in the United States is dominated by a relatively small number of large banks that originate the majority of loans. However, as shown in Chart 11, a simple measure of market concentration given by the share of loans made by the largest five or ten originators actually decreased over the period 2011-12, as a number of the large players reduced their market share. Thus, overall market concentration alone seems unlikely to explain high profits in the mortgage business. This would make sense from a theoretical point of view: There is no particular reason why a concentrated market (but with a large number of fringe players, and price competition) should incur large profits.

Overall market concentration alone seems unlikely to explain high profits in the mortgage business.

Recent work by Scharfstein and Sunderam (2013) comes to a different conclusion. The authors argue that looking at national market concentration may mask differential trends in local market concentration, which matters if borrowers shop locally for their mortgages. Using data from 1994 to 2011, the authors find that higher concentration at the county level is

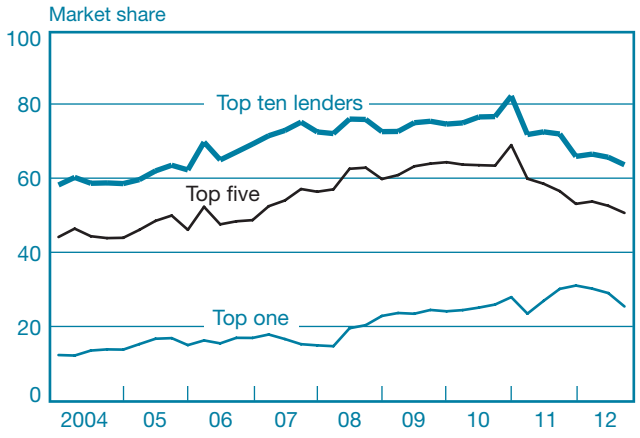
[45] See www.elliemae.com/origination-insight-reports/EMOriginationInsightReportDecember2012.pdf.

[46] The average for HMDA would be higher than the median, but would show similar patterns.

[47] It is interesting to note that the time from refinancing application to funding was significantly lower in 2003, even though application volume was much higher than it was over 2008-12. This is likely driven by tighter underwriting in the recent period compared with during the 2003 refinancing boom.

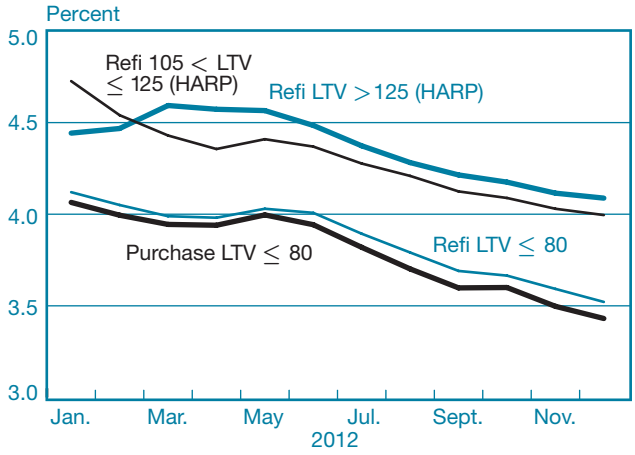
[48] Additionally, existing capacity may have been diverted to defending against putbacks instead of new loan origination.

Chart 11
Origination Market Concentration



Source: *Inside Mortgage Finance*.

Chart 12
Weighted Average Coupons of Different Loan Types



Sources: Fannie Mae; Freddie Mac; eMBS.

Note: The data include thirty-year fixed-rate mortgages with loan amounts less than or equal to $417,000, made to borrowers with a FICO score of at least 720, on owner-occupied one-unit properites.

correlated with a lower sensitivity of refinancing and mortgage rates to MBS yields. It would be interesting to extend their analysis to 2012 to see whether their findings can help explain the increase in OPUCs in that year.

We next turn to an alternative explanation for why originators could make larger profits than in the past, namely that they may enjoy more pricing power on some of their borrowers for reasons unrelated to concentration.

HARP Refinance Loans

A market segment where such pricing power may have been particularly important is the high-LTV segment, which over the past years has been dominated by refinancings through HARP, originally introduced in March 2009. The introduction of revised HARP rules in late 2011, often referred to as "HARP 2.0," led to a significant increase in HARP activity during 2012; the FHFA estimates that in the second and third quarters of 2012, HARP refinancings accounted for about 26 percent of total refinance volume.[49] HARP 2.0 provides significant incentives for same-servicer refinancing (namely, relief from representations and warranties) that are not present to the same extent for different-servicer refinancings. Furthermore, even under identical representation and warranty conditions, a new servicer may be less willing to add high-LTV borrowers to its servicing book, because such borrowers have a higher likelihood of delinquency, which makes servicing high-LTV loans more expensive. For these two reasons, many servicers do not offer HARP refinancing for loans that they are not currently servicing, or only at much worse terms. The result is that the current servicer has significant pricing power over its own high-LTV borrowers looking to refinance.

Is there evidence that lenders can exploit this higher pricing power? The observed note rates for HARP-refinanced loans are at least consistent with this idea. As shown in Chart 12, during 2012 the weighted average coupons (WACs; that is, the loan note rates) on HARP loans with LTVs above 105 tended to be 40-50 basis points higher than those of regular refinancing or purchase loans.[50] Banks earn higher revenues on these HARP loans than on regular loans for two reasons: given the higher note rate, they will typically sell these loans into a pool with a 50-basis-point higher coupon, which usually commands a price premium of around 1.5-2.0 points. Furthermore, thanks to the prepayment protection offered by these pools (as a borrower can only refinance through HARP once), investors are willing to pay a higher price (in the spec-pool market) than for TBA pools; this can add another 1-3 points (depending on the coupon) to the originator's revenue.

[49] See http://www.fhfa.gov/webfiles/24967/Nov2012RefiReport.pdf.

[50] We can also compare WACs on refinancings with LTV between 80 and 95 that are likely to be HARP loans (based on mortgage insurance information) with other loans in the same LTV range that are likely non-HARP loans. On average, the WAC on HARP loans was about 15-20 basis points higher in that range.

Are these higher revenues compensation for higher origination costs for HARP loans? This seems unlikely, as the documentation requirements for HARP loans are in fact significantly lighter than for regular loans. Thus, it is likely that origination costs are *lower*, not higher, for HARP loans relative to regular refinancings.[51]

Another possibility is that high-LTV borrowers are more cash constrained than regular refinancers and thus require higher rebates (negative points) at origination to help cover their closing costs. While this is a possibility, it is unlikely that the difference can offset a significant portion of the additional revenues, especially since closing costs are likely lower than they are for regular loans (thanks, for example, to appraisal waivers).[52]

Finally, for reasons discussed above, the value of base servicing on HARP loans may be significantly lower than that for non-HARP loans with lower LTVs. Even if we assume that the multiple on base servicing drops from 5*x* to 0*x*, however, this would only account for 1.25 points, while, as noted above, revenues are 2.5-5.0 points higher. Furthermore, because HARP borrowers are expected to prepay slowly, the cash flow stream from servicing is in fact more valuable than for regular loans, offsetting part of the higher servicing cost. Also, the expected servicing cost for current servicers declines when loans are refinanced under HARP, as borrowers are less likely to default after the note rate declines (see Tracy and Wright [2012] and Zhu [2012]).

Thus, the evidence strongly suggests that originators have been making larger profits on HARP loans than on regular loans, by being able to exploit their pricing power.

Non-HARP Mortgages

The next question is whether similar pricing power could have contributed to the rise in our OPUCs on regular (non-HARP) loans that seems not fully explained by capacity constraints, as discussed above. While lenders may have pricing power over their HARP borrowers, it is much less clear whether such pricing power may also exist for "regular" loans. Pricing power could arise, for instance, from customers' impediments (actual or perceived) to shop around, an unwillingness of other firms to compete, barriers to entry for new competitors, or a combination of these. Directly measuring originators' pricing power is not a trivial task, and we do not attempt a full analysis here. However, looking at some cross-sectional patterns may suggest some insights.

Chart 12 shows that over 2012, the WAC on non-HARP refinancing loans tended to be slightly larger than it was on purchase loans. This is somewhat surprising if one thinks that the costs of originating a refinance loan are likely lower than those of a purchase loan. In addition, comparing WACs over a longer time period (not shown), it is the case that the positive gap in WACs between purchase and refinancing loans only started emerging in 2010 (and has remained there since); over the period 2005-09, average monthly WACs on refinancing loans were mostly either equal to or below those on purchase loans.[53] However, the WAC divergence could potentially be explained by purchase borrowers paying more points than refinancers; this could be, for instance, because they expect to stay in the mortgage longer or because of tax incentives.[54]

The evidence strongly suggests that originators have been making larger profits on HARP loans than on regular loans, by being able to exploit their pricing power.

One would expect this explanation, if true, to hold across all lenders. However, looking at lender-specific differences in WACs reveals a large variation across lenders. The two panels of Chart 13 show the monthly average WAC for the sixteen largest lenders over 2012 (in terms of number of loans sold to the GSEs), for purchase and refinancing loans separately. We also plot separately the average for all other (smaller) sellers (the thicker lines). We include only thirty-year fixed-rate loans with FICO scores of 720 and higher, and LTVs of 80 or lower, made to single-unit owner-occupiers in order to reduce potential disparities due to differential LLPAs.[55]

[51] Also, the loans with FICO scores of 720 or above that we include in the chart are not subject to loan-level price adjustments under HARP.

[52] Related to this point, it is not the case that HARP note rates are higher because principal amounts are lower than for regular refinancings (as the same fixed closing cost being rolled into the rate will require a larger rate increase for lower principal amounts); controlling for loan amount in a regression basically leaves the estimated differences across loan categories unchanged.

[53] This statement is based on loan-level data from Freddie Mac only, as the Fannie Mae data only became available in 2012.

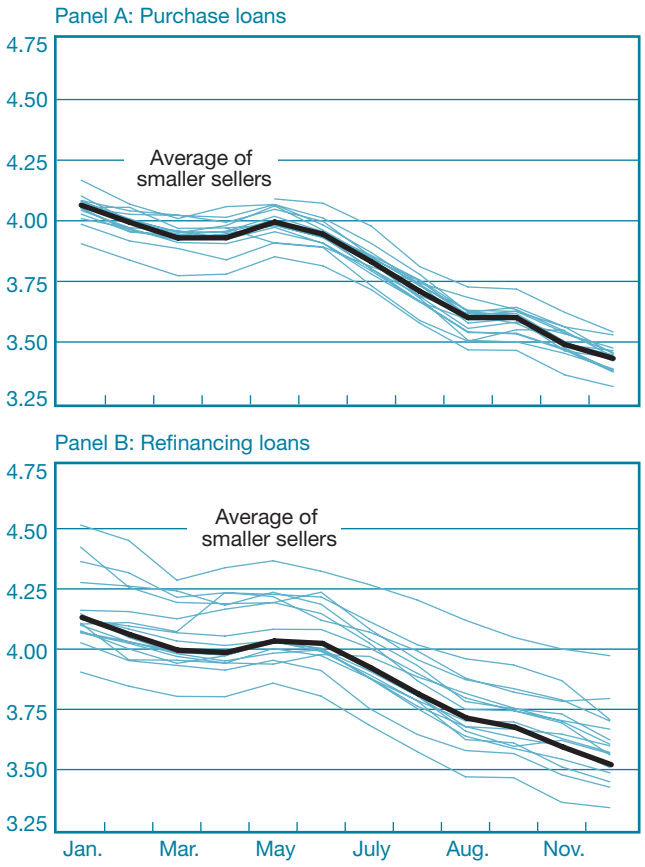
[54] Points paid in cash are fully tax deductible for purchase mortgages in the year the loan is closed. For refinancing mortgages, the deduction is instead spread evenly over the term of the mortgage (for example, thirty years), except if the loan is paid off early, in which case all unused deductions can be taken in the year the loan is paid off. See, for example, www.irs.gov/publications/p936/ar02.html#en_US_2011_publink1000229936.

[55] These calculations are based on the complete set of loan-level disclosures for pools issued in 2012 by Fannie Mae and Freddie Mac.

Chart 13

Dispersion in Weighted Average Coupons across Sellers to Fannie Mae and Freddie Mac, 2012

Percent



Sources: Fannie Mae; Freddie Mac; eMBS.

Note: The data include loans with a FICO score of 720 or higher, an LTV of 80 or lower, an amount less than or equal to $417,000, on owner-occupied single-unit properties, and only for months in which a seller made at least 100 sales.

Panel A of the chart shows that purchase WACs across sellers were quite homogeneous—with the exception of a couple of outliers, most lender WACs lie within a range of approximately 10 basis points. This is consistent with the idea that the purchase mortgage market is quite competitive, as presumably many borrowers shop around (perhaps with the help of their realtor).

Panel B reveals a much larger dispersion for refinancing loans. In particular, while a number of sellers remain concentrated around the thicker line representing the average of smaller players, eight of these large lenders sold loans with WACs that are 15 basis points or more above the thick line in at least one month, and, for six of them, that is the case for at least six out of twelve months.[56] In principle, this observed price dispersion is certainly not inconsistent with the market being competitive; however, under this null hypothesis, it is surprising that the dispersion is so much larger for refinancing loans than for purchases.

As discussed above, during 2012 the HARP program gained significant momentum for high-LTV refinances. A perhaps lesser-known fact is that there exist GSE streamline refinancing programs also for non-HARP loans (with LTV less than 80), with the same cutoff date for eligible mortgages (which must have been delivered to one of the GSEs prior to May 31, 2009). Streamlined refinancing, when done through the institution that currently services the loan, relieves the lender from representation and warranties relating to the borrower's creditworthiness and home value, while a different-servicer refinancing requires more extensive underwriting of the new loan. As a consequence, for borrowers eligible for a streamlined refinancing, there is an advantage to staying with the same servicer/lender, as doing so will reduce the documentation the borrower is required to submit. This, in turn, again creates some pricing power for the current servicer (although likely less so than for high-LTV loans). The population of loans in fixed-rate GSE pools originated prior to June 2009 is large: As of December 2012, about $1.1 trillion of loans were in such pools, relative to an overall Fannie Mae/Freddie Mac fixed-rate universe of about $3.8 trillion. During 2012, about 52 percent of all prepayments came from pools issued prior to June 2009.[57] Therefore, if lenders have pricing power over the refinancings of these loans, this could be a nontrivial contributor to OPUCs.

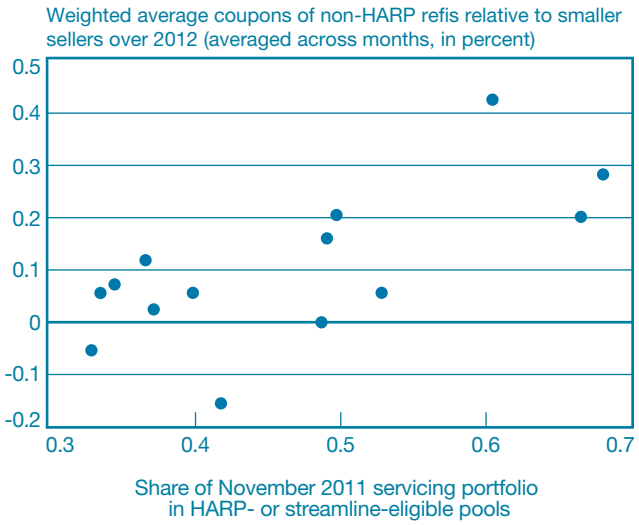
Is there evidence that such pricing power could explain the dispersion in refinancing WACs? Unfortunately, unlike for HARP loans, there is no way for us to observe in the data whether a refinancing was streamlined or not. However, we can look at variation across lenders in the fraction of their servicing portfolio that could potentially be refinanced in a streamlined manner (that is, loans in pools issued prior to June 2009) and correlate this figure with the average WAC of the lenders' non-HARP refinance loans over 2012. Chart 14 shows that there is indeed a positive correlation between the two: The lenders that had a large fraction of potentially streamline-eligible loans in their servicing

[56] With the exception of one of these six lenders, the monthly number of sales of refinancing loans always exceeds 500 loans, meaning that these averages are unlikely to be driven by small-sample noise. Additionally, as above, the result of large WAC dispersion across lenders for refinance loans remains basically unchanged if loan characteristics such as loan amount are added as explanatory variables in a regression framework.

[57] These prepayments include refinancings as well as the loan simply getting paid off (for instance, due to the borrower moving).

Chart 14

Weighted Average Coupons on Regular (Low LTV) Refinance Loans Against Fraction of Servicers' Portfolio Eligible for Streamline Refinancing



Sources: Fannie Mae; Freddie Mac; eMBS.

Notes: HARP- or streamline-eligible pools are pools issued prior to June 2009. The data include only sellers/services with servicing portfolios with more than $1 billion of HARP- or streamline-eligible pools in November 2011. Non-HARP weighted-average coupons are calculated on loans with a FICO score of 720 or higher, an LTV of 80 or lower, an amount less than or equal to $417,000, on owner-occupied single-unit properties.

portfolio at the end of 2011 tend to be those that originated refinance loans with the highest WACs on average over 2012 (that is, those that are above the thick line in panel B of Chart 13). This result is consistent with (though certainly not proof of) originators taking advantage of their pricing power over streamline-eligible borrowers.

5. Conclusions

The widening gap between primary and secondary mortgage rates over the period 2008 to 2012 was due to a rise in originators' profits and unmeasured costs, or OPUCs, as well as increases in g-fees. The magnitude of the OPUCs is influenced by MBS prices, the valuation of servicing rights, points paid by borrowers, and costs such as those from loan putbacks and pipeline hedging.

The rise in OPUCs was mainly driven by higher MBS prices, which were not offset by corresponding increases in measurable costs. Conversely, a decline in the value of mortgage servicing rights may have reduced OPUCs to some extent, and thus contributed to the widening primary-secondary spread. Among harder-to-measure costs, we find that expected putback costs and pipeline hedging likely did not cause a significant portion of the rise in OPUCs. Absent increases in other costs that we cannot measure well, such as operating costs, the rise in OPUCs reflected an increase in originator profits. While market concentration alone does not seem to explain the rise in these profits, capacity constraints do appear to have played a significant role. We also provide evidence suggesting that originators have enjoyed pricing power on some of their borrowers looking to refinance, due to borrowers' switching costs.

Going forward, it will be interesting to study the extent to which interest rate dynamics, capacity expansions, new entry, changes in regulations, and (in the longer term) housing finance reform will affect the pass-through from secondary to primary markets. As illustrated in this article, a number of factors determine this pass-through, and it will therefore be important for policymakers and market participants alike to further improve the measurement and understanding of these factors.

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Rajashri Chakrabarti and Sarah Sutherland

Precarious Slopes? The Great Recession, Federal Stimulus, and New Jersey Schools

- Despite the significance of the Great Recession's impact on the economy, virtually no research exists on how schools were affected.
- This article fills the gap by investigating the effect of the downturn and the federal stimulus on New Jersey school finance patterns.
- The authors provide strong evidence of downward shifts in total school funding and expenditures, relative to trend, following the recession.
- The $2 billion-plus in stimulus earmarked for New Jersey limited damage to budgets; it also helped preserve funding levels in instructional expenditure, the category most closely related to student learning.
- The study offers insight into how school districts fare during downturns and serves as a useful guide for future policy decisions.

"The Legislature shall provide for the maintenance and support of a thorough and efficient system of free public schools for the instruction of all the children in the State between the ages of five and eighteen years."

New Jersey State Constitution, Article V, Section 4

"[T]he New Jersey State Constitution requires the Governor to take care that the laws of this State be faithfully executed…including ensuring compliance with the constitutional mandate that a balanced State budget be maintained."

