Ekonomi-tek Volume / Cilt: 2 No: 1 January / Ocak 2013

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Editor's Introduction

This is the first issue of Volume two of *Ekonomi-tek*, featuring three notable papers. All three relate to the state of economics and economic policies during and after the recent global crisis, otherwise known as the "Great Recession." Two of the papers, the first and the third, were presented at the Third International Conference on Economics of the Turkish Economic Association (ICE-TEA) in November 2012.

We lead off with Joseph E. Stiglitz of Columbia University, recipient of the Nobel Prize in Economic Sciences in 2001 and president of the International Economic Association, 2011-14. In this paper, which is based on his keynote speech at ICE-TEA 2012, the author provides a comprehensive and critical assessment of mainstream macro-economics and outlines the deficiencies of several widely used macro-economic models.

The paper first discusses five key issues that have become part of recent policy debates, namely, the multiplier, contractionary expansion, deleveraging, the liquidity trap and the zero lower bound, and the new normal. It explains why the standard model not only fails to address these issues but offers a misguided framework for them. Then it highlights the glaring deficiencies in the "currently fashionable" standard model: how it ignores imperfections and information asymmetries, relies excessively on rational expectations, overlooks distribution, and fails to model the credit system, including banking and securitization. Ironically, most macro-models, even those used by Central Banks, do not have a "banking sector."

The author goes on to examine the issue of bank recapitalization and asserts that without good models of banking to guide them, monetary authorities were at a loss as to how best to restructure banks. He argues that standard macro-economic models were not designed with the right questions in mind, which he identifies as (a) what causes economic fluctuations, (b) why are declines so rapid, and (c) what explains the slow recoveries from recessions. Finally, Stiglitz gives us his take on the Euro crisis, describing the underlying structural properties of the Eurozone and critiquing the European govern-

ments' policy responses to the crisis. He also submits various policy prescriptions for the powers that be to consider.

The second paper in this issue is authored by Beniamino Moro of the University of Cagliari and gives an impressively detailed explanation of the "Great Crisis," first in the US, from 2007 to 2009, and then in the EU, from 2010 onwards. He shows how the starting point was a US banking crisis with roots in the shadow banking system, or the unregulated banking system. In this context, this author takes us through the complex workings of the banking system in general and the shadow banking system and securitization process in particular.

With the onset of the crisis in the US, there was a phenomenal rise in demand for collateral in the banking system, particularly in the repo and the derivatives markets. Moro stresses the central role played in this turbulent environment by the repo market. He also draws attention to managerial-compensation schemes, which are said to have played a significant role in the US crisis, with their excessive focus on short-term trading profits. The US's fiscal stimulus measures and monetary policy changes, such as quantitative easing, in response to the crisis are also evaluated.

The rest of this paper is devoted to analyzing the EU crisis, which he describes as distinct twin sovereign-debt and banking crises that have mutually fueled each other. Beyond that, Moro peers into the debt-ridden PIIGS countries, recounting the evolution of the fateful financial events and policies there, with an emphasis on Greece. He points to widespread mispricing of risk by capital markets and the resultant misallocation of capital as key factors contributing to the EU crisis.

In the third paper of this issue, Varvara Isyuk of the Centre d'Economie de la Sorbonne, Université Paris 1, examines an interesting scheme called the Capital Purchase Program (CPP), implemented by the US Treasury during the period October 2008-December 2009, as a response to the financial crisis in that country. Under the CPP, the US Treasury injected a huge amount of liquidity (some $205 billion) into 707 banks through the purchase of preferred equity stakes. Not all banks were automatically eligible for the CPP funds; a bank had to request participation in the CPP by applying to the Federal Banking Agency (FBA) and be accepted by the Treasury.

By analyzing the bailout repayments over the four years following the disbursement of the CPP funds, Isyuk has arrived at an empirical evaluation of the efficacy of the program. The results of multinomial logit regression analysis show that the CPP was actually designed to provide liquidity to systemically critical and "too big to fail" commercial banks. At the same time, these

banks were more likely to repurchase their shares from the Treasury than other banks.

The paper argues that saving these banks helped to avoid large external costs that would have been incurred in the event of a widespread collapse of the banking sector; as an additional bonus, taxpayer money was returned in a relatively short period of time. By end-April 2013, the Treasury had recovered $222 billion—more than what it had originally paid out through the CPP—in the form of repayments, dividends, interest, and other income.

Let me end by noting that the next issue of *Ekonomi-tek* will contain a paper by David Colander, well known for his studies of the economics profession, economics education, and complexity and applied-policy economics.

We hope you will be pleased with this issue, as well as with the coming issues.

Ercan Uygur
Editor
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Editörün Sunuşu

Ekonomi-tek'in bu sayısı ikinci Cildin ilk sayısıdır ve dikkat çeken üç makale içermektedir. Her üç makale de, iktisadın ve iktisat politikalarının yakın geçmişteki küresel bunalım veya sıkça kullanılan diğer adıyla "Büyük Durgunluk" sırasındaki ve sonrasındaki durumu ile ilgilidir. Makalelerden ikisi, birinci ve üçüncü, Türkiye Ekonomi Kurumu'nun Kasım 2012'de düzenlediği Üçüncü Uluslararası Ekonomi Konferansı'nda, UEK-TEK'de sunulmuştur.

Columbia Üniversitesi öğretim üyesi, 2001 yılı Ekonomi Bilimleri Nobel ödülü sahibi ve 2011–2014 dönemi Uluslararası Ekonomi Birliği (International Economic Association) başkanı Joseph E. Stiglitz'in makalesiyle başlıyoruz. Yazarın UEK-TEK 2012'de ana davetli konuşmacı olarak yaptığı konuşmasına dayanan bu makalede yazar, ana-akım makroiktisadın kapsamlı ve eleştirel bir değerlendirmesini yapmakta ve yaygın olarak kullanılan makroekonomik modellerin eksikliklerine işaret etmektedir.

Makale ilk olarak yakın geçmişteki iktisat politikası tartışmalarında anahtar konumunda olan beş kavramı incelemektedir. Bunlar; çarpan etkisi, daralmacı genişleme, borçluluğun düşürülmesi, likidite tuzağı ve sıfır alt sınır ile yeni normal'dir. Bu kavramların standart model içinde neden kullanılıp ele alınamadığı ve bu bağlamda bu modelin neden yanlış yönlendirme yaptığı da burada açıklanmaktadır. Makale bundan sonra "günün modası" olan standart modelde göze batan eksikliklere vurgu yapmaktadır. Piyasa aksaklıklarını ve bilgi asimetrilerini dikkate almaması, aşırı biçimde rasyonel beklentilere dayanması, bölüşümü görmezden gelmesi ve bankacılık ve menkul kıymetleştirmeyi de içeren kredi sistemine yer vermemesi bu eksikliklerden bazılarıdır. Hazin olanı, aralarında Merkez Bankalarının bile kullandığı birçok makroekonomik modelde bankacılık sektörünün yer almamasıdır.

Yazar bu konuyu bankacılıkta sermaye yapılanmasını incelemekle sürdürmekte ve şu noktayı vurgulamaktadır; kendilerine yol gösterecek iyi bankacılık modelleri olmadığından, para otoriteleri bankacılığın en iyi biçimde nasıl yeniden yapılandırılacağı konusunda kaybolmuş durumdadırlar. Standart makroekonomik modellerin akıllarda doğru sorular taşınarak tasarlanmadığı görüşünde olan yazar, doğru soruları şöyle sıralamaktadır; (a) ekonomik dalgalanmaların nedeni nedir, (b) ekonomik düşüşler neden çok hızlıdır, (c) dur-

guluklardan çıkışlar neden çok yavaş olmaktadır. Son olarak Stiglitz, Euro bunalımı konusundaki görüşünü sunmakta ve Eurozone bölgesinin yapısal özelliklerini tanımlayıp Avrupa hükümetlerinin bunalım karşısındaki politika tepkilerini eleştirmektedir. Ayrıca, yönetenlerin dikkate alması için çeşitli iktisat politikası reçeteleri sunmaktadır.

Bu sayıdaki ikinci makale İtalya Cagliari Üniversitesi'nden Beniamino Moro tarafından yazılmıştır ve önce 2007'den 2009'a ABD'de, sonra 2010'dan bu yana AB'de oluşan "Büyük Bunalım" konusunda ayrıntılı açıklamalar içermektedir. Yazar, bunalımın ABD'de bankacılık bunalımı olarak başladığını ve köklerinin bu ülkedeki denetimsiz bankacılık olarak da bilinen "gölge bankacılık" kesiminde olduğunu göstermektedir.

Bu çerçevede yazar bizi genel olarak bankacılık sisteminin karmaşık işleyişine, özel olarak gölge bankacılık ve menkul kıymetleşme süreçlerine götürmektedir.

ABD'de bunalımın başlamasıyla bankacılık kesiminde, özellikle de repo ve türev piyasalarında teminat talebinde çok büyük bir artış oldu. Moro, bu çalkantılı ortamda repo piyasasının oynadığı merkezi role vurgu yapmaktadır. Yazar, ABD'deki bunalımda önemli bir rolü olan ve kısa vadeli işlemlerden elde edilen karlara aşırı odaklanan işletme yöneticilerinin ödeme sistemine dikkat çekmektedir. Makalede ayrıca ABD'nin bunalıma karşı tepki olarak getirdiği mali canlandırma önlemleri ve miktar gevşemesi gibi para politikası değişiklikleri de değerlendirilmektedir.

Makalenin geri kalan bölümü AB bunalımına ayrılmıştır ve bu bölgedeki bunalım, bir yandan kamu borcu, diğer yandan bankacılık olmak üzere iki ayrı bunalımın birbirlerini karşılıklı beslemesi şeklinde tanımlanmıştır. Bundan öte Moro, borç batağındaki PIIGS ülkelerindeki (Portekiz, İrlanda, İtalya, Yunanistan ve İspanya), finansal gelişmelerin ve politika tepkilerinin, özellikle Yunanistan'dakilere ağırlık vererek, evrimini ele almaktadır. Burada, AB bunalımında anahtar unsurlardan birisini oluşturan sermaye piyasalarının yaptığı yaygın hatalı risk fiyatlamasına işaret etmektedir.

Bu sayının üçüncü makalesinde Paris 1 Üniversitesi, Sorbonne Ekonomi Merkezi'nden Varvara Isyuk, finansal bunalıma tepki olarak ABD Hazinesi tarafından Ekim 2008-Aralık 2009 döneminde uygulanan Sermaya Satınalma Programı (CPP-Capital Purchase Program) olarak adlandırılan ilginç bir uygulamayı incelemektedir.

CPP uygulamasında ABD Hazinesi tercihli pay senedi satınalma yoluyla, 707 bankaya 205 milyar doları bulan çok büyük bir nakit aktarımı yaptı. CPP fonlarına tüm bankaların otomatik katılma hakkı yoktu; fona katılabilmek için

bir bankanın önce Federal Bankacılık Kurumu'na (Federal Banking Agency) başvurması ve sonra da bu başvurusunun Hazine tarafından kabul edilmesi gerekiyordu.

CPP fonlarının kullanılmasından sonraki dört yıllık süredeki geri ödemeleri inceleyen Isyuk, CPP programının etkinliğini ekonometrik olarak değerlendirmiştir. "Multinomial Logit" yöntemiyle yaptığı tahmin sonuçları, CPP'nin gerçekte "batmasına izin verilemeyecek kadar büyük" ticari bankalara nakit aktarma amacıyla tasarlandığını göstermektedir. Aynı zamanda, bu büyük bankaların pay senetlerini Hazinden geri alma olasılıklarının diğer bankalara göre daha yüksek olduğu ortaya çıkmaktadır.

Makale, bankaların kurtarılması işlemiyle, bankacılık sektöründe oluşabilecek geniş bir çöküntünün yarattığı dışsal maliyetin önüne geçildiğini; bu işlemin ek bir getirisinin de vergi ödeyenlerin paralarının kısa sürede geri dönmesini sağlaması olduğunu savunmaktadır. 2013 Nisan sonu itibariyle, Hazine dağıtılan fonlardan 222 milyar dolar getiri sağladı; bu miktar, geri ödemelerden, temettülerden, faiz ve diğer gelirlerden oluştu.

Gelecek sayıya ilişkin bir noktayı belirterek bitirmek istiyorum; *Ekonomi-tek'in* gelecek sayısında iktisat mesleği, iktisat eğitimi, karmaşıklık ve uygulamalı iktisat politikası çalışmalarıyla bilinen ünlü iktisatçı David Colander'ın bir makalesi yer alacaktır.

Bu sayının ve gelecek sayıların sizleri içerikleriyle mutlu kılacağı umudundayız.

Ercan Uygur
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Ekonomi-tek Volume / Cilt: 2 No: 1 January / Ocak 2013, 1-39

Stable Growth in an Era of Crises: Learning from Economic Theory and History

Joseph E. Stiglitz[*, **]

Abstract

The financial crisis and the Great Recession to which it gave rise exposed the deep flaws in standard macro-economic models, and in the way those models were deployed. In this paper, based on a talk given to the Turkish Economic Association in November 2012, Joseph E. Stiglitz discusses the range of these deficiencies and the ways in which the models must be reformed.

The paper first examines five particular issues in the current policy debate and explains why the standard model provides a misguided framework for addressing them. The paper identifies the fundamental flaws in the standard model, and argues that in trying to fine tune the models for "normal" periods, it failed to address the more profound question of how to explain deep downturns, including slow recoveries.

A central lacuna is the lack of attention to credit and the institutions providing it. It explains how a better understanding of banks would have led to better ways to recapitalize the banking system than those employed in the aftermath of the crisis. Finally, the paper relates all of these issues to the ongoing Euro crisis, showing in particular that the structure of the euro, though seemingly designed to improve the efficiency of resource allocations, has actually created an unstable and inefficient system.

JEL Codes: E1, E3, E4, E5, E6
Keywords: State of macroeconomics, macroeconomic models and their deficiencies, economic crises, macroeconomic policies, recapitalization of the banking system, the Euro crisis.

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* Paper presented to the Turkish Economic Association on November 2, 2012. This lecture is based on joint research over a long period of time with Bruce Greenwald, to whom I am greatly indebted. It builds on Stiglitz (2011). I am also indebted to Arjun Jayadev and Rob Johnson for discussions on the issues raised in this lecture. Financial support from the Institute for New Economic Thinking (INET) is gratefully acknowledged.

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1. Introduction

No one would, or at least should, say that macro-economics has done well in recent years.[1] The standard models not only didn't predict the Great Recession, they said it couldn't happen—bubbles don't exist in well-functioning economies of the kind assumed in the standard model. Not surprisingly, even after the bubble broke, they didn't see the full consequences, and they haven't provided good guidance to policymakers in responding to the crisis. A half decade after the bursting of the bubble, US unemployment is still high—with almost one out of six Americans who would like a full-time job not being able to get one. The government is still financing almost all mortgages.

So, too, our standard models didn't predict the follow-on Euro crisis, neither its occurrence nor its evolution. The test of science is prediction—and one should have some skepticism of a model that can't predict the two biggest macro-events of the last 80 years. A model whose predictive ability is so weak can hardly be relied upon for policy guidance.

In my Adam Smith lecture before the European Economic Association (Stiglitz, 2011), I delineated what I thought were the major deficiencies in the standard model, the Dynamic Stochastic General Equilibrium Model, that evolved out of the representative agent models popular in earlier years. As I emphasized, it is fully appropriate for a macro-economic model to be dynamic, to be stochastic, and to aim for general equilibrium. And any model is a simplification of reality, so it is not a criticism that many things are not included in the model.

The model is, however, rightly criticized for leaving out several aspects of the economy that are central to understanding economic performance in these crises, for making behavioral assumptions that are questionable at best, and for focusing excessive attention on certain aspects of economic behavior that are not central to short-run macro-economic performance.

My talk this afternoon has five sections. The first four are devoted to discussing the general deficiencies in the model, particularly as they apply to understanding this crisis. This should provide guidance to thinking about how macro-economics can and should be reformed. Section 2 looks at five particular issues in the current policy debate and explains why the standard model either does not address them, or provides a framework for addressing

[1] It is striking that Edward C. Prescott once alleged that this is the "golden age of economics." (See his April 2006 lecture at Trinity University in San Antonio, Texas, available at http://www.trinity.edu/nobel/Prescott/Prescott_Webquotes.htm (accessed June 12, 2013).

them that is misguided. Section 3 focuses more narrowly on the deficiencies in the currently fashionable standard model, largely from a theoretical perspective. Section 4 suggests that part of these deficiencies arises from the fact that it has focused on the wrong question; it suggests the questions it should have focused upon. The fifth section looks at one issue in particular that was central to the policy debates four years ago: the best way to recapitalize the banking system.

In the last part of this paper, I focus more narrowly on the issue of the day, the Euro crisis.

2. What's Wrong with Current Macro-economics

Before turning to a more general theoretical discussion of the deficiencies in the standard model, I want to discuss five key issues that have become part of recent policy debates.

Current Policy Debates

A. The Multiplier[2]

There has been considerable discussion of the magnitude of the multiplier associated with government spending, with critics of expansionary government spending suggesting that it is low, zero, or even negative. They look at the experience of different countries over long time periods. Such analyses should be an important warning of the foolishness of mindless regressions. Of course, when the economy is at or near full employment, the multiplier (correctly measured) will be low. Even then, measurement problems (GDP is not a good measure of economic output, providing only a biased estimate of economic performance when the share of government expenditure increases.[3]) and econometric problems bedevil such analyses. But the question is, what will the multiplier be when there is a high level of unemployment and large underutilization of capacity? Since we have not had the levels of unemployment and capacity utilization that we are now experiencing since the Great Depression of the 1930s—and the structure of the economy was markedly different during the Great Depression than now—there is no way we can, with confidence, extrapolate the experiences of previous post- Depression downturns to the current situation.

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[2] For a discussion of some of the issues raised here, see Solow (2012).

[3] See Stiglitz, Sen, and Fitoussi (2010).

Economic theory, though, provides a compelling framework for analysis. The problem is lack of aggregate demand. Government spending increases aggregate demand. We can identify leakages (from savings and imports) and, on the basis of that, calculate the multiplier. Traditional analyses, based on downturns of short duration, focused on one-period multipliers: two years from now, the thinking went, the economy would presumably be back to full employment, and the multiplier would be zero. But this downturn is long term, so in calculating the multiplier, we should calculate the impacts not just for this period, but for subsequent periods as well.

For the United States, this kind of analysis yields a multi-period multiplier (with reasonable values of savings and import coefficients) in the range of 1.5 to 2.

The next question is: are there reasons to believe that there are reactions from market participants that will amplify or reduce these effects, i.e., are there "crowding in" or "crowding out" effects? Again, in normal periods, the Central Bank, worried about an overheated economy, raises interest rates and tightens credit, discouraging investment. The result is that government spending crowds out private investment. But now, the Fed is committed to keeping interest rates low and doing what it can to increase the availability of credit. This explains again both why estimates of the multiplier based on normal periods are irrelevant, and why, in this case, the multiplier will not be reduced by crowding out of investment. There may, in fact, be crowding in of investment—if government spending, for instance, goes to public investment, and public investment is complementary to private investment. Alexander Field (2011), for instance, makes a persuasive case for the theory that infrastructure investment during the Depression enhanced private-sector productivity, and that this helped lay the foundations for strong growth after World War II.

Barro-Ricardo, reasoning similarly, suggests that the increased indebtedness of government will lead to more savings (to offset future tax liabilities). There is little evidence of such an effect in recent years; in fact, the Bush tax cuts gave rise to soaring deficits, which were followed by savings falling to near zero.[4] To believe in the Barro-Ricardo model, one would have to hypothesize that in the absence of the tax cut, savings would have been markedly negative.

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[4] The St. Louis Fed tracks personal savings rate on its website at http://research.stlouisfed.org/fred2/data/PSAVERT.txt (accessed October 31, 2012); the historically low personal savings rates during the Bush years are clear here. See also Delli Gatti *et al*. (2012a and 2012b).

The criticisms of the hypothesis are well known: it ignores capital constraints and distributive effects. Indeed, there may even be "crowding in" of consumption. First, if government spending is for high-return investment, in a period such as the current one where government can borrow at a negative real interest rate, the government's balance sheet will be improved; thus (in the world of rationality, in which taxpayers see through the public veil), savings would be reduced.[5] Moreover, if, as we have already noted is the case now, the downturn is likely to extend for several periods, some of today's savings will be for future consumption; with rational expectations, individuals would then know that incomes in future periods will be higher than they otherwise would have been, meaning that their lifetime budget constraint has moved out. This leads to increased consumption today (Neary and Stiglitz, 1983).

Of course, a good multiplier analysis takes into account the fact that different kinds of expenditures have different multipliers. What matters is not what the average multiplier has been in the past, but the effect of a well-designed expansionary policy today. We have suggested that spending on investments in the US today on education or research has a far higher multiplier, say, than on contractors in Iraq. (Stiglitz, 2010c)

For some highly indebted countries, the additional borrowing to finance expansionary investment oriented fiscal policy would come at a high price; they would have to pay increasingly higher interest rates, which might constrain what they could spend overall on output-expanding projects.[6] In principle, the market should realize this, in which case the greater indebtedness could lead to a lowering of interest rates. But there is no shortage of evidence of market irrationality; and whether justified or not, if increased indebtedness leads to higher interest rates, governments may have to employ another strategy, making use of the balanced-budget multiplier.

Traditional analyses suggested that the balanced-budget multiplier is unity. But well-designed increases in taxes and expenditures can have a balanced-

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[5] Government expenditures do not even have to be investments: if government consumption expenditures and private consumption expenditures are complements, then there will be crowding in of consumption. Moreover, there is another channel through which crowding in of investment, to which we already alluded, takes place: when government investment and private investment are complements.

[6] Rogoff and Reinhardt (2010) suggested, furthermore, that increased indebtedness beyond a 90 per cent debt GDP ratio would lead to significantly lower growth. Putting aside the fact that their analyses ignored the central point we have emphasized—the forms of expenditure and the circumstances of the economy make a big difference—their work has since been thoroughly discredited. See, e.g. Herndon, Ash, and Pollin (2013) . (In addition, they ignore critical issues of causality.)

budget multiplier that is much larger, plausibly twice the traditional number, e.g., tax hikes at the very top reduce consumption by far less than the increased expenditures expand it. Taking advantage of crowding in of consumption and investment can further enhance the balanced-budget multiplier.

B. Contractionary Expansion[7]

There have been some discussions of instances in which government cutbacks have been associated with economic expansion. Some have suggested that these benefits arise from supply-side responses (e.g., as a result of the lower tax rates, now or in the future, a kind of balanced-budget multiplier emerges that is in the opposite direction of that just discussed). But in situations such as the current one, where aggregate demand is limiting output, supply-side responses can even increase unemployment and have an adverse effect on output: the downward pressure on wages shifts the distribution of income towards profits, lowering aggregate demand. This suggests that the few instances of government cutbacks bringing on expansion must be special and peculiar. And indeed that is the case: they happened in small countries that had the good fortune to have exports expand more than enough to fill the gap in aggregate demand caused by reduced government expenditures. They are also typically instances where (a) the country's trading partners were growing, so the export market was expanding; and (b) the country had a flexible exchange rate, so it could quickly become more competitive by lowering interest rates or undertaking other policies that affect the exchange rate. Beyond exchange-rate management, government policies (industrial policies and even budget policies) can influence the extent to which exports expand.

For Europe and America now, the notion that exports could fill the gap created by reduced government spending is a chimera, especially in view of the current global slowdown.

C. Deleveraging

There are many in Europe and America who have pinned their hopes for a quick recovery on deleveraging. There was excess private (mainly household) debt prior to the crisis—especially so once the housing bubble had broken. This indebtedness puts a damper on household spending. However, households are working down this debt. Once they do so, consumption will recover.

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[7] For an excellent discussion of these issues, see Baker (2010), Jayadev and Konczal (2010), and IMF (2010).

High levels of indebtedness do have an adverse effect on consumption, both because of the real wealth effect and because of the effect it has in imposing borrowing constraints (which my own work on imperfect capital markets, arising out of asymmetric information, has emphasized). Still, it would be foolish to think that even after deleveraging, consumption will return to anything like it was before the crisis.

The use of representative agent models has obscured what was going on in the US before the crisis: the bottom 80% were consuming approximately 110% of their income. Even after they deleverage, even after the financial sector is fully restored, we shouldn't expect them to consume, on average, more than 100% of their income. With the top 20% garnering for themselves some 40% of national income, and with their savings rate being roughly 15%, one should expect a national savings rate of some 6%—somewhat higher than we see today but somewhat lower than the prevailing rate in the US in earlier decades. The continuing rise in inequality provides a further argument for why we should not expect a return of the savings rate to pre-crisis levels.

The puzzle is why hasn't the US savings rate increased even more (from slightly more than zero to around 4.5% today). The answer may have to do with slow adjustments in consumption patterns, which are aspects perhaps not adequately incorporated into the traditional models.

If, of course, we do get recovery of the economy through consumption, we should be worried: it would mean a return to unsustainable patterns of the kind that marked the pre-crisis days.

(Interestingly, the representative agent model without financial constraints would suggest that leverage doesn't matter at all. Debt simply reflects an ownership claim on a stream of returns—a transfer of money from debtors to creditors; but such transfers have no effects in this model.)[8]

D. The Liquidity Trap and the Zero Lower Bound

Before the crisis, many economists argued that monetary policy was the main vehicle for regulating macro-economic activity, which the government carried out by manipulating interest rates. I have never found convincing evidence of this; indeed, the relationship between real interest rates and investment (especially outside of real estate) is hard to establish. In most models, if

[8] Of course, in an open economy model, if individuals in a country become indebted to those abroad, it lowers their wealth, and thus their standard of living. This just affects who gets the benefits of the country's output, not the level of output or its rate of growth.

nominal and real interest rates are both put in the right-hand side of a regression, nominal interest rates appear to have more importance.

In this crisis, the Fed (along with other central banks) has lowered interest rates to near zero—real interest rates have become negative-- without producing much of a stimulative effect—indeed, far less than was desired or hoped. I was not surprised, knowing that this situation was only a result of the flawed modeling of investment in the standard model, where credit availability, risk, and risk aversion are given short shrift. (I will return to this subject in more detail below.)

Those who believe in the standard model have suggested that its fundamental problem is the "zero lower bound" on interest rates, a variant of the Keynesian liquidity trap. But the situation during the Great Depression was completely different from today's. Then, prices were falling at 10% a year, so the real interest rate, as interest rates approached zero, was 10%.[9] Today, the real interest rate is -2%. There is no reason to believe that if (expectations of) the inflation rate were to rise to 4% or even 6%, and the real interest rate fell to -4% or -6%, there would be a surge in investment. After all, there is excess capacity in many sectors, and especially in real estate. Getting funds at a lower rate is no reason to boost one's excess capacity. (To be sure, there is a fast enough rate of inflation to make the real interest rate negative enough to *perhaps* stimulate investment. But the uncertainty brought about by this change in economic policy would itself have adverse effects on investment.[10])

Again, the use of overly simplistic models has obscured some potentially important adverse effects of lower interest rates, including lower long-term interest rates achieved through Quantitative Easing. This would have the potential to partially or totally offset the alleged benefits assumed to arise, particularly if the interest elasticity of investment is small. There are, for instance, complex distributive effects. Traditionally, over the long run, creditors have been considered better off than debtors; that being the case, the redistributive effects seen in this scenario would be expected to enhance aggregate demand. However, if debtors have long-term fixed-interest contracts, and if

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[9] What should matter (in the standard theory), of course, for investment is the real product interest rate, not the real consumption interest rate, and when there are large changes in relative prices, as occurred during the Great Depression, these can differ markedly.

[10] Some (Woodford, 2003, 2009) have suggested that what is required is a credible commitment to inflation (e.g., through price-level targeting, which implies when there is less than normal inflation now, perhaps due to deflationary pressures arising from excess capacity, there will be higher than normal inflation in the future). But even if the expected real interest rate were the critical determinant of investment (which we suggest it is not), there is no way that the monetary authority could commit itself to such a policy.

there are groups like the elderly who are dependent on the income from government T-bills and bonds, the effects may well turn out to be negative. This is especially so because the marginal propensity of the elderly to consume may be higher than that of mortgagees. If Quantitative Easing leads to commodity booms (a question that remains in contention), then there is a distributive effect from households to commodity producers, which almost surely has a downward impact on aggregate demand.

In a world of full rationality, as assumed in the traditional models, there is a further negative effect: the long-term bonds that the Fed is buying now will be sold back at a capital loss. The government is (in effect) buying long-term bonds at a peak price. Therefore, under the Barro-Ricardo hypothesis, households should rationally include the expected capital loss in their budget constraints, and thus reduce consumption. (This is the case whether or not accounting rules require the government to recognize the loss, or whether or not the Fed goes through machinations to avoid selling them at a loss by holding them to maturity.)

Finally, in the standard putty-clay model, firms, able to get access to (long-term) capital at a very low interest rate, will invest in highly capital-intensive technologies, because wages have not fallen as much as the cost of capital. But this means, at any given level of demand for output, employment will actually be reduced. Thus, loose monetary policy today *may* be setting up the conditions for a jobless recovery in the future. Even today the outlines of such a situation are already visible. The knowledge that weaker demand for labor lies ahead affects consumption demand directly and indirectly, as it puts further downward pressure on wages, worsening the distribution of income.