State of New Jersey Executive Order No. 14, February 11, 2010

1. Introduction

The relevance of the investment in the education of children to human capital formation and economic growth is well established in economic research.[1] Surprisingly, then, one important component of this topic has been overlooked in the literature: the impact of recessions on education.

The Great Recession was marked by a downturn in housing prices, employment, and business activity, each of which

[1] See Barro (1991), Benhabib and Spiegel (1994), Becker (1994), and Hanushek and Woessmann (2007).

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contributed to reduced tax revenues and larger budget gaps.[2] These shortfalls had a deleterious effect on state and local governments' ability to fully fund schools. While a sparse literature investigates the impact of the severe downturn on other sectors of the economy, there is virtually no research on the effects of the Great Recession, or past recessions, on schools. Our paper starts to fill that void by examining how school finances in New Jersey were affected by the onset of the recession and the federal stimulus funding that followed. Using rich panel data capturing a multitude of school finance variables, we apply a trend-shift analysis to study how the Great Recession and federal stimulus affected the level and composition of funding and expenditures in New Jersey school districts. Our findings offer insight into schools' financial situations during recessions and can assist in future policy decisions.

Demonstrating concern for safeguarding schools during a recession marked by pervasive budget cuts, the federal government designated the largest portion of its planned economic stimulus package for public education. In February 2009, Congress passed the American Recovery and Reinvestment Act (ARRA), an economic stimulus package which provided $840 billion in new spending, with $100 billion designated for public education. Of this $100 billion, New Jersey was allocated $2.23 billion.[3]

In addition to studying the overall impact of the recession on schools, we examine whether the effects varied by a district's poverty level, metropolitan area, and urban status. The analysis yields some interesting results. There is strong evidence of a downward shift—relative to trend—in both revenue and expenditure following the recession in New Jersey. Federal stimulus seemed to have helped in 2010; while revenue and expenditure still fell (relative to trend), the declines were somewhat smaller than in 2009. (We refer to school years by the year corresponding to the spring semester.)

While total funding to schools declined, the various components of aid did not experience symmetric changes. State aid per pupil fell in both years after the recession (relative to trend), as did local funding per pupil. However, the percentage decline in state aid per pupil far exceeded the corresponding decline in local funding per pupil, especially in the second year after the recession. In contrast, there was an upward shift in federal aid per pupil in 2010 following the introduction of the ARRA funds. These changes marked an important shift in the relative reliance of schools on federal, state, and local funding.

[2] See Gerst and Wilson (2010) and Deitz, Haughwout, and Steindel (2010) for an analysis of budget gaps nationally and in New Jersey.

[3] The $2.23 billion figure comes from information provided by the New Jersey Department of Treasury's Office of Management and Budget and represents the total ARRA appropriation for the state.

We also delve deeper into how the different components of expenditures are affected. While instructional expenditure per pupil declined in 2009 relative to trend, there is no evidence of any decrease in 2010. Thus, the federal stimulus funding may have been successful in preventing declines in instructional expenditure, a category including teacher salaries and classroom expenses that most directly affect student learning.

The patterns for instructional support per pupil and student services per pupil are similar to those for instructional expenditure. But other noninstructional categories such as transportation and utilities and maintenance ("utilities") show declines relative to trend in 2009 and 2010. Median teacher salaries show a positive shift in both years, while median teacher experience also increased. These patterns are consistent with an increase in layoffs of less experienced teachers, which would shift the teacher salary distribution to a higher range.

Despite these statewide patterns, there is considerable heterogeneity by poverty level, metropolitan area, and urban status. Specifically, "high-poverty" districts sustained larger falls relative to trend in nearly all expenditure categories compared with their "medium-poverty" and "affluent" counterparts. The metropolitan area of Edison fared best in terms of preserving instructional expenditure and most noninstructional expenditures. Finally, rural districts fare best across most categories, while urban districts experience the largest resource declines.

This paper builds on the existing literature relating to school funding in general (Baker 2009, Bedard and Brown 2000, Betts 1995, Feldstein 1978, Gordon 2004, Rubenstein et al. 2007, and Stiefel and Schwartz 2011), and the literature on New Jersey school finance (Firestone et al. 1994 and Firestone, Goertz, and Natriello 1997). While these authors study school funding patterns broadly, our paper is one of the first to examine whether a recession affects school finance patterns, and what difference federal stimulus funding can have on the trends.

It is worth noting that we view our findings as strongly suggestive, but not necessarily causal. We employ a trend-shift analysis, so theoretically if there were common shocks in the two years following the recession that could affect our financial variables, they would bias our estimates. We conduct a comprehensive analysis of potential confounding factors during this period that might bias our results (see section 4). This analysis helps us interpret the results, frame our perspective, and put bounds on the recession-impact estimates.

Finally, the Great Recession was not a marginal shock; rather, it was a highly discontinuous shock. Therefore, even if there were other small shocks during these two years, they would be dwarfed by a downturn as large as the Great Recession, adding further confidence to our results.

Studying school funding during this period is of paramount importance because schools have a fundamental role

in educating children and fostering human capital formation and growth. Any adverse effect on schools and student learning can have potentially deleterious effects on human capital formation and by extension the nation's future. Our paper provides insight into how school districts fared during the financial downturn and promises to both improve our understanding of schools' financial situations under duress as well as aid future policy decisions.

2. Background

2.1 Overview of the Period's Economic Climate and Education Policies

State and local governments in the United States experienced significant fiscal stress as a result of the Great Recession. The downturns in housing prices, employment, income, and business activity each contributed to lower tax revenues and larger budget gaps.

Local governments have, in the past, relied heavily on property taxes, which in the first half of the decade were supported by a booming housing market. Housing prices in the United States had been increasing at an annual average rate of 7.8 percent between 2000 and 2006, but as delinquencies and foreclosures began to rise, home prices declined at an annual average rate of 3.9 percent during the recession quarters.[4] Demonstrating an even greater swing than the rest of the country, housing prices in New Jersey were increasing at a brisk average of 11.6 percent per year between 2000 and 2006, and fell by an average 4.9 percent per year in the recession quarters. Housing price declines are one of the many contributors to the decline in state and local revenues during the Great Recession.

State governments also took in less revenue as unemployment spikes reduced income taxes collected and lower consumption generated fewer sales taxes. New Jersey also relied heavily on the financial industry to provide an increasing portion of its revenues, but with the recession hitting the finance sector hard, the state's budget gap grew.[5]

To remedy these depletions, Congress passed ARRA in February 2009, an economic stimulus package that provided $840 billion in new spending, with $100 billion designated for public education. Districts were directed to use the ARRA funds to save and create jobs and to boost student achievement. The requirements specified that 81.8 percent of the stabilization funds go toward the support of public education, and that states must restore public education funding in fiscal years 2009, 2010, and 2011 to the greater of the fiscal year 2008 or fiscal year 2009 level.

Of the $100 billion earmarked for public education nationally, New Jersey received $2.23 billion. The largest portion of New Jersey's appropriation was used to implement the state's school funding formula, and these funds were spent by the end of the 2010 school year.

2.2 Overview of New Jersey's Education History and Programs

In January 2008, the School Funding Reform Act (SFRA) was approved by the New Jersey legislature. This Act was the state's first official change to its school funding formula since 1996 and was the product of five years of development by the state's Department of Education. The formula called for a 7 percent increase in state funding for K-12 education in the 2009 school year. The recession officially began in December 2007, and since governments finalize their budgets in the spring prior to the budgeted year, the education budgets for the 2009 school year were the first to be affected. Despite the start of the recession, the amount required by the new SFRA formula was fully met in the 2009 school year, and 2010 budgets were also prepared using the formula.

Midway through 2010, however, the toll of the recession forced some changes. Revenue streams were projected to be $2.2 billion lower than what was necessary to cover the state's budget deficit. Given New Jersey's constitutional mandate to maintain a balanced budget, education funding was reduced midyear.[6] The funding caps for district aid were lowered, and many districts received less state aid than budgeted and less aid than required under the SFRA formula.

[4] For all figures related to home prices, we use the annualized four-quarter price change in the Federal Housing Finance Agency (FHFA) House Price Index averaged over the specified time period. Recession quarters are based on the National Bureau of Economic Research's definition.

[5] Deitz, Haughwout, and Steindel (2010).

[6] In February 2010, a fiscal emergency was declared in New Jersey due to the projected $2.2 billion budget deficit for fiscal year 2010 and a range of cuts were made to ensure compliance with the state's balanced-budget mandate.

3. Data

We developed a rich set of panel data combining annual data at the school district level from multiple sources. The data set covers 572 New Jersey districts for the school years 1999 through 2010.[7] Most of the data were obtained from the New Jersey Department of Education's Office of School Finance. We supplemented this data set with school finance data from the National Center for Education Statistics (NCES) School Finance Survey (F-33) as well as data from the U.S. Census Bureau. Nonfinance data were obtained from the New Jersey Department of Education's Office of Data, Research, Evaluation, and Reporting, NCES's Common Core of Data (CCD), and the U.S. Bureau of Labor Statistics.

The information includes data on total funding, total expenditure, and debt outstanding, as well as data on individual components of total funding and expenditure. On the expenditure side, for example, the figures include spending on instruction, instructional support, student services, transportation, student activities, and utilities. (See Box 1 for definitions of these variables.) We also obtained data on federal aid, state aid, local funding, property tax revenue, and data on median salaries and median years of experience for teachers and administrators.[8]

Nonfinance data include district-level data on various socioeconomic and demographic variables, including enrollment, racial composition, and percentage of students eligible for free or reduced-price lunches. All funding and expenditure variables are analyzed on a per-pupil basis using each school year's average daily enrollment.

Heterogeneity breakdowns are performed by metropolitan division (MD), poverty level, and "urbanicity." MDs are groupings of counties or equivalent entities defined by the U.S. Census Bureau. They are smaller than metropolitan statistical areas but contain a population of at least 2.5 million.[9] Heterogeneity breakdowns for metropolitan areas include the four largest New Jersey MDs: New York-White Plains-Wayne, Edison-New Brunswick, Newark-Union, and Camden (see Map 1).[10]

Box 1
Definitions of Expenditure Components

Instructional

Instructional Expenditures

All expenditures associated with direct classroom instruction: teacher salaries and benefits; classroom supplies.

Noninstructional

Instructional Support

All support service expenditures designed to assess and improve students' well-being: food services, educational television, library, and computer costs.

Student Services

Psychological and health services; school store.

Utilities and Maintenance

Heating, lighting, water, and sewage; operation and maintenance.

Transportation

Total expenditure on student transportation services.

Student Activities

Co-curricular activities: physical education, publications, clubs, and band.

We categorize by poverty level and urbanicity based on the 2008 levels in an effort to capture pre-recession measures. Poverty level is defined by the percentage of students eligible for free or reduced-price lunches. For example, the districts falling above the seventy-fifth percentile in terms of the percentage of students eligible for free or reduced-price lunches are identified as high poverty, those in the bottom twenty-fifth percentile as affluent, and districts falling between these percentiles as medium poverty. Urbanicity designations of rural, urban, or suburban are defined using the NCES CCD classifications. [11]

To account for inflation, all expenditure and aid data were adjusted to 2010 dollars using annual values of the consumer price index for all urban consumers.[12]

[7] See Gerst and Wilson (2010) and Deitz, Haughwout, and Steindel (2010) for an analysis of budget gaps nationally and in New Jersey.

[8] The $2.23 billion figure comes from information provided by the New Jersey Department of Treasury's Office of Management and Budget and represents the total ARRA appropriation for the state.

[9] We use ArcGIS mapping technology and U.S. Census Bureau data to define a district's metropolitan division.

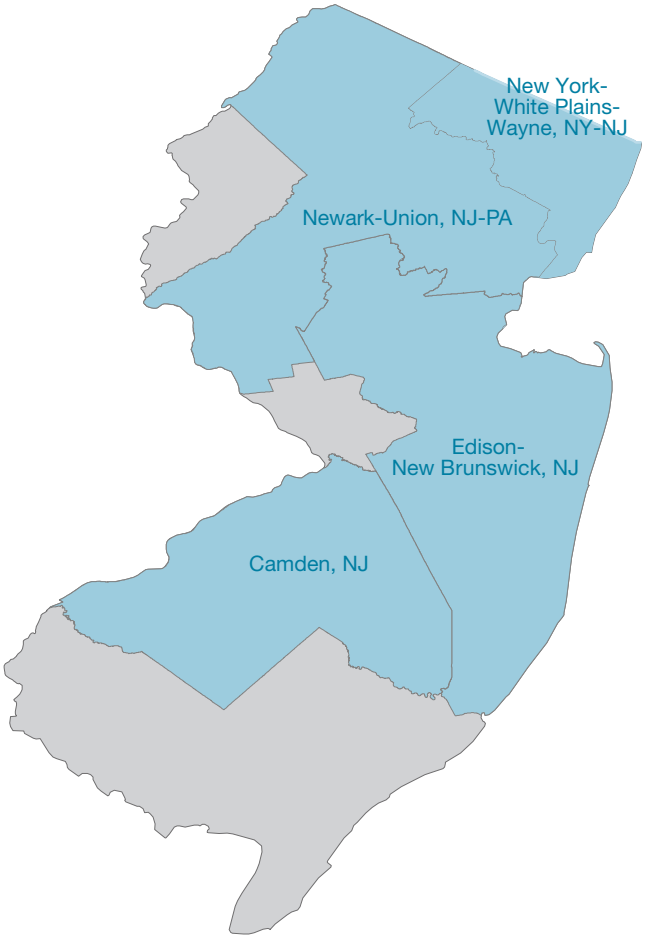
[10] The New York-White Plains-Wayne metropolitan statistical area includes counties in both New York and New Jersey districts. Since it comprises a very populated part of the state of New Jersey, we include it here.

[11] As a point of reference, in the 2007-08 school year, districts at the high poverty level had 27.7 percent of their students receiving free or reduced-price lunches, while the affluent districts had 5.1 percent receiving the same.

[12] Districts in urbanized areas or urban clusters less than thirty-five miles from urbanized areas are categorized as urban. Territories outside principal cities and in urbanized areas represent the suburban districts. NCES uses the U.S. Census Bureau definition of rural territory based on the level of land developed.

Map 1

Four Largest New Jersey Metropolitan Divisions



Source: Authors' representations using U.S. Census Bureau shapefiles.

Note: Our analysis focuses on the four largest New Jersey Metropolitan Divisions identified on this map.

4. Interpretation of Post-Recession Effects

The goal of this paper is to investigate whether the Great Recession and the federal stimulus funding period that followed are associated with shifts in New Jersey education financing. We conduct a trend-shift analysis and use the specification described in Box 2 to analyze these effects. The intuition behind using this methodology is that school finances would be expected to continue to grow at the pre-recession trend had there been no recession. Thus, post-recession effects (α_2 and $[\alpha_2 + \alpha_3]$ in Box 2) are captured by shifts from this trend both in 2009 and 2010.

To quantify the change in each finance variable, we also compute percentage shifts that are obtained by expressing the shifts (α_2 and $[\alpha_2 + \alpha_3]$) from our specification as percentages of the pre-recession (2008) base of the corresponding financial variable (Y_{it}). This pre-recession base is simply the average of each in the 2008 school year. Recall that local, state, and federal governments finalize their budgets in the spring prior to the budgeted year. More specifically, the budgets for the 2008 school year were finalized in the spring of 2007, before the recession officially began in December 2007, and before decision makers were aware of the impending downturn. Therefore, 2008 is taken as the last pre-recession year in this paper.

These percentage effects allow for an easier interpretation and are more informative than the coefficients (α_2 and α_3) alone, since they suggest the size of the effects and facilitate comparison between the shifts in the various financial variables. In our discussion, we focus on two percentage shifts: the 2009 percentage shift immediately following the recession (calculated as $\frac{\alpha_2}{\textit{pre-recession base}}$) for each finance variable (Y_{it}) and the percentage shift in 2010 (calculated as $\frac{\alpha_2}{\textit{pre-recession base}}$) for each finance variable (Y_{it}). The first percentage shift captures the effect of the recession in 2009 and the second captures the combined effect of the recession and the federal stimulus in 2010.

Note that if there were common shocks in the two years following the recession affecting our financial variables, our estimates of the recession and stimulus effects outlined above would be biased. Understanding these potentially confounding factors is essential for interpreting the results. Therefore, we conduct a thorough analysis of them during the period.

First, while interpreting the shift at the onset of the recession, we consider the implementation of the new school funding formula under the SFRA. The formula called for a 7 percent increase in total state funding for K-12 education in the 2009 school year. Since state aid constitutes nearly half of the general-formula aid to districts, the new funding formula should be considered a positive shock not only to state aid, but also to total funding, total expenditure, and the components of total expenditure. Since the shock is in the opposite direction of the recession shock, any negative shift in the school-finance variables in 2009 would be above and beyond the expected positive effect of the new funding formula. Therefore, it is safe to say that negative shifts (if any) in the variables in 2009 are underestimates of the recession effects, though in the correct direction. In contrast, positive shifts could mean that the effect of the SFRA increase surpassed the effect of the recession or that the recession did not have much of a negative effect.

Second, while interpreting the 2010 stimulus shift, we consider the impact of the midyear cuts to the SFRA formu-

la.[13] With the negative effect on state aid funding, we would expect a dampening effect on the positive shock from the ARRA federal stimulus. Note, however, that these cuts only came at midyear and did not affect schools' planned budgets or their expenditures in the first half of the school year. Any positive additional effects in 2010 (over 2009 effects) could therefore be regarded as underestimates of the stimulus effect. Additional negative effects in 2010, however, could mean that the recession effects (including the midyear cuts) dominated. As noted in our overview of New Jersey's education programs in section 2.2, these midyear cuts in 2010 were driven by budget shortfalls brought about by the recession. In that sense, the 2010 shift would still capture the combined effects of the recession and stimulus funding.

5. Results

5.1 Overall Patterns

Using all 572 New Jersey districts in our data set, Chart 1 shows the general statewide trends in per-pupil expenditure and funding, as well as the change over time in federal, state and local contributions to total funding. The dashed line represents the last pre-recession year of 2008 and the x-axis represents the spring term of the school year with the last data point showing 2010. Both total expenditure and total funding show declines in 2009. Despite a slight increase in 2010, the levels for total expenditure and total funding did not return to pre-recession per-pupil levels. Federal aid increased 1 percent between 2008 and 2009, and then jumped 35 percent from 2009 and 2010, the year of the federal stimulus funding. District reliance on federal aid spiked 32 percent between 2009 and 2010, while reliance on state aid dropped 16 percent. But local funding and property tax declined and flattened out in the post-recession period. Relative reliance on local funding actually shifted upward from pre-recession levels, while reliance on state aid declined. (The former is due to a sharp decrease in state aid.) Finally, Chart 1 shows a flattening of enrollment in the post-recession period.

Chart 2 analyzes compositional changes in expenditures. Instructional expenditures show evidence of flattening in 2009, with the pattern reversing in 2010. In contrast, noninstructional categories such as transportation and utilities show either a flattening or a decline in the years of interest. Spending on student activities seems to have remained on trend. Funding for instructional support and student services shows signs of flattening in the first year, then a reversal in 2010. Teacher and administrator salaries (Chart 3) show an upward shift in the post-recession period, at least in 2010. In the next section, we investigate whether these patterns continue to hold in a more formal trend-shift analysis.

Tables 1-6 present results from the estimation of our specification described in Box 2. Each of these tables is structured the same way. The top section of each panel presents the percentage shifts, with the first row capturing the percentage shift in 2009 (calculated as $\frac{\alpha_2}{\textit{pre-recession base}}$), the second row capturing the percentage shift in 2010 (calculated as $(\frac{\alpha_2 + \alpha_3}{\textit{pre-recession base}})$, and the third row showing the pre-recession base of the corresponding school finance variable as (Y_{it}). The bottom section of each panel presents the regression estimations from which the percentage shifts were derived. Referring back to the equation in Box 2, "Trend" in this panel corresponds to α_1, "Recession" to α_2, and "Stimulus" to α_3. Our discussion of results will focus on the shifts. For easier comparability and a visual representation, the same percentage shifts are also illustrated in the corresponding histograms in Chart 4 and Charts 6-9.