(The import of this is *not* that we should have tight monetary policy. It is that we cannot rely on monetary policy for our recovery, and that other government policies have to be put in place to offset the potential and real adverse effects that we have described.)

E. The New Normal[11]

Finally, some have argued that there is a new normal: we should just resign ourselves to the acceptability of a 7% or 8% rate of unemployment. It is structural, they say, a result of the mismatch of workers to jobs. There is much to indicate that, while structural problems may exist, there is also a deficiency in aggregate demand. If serious bottlenecks were afflicting the labor market, we would expect to see, for instance, wages for those laborers rising and—given the downward rigidity of wages—fairly rapid run-ups in average wage

[11] See also Konczal (2011).

en the downward rigidity of wages—fairly rapid run-ups in average wage rates.

My own research with Bruce Greenwald and other colleagues[12] has emphasized the need for structural transformation as the solution to the underlying problem; but even then, we show that government expenditures can reduce unemployment and lift welfare; in addition, we argue that government policies aimed at facilitating structural transformation can be particularly effective. The existence of a structural problem does not mean that we should sit idly by and accept high levels of underutilization of resources indefinitely.

3. Key Failings

Modern macro-economics grew out of an attempt to reconcile traditional Keynesian macro-economics with micro-economics (Greenwald and Stiglitz, 1987a). There were two ways to achieve that reconciliation—try to adapt macro-economics to the micro-economic model of the time, or try to glean from macro-economics insights about what was wrong with the traditional micro-economic models and reform them accordingly. Much of the mainstream of economics took the former course. This was an ironic state of affairs because it was occurring just at the time that standard micro-economics was itself under attack, from the proponents of theories of imperfect and asymmetric information, game theory, and behavioral economics.

The standard representative agent model, and the work that grew out of it, had several flaws. It ignored information imperfections, couldn't embrace information asymmetries, and disregarded the insights from game theory and behavioral economics. My own research into equilibrium models with asymmetric information but rational expectations clearly demonstrates that there are many important phenomena that simply cannot be explained even within that model, even if it is able to explain many phenomena that the standard model with perfect information fails to account for.[13]

Once one went beyond the standard model, one could easily explain market failures, including markets that did not clear. Indeed, the presumption that markets were efficient (Adam Smith's invisible hand) was reversed by the Greeenwald-Stiglitz theorem (1986), which showed that whenever there was asymmetric information or imperfect risk markets—that is, essentially always—markets are not constrained Pareto efficient (taking into account the costs of obtaining information and creating risk markets). That has some im-

[12] See, for instance, Delli Gatti *et al*., (2012a and 2012b).
[13] See Stiglitz (1982).

portant implications: privately profitable transactions may not be socially desirable. The banks may have incentives to engage in contracts with each other that make, for instance, the economic system more unstable (which they did).

Ongoing work in financial economics and macro-economics is providing a fuller taxonomy of the systemic biases in market allocations, e.g., Jeanne and Korinek's work (2010, 2012) showing that there may be excessive borrowing, especially in foreign currencies, or Yildiz's work (2011) pointing to excessive leverage on the part of banks. The intuition behind these results is simple: interventions (e.g., taxes) have a second-order direct effect on welfare, but a first-order effect in shifting constraints, such as self-selection constraints, incentive-compatibility constraints, or borrowing constraints, and in the welfare effects of the induced changes in prices and price distributions. As Greenwald and Stiglitz point out, in such situations, pecuniary externalities matter.[14]

Today's standard model began from a framework that didn't, and couldn't, embrace the kinds of market imperfections and market failures that could explain macro-economic behavior. There was no role for agency costs or externalities, no analysis of incentives for transparency or non-transparency, and no explanation of why financial institutions would have had incentive structures that led to excessive risk taking and short sighted behavior.

While it is important to derive macro-behavior from micro-foundations, it is crucial that we derive it from the *right* micro-foundations, consistent with actual behavior.[15] And, indeed, it is hard to reconcile macro-behavior *under the old-fashioned standard micro-models* with reasonable specifications, e.g., labor supply, risk aversion.

Over the years, as the deficiencies of the standard model have become apparent, a Ptolemaic attempt has been mounted to repair it through such amendments as adding on additional constraints, allowing for some individual heterogeneity, etc. But as I explained in my Smith lecture, these attempted patches remain unsatisfactory. They obviously failed in both of the recent crises, proving themselves to be largely irrelevant. Part of the problem is their

[14] Earlier, Stiglitz (1982) showed the welfare effects of changes in price distributions as a result of changes in investment allocations. Again, markets were not in general (constrained) Pareto efficient.

[15] Ironically, even much of their criticism of Keynesian behavior as being "untheoretical" is itself ungrounded; it didn't take into account the Mantel-Sonnenschein results showing that micro-theory puts few restrictions on aggregate demand functions. Of course, if one makes unreasonable assumptions, such as that all individuals are identical, then there are strong restrictions.

tendency to focus too much on things of second-order import and too little on things of first-order importance. As I said before, all models are simplifications, and some may be useful in providing insights into one problem, others into another problem. The task before us is to formulate models that employ the simplifications that are most relevant for understanding short-run macroeconomic behavior.

Among the central flaws of the standard model are its excessive reliance on rational expectations, in ignoring distribution, and its failure to model the credit system (banking, securitization), including paying insufficient attention to crucial institutional details (e.g., the design of the mortgage system). If everyone were identical, these issues would be irrelevant. Finance is uninteresting if the person can only borrow from himself. As I noted before, there can't be information asymmetries (apart from acute schizophrenia).

Rational expectations are particularly unhelpful in understanding periods of structural transformation, as when the economy goes from agriculture to manufacturing or from manufacturing to the service-sector economy—simply because such transformations happen rarely, and those particular transformations have never happened before. We have argued that the Great Depression is intimately associated with the former transition, the Great Recession with the latter.

The disparity between the standard model and reality inevitably leads to intellectual incoherence on the part of policymakers attempting to be guided by it. For example, in the standard model, diversification leads to lower risk, so policymakers argued for the removal of capital controls, unleashing the free flow of capital across international borders, thereby enhancing diversification. And some policy makers actually fervently believed in the model: as the crisis erupted, they believed that diversification would enable the US to easily weather the coming storm.

But in the wake of that crisis, attention has shifted to contagion. Contagion suggests a disease. Countries that are more interdependent are more likely to suffer from contagion. Suddenly, interdependence no longer seems like such a virtue. Indeed, in epidemiology (from which the term contagion comes), the appropriate response is quarantining the afflicted patients.

A coherent model would incorporate the advantages of diversification prior to the crisis and the disadvantages after a crisis (and crises have been a regular feature of the global economy since the period of liberalization began, in 1980). But none of the standard models did this.

The underlying mathematical structures of the standard model also have to be changed: when there are non-convexities, risk diversification can amplify rather than reduce risk, and non-convexities are pervasive in the economy (see Stiglitz, 2010a, 2010b). Even before the crisis, there had been work showing how the architecture of the economic system could worsen financial fragility, leading to bankruptcy cascades and systemic risk (Allen and Gale, 2000; Greenwald and Stiglitz, 2003; Delli Gatti *et al.*, 2006; Battiston *et al.*, 2007, 2012a, 2012b; Gallegati *et al.*, 2008). Since then, there have been many more studies.[16]

One of the most significant failures of the standard model was its inability to provide an adequate analysis of the supply of credit (Greenwald and Stiglitz, 2003). Credit is not the same as money (though in normal times, credit supply and money supply are related). In standard theory, there is no credit rationing, nor is there a liquidity "problem," though, of course, in times of crisis, the focus is on liquidity. The standard theory cannot explain the lack of availability of credit—even to banks that are allegedly "solvent" but illiquid.

Ironically, most macro- models, even those used by Central Banks, do not have a "banking sector"—yet it was problems in banks that were at the heart of the crisis. Not surprisingly, given the absence of a banking sector, most macro- models do not have a "shadow banking sector" either—and therefore they have nothing to say about the shift from the banking to the shadow banking sector, which has proven so problematic for our economy.

So too the standard models focused on the real T-bill rate, the rate at which government can borrow. But what matters in borrowing is the interest rate at which companies can borrow, not the interest rate at which the government can borrow, and the spread between the two is highly variable, an endogenous variable that has to be explained.

Nor did the analyses of banking regulation before, or after, the crisis incorporate basic insights of modern financial economics—like the Modigliani-Miller theorem, suggesting that additional leverage does not improve the efficiency of the banking system, or the Grossman-Stiglitz theorem, holding that fundamental informational problems would arise in any attempt to move towards securitization of products like mortgages.

The fundamental point is that one cannot summarize the financial sector in a money-demand equation. (And even worse, the money-demand equation doesn't reflect the realities of the modern financial sector, where cash-management accounts mean that there is essentially no opportunity cost to

[16] Haldane (2009), Haldane and May (2010), De Masi *et al*. (2011).

holding money, where most transactions are mediated through credit, not money, and where most transactions are exchanges of assets, not income-generating transactions).

While the standard model focuses too little attention on the determinants of the supply of credit, it focuses too much attention on the problem of intertemporal maximization—not surprising, given the historical evolution of the model. But such intertemporal maximization problems provide little insight into the short-term variations in the level of consumption (savings rates), which are at the heart of short-term macro-economic analyses. And interestingly, none of the policy discussions even refer to such models.[17]

4. An Example: Bank Recapitalization

Earlier I remarked on the absence of detailed modeling of the financial sector, including financial constraints and the determinants of the supply of credit. Summarizing the financial sector in a money-demand equation may work (in some sense) in normal times, but not now, or in other times of crisis (such as East Asia in the '90s).

Banks continue to play an important (though diminished) role in the supply of credit. They are the repository of institutional knowledge (information) that is not easily transferred; their internalization of information externalities results in better incentives for the acquisition of information. They are still the locus of most SME lending (and variability in SME investment and employment is central to understanding macro-economic variability).

Without good models of banking, monetary authorities had little to say about the best way of restructuring banks. The inability to restart lending to SME's in the aftermath of the crisis should not be a surprise; but it is not, as some have suggested, just the standard liquidity trap, where Keynes focused on the difficulty of getting interest rates to zero: how could it be, with interest rates near zero and real interest rates negative? Rather, it arises from the fact that even zero T-bill rates may not induce banks to lend (Greenwald and Stiglitz, 2003).

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[17] Part of the reason is that with durable goods, the flow of consumption services is detached from the flow of expenditures, which can be affected by borrowing constraints, expectations, and perceptions of risk, including the risk of unemployment. While these variables can be incorporated into a more fully specified intertemporal maximization model, doing so is complex, and doing so in a way that is adequate for short-term macro-economic analysis requires models with enough heterogeneity to incorporate some who are capital constrained and some who are not.

Much of the discussion paid little attention to the consequences of how banks would be recapitalized (except among some members of both the Bush and Obama Administrations, who suggested that private money was better than public money—in spite of the unimpressive record of the private sector prior to the crisis, wasting money on a scale beyond the ambitions of most governments). The implicit assumption was that bank managers would treat government-provided funds just like any other source of funds. But an alternative, and perhaps more plausible assumption, is that in the absence of a change in control, bank managers would maximize the expected utility of profits to the old owners (caring little about the returns to the government).

Consider the problem facing many governments: whether to provide funds through preferred shares or equity. We can analyze the consequences by hypothesizing that the bank maximizes the utility (U) of the profits accruing to private owners, π,

Max EU (π)

where $\pi = \max \{(1 - \alpha)(Y - rB - r_g B_g), 0\}$

where α represents the dilution to government (through shares and/or warrants), r_g is the coupon on the preferred shares, B_g is the capital injection though preferred shares, and r is the cost of (government insured) deposits to the bank. (U" < 0 reflecting risk aversion.)

We can distinguish three states of nature (assuming we can order the states by the level of macro-economic activity, denoted by θ)

(a) $\theta \leq \theta_1$: bank goes bankrupt

(b) $\theta_1 \leq \theta \leq \theta_2$: old owners make no profit, but bank does not go bankrupt

(c) $\theta \geq \theta_2$: bank makes profit for old owners, preferred shares are fully paid

Different financial arrangements affect the size of each region and the weight put on each. If the government charges an actuarially fair interest rate on preferred shares, then $r_g > r$, so the region in which old owners make no profit is actually increased. On the other hand, the larger the fraction of government compensation that takes the form of shares, the smaller the region (a) and (b), and the less distorted is the decision making.

It is easy to show in this simple model that the optimal way to provide finance to banks is full share ownership, while the worst (with respect to decision making) is injecting capital just through preferred shares (the route actually chosen).

A full modeling of the banking sector is obviously more complex. But what should be clear is that the simplistic macro- models had little if anything to say about these critical issues—and much of the conventional wisdom was simply misleading.

5. Asking the Right Questions[18]

Despite the flawed assumptions underlying the standard model, confidence in it persisted partly because attention was directed at the wrong question. The real objective of macro-economic models is not to improve our forecast a little bit when things are going well, but to predict the "big" events, critical turning points, like the beginning of a recession. The loss in welfare in failing to predict and deal well with the financial crisis—a loss in output in Europe and the United States that now amounts to trillions of dollars—is an order of magnitude greater than any gain that might have arisen from an increased ability to fine-tune the economy when things are going normally.

The three questions it should have focused on are, in the context of deep downturns:

1. What causes economic fluctuations?

2. How do we explain rapid declines?

3. How do we explain slow recoveries?

The standard model's failings with respect to the first are particularly telling: it assumed that the sources of the disturbances were exogenous "technology shocks," not endogenous—not the credit and other bubbles. What is remarkable is that such endogenous disturbances have been at the root of major fluctuations since the beginning of capitalism. Yet the standard models ignored history (Kindleberger, 1978), as well as theoretical advances (Minsky, 1982) that could have offered possible explanations of these endogenous fluctuations.

In the standard neo-classical model, the economy has buffers that help absorb shocks, rather than amplify them. Moreover, in the absence of war, state variables (that seemingly should be determining economic behavior) change slowly. Why, then, can the state of the economy change so quickly? Models with financial market imperfections (Greenwald-Stiglitz, 1987b, 1988a, 1988b, 1988c, 1990, 1993a) give rise to financial accelerators and provide part of the answer; the fact that DSGE models have incorporated such constraints in recent years is a move in the right direction. But I don't believe that

[18] This section draws upon Stiglitz (2011).

even these fully account for the seeming "fragility" of the economy. A broader range of models needs to be considered (Stiglitz, 2011, 2012).

In many ways, the most important puzzle is how to explain slow recoveries. After all, the country's physical, human, and natural resources today are essentially the same as they were before the crisis, yet output in some countries is still lower than it was before the crisis. In a representative agent model, even debt would not be a problem, since it would be money we owed to ourselves: it doesn't change net worth. And if debt does matter, it implies that distribution also matters and in fact that distribution is of first-order importance. But our standard macro- models, which typically pay scant attention to distribution, now cannot enlighten us as to why it should matter so much. But even if debt matters, in the standard neo-classical model, there is still a full employment equilibrium. One might have thought that policy analyses would focus on what that equilibrium looks like and how we might attain it. By contrast, some of the policy prescriptions seem to have us move away from that equilibrium: lowering wages could lower aggregate demand, leading to still more unemployment.

With Bruce Greenwald and several of my other colleagues, we have constructed models in which economic downturns, such as the current one, persist because, in the process of structural transformation, those in the dying sector get "trapped" by mobility costs. Government spending, and especially industrial policies, can lead to higher output and lower unemployment, thus facilitating the transition.

6. The Fundamental Flaws in the Eurozone Framework

The Euro was a political project, conceived to help bring the countries of Europe together. It was widely recognized at the time that Europe was not an optimal currency area.[19] Labor mobility was limited, the countries' economies were vulnerable to different kinds of shocks, and there were divergent long-term productivity trends. While it was a political project, the politics was not strong enough to create the economic institutions that might have given the Euro a fair chance of success. The hope was that over time, that would happen. But, of course, when national economies were doing well, few felt the impetus to "complete" the project, and when a crisis finally occurred (with the global recession that began in the United States in 2008), it was hard to think through carefully what should be done to ensure the success of the Euro.

[19] See Mundell (1961).

I and others who supported the concept of European integration hoped that when Greece found itself in crisis, in January 2010, European leaders would display both an understanding of what needs to be done to ensure the stability of Greece and the survival of the Euro and enough commitment to European solidarity to ensure that the requisite steps were undertaken. That did not happen, and, swiftly, a project originally designed to bring Europe together became a source of divisiveness. Germans talked about Europe not being a transfer union—a euphemistic and seemingly principled way of saying that they were uninterested in helping their partners, as they reminded everyone of how they had paid so much for the reunification of Germany. Not surprisingly, others talked about the high price they had paid in World War II and the enormous German debts that had been forgiven at the end of the War. Selective memories played out, as Germans talked about the dangers of high inflation; but was it inflation or high unemployment that had brought on the National Socialist government? Is it inflation or unemployment that will fuel the political unrest that lay ahead?

Greece was castigated for its high debts and deficits; it was natural to blame the crisis on excessive profligacy, but again there was selective memory: Spain and Ireland had low debt-to-GDP ratios and a fiscal surplus in the years before the crisis. Therefore, no one could blame these countries' predicament on fiscal profligacy. At the same time, it was clear that Germany's prescription—more severe and more effectively enforced budgetary cutbacks—was not going to help Greece climb out of its hole. On the contrary, there was every reason to believe that this very prescription—known as austerity—would deepen the crisis. Indeed, by so manifestly showing their profound ignorance of the fundamentals underlying the crisis, the authorities scared the markets. Even if they had understood what was at stake, even if they repeatedly reiterated their commitment to the European project, their display of enormous resistance to undertaking the necessary reforms *in the European framework* surely contributed to the markets' loss of confidence, helping to explain why each of the so-called rescue measures turned out to be only temporary palliatives.

In the remainder of this section, I describe several of the underlying *structural* properties of the Eurozone that, if not make the continuation of this crisis or the occurrence of future crises inevitable, certainly make them likely. (What is required is not so much the structural adjustment of the individual countries, but the structural adjustment of the Euro framework.) Many of these are associated with rules that reflected the neo-classical model, with the associated neo-liberal policy prescriptions fashionable (in some circles) at the time of the creation of the Euro.

Europe made two fundamental mistakes: First, it enshrined in its "constitution" these fads and fashions, the concerns of the time, without providing for enough flexibility when responding to changing circumstances and understandings.. And secondly, it failed to notice that even at that time, the limitations of the neo-classical model had been widely exposed—the problems posed, for instance, by imperfect competition, information, and markets to which I referred earlier. Likewise, the neo-classical model failed to recognize the many market failures that require government intervention, or in which government intervention would improve the performance of the overall economy. Most importantly from a macro-economic perspective, there was the widespread belief that so long as the government maintained a stable macroeconomy—typically interpreted as maintaining price stability—overall economic performance would be assured. By the same token, if the government kept budgets in line (kept deficits and debts within the limit set by the Maastricht Convention), the member countries' economies would "converge" so that the single currency system would work. The founders of the Eurozone apparently thought these budgetary/macro-conditions were enough for the countries to converge, i.e., to have sufficient "similarity" for a common currency to work. They were wrong. Equally misguided was the focus of the founders of the Eurozone on government failure, not market failure, and thus they circumscribed the actions that governments could take, setting the stage for the market failures that would bring on the Euro crisis.

So too, much of the framework built into the Eurozone might have enhanced efficiency, *if Europe had gotten the details right and if the neoclassical model were correct.* But the devil is in the details, and some of the prescribed provisions led to inefficiency and instability. The following paragraphs illustrate what I have in mind.

Free mobility of factors without a common debt leads to inefficient and unstable allocation of factors. The principle of free mobility is to ensure that factors move to where (marginal) returns are highest, and if factor prices are equal to marginal productivity, that should happen. But what individuals care about, among other things, is the after-tax returns to labor, and this depends not only on the marginal productivity of labor (in the neo-classical model) but also on taxes and the provision of public goods. Taxes, in turn, depend in part on the burden imposed by *inherited debt.* This can be seen in the cases of Ireland, Greece, and Spain. All three were facing towering levels of inherited debt (a debt that had not swollen to its current levels by making investments in education, technology, or infrastructure, i.e., through the acquisition of assets, but through financial and macro-economic mismanagement in the case of Greece and Ireland or as a result of a crisis that was not of their own mak-

ing, in the case of Spain). This implies migration away from these highly indebted countries to those with less indebtedness, even when marginal productivities are the same; and the more individuals move out, the greater the "equilibrium" tax burden on the remainder becomes, accelerating the movement of labor away from an efficient allocation.[20] (Of course, in the short run, migration may bring positive benefits to the crisis country, as it reduces the burden of unemployment insurance and enhances domestic purchasing power as the remittances from abroad sent by the emigrants roll in. Whether these "benefits" to migration outweigh the adverse effects in the short run noted above is an empirical question. The outward migration also hides the severity of the underlying downturn, since it means that the unemployment rate is less, possibly far less, than it otherwise would be.)[21]

Free mobility of capital and goods without tax harmonization can lead to an inefficient allocation of capital and/or reduce the potential for redistributive taxation, leading to high levels of after-tax and transfer inequality. Competition among jurisdictions can be healthy, but there can also be a race to the bottom. Capital goes to the jurisdiction that taxes it at the lowest rate, not where its marginal productivity is the highest. To compete, other jurisdictions must lower the taxes they impose on capital, and since capital is more unequally distributed than labor, this reduces the scope for redistributive taxation. (A similar argument applies to the allocation of skilled labor.) Inequality, it is increasingly recognized, is not just a moral issue: it affects the performance of the economy in numerous ways (Stiglitz, 2012).

Free migration might result in politically unacceptable patterns of location of economic activity. The general theory of migration/local public goods has shown that decentralized patterns of migration may well result in inefficient and socially desirable patterns of location of economic activity and concentrations of population. There can be congestion and agglomeration externalities (both positive and negative) that arise from free migration. That is why many countries have an explicit policy for regional development, attempting to offset the inefficient and/or socially unacceptable patterns emerging from unfettered markets.

In the context of Europe, free migration (especially that arising from debt obligations inherited from the past) may result in depopulation not only of certain regions within countries but of certain countries. One of the important

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[20] Interestingly, this problem has long been recognized in the theory of fiscal federalism/local public goods. See, e.g., Stiglitz (1977, 1983a, 1983b).

[21] By the same token, if some of the burden of taxation is imposed on capital, it will induce capital to move out of the country.

adjustment mechanisms in the United States (which shares a common currency) is internal migration; and, if such migration leads to the depopulation of an entire state, there is limited concern.[22] But Greece or Ireland are, and should be, concerned about the depopulation of their homelands.

The single-market principle for financial institutions and capital, too, can lead to a regulatory race to the bottom, with at least some of the costs of the failures borne by other jurisdictions. The failure of a financial institution imposes costs on others (evidenced so clearly in the crisis of 2008), and governments will not typically take into account these cross-border costs. That is why either there has to be regulation by the host country (Stiglitz and members of a UN Commission of Experts, 2010), or there has to be strong regulation at the European level.

Worse still, *confidence in any country's banking system rests partially on the confidence in the ability and willingness of the bank's government to bail it out—and/or in the existence of (1) institutional frameworks that reduce the likelihood that a bailout will be necessary, (2) special funds set aside should a bailout be necessary, and (3) procedures in place to ensure that depositors will be made whole.* Typically, there is an implicit subsidy, from which banks in jurisdictions with governments with greater bailout capacity benefit. Thus, money flowed into the United States after the 2008 global crisis, which failures within the United States' financial system had brought about, simply because there was more confidence that the United States had the willingness and ability to bail out its banks. Similarly, today in Europe: what Spaniard or Greek would rationally keep his money in a local bank, when there is (almost) equal convenience and greater safety in putting it in a German bank?[23] Only by paying much higher interest rates can banks in those countries compete, but that puts them at a competitive disadvantage; and the increase in interest rate required may be too great—the bank would quickly appear to be nonviable. What happens typically is capital flight (or, in the current case, what has been described as a capital jog: the surprise is not that capital is leaving, but that it is not leaving faster). But that sets in motion a downward spiral: as capital leaves, the country's banks restrict lending, the economy weakens, the

[22] Some see an advantage: buying influence over that country's senators because it is less expensive.

[23] The exit from Spanish banks, while significant--and leading to a credit crunch--has been slower than some had anticipated. This, in turn, is a consequence of institutional and market imperfections (e.g., rules about knowing your customer, designed to curb money laundering), which, interestingly, the neo-classical model underlying much of Europe's policy agenda ignored. There is far less of a single market than is widely thought to exist.

perceived ability of the country to bail out its banks weakens, and capital is further incentivized to leave.

There are two more fallacies that are related to the current (and inevitable, in the absence of policy and structural reforms) failures of the Eurozone. The first is the belief that there are natural forces for convergence in productivity, without government intervention. To be sure, there can be rising returns (reflected in clustering), the consequence of which is that countries with technological advantages maintain those advantages, unless there are countervailing forces brought about by government (industrial) policies. But European competition laws prevented, or at least inhibited, such policies.[24]

The second fallacy is the belief that it is necessary and almost sufficient by itself, for good macro-economic performance to have low and stable inflation maintained by the monetary authorities. This led to the mandate of the European Central Bank to focus on inflation, in contrast to that of the Federal Reserve, whose mandate includes growth, employment, and (now) financial stability. The contrasting mandates can lead to an especially counterproductive response to a crisis especially one accompanied by cost-push inflation arising from, say, high energy or food prices. While the Fed lowered interest rates in response to the crisis, the continuing inflationary concerns in Europe meant that the Fed's actions were not matched by reductions there. The upshot was an appreciating Euro, with downward effects on European output. Had the ECB taken actions to lower the Euro's exchange value, it would have stimulated the economy, partially offsetting the effects of austerity. As it was, it allowed the US to engage in competitive devaluation against it.

These beliefs also meant that the ECB (and Central Banks within each of the member countries) studiously avoided doing anything about the real-estate bubbles that were mounting in several of them. This was in spite of the fact that the East Asia crisis had shown that private-sector misconduct—not that of government—could bring on an economic crisis. Europe similarly paid no attention to the run-up in current-account balances in several of the countries.

Ex post, many policymakers admit that it was a mistake to ignore these current-account imbalances or financial market excesses. But the then underlying ideology provided no framework (it still doesn't) for identifying good "imbalances," when capital is flowing into the country because markets have rationally identified good investment opportunities, and distinguishing them from bad ones, i.e., those that are attributable to market excesses.

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[24] Even the World Bank has changed its views on industrial policies; yet views about industrial policies are to a large extent enshrined in the Eurozone's basic economic framework. See Lin (2012), Lin and Stiglitz (2013), and Lin, Patel, and Stiglitz (2013).

The immediate problem

The most immediate problem facing the Eurozone is that creating a single currency took away two of the critical adjustment mechanisms (interest rates and exchange rates) and didn't put anything in their place. The United States has an economic framework that deals with most of the problems described earlier: two-thirds of all government expenditures occur at the national level, and the states are restricted (by their own constitutions) from incurring debt, other than for capital projects.[25] Most banks rely on Federal deposit insurance. States are not restricted from engaging in "industrial policies," and poorer states have actively recruited firms to locate in their jurisdictions.[26]

Some hoped that internal devaluation would serve as an effective substitute, i.e., domestic wages and prices would fall. But there are three fundamental problems with this solution: (a) it is hard to coordinate such decreases, and in the absence of such coordination, there can be large and costly changes in relative prices; (b) because debt is denominated in Euros, and thus is not contingent on domestic wages and prices, debt burdens increase—with adverse consequences seen in bankruptcies and disruptions of the domestic financial system; (c) the decrease in collateral values and incomes (especially relative to debts) would have tightened financial constraints, with first-order adverse effects on the economy. Most importantly, if internal devaluation were an effective substitute for nominal devaluations, then the gold standard would not have been an impediment to adjusting to the disturbances surrounding the Great Depression; it would not have been the case that those countries that abandoned the gold standard earlier would have done better. In the case of Argentina prior to its 2001 crisis, prices did fall, but not enough—again, an internal devaluation is not a substitute for exchange-rate adjustment.

Europe has responded to the crisis by refusing to recognize that there were any structural problems with the EU arrangements. Like the IMF and the US Treasury in so many other crises (including the 2008 crisis), it initially saw the problem as a liquidity crisis, a temporary loss of confidence; if the IMF, ECB, and the Commission showed that they stood behind each of the countries, confidence would be restored and the crisis resolved. All that was required was a temporary injection of funds (a loan to the bank or the country). But, of course, such loans don't improve the balance sheet of the country (or

[25] These constitutional requirements have, in recent years, been subverted by the creation of unfunded pension liabilities, which may create within the States some of the same adverse dynamics described earlier for Europe.

[26] However, this has created, to some extent, a race to the bottom, the adverse dynamic that we described as characterizing Europe.

the bank), and if the problems are more fundamental, then they can have negative effects on other claimants, especially if the bailouts are senior to other creditors and even more so if a high interest rate is charged. That's why the East Asian bailouts and the Argentine bailouts had little discernible effect. It is not surprising that neither did the European sovereign bailouts; it is only surprising that it took Europe's leaders so long to recognize this. Later, the ECB lent money to the banks, to lend onward to the governments, to help support bond prices (lower sovereign yields), in the long-term refinancing operation (LTRO) program. Because the money provided to the banks was lent at close to a zero interest rate, and the banks could lend the money onward at much higher rates, this program was, in effect, a massive gift to European banks. The fact that European officials looked at the take-up of the program as a measure of "success" (as well as the *temporary* reduction in sovereign risk premiums) was perhaps symptomatic of a lack of understanding of the underlying problems. To be sure, there were real effects from the hidden recapitalization of the banks. But the effects on sovereign risk premiums were temporary: only coercion would induce them to permanently put a disproportionately large fraction of their balance sheet in these highly risky assets.