As Table 1, panel A, and Chart 4 show, both total expenditure and total funding experience downward shifts relative to trend in 2009, signifying the negative effect of the recession. Again, note that these effects are likely underestimates of the corresponding recession effects since the change in the SFRA funding formula had a positive effect on overall school aid. Declines are evident in 2010 as well, but they are somewhat more modest, at least for total expenditure per pupil.

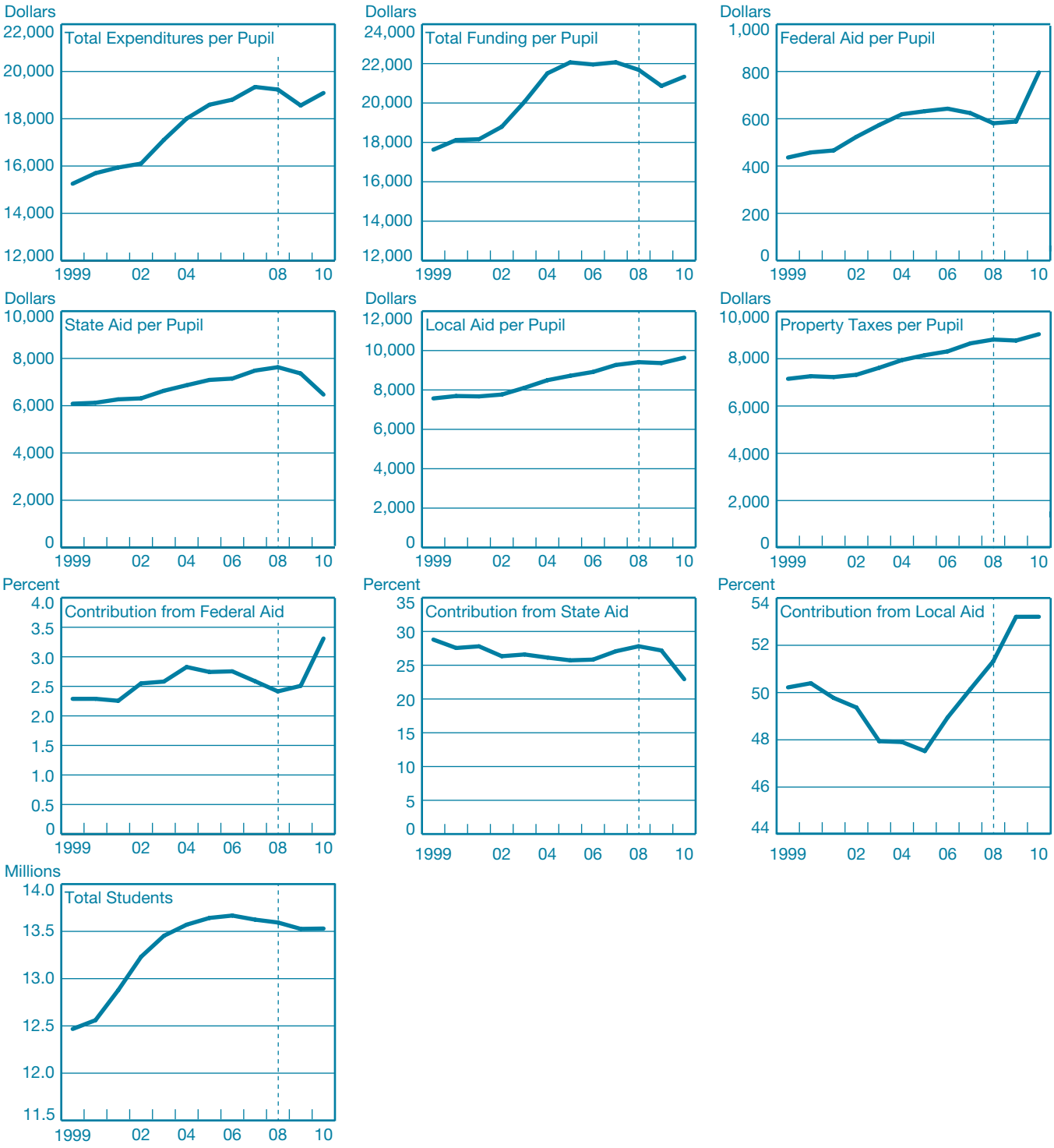
As we expected, federal aid per pupil shows a sharp upward shift relative to trend in 2010, coinciding with the infusion of federal funds from the ARRA stimulus. In contrast, state aid per pupil declines from trend in both years after the recession. Recall from our earlier discussion that the SFRA led to an upward shift in state aid per pupil in 2009, so the decline that year is likely an underestimation of the true recession effect. Digging deeper, we find that although the funding targets set by the SFRA formula were achieved in 2009, state-level cuts in categories outside the formula, such as pension funding, led to a negative shift in overall state aid.

Historically, a significant portion of state aid has been distributed to the New Jersey Teachers' Pension and Annuity Fund (TPAF). Allocations are not stipulated in the SFRA formula, so in 2009, when the recession began depleting revenue flows, pension funding was cut dramatically. Chart 5 shows the trends in total state aid, TPAF funding, and state aid

[13] Midway through the 2009-10 school year, the funding caps for district aid were lowered, and many districts received less state aid than was budgeted and less aid than was required under the SFRA formula.

Chart 1

Trends in School Revenue and Expenditures during the Great Recession

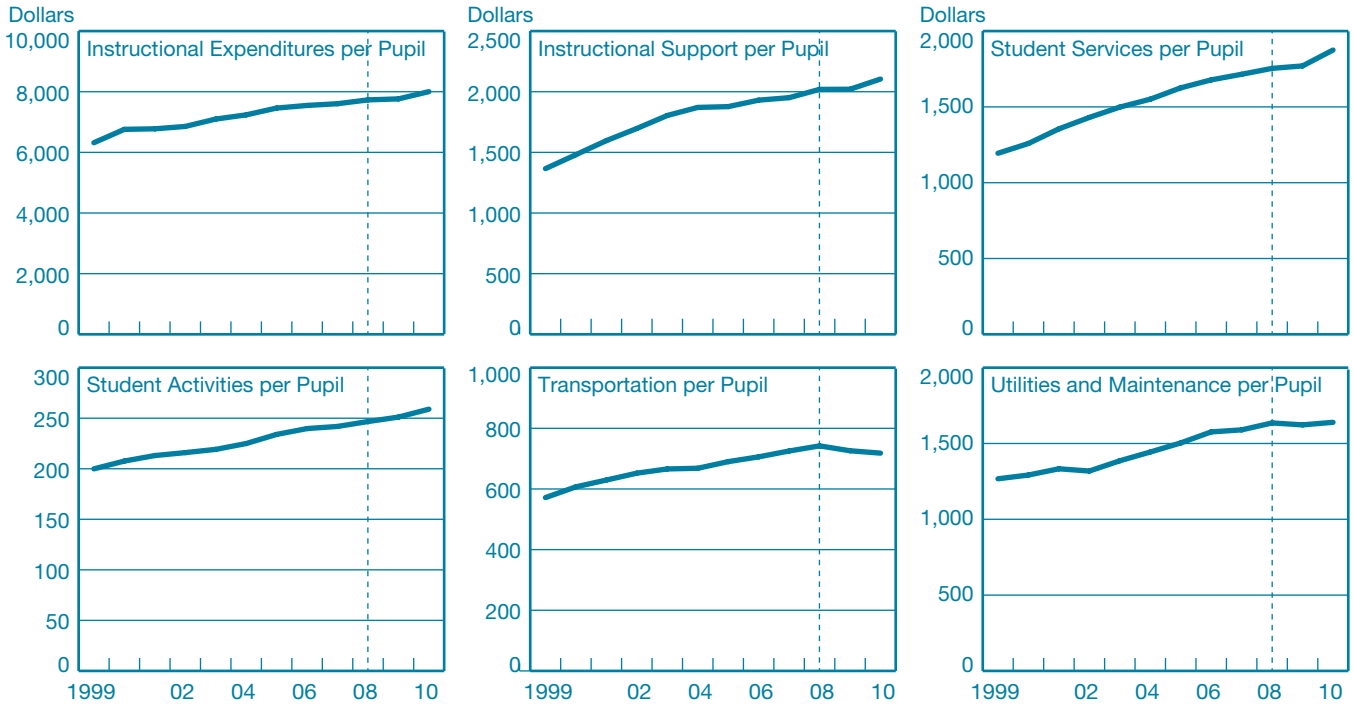


Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary and Taxpayers' Guide to Education Spending.

Note: Years denote spring terms.

Chart 2

Trends in School Revenue and Composition of Expenditures during the Great Recession

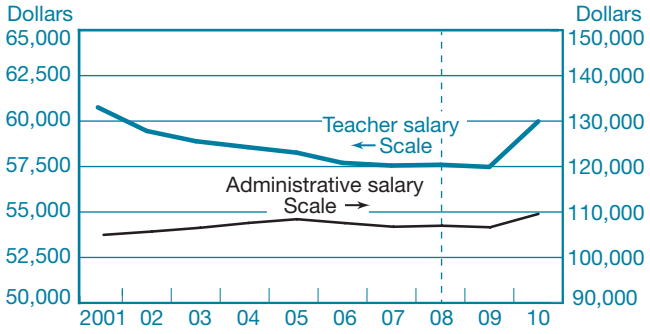


Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary and Taxpayers' Guide to Education Spending.

Note: Years denote spring terms.

Chart 3

Median Salary for Teachers and Administrators



Source: Authors' calculations, using the New Jersey Department of Education's Report Card data.

Notes: Years denote spring terms. Y-axis figures represent averages of all district medians. Data are inflation adjusted.

less TPAF funding. The vertical line represents the immediate pre-recession school year. While total state aid declined between 2008 and 2009, in large part due to the decline in TPAF funding, state aid less TPAF increased. So while the SFRA insulated other parts of state aid, the recession adversely affected TPAF funding in 2009, which, in turn, negatively affected total state aid per pupil.

These patterns are also reflected in a formal trend-shift analysis of the state aid components. (For brevity, corresponding estimates are not reported, but are available on request.) The situation in 2010, however, is different. Although the state budgets for 2010 were established using the SFRA formula, revenue streams that year were less than expected. In an unprecedented move, the funding formula was revamped significantly at midyear. The funding caps for district aid were lowered, and many districts received considerably less state aid than was budgeted and less aid than was required under the SFRA funding formula. Indeed, Chart 5 shows that declines are evident in total state aid as well as in state aid less TPAF. Results for 2009 and 2010 suggest that the Great Recession had a marked negative effect on state aid to districts.

Table 1

Patterns in Revenue and Expenditures per Pupil during the Financial Crisis and Fiscal Stimulus Period

Panel A	(1) Total Expenditures per Pupil	(2) Total Funding per Pupil	(3) Federal Aid per Pupil	(4) State Aid per Pupil	(5) Local Aid per Pupil	(6) Property Taxes per Pupil
Percentage shift in 2008-09	-9.51***	-12.68***	-17.5***	-4.02***	-3.36***	-2.81***
Percentage shift in 2009-10	-8.48***	-12.58***	13.02***	-18.46***	-2.66***	-1.74**
Pre-recession base	20,180	23,460	565	6,220	11,539	11,093
Trend	567.6***	694.9***	15.3***	116.4***	349.16***	326.33***
	(25.0)	(38.9)	(2.0)	(6.3)	(10.9)	(10.2)
Recession	-1,919.0***	-2,974.1***	-98.8***	-250.2***	-387.61***	-311.28***
	(161.0)	(295.1)	(16.6)	(48.8)	(66.3)	(63.2)
Stimulus	208.2	24.9	172.4***	-897.9***	80.67	118.39
	(195.2)	(338.9)	(18.2)	(59.8)	(93.6)	(89.9)
Observations	6,753	6,753	6,753	6,753	6,753	6,495
R^2	0.576	0.511	0.829	0.936	0.869	0.884

Panel B	(7) Contribution from Federal Aid	(8) Contribution from State Aid	(9) Contribution from Local Aid	(10) Total Students
Percentage shift in 2008-09	-10.81***	4.01***	7.48***	-3.56***
Perecentage shift in 2009-10	20.71***	-10.82***	7.58***	-4.26***
Pre-recession base	2	27.8	51.3	2,384.9
Trend	0.01	-0.27***	0.10*	14.4***
	(0.0)	(0.0)	(0.1)	(1.5)
Recession	-0.26***	1.12***	3.84***	-85.0***
	(0.1)	(0.2)	(0.4)	(14.3)
Stimulus	0.76***	-4.12***	0.05	-16.4
	(0.1)	(0.3)	(0.5)	(18.9)
Observations	6,759	6,759	6,759	6,753
R^2	0.799	0.926	0.784	0.995

Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary and Taxpayers' Guide to Education Spending.

Notes: Robust standard errors are in parentheses. All regressions control for racial composition and percentage of students eligible for free or reduced-price lunch, and include school district fixed effects. Pre-recession base is expressed in 2010 constant dollars.

***Statistically significant at the 1 percent level.

**Statistically significant at the 5 percent level.

*Statistically significant at the 10 percent level.

As would be expected given the recession's shock to housing prices and local revenue streams, local funding per pupil and property taxes per pupil show negative shifts relative to trend in both years after the recession (Table1 and Chart 4). It follows from the above analysis that without the support of the federal stimulus in 2010, total aid to districts would have declined even further from their depleted levels.

Table 1, panel B, illustrates percentage shifts in federal, state, and local contributions to total school funding. The patterns reveal that the above changes led to districts relying less on state aid and, instead, becoming largely funded more by federal aid in the 2010 school year. Thus, the Great Recession and the associated infusion of funds from the federal stimulus package seem to have led to a compositional shift in

Box 2

Empirical Strategy

To analyze how New Jersey school finances were affected during the Great Recession and the ARRA federal stimulus period, we conduct a trend-shift analysis using the following specification:

$$Y_{it} = \alpha_1 T + \alpha_2 v_1 + \alpha_3 v_2 + \alpha_3 X_{it} + f_i + \varepsilon_{it},$$

where Y_{it} represents a school finance variable for school district i in year t; T represents the time trend and takes a value of 0 in the immediate pre-recession year (2008) and increases in increments of 1 for each subsequent year and decreases by 1 in each previous year; f_i denotes school district fixed effects and controls for any fixed characteristics of districts; X_{it} denotes controls for racial composition and poverty level (percentage of students eligible for free and reduced price lunches) of the district; v_1 =1 if year ≥ 2009 and 0 otherwise; v_2 =1 if year ≥ 2010 and 0 otherwise.[a]

The coefficient α_1 represents the overall trend in the corresponding financial variable during the pre-recession period. The coefficients of interest are α_2, representing the intercept shift at the onset of the recession, and α_3 representing the additional intercept shift during the federal stimulus period. In Tables 1-6, we define α_2 as "Recession" and α_3 as "Stimulus." The shifts relative to preexisting trends in 2009 and 2010 are captured by α_2 and $(\alpha_2 + \alpha_3)$, respectively.

[a] Local, state, and federal governments finalize their budgets in the spring prior to the budgeted year. More specifically, the budgets for the 2008 school year were finalized in the spring of 2007, before the recession officially began (in December 2007, as defined by the National Bureau of Economic Research), and before decision makers were aware of the impending recession. Therefore, 2008 is considered pre-recession in our analysis of financial variables, and 2009 is taken as the first year budgets were directly affected by recession.

aid to New Jersey. Map 2 provides additional illustration of the increased reliance on federal aid in 2008 (the immediate pre-recession year) and 2010. It shows a nearly across-the-board increase in the federal share of total aid in 2010. Finally, Table 1, panel B, column 10, shows evidence in favor of negative shifts in student enrollment in both years after the recession.

Next, we analyze whether the various expenditure categories follow the declining path experienced by aggregate expenditure in the years after the Great Recession hit. Table 2 and Chart 6 present this analysis. Interestingly, there is marked variation. While instructional expenditure suffers a negative shift from trend in 2009, there is no evidence of any negative effect in 2010. This pattern is repeated for instructional support per pupil and student services per pupil. The resilience is in spite of the 2010 cuts to the education budget discussed above. These findings suggest that the federal stimulus funds tempered the negative effect of the recession, at least in these categories. In contrast, other noninstructional categories such as transportation and utilities suffer statistically significant declines from trend during this period. Conversations with New Jersey Department of Education staff revealed that the state, faced by constrained budget conditions, cut back on nonessential transportation costs, such as courtesy busing.[14] We find this information is consistent with the above patterns in transportation spending evident in our data.

Patterns suggest that New Jersey tried to maintain continuity in the expenditure categories most related to student learning and development. Instructional expenditure, which includes teacher salaries and classroom expenses, constitutes the spending category that most directly supports students' learning. With ARRA funds coming in, there is no evidence of the negative effects on this category seen in the year prior to the stimulus. Like instructional expenditure, instructional support, student services, and student activities closely relate to the development of the student. These categories, combined with instructional expenditure, are arguably the categories that most directly impact a students' access to a "thorough and efficient" education. In summary, our results show that the post-recession period was characterized by a shift in composition of expenditures in favor of categories that are linked most closely to students' learning and development.

Columns 7 and 8 in Table 3, panel B, investigate the Great Recession's impact on median teacher and administrator salaries. Teacher salaries show an upward shift in both years after the recession; administrator salaries show a downward shift in the first year, which turns positive in the second year.

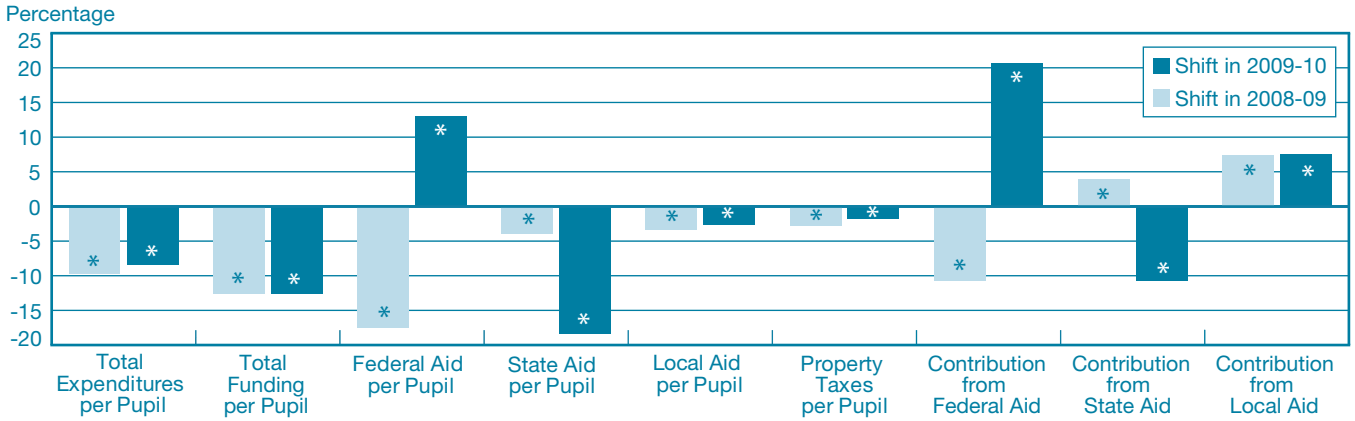
To understand and interpret these results, there are two key factors to consider. First, education personnel retirements spiked during this period, as rumors of potential pension funding cuts spread across districts.[15] Recall that New Jersey is one of the few states in which the state funds pensions, and with state revenue streams depleted, pensions were seen as a probable area to cut. Since teachers and administrators at the age of retirement tend to have the highest salaries, an increase in retirements would logically lead to a decline in the overall median salary. This result is not what we see for teacher salary, although the increase in administrative retirements in 2009 is consistent with the negative shift seen in median administra-

[14] Courtesy busing is the nonmandatory provision of busing such as for students living within walking distance of the school or who otherwise have a reasonable alternative to busing.