Indeed, there was something especially peculiar about Europe's attempt at a bootstrap operation, whereby lending to the government would help bail out the banks, and lending to the banks would help bail out the governments.

But at least this bootstrap attempt didn't have the adverse effects of austerity: predictably, austerity brought growth down, and as austerity spread throughout Europe, it helped bring on a European-wide recession, weakening the banks at the same time that it had disappointing fiscal benefits. As growth slowed and the ranks of the unemployed increased, revenues declined (from what they otherwise would have been) and expenditures (e.g., for unemployment benefits) climbed.

European officials who prescribed austerity suggested, when these programs were first adopted,[27] that by now those who adopted their programs would be on their way to restored prosperity.[28] They have been wrong, and repeatedly so. They have repeatedly underestimated the magnitude of the downturn that their policies would bring about, and as a result, they have con-

[27] For example, British Conservative David Cameron in his April 2009 speech, "The Age of Austerity," expounded on austerity not as just a short-term strategy but as a philosophical shift that would restore the vibrancy of Britain's economy. Without it, he said, "[W]e risk becoming once again the sick man of Europe. Our recovery will be held back, and our children will be weighed down, by a millstone of debt." The actual results of austerity in Britain have not lived up to his promises, to say the least.

[28] This section is a revised version of the preface to Stiglitz (2012).

sistently underestimated the fiscal benefit that would be derived: deeper downturns inevitably result in lower revenues and higher expenditures for unemployment and social programs. Though they then try to shift the blame back on to the crisis countries for missing the fiscal targets, the fact is that it is their misdiagnosis of the problem and the resulting wrong prescription that should be held accountable. Spain and Greece are in Depression—there is no other way to describe the situation—and that depression is largely a result of misguided policies foisted on these countries (though their own leaders are to blame, for having acquiesced, but only as seeing, perhaps wrongly, that the proposed "solution" was better than the alternative).

Today, the problem in Europe is inadequate overall demand. As the downturn continues, banks are less willing to lend, housing prices decline, and households become poorer and poorer and more uncertain of the future, depressing consumption further. Europe's problem today is lack of aggregate demand, and austerity exacerbates that problem.

No large economy—and Europe is a large economy--has ever emerged from a crisis at the same time that it has imposed austerity. Austerity always, inevitably, and predictably makes matters worse. The only examples where fiscal stringency has been associated with recovery are in countries where reductions in government spending are offset by increases in exports. These are generally small countries, typically with flexible exchange rates, and where trading partners are growing robustly. But that is hardly the situation confronting Europe's crisis countries today: their major trading partners are in recession, and each has no control over its exchange rate.[29]

European leaders have recognized that Europe's problems will not be solved without growth. But they have failed to explain how growth can be achieved with austerity. Instead, they assert that what is needed is a restoration of confidence. However, austerity will not bring about either growth or confidence. Europe's sorry record of ultimately failed policies—after repeated attempts to fashion patchwork solutions for economic problems it was misdiagnosing—have undermined confidence. Because austerity has destroyed growth, it has also destroyed confidence, and will continue to do so, no matter how many speeches are given about the importance of confidence and growth.

The austerity measures have been particularly ineffective, because the market understood that they would bring with them recessions, political turmoil, and disappointing improvements in the fiscal position, as tax revenues

[29] Alesina and Ardagna (2010) have tried to propagate the idea that expansionary contractions are possible. But there is a growing consensus that their analyses are badly flawed, and that that is not the case. See, e.g., IMF (2010), Baker (2010), and Jayadev and Konczal (2010).

declined. Rating agencies have downgraded countries instituting austerity measures, and rightly so. Spain was downgraded as the first austerity measures were passed: one of the rating agencies believed that Spain would do what it promised, and it knew that that meant low growth and a worsening of its economic woes.

By the same token, while structural reforms will be important for future growth and standards of living in many of the European countries, including those currently afflicted with crisis, structural reforms take time. They affect long-term standards of living, but structural rigidities did not precipitate the crisis. It was a financial and real-estate crisis that did that.[30] Most of the structural reforms are supply-side measures, but as I noted, the problem today is an inadequacy of demand; worse, many of the structural reforms will exacerbate that problem, especially those that end with lower wages and have adverse distributional effects.

Responding to the crisis

This analysis of the fundamental flaws underlying the Eurozone suggests a set of policies that *might* help resolve the crisis. I say *might*: these reforms are necessary to make the Euro work, but they are not necessarily sufficient. The divergence between an optimal currency area and the Eurozone—the divergences, for instance, in economic structures that can give rise to desired changes in exchange rates, either in the short run in response to shocks, or in the long run in response to systemic differences in productivity and inflation trends—may be too large to make a system of a single currency work.

Mutualization of debt

The first necessary reform is a common fiscal framework—more than and fundamentally different from an austerity pact, or a strengthened version of the growth and stability pact. As I noted, it was not overspending that brought on Spain's or Ireland's problems.

One of the basic problems confronting the Eurozone is that current arrangements have effectively meant that countries were borrowing in a currency over which they had no control—much like developing and emerging markets that borrowed in dollars or Euros. There is no risk that the US will ever default on its debt, owed in dollars, simply because it controls the printing presses (a fact that at least one of the rating agencies seems unaware of).

[30] As is the case in the United States, there may be deeper problems: structural transformation that is required by the decline in manufacturing employment and globalization.

The value of those dollars might diminish were it to resort to such measures, but (politics aside) there is unlikely to be any event of sufficient moment to change expectations of inflation so dramatically as to bring on a crisis.

What is required then is "mutualization" of debt—European-wide debt, owed in Euros. This would make Europe's debt similar to America's debt, and with Europe's overall debt-to-GDP ratio lower than that of the US, presumably interest rates would be comparable. Such mutualization would lower interest rates, allowing more spending to stimulate the economy and restore growth.

Mutualizaton of debt could be accomplished through a number of institutional mechanisms (Eurobonds, ECB borrowing and on-lending to nations). How to design such a system (in a way that did not lead to excessive borrowing) would take me beyond this paper. For now, I simply note: the position of some in Europe against such mutualization—claiming that Europe is a transfer union—is wrong on two counts:

(a) It exaggerates the risk of default, at least the risks of default *if* debt is mutualized. At low interest rates, most of the crisis countries should have no trouble servicing their debts.[31]

Of course, in the absence of debt mutualization, there is a serious risk of partial default (which has already happened in the case of Greece). The irony is that existing arrangements may actually lead to larger losses on the part of creditor countries than a system of well-designed mutualization.

(b) Any system of successful economic integration must involve some assistance from the stronger countries to the weaker. (The desirability of such transfers, even in the absence of economic integration, was evidenced by the Marshall Plan after World War II and the large debt forgiveness of Germany by the Allies. More recently, Europe itself has provided substantial funds to new entrants, to enable their economies to converge.)

A common financial system

The second necessary reform is a common banking system—with deposits insured by a European-wide deposit insurance fund, and with common regulations and a common approach to resolution of insolvent banks. I have already explained why a common deposit insurance fund is required: without that, funds will flow from the banking system of "weak" countries to the banks in strong countries, weakening further those already having problems.

[31] The exception is Greece, for which there has already been debt restructuring.

But without a common regulatory system, a system with a common deposit insurance scheme could be open to abuse.

But a common regulatory system should have scope for taking different macro-prudential stances in different countries, or even regions within a country. We described earlier how having a single Central Bank took away an important instrument of adjustment—the interest rate. But there are a host of other regulatory provisions (such as capital adequacy requirements) that can be adjusted according to the macro-economic circumstances.[32] Lending standards for mortgages should, for instance, be tightened at a place or time where there appears to be the risk of a bubble forming.[33]

Further reforms that are desirable and perhaps even necessary if the Euro is to survive entail a move towards tax harmonization, restricting the race to the bottom in capital taxation, and eliminating the distortions caused by tax competition among countries. Industrial policies that would allow those behind to catch up are necessary to prevent further divergences within the countries of Europe.

Towards debt restructuring

For most Eurozone economies, these reforms would, for now, suffice. But there may be some (like Greece) where the cumulative impact of past mistakes (not only their own past budgetary mistakes, but also those that were forced on them in the early responses to the crisis) is such that more is needed. They will have to restructure their debts.

Debt restructuring is an essential part of capitalism. Every country has a bankruptcy law that facilitates the restructuring of debts in an orderly way. Though after the Argentine crisis there were calls for the creation of sovereign-debt restructuring mechanisms, one of President Bush's many sins was to veto that initiative[34]. In the subsequent years, when there were no sovereign-debt crises, there was little concern about the issue. Elsewhere, I have described what such a mechanism might look like (Stiglitz, 2010b)[35]. But in the absence of such a mechanism, countries have to act on their own—as Argentina showed were possible.

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[32] One of the lessons of the crisis was that monetary authorities relied excessively on interest rates.

[33] This was evidenced, for instance, by a rapid increase in housing prices relative to income, or by an abnormally rapid expansion of credit.

[34] Though a few others joined in opposition.

[35] There is also need in many cases for private debt restructuring, e.g. of mortgages. For how this might be done, see Stiglitz and Zandi (2012) or Stiglitz (2010c).

But if some country needs debt restructuring to enhance growth, it should be done quickly and deeply. And one shouldn't feel too sorry for the creditors: lenders have been receiving high interest rates reflecting such risks.[36] There is some evidence that, on average, they are more than compensated for such risks. By the same token, as we noted earlier, the costs to the economies doing the restructuring may be less than widely assumed. Both theory and evidence suggest that countries that do such restructuring can later regain access to global financial markets, often quickly; but even if, going forward, countries have to rely on their own savings, the adverse consequences may be far less than the benefits they receive from the debt restructuring.[37]

Argentina has also shown that there is life after debt and that there are large benefits to the reform of monetary arrangements. Indeed, there are good reasons to believe that a deep debt restructuring will have positive benefits—providing more fiscal space for expansionary policies, so long as the government does not have a primary deficit. It is important that the debt write-down be deep—otherwise, the lingering uncertainty about the possibility of another debt restructuring will cast a pall over the recovery. And because of the uncertainty about future growth, and therefore of debt sustainability, GDP-indexed bonds may represent an effective form of risk-sharing (which can be thought of, at the sovereign level, as the equivalent of the conversion of debt into equity, at the corporate level—see Miller and Zhang, 2013, and Griffith-Jones, 2013).

The end of the Euro?

The analysis of this paper has suggested that prospects for the 17-nation Eurozone's survival, in its current form, are bleak. Its end, as was its creation, is as much a matter of politics as economics. European leaders continually affirm their commitment to do what is required to sustain it; but at the same time, key European leaders have shown that they do not seem to understand what is required to sustain it, and have ruled out many of the necessary measures. They have continually repeated a mantra—that one has to restore confidence and grow the economy—as they have put forth measures that have undermined long-term confidence and have put the economy into recession.

Even when most European leaders seem to have eventually grasped what is required, there are two overriding snags: can they achieve the unanimity required, given differences in the perspectives, interests and politics in the different countries; and can they achieve the requisite agreements fast enough?

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[36] Or they should have done so, had they done their due diligence.

[37] As the paper by Sandleris (2012) points out, the costs may be less related to those imposed externally, and more related to failures of the government to deal effectively with the internal disturbances associated with debt restructuring, e.g., to the financial system (banking, insurance, and pensions).

The incongruence between the pace of markets and that of the politics could present a separate problem for the survival of the Euro. Indeed, the slow pace at which the fundamental cracks in the system are being addressed is already causing problems: the financial sector in the crisis countries continues to be weakened, both as austerity exerts its toll on the individual economy and as capital flees that country. This means that the magnitude of the assistance that eventually may be required is likely to be far greater than it would have been had the reforms been undertaken earlier.[38]

Many European leaders have recognized that *eventually* a single banking framework, with common regulations, deposit insurance, and resolution, will be necessary. But others argue that such a dramatic reform must be done carefully, in a step-by-step process. First, there must be common regulations, and when the regulatory system has been "proven," Europe can go on to the next stage(s). Were there not an ongoing crisis, such an argument would have some merit. But those with capital in, say, the Spanish banks will not wait: the benefits of waiting are nil, the risks are substantial. And so, while European leaders dither, the banking system will be weakened.

ECB lending (in the unlimited amounts promised, provided that the country requests it and subjects itself to conditionality) may delay the day of reckoning. But one should be clear that the issue facing, say, the Spanish banks is not just one of liquidity. If the funds are accompanied by the austerity conditionality that has marked earlier programs, unaccompanied by any program that would lead to growth, then the banks will continue to get weaker; and even the anticipation that this might be so will contribute to funds leaving the banks. What is necessary for a return of "confidence" in the banking system is (a) a belief that further losses will be limited; and (b) the government has the resources and willingness to rescue the bank, should it run into problems. But under current policies, not only are the banks' losses likely to continue to mount, each government's ability to rescue its banks will continue to deteriorate.

Alternatively, those with funds in Spanish banks might be willing to keep their funds there, were they confident that Europe will step into the breach. But Europe's equivocation has not helped, a timorousness stoked by Northern Europe's attempts to limit its exposure, in response to domestic political pressures. After recognizing in the summer of 2012 that the "bootstrap" approach would not work, and that Europe's support would have to go directly to the banks, there appears (as this paper goes to press) to be some backtracking—perhaps the legacy "debts" will not be covered. After recognizing that there

[38] The slow pace of reforms has led to other problems: Ireland, one of the first countries to receive assistance, is concerned that later countries will get a better "deal."

needs to be a common financial framework, again there appears to be some backtracking: perhaps only the large banks should be included. (While the failure of a single small bank would not itself cause large systemic effects throughout Europe, the failure of a number of small banks could; and what is at stake is not just the "systemic risk" of Europe's financial system, but the capacity of the Spanish banking system to provide credit, especially to SMEs, and this credit may be even more dependent on the strength of the smaller banks than on that of the larger banks.)

There is likely to be turmoil in the process of the restructuring of the Eurozone, and the resulting downturn could be significant. But under the current regime, the prospects for crisis countries are truly bleak: for some, depression as far as the eye can see. Europe has offered no alternative vision.

The current regime is also undermining the legitimacy of democratic economic institutions. The European project was a top-down initiative. There was a *very* short period of prosperity[39]—based in some countries on access to credit at irrationally low interest rates. The promises of *sustained* prosperity were not delivered upon. The rules of the game not only failed to deliver on sustained macro-economic growth, they also have led to widening inequality, with governments restrained in their ability to redress growing inequities. Evidently, the elites created a system that seems to have done well for those at the top.