[15] Surmised using data available from the State of New Jersey Department of the Treasury's Division of Pensions and Benefits.

Chart 4

Patterns in Revenue during the Financial Crisis and Federal Stimulus Period

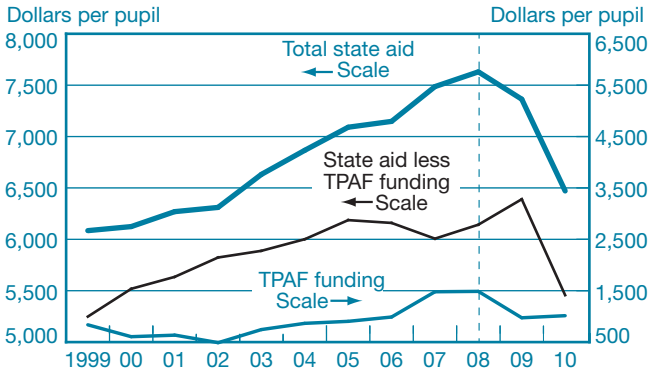


Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary and Taxpayers' Guide to Education Spending.

Note: The * symbol denotes significance at the 10, 5, or 1 percent level.

Chart 5

Trends in State Aid to Teachers' Pension Funds



Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary and Taxpayers' Guide to Education Spending.

Notes: Years denote spring terms. TPAF is Teacher's Pension Annuity Fund.

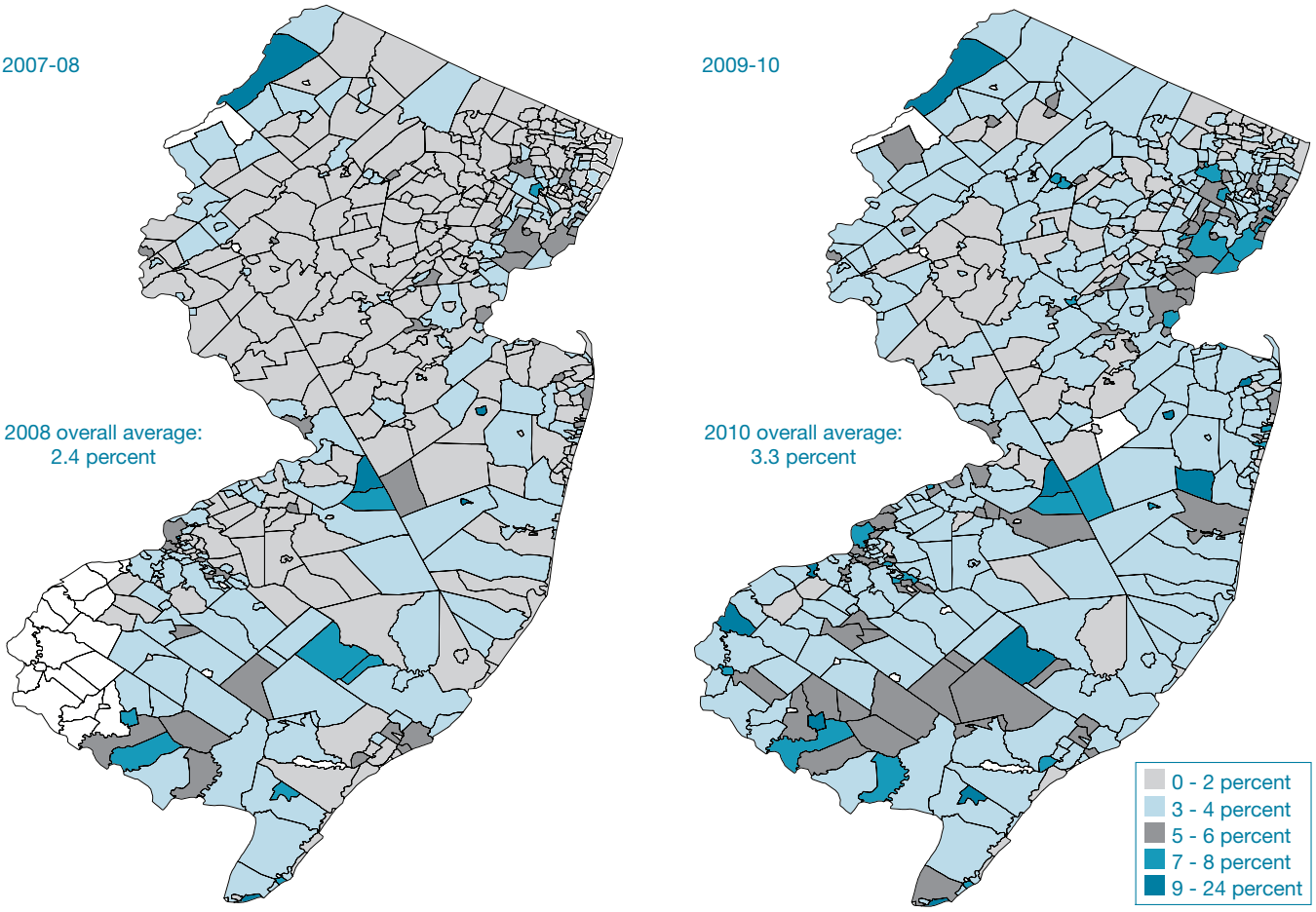
tive salary. This relationship is corroborated by the patterns we observe in median years of experience of administrators. Though not statistically significant, there is a small decline in administrators' years of experience in 2009 revealed in Table 3, column 2, a factor potentially contributing to the decline in administrators' median salary.

There is more to the story, however. To understand fully the patterns in teacher and administrator salaries, we consider a second factor: nontenured dismissal. In New Jersey, public school employees attain tenure in their third year of employment. With tenure, it becomes very difficult for an employee to be fired without extraordinary cause.[16] As a result, the vast majority of layoffs in New Jersey public education affect employees in their first and second years, reducing the number of employees at lower-level salaries. As Table 3, column 1, shows, there is strong evidence of large positive shifts in teachers' years of experience in both 2009 and 2010 relative to trend, and both these effects are highly statistically significant. These results support the hypothesis that dramatic cuts in the number of lower-level employees increase the overall median teacher salary significantly in both years. Administrative employees' years of experience also showed a positive shift in 2010, although this finding is not statistically significant. These patterns provide evidence that the significant positive shifts in median teacher and administrative salaries are likely due to a culling of lower-level public education employees during the post-recession era.

[16] New Jersey Statutes, Section 18a:6-10.

Map 2

Percentage of District Revenue from Federal Sources



Sources: Authors' calculations, using the U.S. Census Bureau shapefiles and the New Jersey Department of Education's Audit Summary and Taxpayers' Guide to Education Spending.

5.2 Examining Heterogeneities by School District Poverty Level

While the above analysis focuses on aggregate patterns, the rest of the paper investigates whether there were differences in impacts within the state by various characteristics, such as poverty status, location, and urbanicity. In the interest of space, we focus here only on a subset of the finance indicators of most interest: components of expenditure. This analysis provides useful insight into how the different districts allocated funds, and how the students in these districts were affected. Results for the other indicators are available on request.

Discussions about spending on education in New Jersey are most often framed in reference to wealth levels. In this vein, Table 4 and Chart 7 present the results for variations by poverty level.[17] Affluent districts fared best in terms of preserving instructional expenditure as well as most of noninstructional expenditure (instructional support, student services, and transportation). They also experience the largest upward shifts in median teacher salaries and years of experience in both years after the recession. The combined results for salary and experience imply that affluent districts may have had the largest instance of lower-level teacher layoffs. Affluent districts

[17] Charts 7-10 are placed in the "Conclusion" of this article (pages 16-24).

Table 2

Patterns in the Composition of Expenditures during the Financial Crisis and Fiscal Stimulus Period

Panel A	(1) Instructional Expenditures per Pupil	(2) Instructional Support per Pupil	(3) Student Services per Pupil	(4) Transportation per Pupil
Percentage shift in 2008-09	-2.14***	-2.12**	-2.0**	-3.21***
Percentage shift in 2009-10	0.14	-0.86	0.97	-5.41***
Pre-recession base	7,787	1,909	1,599	763
Trend	165.4***	66.3***	57.4***	17.2***
	(5.9)	(2.3)	(1.8)	(1.1)
Recession	-166.5***	-40.5**	-31.9**	-24.5***
	(38.9)	(18.2)	(14.4)	(9.1)
Stimulus	177.6***	24.2	47.4**	-16.8
	(48.9)	(25.0)	(19.2)	(12.3)
Observations	6,752	6,752	6,752	6,744
R^2	0.627	0.704	0.742	0.825
Panel B	**(5) Student Activities per Pupil**	**(6) Utilities and Maintenance per Pupil**	**(7) Median Teacher Salary**	**(8) Median Administrative Salary**
Percentage shift in 2008-09	0.81	-2.35***	1.32***	-1.16***
Percentage shift in 2009-10	1.18	-4.50***	6.45***	1.55***
Pre-recession base	238	1,615	57,598	107,074
Trend	5.0***	49.3***	-387.8***	130.9*
	(0.3)	(1.6)	(39.2)	(73.0)
Recession	1.9	-37.9***	761.3***	-1,239.4***
	(2.5)	(11.8)	(215.8)	(457.4)
Stimulus	0.9	-34.9**	2,956.5***	2,896.3***
	(3.1)	(15.0)	(253.7)	(592.5)
Observations	6,685	6,752	5,614	5,605
R^2	0.959	0.728	0.815	0.787

Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary, Taxpayers' Guide to Education Spending, and Report Card data.

Notes: Robust standard errors are in parentheses. All regressions control for racial composition and percentage of students eligible for free or reduced-price lunch, and include school district fixed effects. Pre-recession base is expressed in 2010 constant dollars.

***Statistically significant at the 1 percent level.

**Statistically significant at the 5 percent level.

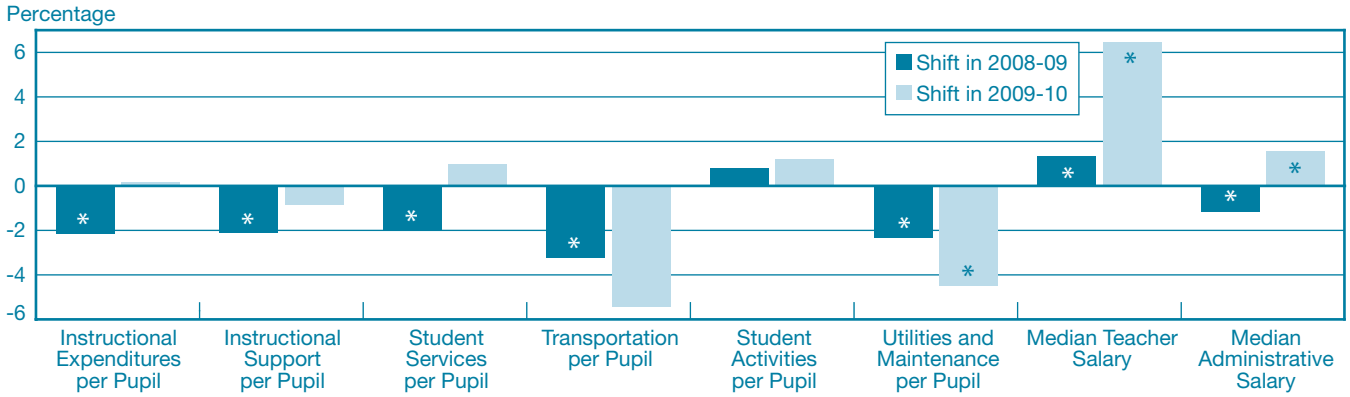
*Statistically significant at the 10 percent level.

have the smallest declines in expenditures on utilities in 2009, but their experience in 2010 is not very different from that of high- and medium-poverty districts in this category.

The most noteworthy pattern revealed in this analysis is the comparatively large declines in spending in both instructional and noninstructional categories. The most disparate examples are the shifts in student services and instructional support in 2010; while high-poverty districts show large, statistically significant declines, the affluent districts show large, statistically significant increases. The variables for student services and instructional support capture expenditures on services that are designed to support, assess, and improve students' well-being. They include social work, health services, technology, library costs, and student guidance.

Chart 6

Patterns in Expenditures during the Financial Crisis and Federal Stimulus Period



Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary, Taxpayers' Guide to Education Spending, and Report Card data.

Note: The * symbol denotes significance at the 10, 5, or 1 percent level.

Table 3

Patterns in Years of Experience during the Financial Crisis and Fiscal Stimulus Period

	(1) Median Teacher Years of Experience	(2) Median Administrator Years of Experience
Percentage shift in 2008-09	8.80***	-0.10
Percentage shift in 2009-10	15.96***	1.91
Pre-recession base	10.13	20.57
Trend	-0.42***	-0.45***
Recession	0.89***	-0.02
Stimulus	0.73***	0.41
Observations	5,614	5,605
R^2	0.72	0.593

Source: Authors' calculations, using the New Jersey Department of Education's Report Card data.

Notes: Robust standard errors are in parentheses. All regressions control for racial composition and percentage of students eligible for free or reduced-price lunch, and include school district fixed effects. Pre-recession base is expressed in 2010 constant dollars.

***Statistically significant at the 1 percent level.

**Statistically significant at the 5 percent level.

*Statistically significant at the 10 percent level.

5.3. Examining Heterogeneities by Urbanicity

Another characteristic of school districts frequently covered in discussions about New Jersey education financing is urbanicity. Historically, since urban districts generally have lower property values and more apartment buildings housing multiple families, the ratio of students to potential sources of tax income is higher than for suburban or rural districts. The result has been a large disparity between the per-pupil aid available for wealthier, rural districts compared with poorer, urban districts.

Table 5 and Chart 8 analyze variations by urban, suburban, and rural status.[18] Once again, while all three groups exhibit statistically significant declines in instructional expenditure in 2009, there is no evidence of negative effects in 2010, suggesting stimulus funding helped offset the trend. This pattern repeats consistently throughout our results, suggesting that the districts in general strive to preserve instructional expenditure. While the decline in instructional expenditure in 2009 is most pronounced for urban districts, the experiences in 2010 are very similar across the three groups.

In most noninstructional categories (instructional support, student services, transportation, and student activities), the rural districts fare the best, while the urban districts fare the worst. The experiences of the three groups are very similar for expenditures on utilities.

[18] Tables 5 and 6 are placed in the "Conclusion" of this article (pages 16-24).

Table 4

Heterogeneities by School District Poverty Level

Panel A	Instructional Expenditures per Pupil			Instructional Support per Pupil			Student Services per Pupil		
	High Poverty	Medium Poverty	Affluent	High Poverty	Medium Poverty	Affluent	High Poverty	Medium Poverty	Affluent
Percentage shift in 2008-09	-3.19***	-2.78***	-1.24	-5.23**	-2.15*	-0.83	-4.63**	-2.69**	-0.41
Percentage shift in 2009-10	-1.93	0.21	0.99	-8.06***	0.94	3.20	-5.21**	1.34	4.61**
Pre-recession base	8,039	7,667	7,749	2,121	1,790	1,913	1,736	1,515	1,615
Trend	227.8***	175.3***	100.0***	101.6***	56.6***	53.2***	88.6***	50.2***	44.6***
	(15.2)	(8.0)	(9.0)	(7.6)	(2.7)	(3.3)	(5.1)	(2.3)	(3.1)
Recession	-256.3***	-212.9***	-96.2	-111.0**	-38.5*	-15.9	-80.3**	-40.8**	-6.6
	(92.2)	(49.3)	(64.5)	(46.3)	(20.2)	(30.8)	(35.0)	(17.6)	(27.1)
Stimulus	101.2	229.0***	173.1*	-59.9	55.3**	77.1	-10.2	61.1**	81.1**
	(98.3)	(70.1)	(96.2)	(58.8)	(27.8)	(49.1)	(36.9)	(26.5)	(41.0)
Observations	1,682	3,240	1,828	1,682	3,240	1,828	1,682	3,240	1,828
R^2	0.442	0.816	0.827	0.633	0.806	0.803	0.692	0.809	0.796
Panel B	**Transportation per Pupil**			**Student Activities per Pupil**			**Utilities and Maintenance per Pupil**		
	High Poverty	Medium Poverty	Affluent	High Poverty	Medium Poverty	Affluent	High Poverty	Medium Poverty	Affluent
Percentage shift in 2008-09	-5.83**	-3.68***	-0.85	0.73	0.54	0.68	-2.20	-3.65***	-1.49
Percentage shift in 2009-10	-9.71***	-3.54	-4.57	2.91	-0.21	-0.14	-5.26***	-4.39***	-4.53***
Pre-recession base	729	774	780	193	241	281	1,721	1,581	1,568
Trend	28.1***	17.4***	6.1***	4.7***	5.9***	3.9***	64.3***	51.2***	35.1***
	(2.7)	(1.4)	(2.3)	(0.5)	(0.4)	(0.6)	(4.0)	(2.3)	(2.9)
Recession	-42.5**	-28.5***	-6.6	1.4	1.3	1.9	-37.8	-57.7***	-23.4
	(17.8)	(9.1)	(26.0)	(4.4)	(3.5)	(5.4)	(25.6)	(15.7)	(21.3)
Stimulus	-28.3	1.1	-29.0	4.2	-1.8	-2.3	-52.7*	-11.7	-47.6
	(19.0)	(17.2)	(32.2)	(5.0)	(4.5)	(6.7)	(27.0)	(23.4)	(29.4)
Observations	1,682	3,239	1,821	1,657	3,211	1,815	1,682	3,240	1,828
R^2	0.816	0.901	0.755	0.933	0.966	0.965	0.666	0.810	0.802

All three groups show positive shifts in median teacher salary and experience. However, rural districts show smaller spikes in both measures compared with the suburban and urban districts, suggesting that lower-level teacher layoffs may have been less prevalent in rural districts.

5.4. Examining Heterogeneities by Metropolitan Area

We next look at the variations by metropolitan area, analyzing New Jersey's four largest metropolitan divisions: New York-White Plains-Wayne, Edison-New Brunswick, Newark-Union, and Camden. Note that there is substantial diversity within these areas by poverty and urbanicity. This fact makes studying heterogeneities by poverty and urbanicity along with distinctions by MD all the more relevant.

Recall that Map 1 defines the metropolitan areas of New Jersey. Newark constitutes the northwest portion of the state and includes the most affluent districts. East of Newark, the Wayne district is second in terms of wealth and has the largest population of Hispanic and Asian students. The Edison districts are similar in demographics to Wayne, however, on average, Edison hosts larger districts. Camden districts have the highest instance of poverty, the largest black student population, and the largest number of small-sized districts.

Table 4 (continued)

Heterogeneities by School District Poverty Level

	Median Teacher Salary			Median Teacher Years of Experience		
Panel C	High Poverty	Medium Poverty	Affluent	High Poverty	Medium Poverty	Affluent
Percentage shift in 2008-09	0.77	1.30**	2.37***	7.78***	8.53***	13.15***
Percentage shift in 2009-10	5.19***	6.54***	8.15***	14.59***	14.22***	26.31***
Pre-recession base	57,492	57,312	58,286	10.28	10.55	9.12
Trend	-54.7	-418.4***	-586.0***	-0.3***	-0.4***	-0.5***
	(89.1)	(57.7)	(70.7)	(0.0)	(0.0)	(0.0)
Recession	443.5	746.8**	1,379.9***	0.8***	0.9***	1.2***
	(434.5)	(313.0)	(415.5)	(0.2)	(0.2)	(0.2)
Stimulus	2,539.8***	3,000.4***	3,372.1***	0.7***	0.6***	1.2***
	(431.5)	(384.7)	(510.1)	(0.2)	(0.2)	(0.3)
Observations	1,397	2,711	1,506	1,397	2,711	1,506
R^2	0.821	0.826	0.834	0.750	0.744	0.663

Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary, Taxpayers' Guide to Education Spending, and Report Card data.