In many quarters, there is concern about the ceding of effective economic power—originally to Brussels' bureaucrats, but increasingly to German politicians, undermining national democracies.

There are a variety of ways by which the current form of the Eurozone might end. There was, of course, in its creation the assumption that it would never end (though monetary arrangements have frequently had to be changed), and so there was no provision for contingencies similar to that which the Eurozone is now facing. It might end by the ECB refusing to discount the bills of the banks of a member country—in effect, ceasing to act as a Central Bank for that country, and forcing the country's old Central Bank to resume that role. Or it might end in a popular uprising against the continued depression forced on the crisis countries by Europe's leaders.

However the breakup of the Euro occurs, it is likely to be costly. Nevertheless, there are several options for reducing those costs. There is growing agreement among economists that the least costly form of break-up would entail Germany leaving the Euro. The New Euro (so defined) would almost

[39] Monetary arrangements often have a short life span—witness the ERM. Even the Bretton Woods system (fixed exchange rates) lasted less than three decades.

surely depreciate relative to the Mark, correcting current-account imbalances within Europe, strengthening growth in crisis countries, and enabling those countries to more easily meet their debt obligations.

At the same time, the stronger Mark would enable Germany to easily meet its debt obligations. Some creditors might feel that they were being cheated, being paid back in the depreciated (New) Euro; but credit contracts are typically unindexed, and there are a host of contingencies that affect the real value of what is repaid. Creditors receive a risk premium for bearing those risks. Whatever happens has distributive consequences; other ways of having the Eurozone dissolved entail adverse effects on borrowers.

7. Concluding Comments

Most crises are manmade. They are not caused by famines or other natural disasters. They are often the result of unstable market processes—not a sudden change in government policies. On the other hand, government policies can affect the likelihood of the occurrence of crises and their consequences. Government policies can affect countries' exposure to risk and the structural stability of the system as well as impede or facilitate adjustments. The elimination of automatic stabilizers, and their replacement in some cases by automatic destabilizers, has introduced new instabilities into the economic system. Deregulation and financial and capital-market liberalization have provided new opportunities for destabilizing market processes and opened up new channels by which the instabilities in one country can affect others (Delli Gatti *et al.*, 2006).

We have seen how institutional changes surrounding the Eurozone—intended to create a more stable and prosperous economy—played out in ways that were, at the time of the founding of the Euro, largely unanticipated, but which—at least in hindsight— were totally understandable given the structural flaws in the Eurozone institutional arrangement. We have seen, too, how the policy responses to the crisis, as it unfolded have, in many cases, only made matters worse.

There are alternative policies that would enhance stability and, should a crisis occur, be more likely to restore the economy to prosperity. But to adopt these policies, one has to break out of the ideological straitjacket of market fundamentalism/neo-liberalism and much of conventional economics.

There was no sudden change in the underlying state variables describing the European economy, no war that wiped out large portions of its physical and human capital stock, not even an innovation or an economic transformation that would have led to rapid obsolescence of its capital stock. There have, of course, been sudden changes in expectations, and in our understandings:

we know (or at least we *should* now know) that markets are not necessarily quickly self-correcting, that under-regulated markets can give rise to bubbles and credit excesses, that Greece or Spain having the same currency as Germany does not mean that Greek or Spanish debt is as safe as that of Germany, and it may not even fully eliminate exchange-rate risk and, in ways that we have explained, may actually increase default risk.

Crises are complex events, and it is inevitably overly simplistic to find a single-causal explanation. Still, it should be clear that the Euro crisis, like so many other crises, is more attributable to market excesses than to government profligacy. If government is to be blamed, it is for a failure to tame the (repeated) market excesses. (And even when there is government profligacy, the market is almost always a co-conspirator—lending excessively at easy terms, in its irrational optimism about the prospects of repayment.) Prevention entails understanding how to curb the excesses, and how to design institutional arrangements that limit the opportunity for such excesses. Resolution entails understanding how to ensure that, after a crisis, resources are put back to use as quickly as possible.

With or without such excesses, economies are exposed to shocks; different institutional arrangements heighten the exposure to such shocks, amplify the effects, make the effects more persistent, and impede adjustment afterward. Market forces by themselves may not only lead to endogenous disturbances (like bubbles), but may respond to shocks in a destabilizing way. Government intervention (e.g., through debt restructuring, countercyclical macro-policies, and well designed bank recapitalizations) can reduce the enormous costs that have traditionally been associated with crises.

Crises are perhaps an inherent feature of capitalism. But they do not have to be as frequent, as deep, and as costly as they have been.

The standard macro-economic models ignored history—which had shown that capitalism had been marked by large fluctuations, with great suffering, since the start. The models equally ignored key market failures that help explain persistent inefficiencies and instabilities. In doing so, policymakers using those models may have violated the central principle of Hippocrates: do no harm. he policies and institutional arrangements based on these simplistic models and theories created the pre-conditions for these crises and have contributed to the slow recovery from this Great Recession—a downturn that, while not as deep as the Great Depression, may begin to rival it in duration.

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Ekonomi-tek Volume / Cilt: 2 No: 1 January / Ocak 2013, 41-77

The Run On Repo and the Liquidity Shortage Problems of the Current Global Financial Crisis: Europe vs. The US

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Abstract

This paper discusses several key issues regarding the current Great Crisis, which has extended over two periods. The first period covered the 2007-09 subprime crisis in the US, while the second took the form of a twin sovereign debt and banking crisis in Europe after 2010, and persists until now. At the core of the problem is the emergence over the last 30 years of a shadow banking system, which re-created the conditions for a panic. This time, the panic firstly took place in the repo market, which suffered a run when "depositors" demanded ever-increasing haircuts. Fears of insolvency reduced interbank lending, and this so-called "run on repo" caused temporary disruptions in the pricing system of short-term debt markets.

The subsequent crisis reduced the pool of assets considered acceptable as collateral, resulting in a liquidity shortage. With declining asset values and more frequent haircuts, the US banking system was effectively insolvent for the first time since the Great Depression. Via the banking system, the American "run on repo" soon infected the European financial system, becoming both a twin sovereign debt and banking debacle in many peripheral Euro area countries that raised doubts of the survival of the Euro and the regular functioning of the European Monetary System. The paper concludes that, for a successful European crisis resolution, we need to implement both a fiscal union and a banking union, ensuring that fiscal and banking policies in the Eurozone are partly centralized so as to meet the requirements necessary for the regular functioning of a monetary union.

JEL codes: E44, E52, G01, G15, G28.
Keywords: Financial crisis, shadow banking system, panic, sovereign debt crisis, banking crisis.

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I wish to thank Riccardo De Lisa, Paolo Mattana, Vincenzo Merella, Alessio Moro, and Romano Piras and two anonymous referees for their comments, which helped me greatly. The usual disclaimers apply.

1. Introduction

In the 19th century, before the advent of deposit insurance, periodic financial shocks caused depositors to be anxious about their savings, followed by their running to their banks *en masse* demanding their cash. In January 2006, in the US, there was a similar shock brought on by a fall in house prices. A year and a half later, in August 2007, a financial crisis sprang up in the subprime mortgage market, with firms withdrawing credit from other firms. Thus, a "banking panic" had arisen on the back of the dramatic decline in subprime mortgage values, itself caused by the real-estate downturn. This confirmed the impression that uninsured bank debt was vulnerable to panic. This was the origin of the Great Crisis, which first occurred in the US, while the second one began in Europe after 2010. It is essential for both Americans and Europeans to understand that it was a banking panic that underlay this two-pronged crisis if they are to learn the dynamics of financial crises in general and to design meaningful regulations of the financial system.

Currently, the new focus of turbulence is Europe, where a severe financial crisis is still under way. Its origin can be directly traced back to the American crisis of 2007-09, which spilled over into a sovereign debt crisis in several Euro area countries in early 2010. However, although this is usually described as a sovereign debt crisis, in fact it was really a sequence of interactions between sovereign debt problems and banking problems.

The sovereign debt panic, the global financial crisis (as symbolized by the dramatic collapse of the investment banking house Lehman Brothers), and the ensuing stresses in several European countries' banking sectors are all connected. With deteriorating public finances in several European countries, sovereign risk has spread and worsened many banks' balance sheets. Therefore, the European situation is best described as distinct twin sovereign debt and banking crises that mutually fuel each other, with the result of this interaction being a gradual contagion spreading to more countries and more asset classes.

Part of this scenario featured a run on the repo market in the US sparked by fears of insolvency; this, in turn, had the effect of reducing interbank lending in Europe. The subsequent crisis shrank the pool of assets accepted as collateral, giving rise to a liquidity shortage. This situation made certain observers doubt the very survival of the Euro and the European Monetary System. To put all of the above into perspective then, let us distinguish a first period of the Great Crisis—the American crisis of 2007-09—from a second one consisting of a twin European sovereign debt and banking crisis, which began in 2010 and persists to this day.

The paper is organized as follows. The next three sections identify the core of the problem, which is the emergence in the last 30 years of a shadow banking system, which re-created the conditions for a panic. Shadow banking is, in effect, unregulated banking. Thus, it is riskier than conventional banking in that it lays the groundwork for the kind of financial vulnerability that made the Great Depression possible. Section 5 deals with managerial compensation schemes and the pricing of risk. Section 6 covers fiscal stimulus and the monetary policy interventions that were employed to defuse the crisis. Section 7 illustrates the transformation of the phenomenon into a European twin sovereign debt and banking crisis, and Section 8 outlines the mispricing of risk and imbalances in the Euro area. Finally, Section 9 contains the conclusion.

2. The Essential Function of Banks and Banking

The traditional view of the world held by economists is one where functioning economies are the outcome of the "invisible hand," that is, a world where private economic decisions are unknowingly guided by prices to allocate resources efficiently. However, the current financial crisis raises a question: how is it that we got slapped in the face by the invisible hand? (Gorton, 2009, 2010). What happened? Although the answer is not straightforward, most economists would agree that the shadow banking system lies at the heart of the problem. That system was vulnerable to a banking panic, which started in the US in August 2007 and continues to this day in Europe.

The period between 1934, when the US first introduced deposit insurance, and the start of the current crisis was one of quiescence. But, from a historical perspective, banking panics are the norm. The original banking system underwent a transformation over the last several decades, and this laid the groundwork for a panic. Realizing that the shadow banking system is, in fact, real banking now and that the current market turmoil constitutes a banking panic is a prerequisite to understanding the Great Crisis of today.[1]

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[1] The classical reference on financial crises is the well known and much-cited essay by Kindleberger (1978), who notes that they characterize the history of the development of capitalism all over the world. Recent review articles on the argument are by Fratianni (2008), who shows that financial crises are far from being a rare phenomenon, and by Reinhart and Rogoff (2008, 2009), who point out the regularities of financial crises along with eight centuries of economic history. Further articles on the subject include: Shachmurove (2010), who agrees that financial crises are all similar; Vives (2010), who reviews the academic theoretical and empirical literature on the potential trade-off between competition and stability in banking; Razin and Rosefielde (2011) survey three distinct types of financial crises that took place in the 1990s and 2000s, one of which is the 2007-09 crisis; and Claessens and Kose (2013), who focus on the main theoretical and empirical explanations of four types of financial crisis: currency crises, sudden stops, debt crises, and banking crises. Further-

A banking panic means that the banking system is insolvent, i.e., it cannot honor contractual obligations: there are no private agents who can buy the amount of assets necessary to recapitalize the banking system. When this happens, many markets stop functioning, followed by deleterious effects on the real economy.

Gorton and Pennacchi (1990) argue that the essential function of banking is to create a special kind of debt that is immune to adverse selection by privately informed traders (Holmström, 2008). The leading example of this is demand deposits. More generally, this kind of debt is very liquid because its value rarely changes, so it can be traded without fear of some people having secret information about the value of it. If speculators are able to learn information that is private (only they know it), then they can take advantage of the less informed in trading. However, this is not a problem if the value of the security is not sensitive to such information. This "informationally-insensitive" debt originally was limited to demand deposits.

Demand deposits are of no use to large firms, banks, hedge funds, and corporate treasuries, which may need to deposit large amounts of money for a short period of time. Their needs are satisfied by the repurchase ("repo") market, where large amounts of money can be deposited with a bank and collateralized with bonds, which the depositor receives and may then use elsewhere. Furthermore, repo is short-term, like demand deposits, and it can be withdrawn at any time, also like demand deposits. The bank backs the deposits with bonds as collateral, and often that collateral has been in the form of securitized products, i.e., bonds issued by special-purpose vehicles to finance portfolios of loans. In the time leading up to the 2007 collapse, the demand for collateral grew to include securitized products because of the rapidly rising need for collateral in the repo banking system, for collateralizing derivatives positions, and for use for settlement purposes (Gorton, 2009).

Repo is essentially shorthand for depository banking, built around informationally-insensitive debt. In a repo transaction, one side of the transaction wants to borrow money, and the other side wants to save money by depositing it somewhere safe. Think of the borrower as a bank and the lender as a depositor that happens to be a corporation, a bank, insurance company, pension

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more, a comprehensive investigation of the real effects of banking crises is reviewed by Carpinelli (2009), while the theoretical debate on the recent Great Crisis is critiqued by Moro (2012). Finally, Brunnermeier and Oehmke (2012) survey the literature on bubbles, financial crisis, and systemic risk, while Goldstein and Razin (2013) review three branches of theoretical literature on financial crises: the first one deals with the banking crisis, the second with frictions in credit and interbank markets, and the third with currency crises.

fund, institutional investor, or hedge fund. The depositor receives a bond as collateral for his deposit.

When the depositor turns over its money to the bank, the collateral may involve a "haircut" or margin. The haircut is the percentage difference between the market value of the pledged collateral and the amount of funds lent. For example, a haircut of 5% means that a company can borrow $95 for each $100 in pledged collateral. The size of the haircut reflects the credit risk of the borrower and the riskiness of the pledged collateral. Another important feature of repo is that the collateral can be re-hypothecated. In other words, the collateral received by the depositor can be used or spent in another transaction, i.e., it can be used to collateralize a transaction with another party. Intuitively, re-hypothecation is tantamount to conducting transactions with the collateral received against the deposit.

Historically, only banks and the government could create informationally-insensitive debt, but the demand for such debt has ballooned. Now there is a range of securities with different information sensitivities. The notion of "informationally-insensitive" debt corresponds to the institutions that "surround" debt, as distinct from equity. Equity is very informationally-sensitive. It is traded on centralized exchanges, and individual stocks are followed by analysts. Because debt is senior, and because securitized debt is backed by portfolios, senior tranches of securitizations are informationally-insensitive, though not riskless like demand deposits.

Informationally-insensitive debt does not need extensive institutional infrastructure, like equity. So, for example, the job of rating agencies need not be as in-depth as that of equity analysts (Gorton and Pennacchi, 1993; Gorton and Souleles, 2006). Obviously, informationally-insensitive debt is debt that no one has to devote a lot of time and resources to investigating. In fact, it is exactly designed to avoid that. In the same way, consumers do not spend a lot of time doing due diligence on the bank that is holding the money of someone buying something from them. A "systemic shock" to the financial system is an event that causes such debt to become *informationally-sensitive*: i.e., subject to adverse selection now that the shock has created sufficient uncertainty as to make speculation profitable.

According to Gorton (2009), the current crisis has its roots in the transformation of the banking system over the last 30 years, which involved two important developments. First, derivative securities experienced exponential growth, creating an enormous demand for collateral, i.e., informationally-insensitive debt. Second, there was a massive movement of loans originated by banks into the capital markets in the form of securitization and loan sales.

Securitization is defined as the issuance of bonds ("tranches") that came to be used extensively as collateral in sale and repo transactions; this, in turn, freed other categories of assets, mostly treasuries, for use as collateral for derivatives transactions and for use in settlement systems.

Repo is a form of banking in that it involves the "deposit" of money on call (as repo is short-term, mostly overnight) backed by collateral. The ongoing financial panic centered on the repo market, which suffered a run when "depositors" required ever-greater haircuts to allay their concerns about the value and liquidity of the collateral should the counterparty bank fail. Therefore, in order to fully understand the present global financial crisis, it is important to agree that the "shadow banking system" is, in fact, banking.[2]

3. The Role of the Shadow Banking System and the Securitization Process

It is generally accepted that one of the key factors in bringing on the crisis was the lack of a regulatory framework for the shadow banking system, derivatives, or off-balance-sheet financing.[3] Financial deregulation and liberalization had amplified the scope for speculation. Elsewhere in the financial system, laws had been changed or enforcement weakened.[4] Financial institutions in the shadow banking system were not subject to the same regulations as depository banks, allowing them to assume additional debt obligations relative to their financial cushion or capital base. These entities were vulnerable because they borrowed short-term in liquid markets to purchase long-

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[2] This interpretation of the shadow banking system is extensively developed by Gorton (2009), Gorton and Metrick (2009b, 2012a), and Gorton and Ordonez (2012).

[3] The "shadow banking system" encompasses all financial institutions such as money-market funds, investment banks, hedge funds, insurance companies, mortgage companies, government-sponsored enterprises, and other financial intermediaries involved in facilitating the creation of credit across the global financial system, but whose members are not subject to regulatory oversight. The shadow banking system also refers to unregulated activities by regulated institutions, such as over-the-counter (OTC) derivatives and, particularly, credit-default swaps (CDS). The essence of this term is to differentiate between those parts of the financial system that are visible to regulators and under their direct control and those that are not.

[4] The process of banking deregulation that contributed greatly to the crisis began in October 1982, when President Ronald Reagan signed into law the Garn-St. Germain Depository Institutions Act. In November 1999, President Bill Clinton signed the Gramm-Leach-Bliley Act, which repealed part of the Glass-Steagall Act of 1933. This repeal has been criticized for eliminating the separation between commercial banks, which traditionally had a conservative culture, and investment banks, which had a more risk-taking culture. Finally, in 2004, the Securities and Exchange Commission relaxed the net-capital rule, which enabled investment banks to substantially increase the level of debt they were taking on. The role of institutions in the recent financial crisis is analyzed by Schachmurove (2012).

term, illiquid, and risky assets. This meant that disruptions in credit markets would subject them to rapid deleveraging and selling off of their long-term assets at depressed prices.

Paul Krugman has described the run on the shadow banking system as the "core of what happened" to trigger the crisis. “As the shadow banking system expanded to rival or even surpass conventional banking in importance, politicians and government officials should have realized that they were re-creating the kind of financial vulnerability that made the Great Depression possible, and they should have responded by extending regulations and the financial safety net to cover these new institutions. Influential figures should have proclaimed a simple rule: anything that does what a bank does, anything that has to be rescued in crises the way banks are, should be regulated like a bank.” He referred to this lack of controls as "malign neglect" (Krugman, 2009, pp. 162-3).

Contrary to Krugman’s prescription, regulators and accounting standard-setters allowed depository banks to move significant amounts of assets and liabilities off-balance-sheet into complex legal entities called structured investment vehicles (SIV), masking the weakness of the capital base of the institution or the degree of leverage or risk taken.[5] The whole derivatives market was never regulated.[6] How was this possible? Following Gorton and Pennacchi (1990, 1993), we can say that banks created liquidity by producing securities that were informationally-insensitive. These bonds were not subject to adverse selection when traded because it was not profitable to produce private information to speculate on them. In the extreme, these securities were

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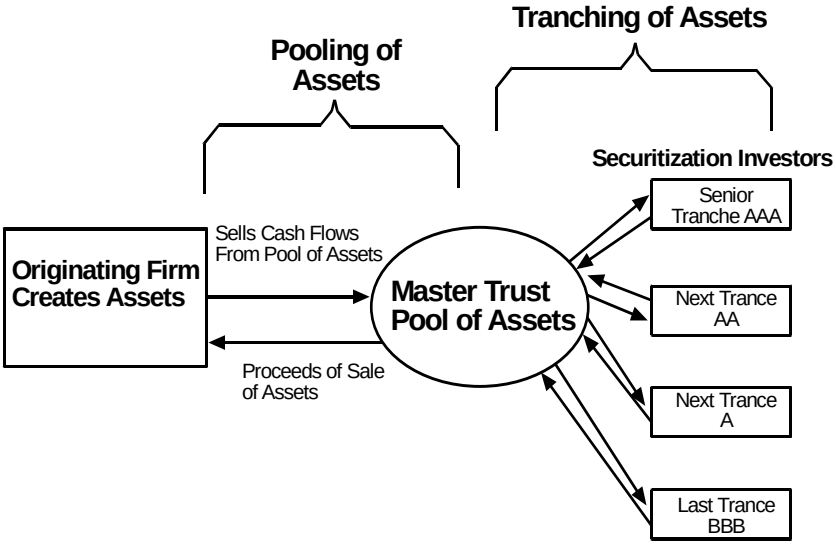
[5] According to Greenspan (2010, p. 20), inhibiting irrational behaviour when it can be identified, through regulation, as recent history has demonstrated, could be stabilizing. But, there is an inevitable cost of regulation in terms of economic growth and standards of living when it imposes restraints beyond containing unproductive behaviour. Regulation by its nature imposes restraints on competitive markets. The elusive point of balance between growth and stability has always been a point of contention, especially when it comes to financial regulation. According to Strahan (2003, p.111), deregulation was followed by better performance of the real economy. State economies grew faster and had higher rates of new business formation after this deregulation. At the same time, macroeconomic stability improved.

[6] With the advice of the President's Working Group on Financial Markets, the Commodity Futures Modernization Act of 2000 allowed the self-regulation of the over-the-counter (OTC) derivatives market. Knight (2008) highlighted the key features of the turmoil as follows: the lack of transparency in the originate-to-distribute model (see footnote 8); the role played by credit rating agencies in the evaluation of structured products; and the covert reliance on special-purpose vehicles to conduct off-balance-sheet financial transactions on a large scale. The effect of all these influences was that when the "Minsky moment" came, perceptions of risky exposures, both to credit losses and to liquidity shortages, rose sharply, as did uncertainty about where those exposures might materialize. The "Minsky moment" refers to Minsky’s (1982) prediction that a new financial crisis was going to happen. On financial innovation, see Merton (1992), Tufano (2004), and Lerner (2006).

valued riskless, like insured demand deposits (Dang et al., 2009). Shadow banking corresponds to the process of creating this type of debt. Clearly, if the debt is a claim on a diversified portfolio, like a portfolio of bank loans, this is made easier. However, this portfolio need not reside at a regulated commercial bank.

Likewise, a corporation may be financed by issuing securities that are claims on its general credit; in other words, the securities are backed by the assets of the company (bonds); alternatively, the enterprise may finance itself by segregating specified cash flows and selling claims specifically linked to those specified cash flows. The latter strategy is accomplished by setting up another company, called a Special-Purpose Vehicle (SPV) or Special-Purpose Entity (SPE), and then selling the specified cash flows to this sister company. The SPV, in turn, issues securities into the capital market to finance the purchase of the cash flows from the original corporation (called the "sponsor"). The sponsor services the cash flows, i.e., makes sure that the cash flows are arriving. The SPV is not an operating company in the usual sense. It is more of a robot company in that it is a set of rules, without employees or physical location. This process is called securitization.

Figure 1. The Tranching Mechanism



Source: Gorton (2009).

Securitization involves seniority and large portfolios. Figure 1 shows the general process of securitization, where the cash flows from assets (loans) created by an originating firm are sold to a special-purpose vehicle, which finances this by issuing securities in the capital markets. These securities are based on seniority and are called "tranches." As shown in the figure, securitization consists of two conceptual steps. First, underlying cash flows from assets are put into a pool. This means the specific assets that are generating the cash flows, usually loans of some sort, are identified and sold to the SPV (often, its legal structure is a Master Trust). Second, the pool of cash flows sold to the SPV is tranched: securities with different seniorities are designed and issued against the pool. Another way to say this is that the SPV has to have a capital structure, so its liability side must be designed. This is called tranching (Gorton and Souleles, 2006; Gorton, 2009; Brunnermeier, 2009).

According to Gorton (2009), securitized asset classes, e.g., mortgages, credit-card receivables, and auto loans, may be examples of relatively informationally-insensitive debt, created by the private sector without government insurance. Several features make securitization debt potentially immune from adverse selection. First, most of the debt is senior and investment-grade. Second, with securitization, the debt is backed by portfolios. Third, a by-product of many structured products is that they are complex, as explained by Gorton (2008). Complexity raises the cost of producing private information. Finally, securitization does not involve traded equity; this is important because there is no information leakage or externalities from the equity market, as with corporate bonds. In summary, senior tranches of securitizations are informationally-insensitive, though not riskless like demand deposits. The most senior tranches of securitization transactions have never experienced defaults.

The banking model in which loans are pooled, tranched, and then resold via securitization is defined as the "originate-to-distribute" model, as opposed to the traditional banking model, in which the issuing banks hold loans until their maturity, when they are repaid (Brunnermeier, 2009; Hull, 2009; Gorton and Metrick, 2012b).[7]

[7] Gorton (2009, 2010) strongly disagrees with the "originate-to-distribute" explanation of the crisis, which places the blame on the misaligned incentives of the underwriters, who believed they had little exposure to risk, on the rating agencies, which did not properly represent risk to investors, and on a decline in lending standards, which allowed increasingly poor loans to be made. Here Gorton becomes much less convincing, especially in light of later information, and he argues as if proponents of the originate-to-distribute explanation are directly attacking the general process of securitization itself. But there is little in Gorton's account to suggest that the originate-to-distribute explanation is excluded by the asymmetric-information hypothesis. Simply because many lenders went under after the fact does not

4. The Demand for Collateral and the Rise of the Repo Market: The Explosion of the Crisis

Collateral is like currency for businesses; they need to post collateral to mitigate the risk of their own default, but they also obtain collateral that can be reused. "Posting collateral" is a way to back up one's promise to pay, and it is acceptable as long as the collateral does not lose value while being held by the counterparty. Collateral is almost synonymous with informationally-insensitive debt, although obviously there are degrees of sensitivity. The use of collateral has expanded rapidly in the last 20 years. This is due, in large part, to the use of bilateral collateral agreements to address counterparty risk.

There is a huge demand for collateral from financial institutions, e.g., dealer banks and commercial banks, a demand that has grown to an enormous extent. First, collateral is needed in repo markets, where the transaction involves the "deposit" of cash in exchange for a bond as collateral. Second, derivatives markets use it to offset counterparty credit risk. Finally, collateral is called for in payment and settlement systems (Bank for International Settlements, 2001; Singh and Stella, 2012).

However, the greatest source of demand for collateral is the repo market. Creation of this informationally-insensitive debt is the function of the banking system. In the regulated bank sector, this corresponds to insured demand deposits. The characteristics of demand deposits are: (1) they have no fixed maturity so they can be exchanged for cash at par on demand; (2) they are senior claims; (3) they are claims on a portfolio; (4) they can be used in transactions.

This form of debt is created by depository institutions and by money-market mutual funds that offer checking accounts. Shadow banking combines repo with securitization (or other forms of informationally-insensitive debt) to accomplish the same function for firms. Senior tranches of securitized debt and commercial paper are also quite informationally-insensitive. Therefore, the participants in the shadow banking system, which is essentially the combination of repo and securitized debt, should be regarded as banks in the main, according to the following criteria: (1) repo has a short maturity, it is typically overnight, and can be withdrawn (not rolled over) on demand; (2) it is senior in that the collateral is senior, but also senior in the sense that there may be a

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mean that their incentives were necessarily aligned correctly beforehand. However, there is some anecdotal evidence to suggest that a number of the most troubled financial institutions ran into difficulties in 2007-08 precisely because they did not distribute all of the securitized debt they created, but kept a significant portion on their own balance sheets instead (Lo, 2012, p. 10).

haircut (Gorton and Metrick, 2009a) on the collateral; (3) repo collateral is backed by a portfolio if the collateral is securitization-based debt; (4) the collateral can be used in other transactions, i.e., it can be re-hypothecated (Gorton, 2009).

The players in the shadow banking system are different from depository institutions in that their activity involves the repo market, where depositors and lenders are individually matched; each depositor gets his own collateral. Securitization enters the picture via the need for collateral. If securitization debt is informationally-insensitive, it can be an input into the repo system in the role of a kind of transaction medium, i.e., collateral that can be re-hypothecated. Therefore, we can say that the shadow banking system is, in fact, an integral part of the banking system, although it is not regulated as commercial banks are. The depositors (lenders) are firms seeking a place to save cash in the short term, often in money-market funds. The borrowers are financial institutions seeking cash to finance themselves. The deposits are designed to be informationally-insensitive by being backed with informationally-insensitive collateral. Often that collateral is a securitization bond. The collateral can be spent or re-hypothecated. Depositors can withdraw their funds by not rolling over their repo agreements, and returning the bond, or they can withdraw by increasing the haircut on the collateral. This is depository banking in a different form, but banking nonetheless. However, like demand deposits at regulated commercial banks, this system is vulnerable to panic (Gorton, 2009).

The first part of the present Great Crisis began in the US with a panic in the subprime-mortgage market, where subprime mortgages were being bundled into massive mortgage-backed securities (MBSs) that were then used to create collateralized-debt obligations (CDOs).[8] A CDO is a type of bond based on portfolios of other debt instruments such as mortgages, auto loans, student loans, or credit-card receivables. These underlying assets serve as collateral for the CDOs. In the event of default, the bondholders become owners of the collateral. As explained in Section 3, because CDOs have different classes of priority known as "tranches," their risk/reward characteristics can be very different from one tranche to the next, even if the collateral assets are relatively homogeneous.