Notes: Robust standard errors are in parentheses. All regressions control for racial composition and percentage of students eligible for free or reduced-price lunch, and include school district fixed effects. Pre-recession base is expressed in 2010 constant dollars.

***Statistically significant at the 1 percent level.

**Statistically significant at the 5 percent level.

*Statistically significant at the 10 percent level.

Table 6 and Chart 9 show our findings. While all four MDs suffer declines in instructional expenditure in 2009, these patterns reverse in 2010 when they each shift upward slightly. Camden endures the largest decline in 2009, while the MDs for the most part see similar positive reversals in 2010. The exception is Edison, which experiences an upward shift about double the size of the other MDs. In most of the noninstructional categories, Edison stands out as having the largest upward shifts. All MDs show positive shifts in median teacher salaries and years of experience, with Wayne showing the largest increase in both years in both categories. In summary, our results show quite a lot of variation across MDs, providing evidence that New Jersey regions reacted differently to a lack of resources.

6. Conclusion

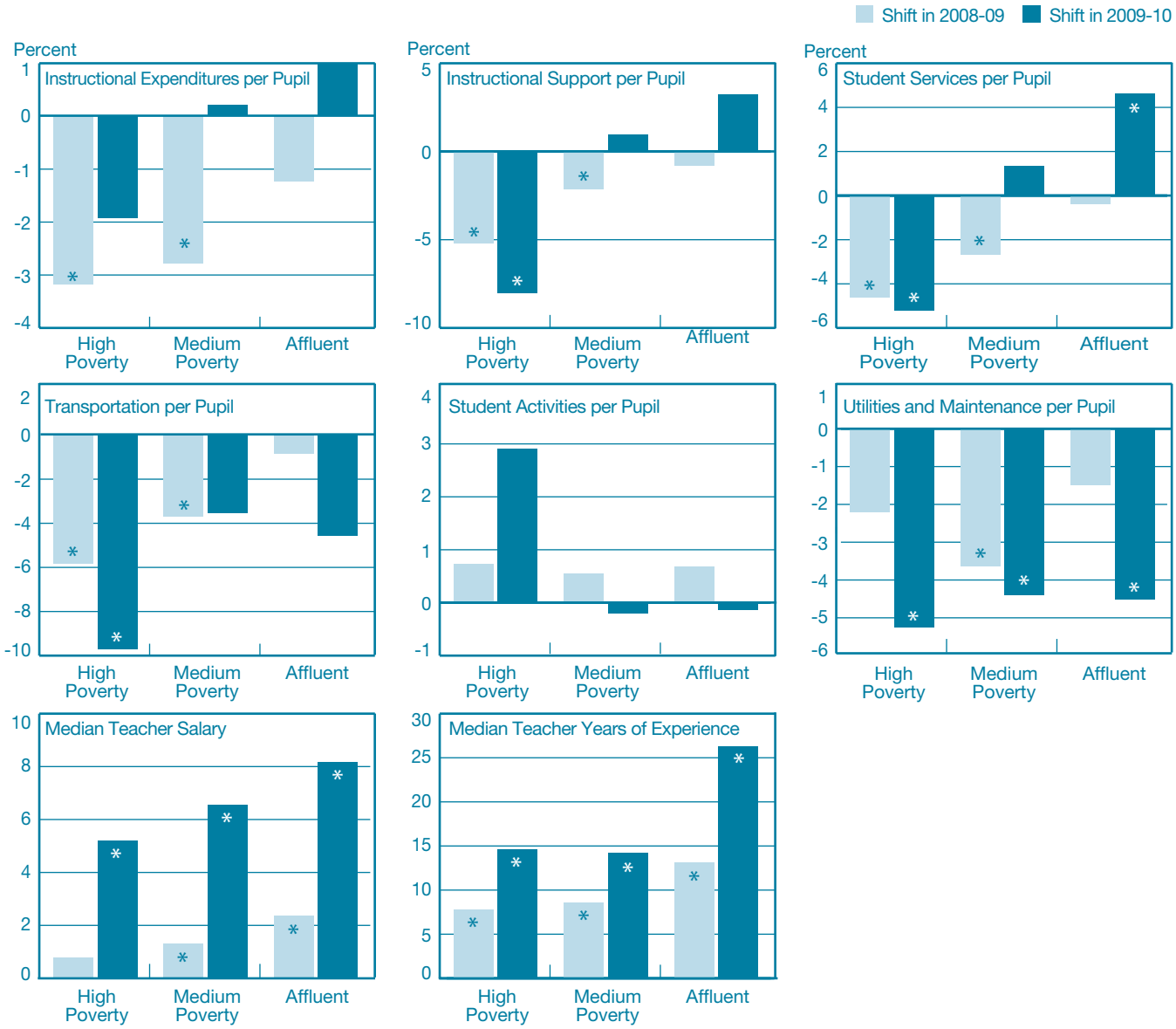
This paper explores how school finances in New Jersey were affected during the Great Recession and the ARRA federal stimulus funding that followed. The analysis yields some interesting results. There is strong evidence of a downward shift in both total funding and expenditure, relative to trend, following the recession in New Jersey. Federal stimulus sparks improvements in 2010; while both variables still exhibit declines, they are somewhat smaller than in 2009. There is also strong evidence of substitution of funds on the aid side. The infusion of funds from the federal stimulus occurs simultaneously with statistically and economically significant cuts in state and local financing, especially the former. As a result, relative reliance on federal aid increases in 2010, while reliance on state aid declines. Without the support of the federal stimulus in 2010, our results suggest that total aid to districts would have declined significantly more.

Our results also show that the post-recession period is characterized by a compositional shift in expenditures in favor of categories linked most closely to student learning. The categories for instructional expenditure, instructional support, student services, and student activities are preserved in 2010 when districts receive ARRA support.[19] In contrast, transportation and utilities expenditures decline, suggesting that

[19] While instructional support saw a small negative shift of less than 1 percent in 2010, it is statistically not different from zero and considerably smaller than the negative shift in 2009, suggesting stimulus funding helped to moderate the recession's negative effects and preserve funding approximately at trend level.

Chart 7

Heterogeneities by School District Poverty Level



Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary, Taxpayers' Guide to Education Spending, and Report Card data.

Note: The * symbol denotes significance at the 10, 5, or 1 percent level.

policymakers prioritized spending on categories most related to student learning and development.

We also find some interesting patterns in the teacher and administrator labor market. The shifts in median salary and years of experience suggest a culling of lower-level public education employees during the post-recession era, perhaps driven by New Jersey's tenure rules, which make it difficult to lay off more experienced employees.

In addition to studying the overall impact of the recession, we examine whether its effects varied by poverty, urban status, and metropolitan area. We find considerable heterogeneity. For example, the high-poverty and urban groups sustain the largest declines (relative to their respective trends) in the post-recession era. The most extreme examples in the poverty-level heterogeneities are the shifts in spending on student services and instructional support in 2010. The high-poverty

Table 5

Heterogeneities by School District Urbanicity

	Instructional Expenditures per Pupil			Instructional Support per Pupil			Student Services per Pupil		
Panel A	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural
Percentage shift in 2008-09	-3.83***	-1.89***	-2.24**	-4.58	-2.3**	0.16***	-3.30	-2.00*	-0.98
Percentage shift in 2009-10	0.80	0.21	0.02	-2.88	-1.35	2.21	-1.18	0.94	2.00
Pre-recession base	8,210	7,820	7,511	2,181	1,954	1,640	1,832	1,641	1,351
Trend	245.1***	154.5***	183.6***	92.1***	69.7***	53.5***	85.7***	59.5***	47.0***
	(19.7)	(7.9)	(9.5)	(8.8)	(3.1)	(3.7)	(8.0)	(2.3)	(3.0)
Recession	-314.5**	-147.5***	-168.1**	-99.8	-44.9**	2.7	-60.5	-32.8*	-13.3
	(152.4)	(47.2)	(67.3)	(85.6)	(21.7)	(32.2)	(68.1)	(17.0)	(26.9)
Stimulus	380.5*	164.1***	169.9*	37.1	18.6	33.6	38.9	48.3**	40.3
	(206.8)	(58.2)	(86.8)	(108.3)	(30.3)	(40.3)	(87.1)	(22.7)	(35.3)
Observations	440	5,041	1,271	440	5,041	1,271	440	5,041	1,271
R^2	0.797	0.591	0.821	0.828	0.679	0.756	0.84	0.719	0.774
	Transportation per Pupil			Student Activities per Pupil			Utilities and Maintenance per Pupil		
Panel B	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural
Percentage shift in 2008-09	-6.16	-4.48***	1.09	0.52	0.47	2.96	-1.70	-2.28***	-2.47
Percentage shift in 2009-10	-11.78***	-5.85***	-2.46	0.42	0.63	4.86	-4.51***	-4.35***	-4.71**
Pre-recession base	691	701	1,037	181	259	172	1,743	1,631	1,512
Trend	21.0***	14.4***	21.8***	5.6***	5.7***	2.7***	78.5***	45.8***	52.9***
	(3.1)	(1.3)	(2.4)	(0.8)	(0.4)	(0.6)	(4.6)	(2.1)	(2.7)
Recession	-42.6	-31.4***	11.3	0.9	1.2	5.1	-29.7	-37.2***	-37.4
	(26.7)	(10.8)	(19.2)	(6.5)	(2.9)	(5.8)	(47.3)	(13.9)	(23.1)
Stimulus	-38.9	-9.6	-36.8	-0.2	0.4	3.3	-48.9	-33.8*	-33.8
	(30.0)	(14.9)	(25.1)	(9.1)	(3.7)	(7.1)	(52.9)	(17.5)	(31.7)
Observations	440	5,033	1,271	432	5,009	1,244	440	5,041	1,271
R^2	0.905	0.802	0.847	0.968	0.954	0.971	0.898	0.701	0.787

districts show large, statistically significant declines in these categories, while the affluent districts show large, statistically significant increases. These variables capture the expenditure on services to support, assess, and improve students' well-being, including social work, health services, technology, library costs, and student guidance.

Since New Jersey spent its appropriation of ARRA funds in 2010, a valid question here is how we might expect the state to fare in the near future. Considering the slow recovery of economic activity and employment, state and local revenues will likely continue to come in below trend. The end of the federal stimulus funding and lower-than-trend growth in state and local revenues could lead to more significant downward pressure on funding and expenditures, including the various components of expenditures. In fact, some of this pressure is already evident.

Using a compilation of the annual budgets for the United States and the state of New Jersey, we plot budgeted and actual funding per pupil over 2000-12 in Chart 10. The chart shows a noticeable decline in budgeted funding after 2010. It also reveals that New Jersey planned for steeper declines in 2011 compared with the nation as a whole.

The state's budget for the 2011 school year explicitly states that funds were not available to replace the ARRA funding of 2010. The funding levels required by the state's SFRA formula were not met, and the 2011 budget shows statewide declines, with many districts' aid being reduced as much as 5 percent from the previous year. Cuts were made in many expendi-

Table 5 (continued)
Heterogeneities by School District Urbanicity

	Median Teacher Salary			Median Teacher Years of Experience		
Panel C	Urban	Suburban	Rural	Urban	Suburban	Rural
Percentage shift in 2008-09	3.42**	1.51***	0.07	9.17**	10.32***	4.29**
Percentage shift in 2009-10	8.05***	7.13***	3.33***	17.43***	18.58***	7.72***
Pre-recession base	58,634	57,838	56,291	10.90	9.69	11.66
Trend	-446.8**	-476.8***	-108.3*	-0.4***	-0.5***	-0.3***
	(179.7)	(48.8)	(65.3)	(0.1)	0.0	0.0
Recession	2,005.5**	873.6***	40.6	1.0**	1.0***	0.5**
	(823.6)	(253.6)	(447.6)	(0.4)	(0.1)	(0.3)
Stimulus	2,712.8***	3,250.6***	1,834.1***	0.9*	0.8***	0.4
	(987.9)	(296.5)	(547.8)	(0.5)	(0.1)	(0.3)
Observations	366	4,192	1,056	366	4,192	1,056
R^2	0.882	0.795	0.853	0.728	0.699	0.741

Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary, Taxpayers' Guide to Education Spending, and Report Card data.

Notes: Robust standard errors are in parentheses. All regressions control for racial composition and percentage of students eligible for free or reduced-price lunch, and include school district fixed effects. Pre-recession base is expressed in 2010 constant dollars.

***Statistically significant at the 1 percent level.

**Statistically significant at the 5 percent level.

*Statistically significant at the 10 percent level.

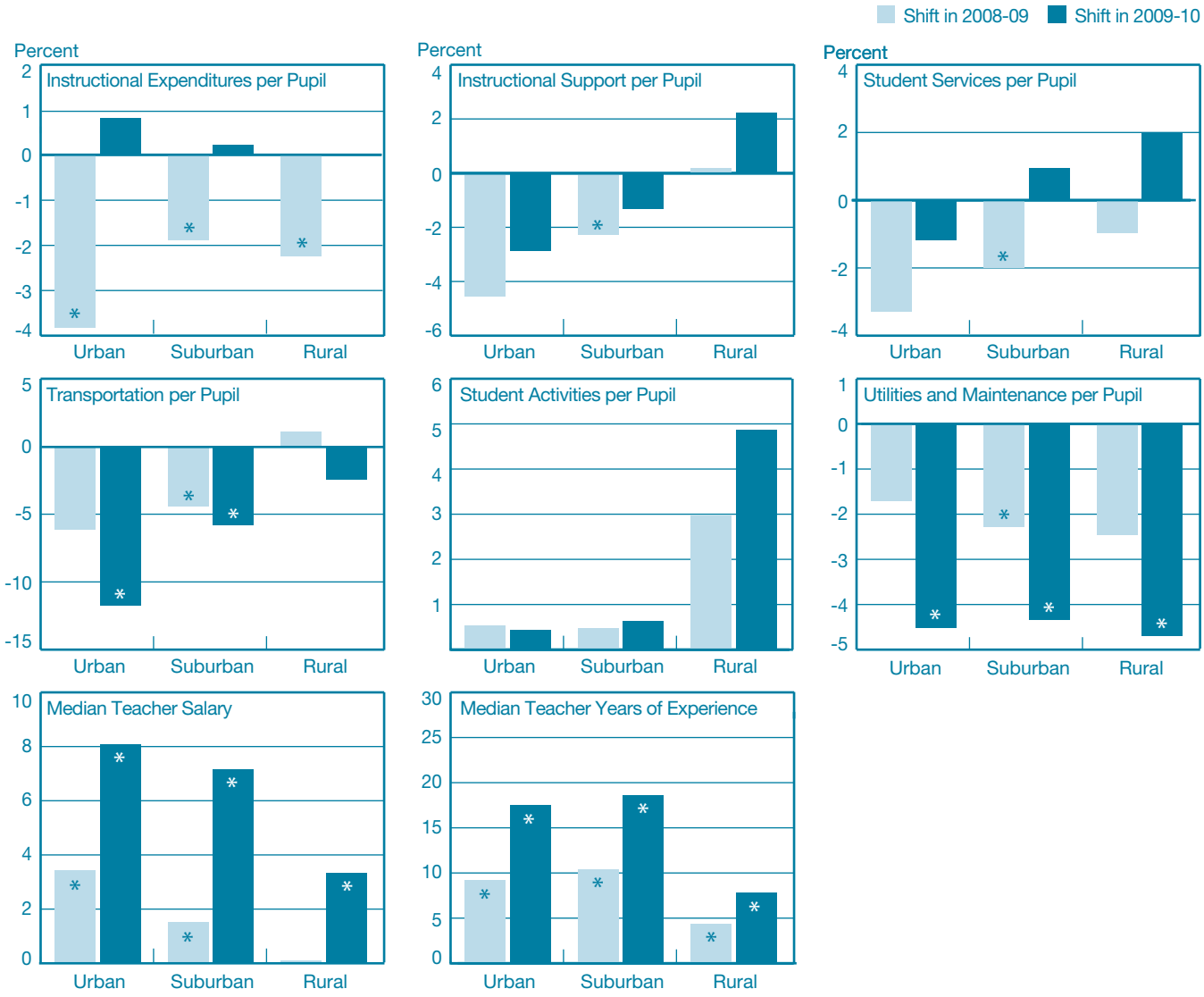
ture categories, leaving the planned expansion of a preschool program stalled, special education allocations and nonpublic school aid 15 percent below projected need, debt service aid down by 15 percent, and funding for adult education slashed entirely. Data from the state's Department of Education show that in 2011 the number of full- and part-time public school teachers in New Jersey dropped 4 percent, while the number of administrators fell 7 percent.

As economists are predicting continued softness, school districts will likely face hard decisions ahead involving cuts to the critical instructional expenditure category that they have so far been successful in preserving. This possibility could have adverse effects on human capital formation and, by extension, the nation's future. Our findings form an important basis for understanding schools' financial situations during recessions and can serve to guide future policy decisions.

The authors thank Jason Bram, Erica Groshen, Andrew Haughwout, James Orr, Joydeep Roy, Amy Ellen Schwartz, Leanna Stiefel, Giorgio Topa, and seminar participants at the Federal Reserve Bank of New York and the New York University-FRBNY Fiscal Breakfast for valuable insight and feedback. They are grateful to Kevin Dehmer, Susan Ecks, Frank Lavdas, and the New Jersey Department of Education for patiently answering numerous questions and providing generous help in acquiring the data. They also thank staff at the U.S. Census Bureau, the U.S. Department of Education, and the New Jersey School Boards Association for answering many questions and providing assistance with different parts of the data. Elizabeth Setren provided excellent research assistance.

Chart 8

Heterogeneities by School District Urbanicity



Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary, Taxpayers' Guide to Education Spending, and Report Card data.

Note: The * symbol denotes significance at the 10, 5, or 1 percent level.

Table 6

Heterogeneities by School District Metropolitan Area

	Instructional Expenditures per Pupil				Instructional Support per Pupil				Student Services Per Pupil			
Panel A	Camden	Edison	Newark	Wayne	Camden	Edison	Newark	Wayne	Camden	Edison	Newark	Wayne
Percentage shift in 2008-09	-2.58***	-1.56	-2.46***	-1.22	-1.99	0.90	-1.48	-3.87	-3.17	1.39	-1.26	-3.38
Percentage shift in 2009-10	0.43	1.30	0.24	0.16	-1.85	4.30	0.89	-4.95	-2.10	5.55*	3.09*	-1.20
Pre-recession base	7,314	7,783	7,974	7,862	1,757	1,868	1,998	2,031	1,464	1,594	1,692	1,676
Trend	176.2***	185.7***	146.4***	79.1***	68.5***	68.5***	67.1***	59.3***	58.7***	63.1***	56.7***	53.8***
	(11.1)	(18.3)	(8.8)	(9.4)	(4.4)	(6.2)	(3.6)	(7.2)	(3.5)	(5.0)	(3.1)	(4.8)
Recession	-189.0***	-121.8	-196.2***	-96.1	-35	16.9	-29.5	-78.6*	-46.4	22.2	-21.3	-56.6
	(67.7)	(104.2)	(65.6)	(70.1)	(36.2)	(39.8)	(33.4)	(44.0)	(28.4)	(36.2)	(27.8)	(36.2)
Stimulus	220.6**	223.0*	214.9**	108.9	2.6	63.4	47.4	-22.1	15.7	66.3	73.5**	36.5
	(88.2)	(128.8)	(84.6)	(82.8)	(41.9)	(56.4)	(42.1)	(72.1)	(32.9)	(49.5)	(36.9)	(42.8)
Observations	1,252	1,424	1,605	1,260	1,252	1,424	1,605	1,260	1,252	1,424	1,605	1,260
R^2	0.784	0.368	0.783	0.842	0.752	0.518	0.776	0.8	0.768	0.577	0.79	0.836
	Transportation per Pupil				Student Activities per Pupil				Utilities and Maintenance per Pupil			
Panel B	Camden	Edison	Newark	Wayne	Camden	Edison	Newark	Wayne	Camden	Edison	Newark	Wayne
Percentage shift in 2008-09	-6.42***	-4.35**	-1.06	-2.83	1.38	-0.60	-0.23	2.72	-2.16	-0.17	-2.69**	-2.41
Percentage shift in 2009-10	-9.2***	-7.47***	-4.27**	-3.95	0.75	1.56	0.76	0.16	-4.50***	-2.22	-5.48***	-4.86***
Pre-recession base	726	811	822	612	223	253	264	269	1,540	1,659	1,616	1,616
Trend	23.8***	15.5***	11.8***	4.2	4.6***	6.2***	4.5***	5.1***	49.9***	55.6***	43.3***	34.0***
	(2.3)	(2.2)	(2.0)	(3.3)	(0.7)	(0.7)	(0.7)	(0.7)	(3.2)	(4.7)	(2.6)	(3.2)
Recession	-46.6***	-35.3**	-8.8	-17.4	3.1	-1.5	-0.6	7.3	-33.2	-2.9	-43.5**	-39.0*
	(15.0)	(17.8)	(13.6)	(30.4)	(5.3)	(5.7)	(5.9)	(5.2)	(22.3)	(29.2)	(21.4)	(23.1)
Stimulus	-20.1	-25.3	-26.4	-6.8	-1.4	5.5	2.6	-6.9	-36.1	-33.9	-45.1*	-39.5
	(18.8)	(21.1)	(16.8)	(35.4)	(6.6)	(7.5)	(6.9)	(6.1)	(27.3)	(37.1)	(26.8)	(30.4)
Observations	1,252	1,424	1,597	1,260	1,229	1,412	1,595	1,259	1,252	1,424	1,605	1,260
R^2	0.897	0.777	0.916	0.738	0.959	0.946	0.962	0.971	0.849	0.482	0.813	0.899

Table 6 (continued)

Heterogeneities by School District Metropolitan Area

	Median Teacher Salary				Median Teacher Years of Experience			
Panel C	Camden	Edison	Newark	Wayne	Camden	Edison	Newark	Wayne
Percentage shift in 2008-09	0.02	1.87**	1.89***	2.87***	3.62	11.78***	12.51***	13.11***
Percentage shift in 2009-10	4.27***	7.64***	7.76***	9.47***	7.24***	22.48***	21.9***	25.14***
Pre-recession base	56,138	55,400	58,511	60,527	11.05	9.34	9.59	9.15
Trend	-66.3	-493.4***	-607.1***	-1,087.2***	-0.3***	-0.5***	-0.5***	-0.7***
	(74.3)	(79.1)	(76.0)	(105.8)	0.0	0.0	0.0	0.0
Recession	11.7	1,037.6**	1,106.8***	1,734.9***	0.4	1.1***	1.2***	1.2***
	(436.7)	(471.4)	(427.6)	(560.0)	(0.3)	(0.2)	(0.2)	(0.2)
Stimulus	2,383.8***	3,195.2***	3,430.8***	3,995.3***	0.4	1.0***	0.9***	1.1***
	(530.4)	(559.4)	(504.9)	(617.4)	(0.3)	(0.3)	(0.2)	(0.3)
					1,042.0	1,181.0	1,335.0	1,047.0
Observations	1,042	1,181	1,335	1,047				
R^2	0.809	0.788	0.813	0.812	0.718	0.692	0.694	0.698

Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary, Taxpayers' Guide to Education Spending, and Report Card data.

Notes: Robust standard errors are in parentheses. All regressions control for racial composition and percentage of students eligible for free or reduced-price lunch, and include school district fixed effects. Pre-recession base is expressed in 2010 constant dollars.

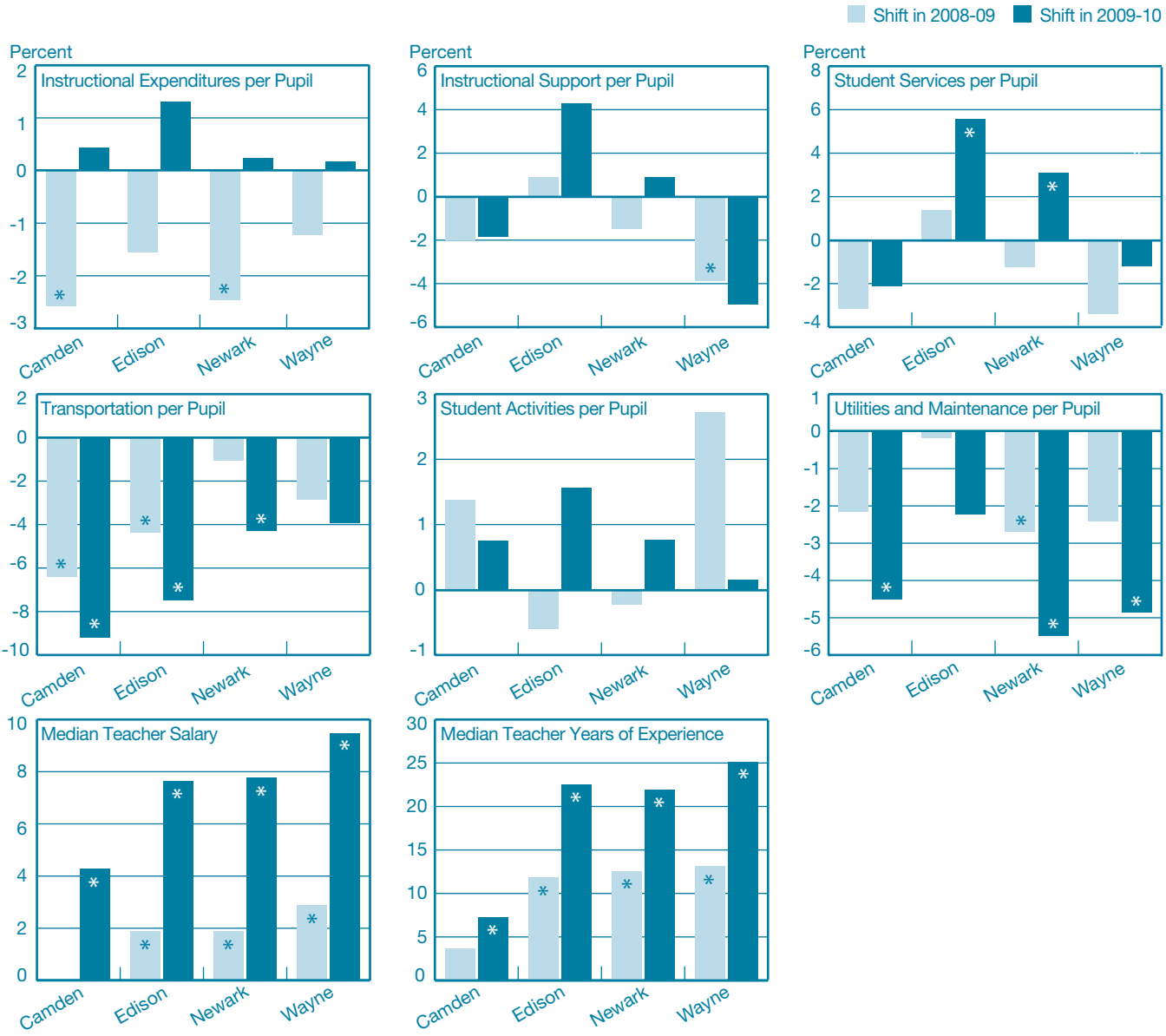
***Statistically significant at the 1 percent level.

**Statistically significant at the 5 percent level.

*Statistically significant at the 10 percent level.

Chart 9

Heterogeneities by School District Metropolitan Division

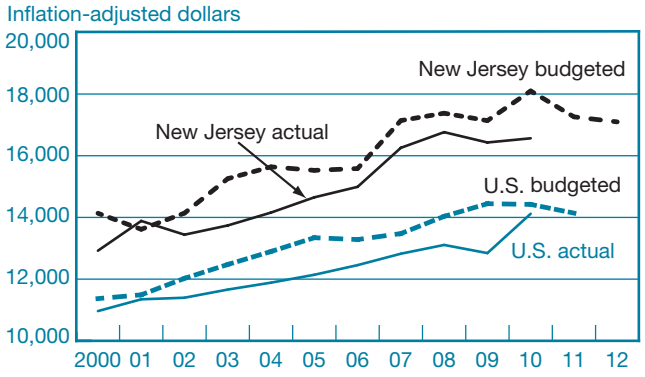


Sources: Authors' calculations, using the New Jersey Department of Education's Audit Summary, Taxpayers' Guide to Education Spending, and Report Card data.

Note: The * symbol denotes significance at the 10, 5, or 1 percent level.

Chart 10

Total Funding per Pupil: Budgeted versus Actual



Source: Authors' calculations, using U.S. Department of Education and New Jersey State Treasury data.

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Carlo Rosa

The Financial Market Effect of FOMC Minutes

- There is a vast array of evidence on the financial market effect of monetary news released on Federal Open Market Committee (FOMC) meeting days.
- Yet little is known about the real-time response of U.S. asset prices to the information contained in the FOMC minutes.
- This article uses a novel data set to examine the effect of the FOMC minutes release on U.S. asset prices.
- The release is shown to significantly affect the volatility of U.S. asset prices and their trading volume, with the magnitude of the effects economically and statistically significant.
- The asset price response to the FOMC minutes has declined since 2008, suggesting greater transparency by the Committee.

1. Introduction

Many studies have examined the influence of the Federal Reserve's unanticipated target rate decisions on U.S. asset prices.[1] A recent strand of literature has also looked at the asset price response to the Federal Open Market Committee (FOMC) statements.[2] Despite the vast and growing empirical evidence on the financial market effect of monetary news released on FOMC meeting days, little is known about the real-time response of U.S. asset prices to the information originating from central bank minutes. This article fills the gap by using a novel, high-frequency data set to broaden the understanding.

Central bank communication has become increasingly transparent over the past decade. This is important not only for reasons of democratic legitimacy and accountability but also for monetary policy to be most effective (Woodford 2005). Central banks use many communication channels, including media statements, press conferences, speeches, reports, and minutes. This article contrasts the effect of FOMC statement releases with that of FOMC minutes releases. These two releases differ mainly in the amount and timeliness of

[1] See, for example, Kuttner (2001), Rigobon and Sack (2004), Bernanke and Kuttner (2005), Fleming and Piazzesi (2005), Faust et al. (2007), and the references therein.

[2] See, for instance, Gurkaynak, Sack, and Swanson (2005) and Rosa (2011a, 2011b).

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their information. FOMC statements explain the rationale for the policy action and convey the outlook for the future monetary policy stance. FOMC minutes provide more detailed information on the range of Committee members' views on the appropriate policy stance, on the U.S. economic outlook, and on the near-term monetary policy inclination. The statement is released at the moment of the target rate decision, whereas the minutes come out three weeks after the FOMC meets. The extent to which market participants may scrutinize the FOMC minutes to gain information beyond what is contained in the statement is a question to be answered empirically.

The article's main findings can be summarized as follows. First, I examine the financial market effect of the release of FOMC minutes on U.S. asset prices (Treasury rates, stock prices, and U.S. dollar exchange rates) using a high-frequency, event-study analysis. The use of intraday data allows for better isolation of the response of asset prices to the minutes release, since no other economic news is systematically released within such a narrow (five-minute) window around the monetary announcement. The release of the minutes is shown to induce "higher than normal" volatility across different asset classes. For instance, the volatility of two-year Treasury yields is roughly three times larger on event days than during a period free of such an event. This finding suggests that the FOMC minutes provide market-relevant information and is consistent with the results of Boukus and Rosenberg (2006) showing that the themes of the FOMC minutes are correlated with current and future economic conditions.[3]

Second, to gauge the importance of the minutes' release, I compare the increase in the variance of U.S. asset prices attributed to the minutes with the response brought about by the release of the FOMC balance-of-risk statement, the nonfarm payroll macroeconomic announcement, and the Institute for Supply Management (ISM) manufacturing index (a purchasing survey of the U.S. manufacturing sector). The financial market effect of the FOMC minutes is similar to that of the ISM manufacturing index, although smaller than the market effect induced by the FOMC statement and nonfarm payrolls, often referred to as the "king" of announcements by market participants (Andersen and Bollerslev 1998).

Third, I document that the asset price response to the minutes has declined in the recent period. One potential interpretation of this finding is that the statement has become more informative and that the FOMC has put more effort into greater transparency by releasing information in a timelier manner.

Finally, the robustness of the above results is examined along several dimensions. For instance, I carry out the analysis using trading volumes, redo the computations on a different subsample, and perform a comparative exercise by looking at the financial market effect of the release of the Bank of England minutes. This sensitivity analysis corroborates the core finding that central bank minutes contain market-relevant information, especially for fixed-income securities.

The rest of the article is organized as follows. Section 2 describes the data set. In section 3, I discuss the empirical results of the asset price reaction to the release of FOMC minutes. The robustness of the results is examined in section 4, followed by a conclusion in section 5.

2. Data

The high-frequency data on U.S. asset prices I use consist of quotes measured at five-minute intervals of on-the-run two- and ten-year Treasury yields, futures prices on the S&P 500 stock index, and the U.S. dollar exchange rate against the euro, Swiss franc, and Japanese yen, covering the period January 2005 to March 2011. Prior to 2005, the FOMC minutes were released only after the next meeting had finished, rendering them largely of historical interest. The sample ends in March 2011 to exclude the period when the FOMC started to release the Summary of Economic Projections and to hold a press conference immediately after its meeting. Midpoints of bid/ask quotes or indicative quotes, observed at the end of each five-minute interval, are used to generate the series of (equally spaced) five-minute continuously compounded asset price returns.[4] The Treasury bond yields are provided by Tradeweb and are based on indicative prices, rather than transaction prices.[5] Hence, there are no associated volume data available. The S&P 500 futures data refer to the E-Mini S&P, a stock market index futures contract traded on the Chicago Mercantile Exchange's Globex electronic trading platform, and consist of both prices and trading volumes. A continuous series is constructed by considering the front-month contract, and rolling over to the next contract on expiration date. Foreign exchange data are provided by EBS (Electronic Broking System, now part of ICAP) and include trading volume in the global interdealer

[3] Similarly, Apel and Blix Grimaldi (2012) show that the sentiment of the Sveriges Riksbank minutes is useful in predicting the bank's future policy rate decisions.

[4] For instance, Bandi and Russell (2008) argue that five-minute returns provide a reasonable balance between sampling too frequently (and confounding price reactions with market microstructure noise, such as the bid-ask bounce, staleness, price discreteness, and the clustering of quotes) and sampling too infrequently (and blurring price reactions to news).

[5] Although the use of market data may be preferred, the existing literature on exchange rates (for example, Phylaktis and Chen [2009] and Danielsson and Payne [2002]) has documented that indicative data bear no qualitative difference from data on transaction quotes. Hence, it is extremely unlikely that the results of this study are driven by the use of indicative quotes.

Summary Statistics

	Two-Year Treasury	Ten-Year Treasury	S&P 500	Euro/U.S. Dollar	Swiss Franc/ U.S. Dollar	Japanese Yen/U.S. Dollar
Mean	0	0	0	0	0	0
Median	0	0	0	0	0	0
Maximum	0.21	0.18	4.32	1.57	2.32	2.5
Minimum	-0.44	-0.31	-2.95	-1.19	-2.27	-2.77
Standard deviation	0.01	0	0.09	0.04	0.05	0.05
Skewness	-2.14	-2.63	0.61	0.12	0.35	0.08
Kurtosis	253	221	74	47	78	122
Jarque-Bera *p*-value	0	0	0	0	0	0
Observations	221,729	287,575	406,727	452,549	447,342	450,427

Source: Author's calculations.

Notes: The table reports summary statistics for the variables used in the econometric analysis. The sample period is January 2005 to March 2011, excluding all weekend days. The asset price return is either the five-minute change in the bond yields or the five-minute percentage change in the stock price or the U.S. dollar exchange rate pairs.

spot market (see Chaboud et al. [2004] for a detailed description of the data).[6] As noted by Chaboud, Chernenko, and Wright (2008), EBS and Reuters are two electronic broking systems used globally for interdealer spot trading. Trading in the euro-dollar and dollar-yen currency pairs is concentrated primarily on EBS.

The table, which presents a selection of descriptive statistics for all variables used in this study, reveals that the mean and median of the five-minute bond yield changes and stock and exchange rate returns are very close to zero. All returns are approximately symmetric and all display excess kurtosis. The Jarque-Bera statistics strongly reject the null hypothesis that returns are normally distributed.

3. Results

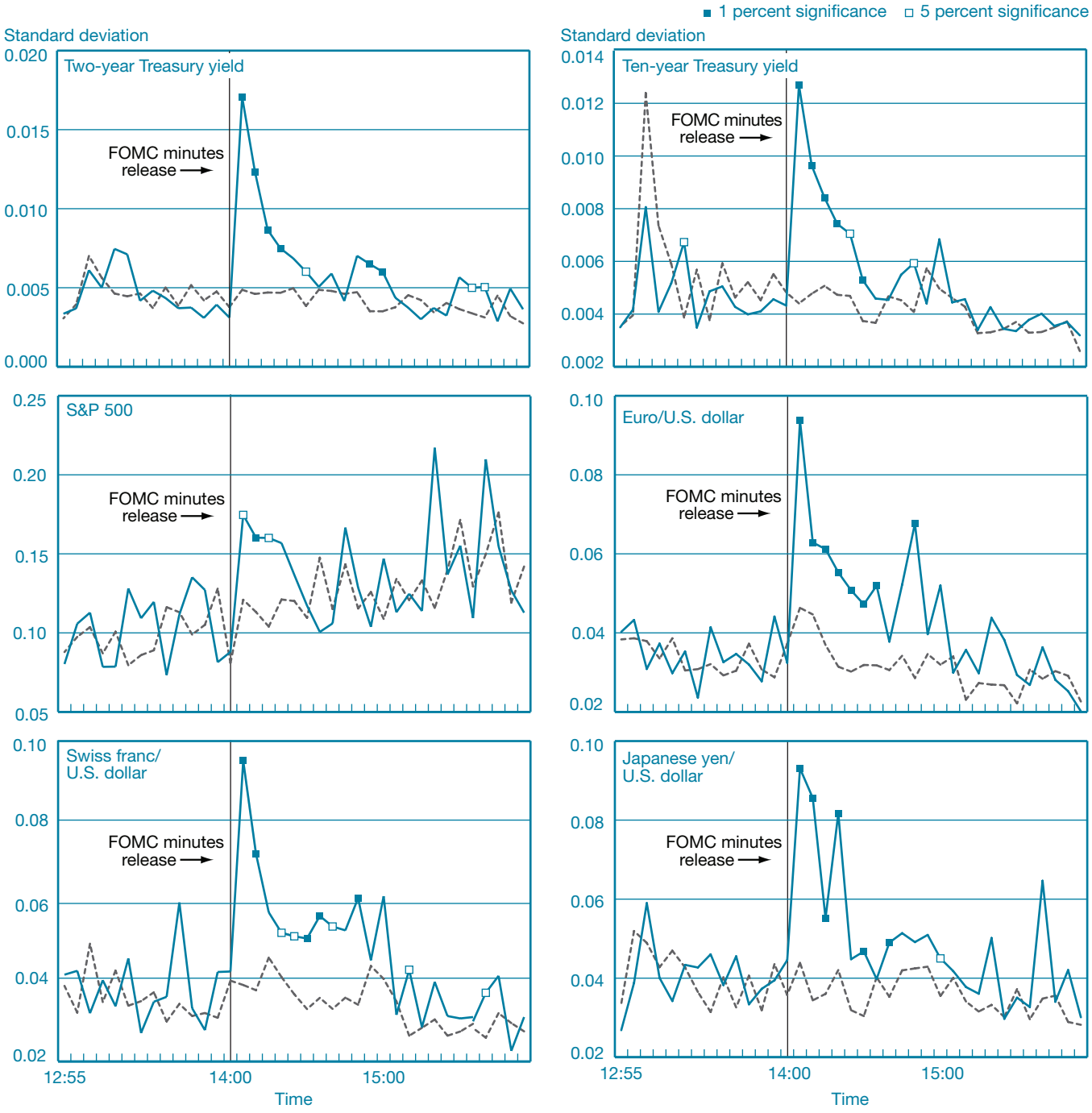
A model testing for the financial market effect of central bank minutes would ideally identify the surprise component of their content. Unfortunately, there are no direct measures of market expectations about the information contained in the FOMC minutes. Hence, to get around the difficulties of quantifying the surprise component, I follow the methodology of Kohn and Sack (2004) and look at whether, and to what extent, the volatility of asset prices is higher on release days compared with nonevent days. The idea is that as long as the content of the minutes is not always completely anticipated, the release of the minutes causes market participants to revise their expectations, and this should be reflected in higher volatility of asset prices compared with a period free of such an event. Since asset price volatility may be time-varying, it is important to properly control for both intraday and day-of-the-week effects when gauging whether the release of the minutes induces elevated price fluctuations. To that end, Chart 1 displays 1) the standard deviation of the five-minute returns on release days and 2) the standard deviation of the five-minute returns on the same weekdays (of the previous and following week of the release day of the FOMC minutes) and hours, but on nonannouncement days.[7] The vertical line is shown at the release time of the FOMC minutes, that is, 2 p.m. ET. The dark and white squares denote significance of the differences at the two-sided 1 and 5 percent levels, respectively. Since asset price returns are not normally distributed, I use the test statistic proposed by Levene (1960) to test the null hypothesis of equal variances in each subgroup. Fifty sets of FOMC minutes were published between January

[6] The foreign exchange trading volume data are proprietary; to preserve data confidentiality, I report only relative volumes expressed in ratio form, rather than as actual amounts of base currency.

[7] More specifically, for both announcement and nonannouncement days the standard deviation is defined as $\sqrt{\sum_{t=1}^{T}(r_t - \bar{r})^2/(T-1)}$, where r_t is the five-minute return, T is the number of observations in the sample, and $\bar{r}$ is the sample mean. As a robustness check, I also consider the squared root of the mean of squared returns, that is, $\sqrt{\sum_{t=1}^{T} r_t^2/(T-1)}$; the results (available upon request) remain extremely similar. To compute "normal" U.S. asset price volatilities, that is, the volatility that would be expected to prevail on control (or nonevent) days, as a further robustness check I also use the previous and following day of the release day of the FOMC minutes. It is reassuring that the results reported in Chart 1 continue to hold.

Chart 1

The Volatility of Asset Prices around FOMC Minutes Releases



Source: Author's calculations.

Notes: The chart plots the standard deviation of five-minute asset price returns around the FOMC minutes (solid line) and on control days (the same weekdays and hours of the previous and following weeks of the FOMC minutes release day; dashed line). The sample period is January 2005 to March 2011. The interval spans from one hour before to two hours after the event time. The vertical line signifies the release time of the FOMC minutes, 2 p.m. ET. Levene (1960) statistics are employed to test the null hypothesis of equal variances in each subgroup. Dark and white squares denote significance of the differences at the two-sided 1 and 5 percent level, respectively.

2005 and March 2011.[8] The release of the minutes induces significantly "higher than normal" volatility on asset prices, especially at the time of the release, and up to roughly one hour after the announcement. For instance, the volatility of two-year Treasury yields suddenly jumps at the time of the release—it is roughly three times larger on event days compared with a period free of such an event, and it remains significantly higher until around 3 p.m. ET. Treasuries, especially at shorter maturities, are the most affected asset class, closely followed by U.S. dollar exchange rates, whereas the response of stock prices is less pronounced, though still significantly higher than it is on nonevent days, and shorter-lived.[9]

This finding indicates that FOMC minutes provide market-relevant information that is incorporated into asset prices. To gauge the order of magnitude of these effects, I compare the increase in the volatility of U.S. asset prices attributed to the minutes with that induced by the release of the FOMC balance-of-risk statement, the nonfarm payroll macroeconomic announcements (one of the most closely followed announcements by the financial press), and the ISM manufacturing index. Panel A of Chart 2 shows that the FOMC statement exerts an economically large and highly significant effect on asset prices. For instance, the ten-year rate, S&P 500 stock prices, and the euro-dollar exchange rate are at least eight times more volatile on event days compared with nonevent days. The least affected asset price is the Japanese yen, but that is still four times as volatile as it is on normal days. The absorption of news is also more prolonged, taking roughly one hour and thirty minutes, compared with the time associated with the release of the FOMC minutes. As documented by Rosa (2011a), for U.S. stock and volatility indexes (the Dow Jones Industrial Average, NASDAQ 100, S&P 500, and VIX), after the initial effect the market will seek its new equilibrium, taking into account the additional information generated by the stock price changes following the FOMC announcements and the subsequent commentaries on the Federal Reserve's decisions provided in real time by financial analysts. Therefore, although the FOMC monetary news affects asset prices immediately, the market dynamics toward its new equilibrium are protracted and extend well beyond the initial effect. Consistent with the findings of Fleming and Remolona (1999) and Balduzzi, Elton, and Green (2001), I show in panel B of Chart 2 that nonfarm payrolls exert a similar effect on the release of FOMC statements and a much larger effect than does the response of asset prices to the release of FOMC minutes.[10] The response of ten-year Treasury rates and S&P 500 stock prices to nonfarm payrolls is smaller than the response induced by the FOMC statement, whereas the U.S. dollar exchange rates are more sensitive to nonfarm payrolls than to monetary news. To better assess the economic importance of the financial market effect of the release of the FOMC minutes, in panel C of Chart 2 I show that the release of the ISM manufacturing index induces "higher-than-normal" volatility that has roughly the same order of magnitude as the "excess" volatility induced by the minutes.[11] For instance, at the news release time (2 p.m. for the minutes and 10 a.m. for the ISM manufacturing index), the volatility of the two-year Treasury yield equals 0.016 (1.6 basis points) for both releases, compared with a "normal" volatility of 0.004.

I also investigate whether the informational content of the FOMC minutes has changed over time by splitting the sample into two subsamples. Chart 3 displays 1) the standard deviation of the five-minute returns on release days and 2) the standard deviation of the five-minute returns on the same weekdays (of the previous and following week of the release day of the minutes) and hours, but on nonannouncement days, for two samples: January 2005-December 2007 in panel A and January 2008-March 2011 in panel B. The chart documents that the overall level of volatility on nonevent days has increased during the financial crisis, especially for stock prices. Moreover, the level of asset price volatility on release days has become more similar to the level of volatility on control days for 2008-11 compared with 2005-07. One potential interpretation of this finding is that FOMC communication before the release of the minutes has become more informative, possibly indicating that the Committee has achieved greater transparency by releasing news in a more timely manner. A complementary interpretation is that the sensitivity of asset prices and, in particular, of interest rates, to news diminishes when short-term rates hit the zero lower bound. The evidence provided by Swanson and Williams (2012), however, rejects this hypothesis.

[8] The release dates can be found on the Federal Reserve Board's website, and are known to market participants well in advance.

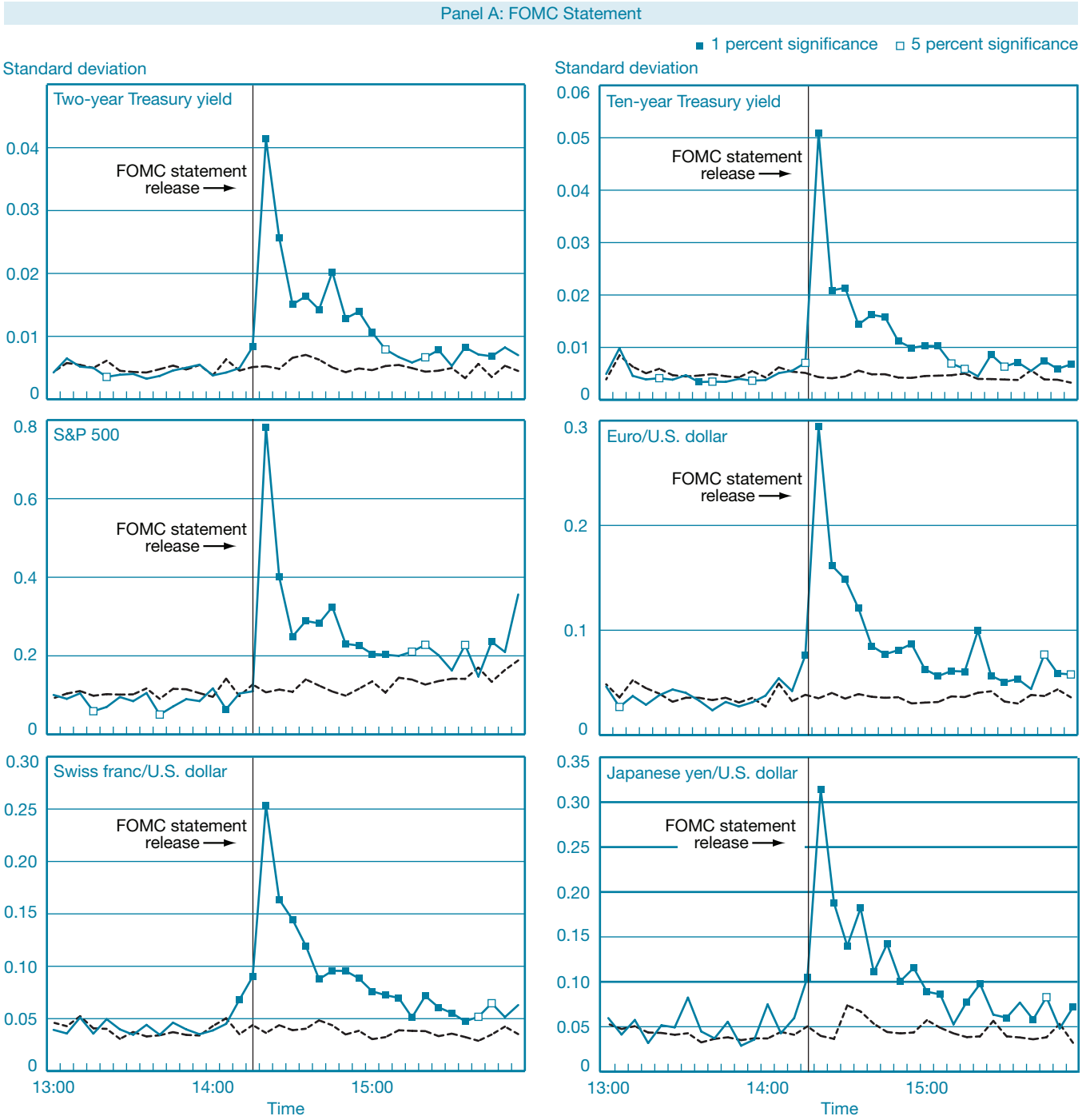
[9] Since writing this article, I have become aware of a very recent and somewhat related work by Jubinski and Tomljanovich (forthcoming) that looks at the intraday response of individual equity prices to FOMC minutes for a short, precrisis sample period (2006-07) using a GARCH model.

[10] The set of nonannouncement days for the nonfarm payroll release is defined as follows. First, I run the Bloomberg function "ECO United States," which provides time series data for all U.S. macroeconomic news stored by Bloomberg. Next, I select the same weekdays of the previous and following week of the release day of nonfarm payrolls. Finally, I define as nonannouncement days the subset of days that do not feature any 8.30 a.m. ET macroeconomic news releases.

[11] Strictly speaking, since the ISM index and the minutes are released at different times, given the intraday volatility pattern displayed by asset prices (as documented, for instance, in Andersen and Bollerslev [1997, 1998]), it is not possible to compare their financial market effects.

Chart 2

The Volatility of Asset Prices around FOMC Statement, Nonfarm Payrolls, and ISM Manufacturing Index Releases



Source: Author's calculations.

Notes: The chart plots the standard deviation of the five-minute asset price returns around the news release (solid line) and on control days (the same weekdays and hours of the previous and following weeks of the event day; dashed line). The sample period is January 2005 to March 2011. The interval spans from one hour before to two hours after the event time. The vertical line signifies the release time of the FOMC statement (see Rosa [2012] for the exact time stamps of the FOMC meetings) in panel A, nonfarm payrolls (8:30 a.m. ET) in panel B, and ISM manufacturing index (10:00 a.m. ET) in panel C. Levene (1960) statistics are employed to test the null hypothesis of equal variances in each subgroup. Dark and white squares denote significance of the differences at the two-sided 1 and 5 percent level, respectively.

Chart 2 (continued)
The Volatility of Asset Prices around FOMC Statement, Nonfarm Payrolls, and ISM Manufacturing Index Releases

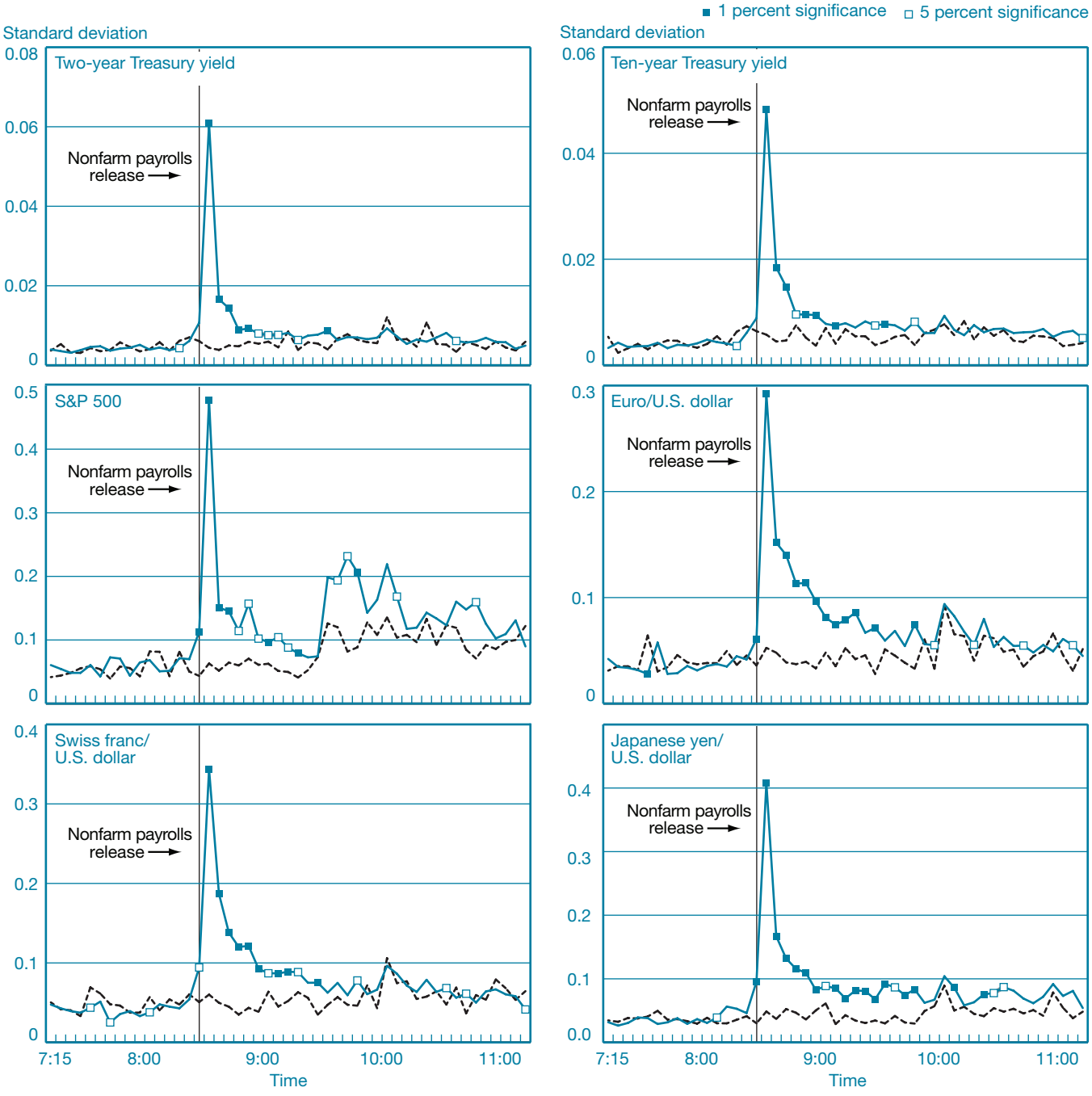
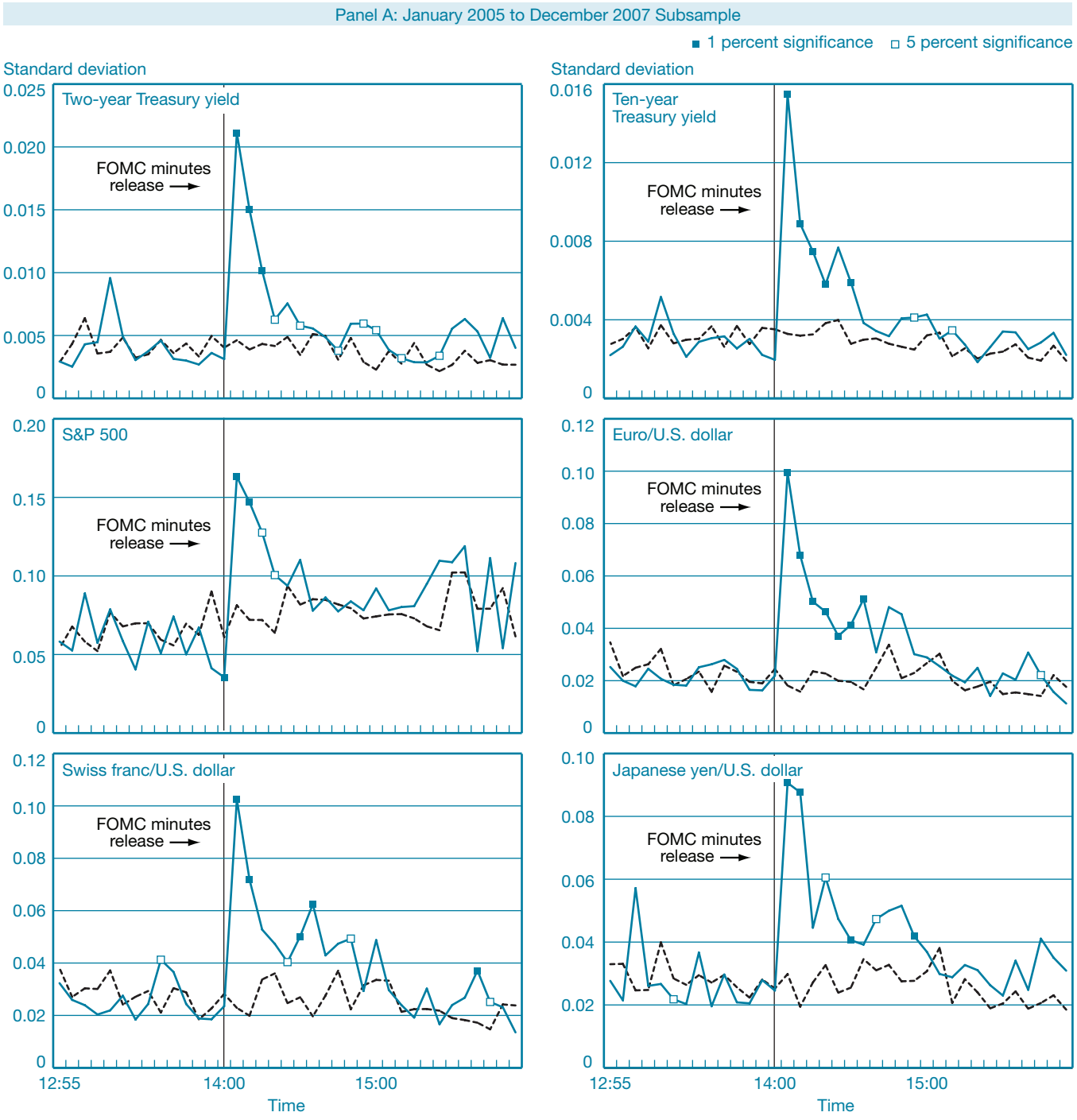


Chart 2 (continued)
The Volatility of Asset Prices around FOMC Statement, Nonfarm Payrolls, and ISM Manufacturing Index Releases

Chart 3
The Volatility of Asset Prices around FOMC Minutes Releases: Subsamples



Source: Author's calculations.

Notes: The chart plots the standard deviation of five-minute asset price returns around the FOMC minutes release (solid line) and on control days (the same weekdays and hours of the previous and following weeks of the FOMC minutes release day; dashed line) for two subsamples: January 2005 to December 2007 in panel A and January 2008 to March 2011 in panel B. The interval spans from one hour before to two hours after the event time. The vertical line signifies the release time of the FOMC minutes, 2 p.m. ET. Levene (1960) statistics are employed to test the null hypothesis of equal variances in each subgroup. Dark and white squares denote significance of the differences at the two-sided 1 and 5 percent level, respectively.

Chart 3 (continued)
The Volatility of Asset Prices around FOMC Minutes Releases: Subsamples

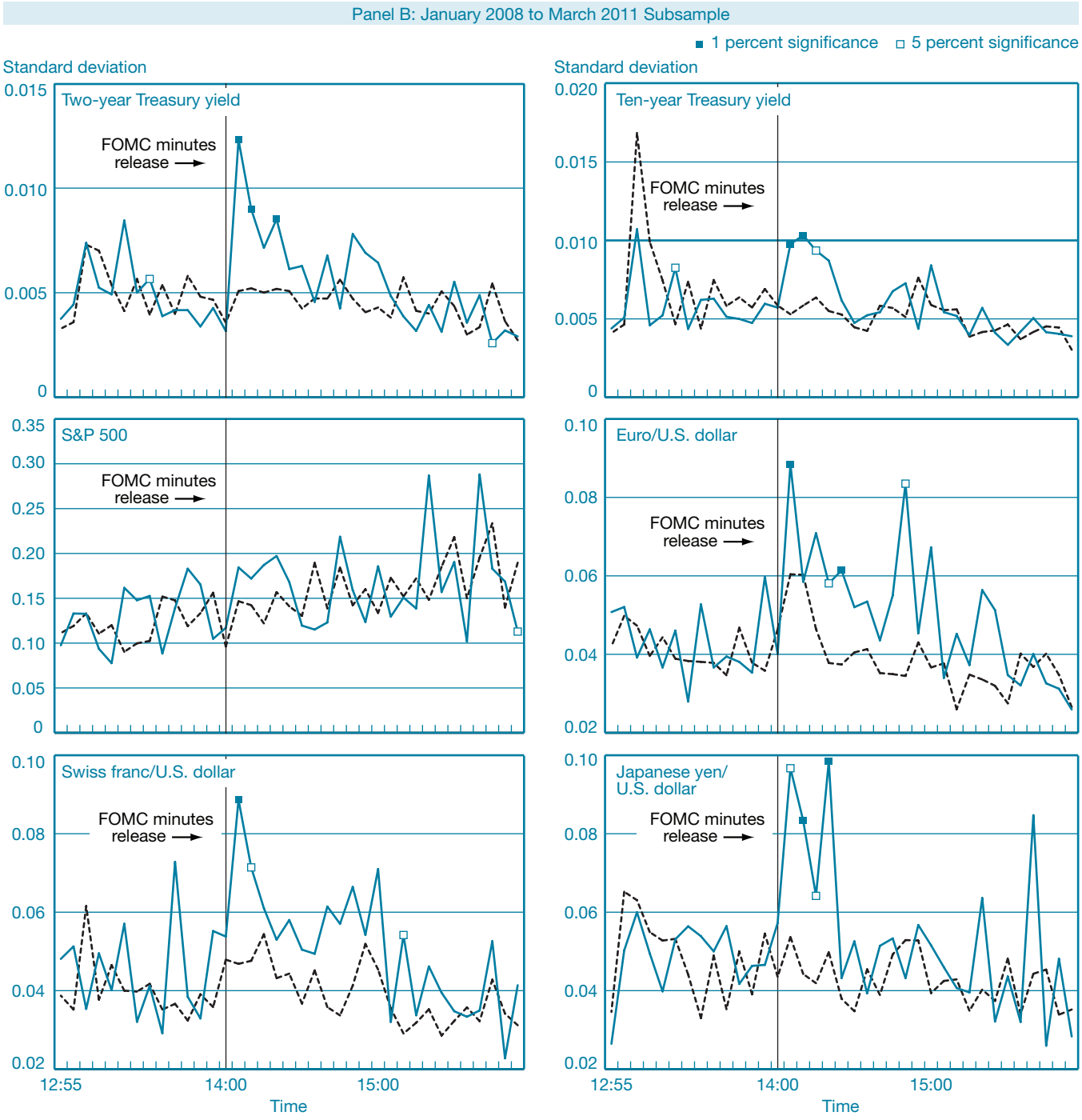
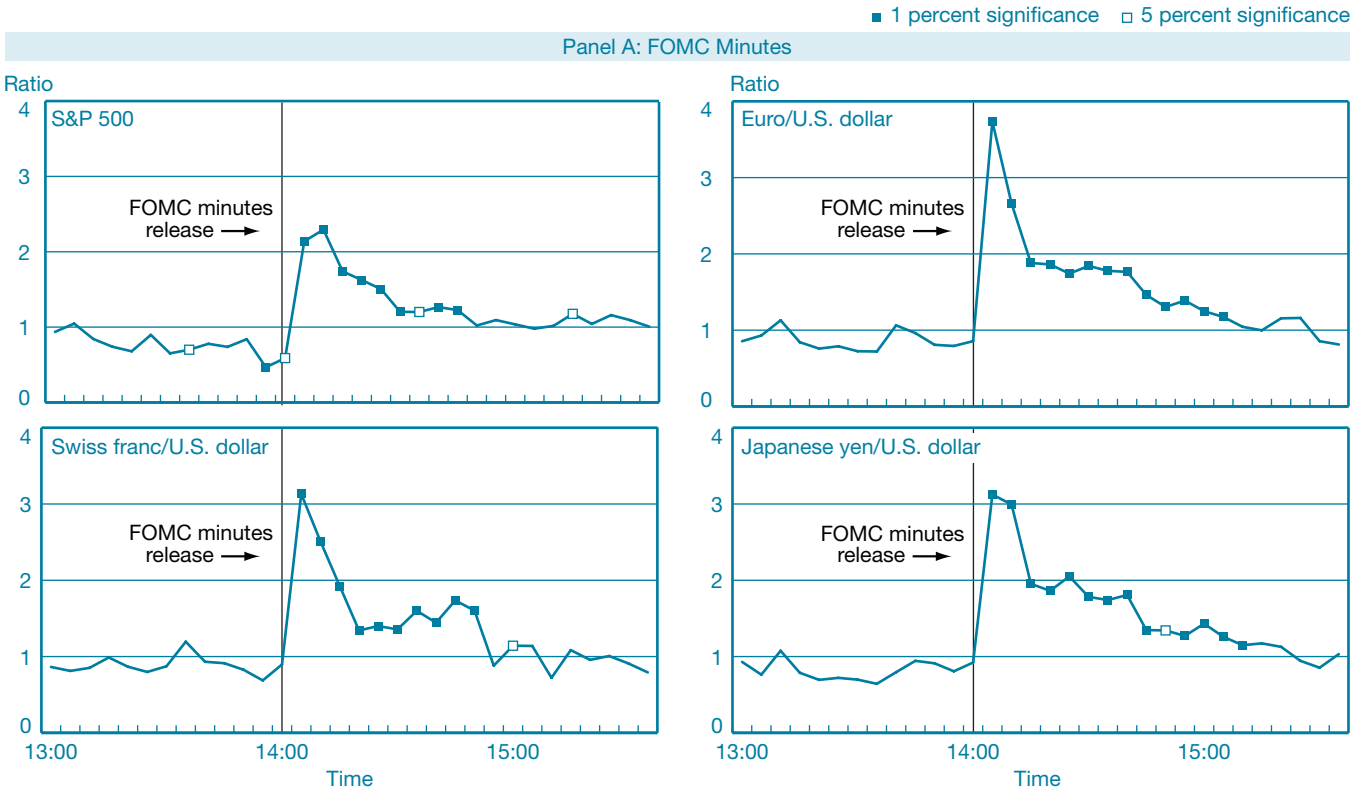


Chart 4
Trading Volumes around FOMC Minutes and Statement Releases



Source: Author's calculations.

Notes: The chart plots the median ratio between volumes around the FOMC minutes and statement releases and volumes on control days (the same weekdays and hours of the previous and following weeks of the event days). The sample period is January 2005 to March 2011. The interval spans from one hour before to two hours after the event time. The vertical line signifies the release time of the FOMC minutes, 2 p.m. ET, in panel A and of FOMC statements (see Rosa [2012] for the exact time stamps of the FOMC meetings) in panel B. The Wilcoxon signed ranks test (Newbold 1988) is employed to test the null hypothesis that the median ratio between five-minute volumes in the two subgroups equals 1. Dark and white squares denote significance of the differences at the two-sided 1 and 5 percent level, respectively.

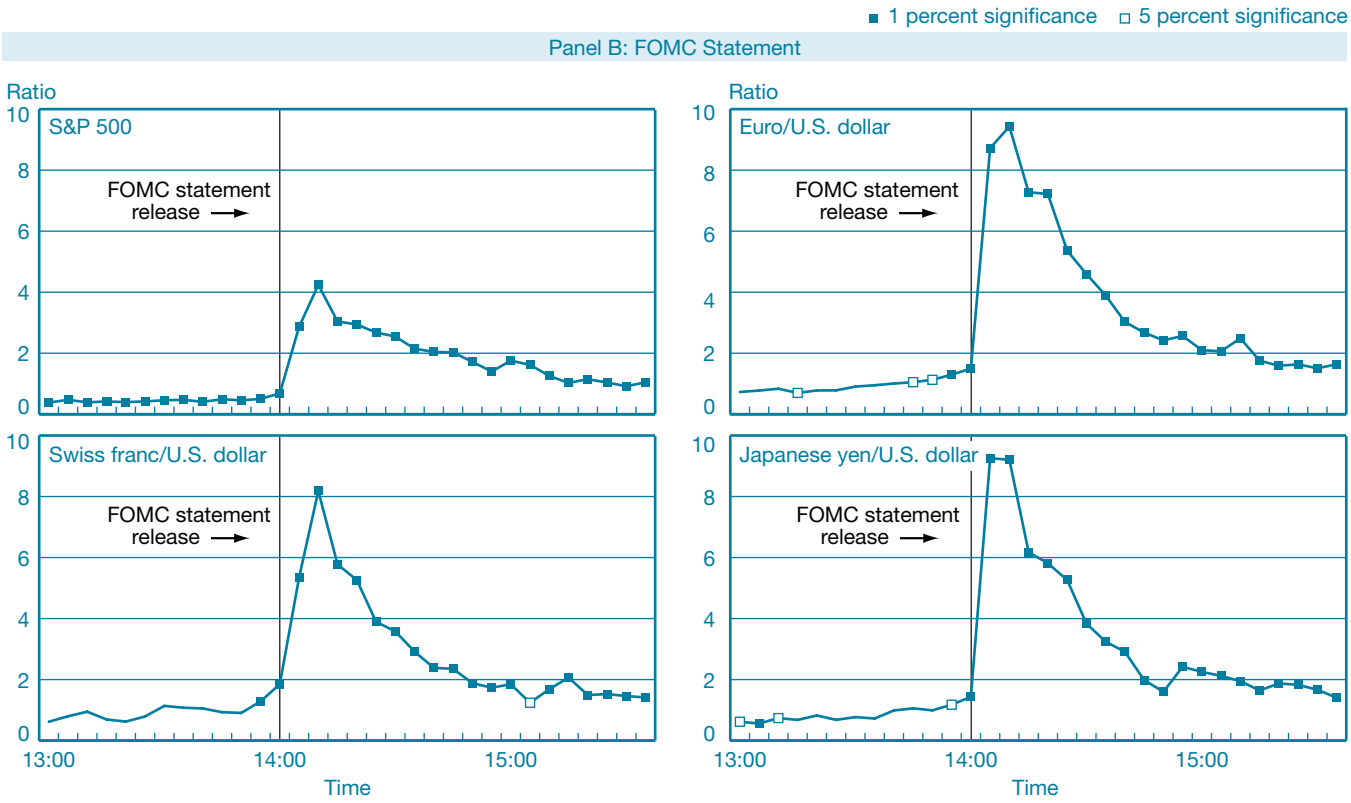
4. Robustness Checks

To test the robustness of the baseline results of the previous section, I also carry out the analysis using trading volumes for the S&P 500 stock index and U.S. dollar exchange rates, I redo the computations on a different subsample, and I look at the financial market effect of the release of the Bank of England minutes.

First, paralleling my earlier analysis on realized volatility, I examine the relationship between trading volumes and the arrival of news. To adjust for trend growth in trading volumes, and to avoid overweighting the most recent years, for each release day of the FOMC minutes I compute the ratio between 1) the five-minute volumes on release days and the average of 2) the five-minute volumes on the same weekdays (of the previous and following week of the release day of the FOMC minutes) and hours, but on nonannouncement days. Then I test the null hypothesis that the median ratio equals 1, that is, that the trading activity is the same on days of FOMC minutes releases and nonevent days. The Wilcoxon signed ranks test (see Newbold [1988]) is employed to account for the possibility that the ratio is not normally distributed. Since the existing literature documents a positive contemporaneous relation between volume and volatility (see Karpoff [1987] and more recently Giot, Laurent, and Petitjean [2010] for detailed surveys), I expect that volumes will also respond to the release of the FOMC minutes and statements.[12] Panel A of Chart 4 shows that trading activity is lower than normal before the

[12] For brevity, and because the results are very similar to those on volatility, I provide in a separate appendix (available on request) charts on trading activity around the release of nonfarm payrolls compared with nonevent days.

Chart 4 (continued)
Trading Volumes around FOMC Minutes and Statement Releases



release of the minutes, jumps at the time of the release, and then gradually returns to its normal level. The response is most pronounced for the euro (four times as large as on nonevent days) and least pronounced for the S&P 500 (twice as large), with the Swiss franc and Japanese yen lying in the middle (three times). Panel B indicates that trading activity around the release of the FOMC statement strongly and significantly increases for all assets, especially for the euro and yen (around ten times, compared with nonevent days).[13] The effect on volumes is persistent, and lasts at least one hour and thirty minutes after the event. Of note, the volume on the S&P 500 is especially low before the release time, suggesting highly significant *intraday* preannouncement effects in the stock market. In other words, stock traders restrain from transacting before the news release, and wait for resolution of the uncertainty regarding its outcome.[14] In summary, trading volumes respond similarly to volatility, with both stock prices and U.S. dollar exchange rates strongly affected by this monetary news.

Second, I examine whether the asset price response depends on the length of the FOMC meeting, namely, whether it is a one- or two-day event. Two-day meetings usually provide more time to discuss special topics. I find that the significant increase in volatility is not related to the type of FOMC meeting (results available upon request).

Finally, to show whether the results of increased volatility and volume on release days of FOMC minutes hold for other central banks, I examine the financial market effect of the Bank of England official communication. I look at two types of communication: the minutes of the Monetary Policy Committee (MPC) meetings and the Inflation Report. Since November 1998, the minutes have been published at 9:30 a.m.

[13] This finding is in line with the intraday results of Fleming and Remolona (1999) for the Treasury market and Fleming and Krishnan (2012) for the Treasury inflation-protected securities market. Fischer and Ranaldo (2011) show that daily global currency volumes increase on FOMC meeting days.

[14] This result is consistent with the "calm-before-the-storm" effect documented in Jones, Lamont, and Lumsdaine (1998) for macroeconomic news and Bomfim (2003) for FOMC target rate decisions.

London time on the Wednesday of the second week after the meetings take place; before that date, the Bank of England minutes were released after the following MPC meeting. The minutes provide information on the MPC's assessment of the economic outlook and risks, as well as on each Committee member's voting record and assessment of the future monetary policy stance. The Inflation Report is a quarterly publication containing the MPC's projections for output growth and inflation, presented in so-called "fan charts," as well as a detailed analysis of the economic outlook and risks. The report is released at 10:30 a.m. London time and is accompanied by a press conference. Overall, 147 minutes and 49 Inflation Reports have been published between January 1999 and March 2011. Consistent with the existing literature, I expect that U.K. assets react to Bank of England official communication.[15] Estimation results (available upon request) show that the volatilities of both five- and ten-year U.K. gilts are roughly twice as large at the release time of the minutes compared with nonevent days, and they remain larger than normal for around one hour after the event. Also, the British pound exchange rates (against the euro, U.S. dollar, and Japanese yen) significantly respond to the release of the minutes, whereas the volatility of the FTSE 100 is more muted and not significantly different from volatility during "normal" times. The volatility pattern around the release of the Inflation Report is similar to the pattern displayed around the release of the minutes. The major difference is that the Inflation Report has a stronger immediate effect on asset prices compared with the effect of the minutes. For instance, the volatility of the British pound exchange rate is roughly four times volatility on nonevent days. In summary, the empirical evidence supports the hypothesis that the Bank of England minutes and Inflation Report convey valuable information to investors, with the strongest effect on interest rates and exchange rates.

[15] Gerlach-Kristen (2004) documents that the MPC's voting record contained in the minutes helps predict the future Bank of England policy rate changes. Reeves and Sawicki (2007) investigate the effect of Bank of England communication between 1997 and 2004, and show that the minutes and the Inflation Report significantly affect daily U.K. short-term interest rates.

5. Conclusion

The high-frequency reaction of asset prices to news announcements represents a simple and precise tool for assessing how information is impounded into security prices. This article examines whether, and to what extent, the FOMC minutes contain market-relevant information by looking at asset price volatility and trading volume in a narrow window around the release of the minutes. The results show that the release significantly affects both the volatility of U.S. asset prices and their trading volume. The magnitude of these effects is similar to the financial market effect of a macroeconomic release such as the ISM manufacturing index, but is smaller than the market effect induced by the release of the FOMC statement and nonfarm payrolls. The asset price response to the minutes, however, has declined since 2008, suggesting the greater transparency of the FOMC.

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