[8] The term "subprime" refers to the credit quality of the mortgage borrower as determined by various consumer credit-rating bureaus. The highest-quality borrowers are referred to as "prime"; hence, the term "prime rate" refers to the interest rate charged on loans to such low-default-risk individuals. Accordingly, "subprime" borrowers have lower credit scores and are more likely to default than prime borrowers.

The collapse gained momentum with the bursting of the housing bubble in 2006: house prices flattened, and then began to decline. Refinancing a mortgage became impossible, and mortgage delinquency rates rose. The products that were created by the securitization of mortgages lacked transparency, with the payoffs from one product depending on the performance of many others. Market participants relied on the AAA ratings assigned to financial products without evaluating the models that had been used by the rating agencies (Hull, 2009).

The opaqueness of the structures of the mortgage-backed securities delayed the unraveling of the mess. No one knew what was going to happen—or rather, many people thought they knew, but no single view dominated the market. As a device for aggregating information, the market turned out to be slow to come up with an answer in this case. When the answer did come to the market, structured investment vehicles and related conduits, which held a sixth of the highest-quality-rated CDO tranches, simply stopped rolling over their short-term debt. Interestingly, this was not due to overexposure in the subprime market. Gorton (2009) estimates that only 2% of structured investment vehicle holdings were subprime. The real cause was investors' inability to penetrate the portfolios far enough to make the determination due to their asymmetric information.

At each step in the chain, one side knew significantly more than the other about the underlying structure of the securities involved (Hull, 2009). At the top of the chain, an investor might know absolutely nothing about the hundreds of thousands of mortgages several layers below the derivative being traded, and in normal situations, this does not matter. In a crisis, however, it clearly does. The rational investor will want to avoid risk; but, as Gorton analogizes, the riskier mortgages in mortgage-backed securities had been intermingled like salmonella-tainted frosting among a very small batch of cakes that have been randomly mixed with all the other cakes in the factory and then shipped to bakeries throughout the country. To continue the analogy, the collapse of the structured investment vehicle market, and the consequent stall in the repo market, represented the market recalling the contaminated cakes (Lo, 2012, p. 9).

Here the story becomes more familiar to the historians of financial crises. Dislocation in the repo market was the first stage of a much broader liquidity crunch. Short-term lending rates between banks rose dramatically, almost overnight, in August 2007, as banks became more uncertain about which of their counterparties might be holding the cakes with tainted frosting and possibly shut down by food inspectors, i.e., which banks might be insolvent because of declines in the market value of their assets. Fears of insolvency will

naturally reduce interbank lending, and this so-called "run on repo" (Gorton and Metrick, 2009b, 2010, 2012c) caused temporary disruptions in the pricing system of short-term debt markets, an important source of funding for many financial institutions. The subsequent crisis has reduced the pool of assets considered acceptable as collateral, resulting in a liquidity shortage (Singh and Stella, 2012). Concerns about the liquidity of markets for the bonds used as collateral led to increases in repo haircuts. With declining asset values and rising haircuts, the US banking system was effectively insolvent for the first time since the Great Depression (Gorton and Metrick, 2010).

In retrospect, the events in August 2007 were just a warm-up act for the main event that occurred in September 2008, when Lehman Brothers failed, triggering a much more severe run on repo in its aftermath. Gorton believes that the regulatory insistence on mark-to-market pricing, even in a market with little to no liquidity, exacerbated the crisis.[9] Certainly there was a substantial premium between mark-to-market values and those calculated by actuarial methods. These lowered asset prices then had a feedback effect on further financing, since the assets now had much less value as collateral, creating a vicious circle.

5. Managerial Compensation Schemes and the Pricing of Risk

According to many commentators, a key role in the American crisis was also played by managerial compensation schemes and the associated leaks in corporate governance. Compensation contracts were supposedly too focused on short-term trading profits rather than long-term incentives. But, in a study of the executive compensation contracts at 95 banks, Fahlenbrach and Stulz (2011) report that CEOs' aggregate stock and option holdings were more than eight times the value of their annual compensation, and the amount of their personal wealth at risk prior to the financial crisis makes it improbable that the rational CEO knew in advance of an impending financial crash, or knowingly engaged in excessively risky behaviour (Lo, 2012).[10]

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[9] "Mark-to-market pricing" is the practice of updating the value of a financial asset to reflect the most recent market transaction price. For illiquid assets that do not trade actively, marking such assets to market can be quite challenging, particularly if the only transactions that have occurred are fire sales in which certain investors are desperate to rid themselves of such assets and must sell them at substantial losses. This has the effect of causing all others who hold similar assets to recognize similar losses when they are forced to mark such assets to market, even if they have no intention of selling those assets (Lo, 2012, p. 10).

[10] Bebchuk and Spamann (2009) and Bhagat and Bolton (2011) seek to shed some light on how banks' executive pay may have produced incentives for excessive risk-taking and how such pay should be reformed. In the case of Bear Stearns and Lehman Brothers, Bebchuk et

Furthermore, the rating agencies failed to signal the real risk associated with each financial product (Utzig, 2010; Hull, 2009). The central activity of the financial industry is creating and trading assets of uncertain value, while the liabilities in the case of banks are guaranteed by the state. They are highly leveraged businesses: leverage of 30 to one was and still remains normal in most financial institutions, including banks, but higher leverage than that is not rare. Indeed, empirical data show that the leverage of investment banks had been very high since the end of the '90s, and, in the cases of Goldman Sachs, Merrill Lynch, and Lehman Brothers, it was greater in 1998 than it was in 2007, on the eve of the financial crisis (Lo, 2012).

The pricing of risk refers to the incremental compensation required by investors for taking on additional risk, which may be measured by interest rates or fees. For a variety of reasons, market participants did not accurately measure the risk inherent in financial innovations such as mortgage-backed securities and collateralized-debt obligations, nor did they understand its impact on the overall stability of the financial system (Hull, 2009). The massive, mind-boggling losses they subsequently sustained have dramatically impacted the balance sheets of banks and insurance companies across the globe, leaving them with very little capital to continue operations.[11] Another cause of the disaster was the widespread reliance on Li's formula, known as a Gaussian copula function, in pricing any kind of asset's risk. This formula originally looked like an unambiguously positive breakthrough, a piece of financial technology that allowed hugely complex risks to be assessed with more ease and accuracy than ever before. Li made it possible for traders to sell vast quantities of new securities, expanding financial markets to unimaginable levels. This formula assumed that the price of credit-default swaps was correlated with, and could predict the correct price of, mortgage-backed securities. Because it was highly tractable, it rapidly came to be preferred by a huge percentage of CDO and CDS investors, issuers, and rating agencies.

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al. (2010) argued that their CEOs cashed out hundreds of millions of dollars of company stock from 2000 to 2008; hence, the remaining amount of equity they owned in their respective companies toward the end may not have been sufficiently large to have had an impact on their behaviour. Furthermore, in an extensive empirical study of major banks and broker-dealers before, during, and after the financial crisis, Murphy (2012) concludes that the Wall Street culture of low base salaries and outsized bonuses of cash, stock, and options actually reduces risk-taking incentives, not unlike the so-called "fulcrum fee," in which portfolio managers have to pay back a portion of their fees if they underperform (Lo, 2012, p. 2).

[11] Farmer et al. (2012) demonstrate that financial markets, by their nature, cannot be Pareto efficient, except by chance. Although individuals are rational, they show that it is sufficient to assume heterogeneity in an agent's subjective discount factor to conclude that markets are not Pareto efficient.

Li's formula was adopted by everybody, from bond investors and Wall Street banks to rating agencies and regulators, and became so deeply intertwined with day-to-day operations that warnings about its limitations were largely ignored. As innovative financial assets became more and more complex, and thus harder and harder to value, nervous investors were reassured when they saw that both the international bond-rating agencies and the bank regulators (who had allowed themselves to become dependent on those agencies) had implicitly endorsed certain complex mathematical models that theoretically showed the risks to be far smaller than they actually proved to be in practice (Hull, 2009). Similarly, the rating agencies relied on the information provided by the originators of synthetic products. It was a shocking abdication of responsibility. Li's Gaussian copula formula will go down in history as instrumental in causing the unfathomable losses that brought the world financial system to its knees. However, it should be noted that no single factor alone bears full responsibility for what happened; it was the confluence of all of them that served to spread the risk—and the fear—throughout the financial markets. Brunnermeier et al. (2011) weigh in on the peculiar nature of systemic risk: first, it cannot be detected by measuring cash instruments, e.g., balance-sheet items or ratios such as leverage and income-statement items; second, it typically builds up in the background before materializing in a crisis; and, third, it is determined by market participants' endogenous response to various shocks.

6. Fiscal Stimulus and Monetary Policy Interventions in Response to the Crisis

The first part of the crisis, the American one, hit its peak in September and October 2008. Several major institutions failed, were acquired under duress, or were subject to government takeover. The crisis rapidly escalated and spread into other economies worldwide, resulting in a number of European bank failures, plunges in various stock indexes, and large tumbles in the market value of equities and commodities. Both MBSs and CDOs had been purchased by corporate and institutional investors globally. Significant quantities of derivatives such as CDSs on the books of banks also deepened the linkage between large financial institutions. Moreover, the de-leveraging of certain financial institutions, which occurred as assets were sold to pay back obligations that could not be refinanced in frozen credit markets, further accelerated the liquidity crisis.

World political leaders, national ministers of finance, and central banks coordinated their efforts in a bid to reduce fears (Fraher and Kennedy, 2008). At the end of October 2008, a currency crisis developed, with investors trans-

ferring vast capital resources into stronger currencies such as the Euro, the yen, the dollar, and the Swiss franc, leading many emerging economies to seek aid from the IMF.[12] The US Federal Reserve and central banks around the world expanded their money supplies to head off the risk of a deflationary spiral. In addition, many governments enacted large fiscal stimulus packages, by borrowing and spending to offset the shrinkage in private-sector demand produced by the crisis. In fact, the US implemented two stimulus packages, totaling nearly $1 trillion, during 2008 and 2009. Part of their purpose was to bail out ailing corporations, as mentioned above. To date, various US government agencies have committed or spent trillions of dollars in loans, asset purchases, guarantees, and direct spending.

The credit freeze brought the global financial system to the brink of collapse. The response of the US Federal Reserve, the European Central Bank, and other central banks was immediate and dramatic. During the last quarter of 2008, these central banks purchased $2.5 trillion of government debt and the problematic assets weighing down the balance sheets of certain troubled banks. This represented the largest liquidity injection into the credit market, and the largest monetary policy action, in world history. In addition, the governments of several European nations along with that of the US boosted the capital bases of their national banking systems by $1.5 trillion, by purchasing newly issued preferred stock in their countries' major banks (Altman, 2009).

At the end of 2008, some analysts argued that the Fed was out of ammunition when overnight interest rates reached zero, but it continued to purchase assets and engaged in "quantitative easing."[13] From the beginning of 2009 until early December, the Fed, under the auspices of its Large Scale Asset Purchase (LSAP) program, had bought approximately $300 billion in Treasury securities, $150 billion in debt securities of Fannie Mae and Freddie Mac,

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[12] Financial crises are often associated with significant movements in exchange rates, which reflect both increasing risk aversion and changes in the perceived risk of investing in certain currencies. Kohler (2010) explains why exchange-rate movements during the global financial crisis of 2007-09 were unusual. Unlike in two previous episodes–the Asian crisis of 1997-98 and the crisis following the Russian debt default in 1998–in 2008, many countries that were not at the center of the crisis saw their currencies depreciate sharply. Later, such crisis-related movements reversed strongly for a number of countries. Two factors are likely to have contributed to these developments. First, during the latest crisis, safe-haven effects went against the typical pattern of crisis-related flows. Second, interest-rate differentials explain more of the crisis-related exchange-rate movements in 2008-09 than in the past. This probably reflects structural changes in the determinants of exchange-rate dynamics, such as the increased role of the so-called carry trade.

[13] "Quantitative easing" is defined as a policy strategy of seeking to reduce long-term interest rates by buying large quantities of financial assets when the overnight rate is zero (Bullard, 2010).

and $1.1 trillion of fixed- rate mortgage-backed securities (MBSs) guaranteed by Ginnie Mae, Fannie Mae, and Freddie Mac. When completed, the Fed's total assets will reach $2.6 trillion, and the Fed will own about one-fourth of the total outstanding amounts of Treasury and agency-guaranteed MBSs.

The monetary base in the US reached $2.4 trillion in 2010 and $3.1 trillion by the end of 2012. In December 2007, it was approximately $830 billion, with only $10-15 billion held by banks as deposits at the Fed (Bullard, 2010). For a comparison, the Bank of England initiated quantitative easing in March 2009 and purchased more than £175 billion in British Treasuries. In 2010, it held more than one-quarter of all such securities outstanding (Bullard, 2010).

Currently, the final effects of the quantitative easing that has been carried out are not known. Economic theory has yet to develop macroeconomic models with financial sectors adequately detailed to explore channels through which quantitative easing might boost economic activity. In fact, quantitative easing implies a risk of the enlarged monetary base fueling an undesirable overexpansion of credit, which, in turn, will set the stage for a surge in the inflation rate. Therefore, a key plank in the monetary strategy must be the stabilization of inflation expectations.

7. The Shift of the Crisis Into a European Twin Sovereign Debt and Banking Crisis

A notable aspect of the global contagion has been the extension of the crisis to European countries' sovereign debt.[14] This extension represents the second part of the current Great Crisis, what we call the European counterpart. It began with Greece, but suddenly it spread to other countries of the Eurozone like Portugal, Ireland, Italy, and Spain (the PIIGS countries for short), as well as, most recently, Cyprus. The phenomenon of sovereign borrowers possibly "getting sick" is not confined to the Euro zone but could extend to the world's biggest economies, like the UK, Japan, and the US. The problem is that the expansionary fiscal policies of deficit spending implemented by most

[14] Forbes (2012) surveys and assesses the academic literature on defining, measuring, and identifying financial contagion and the various channels by which it can occur, highlighting contagion risks in the Euro area. More generally, Das et al. (2012) discuss some salient features of the current generation of sovereign asset and liability management approaches, including objectives, definitions of relevant assets and liabilities, and methodologies used in obtaining optimal outcomes. The European public-debt problems are also analyzed by Driffill (2013) and reviewed from an empirical point of view by Tomz and Wright (2013).

countries to tackle the crisis have created huge deficits, and these will be difficult to digest in the years ahead.[15]

Indeed, the new center of market turbulence is now Europe, which is in the midst of a severe financial crisis. What is often described as a sovereign debt crisis is actually a sequence of interactions between sovereign problems and banking problems. The sovereign debt crisis is a direct outgrowth of the global financial crisis and the resulting stresses in European countries' banking sectors following the bankruptcy of Lehman Brothers. With deteriorating public finances, sovereign risk is perceived to have increased and worsened banks' balance sheets.[16] So the situation is best described as twin sovereign debt and banking crises that mutually reinforce each other, the result of which is a gradually moving cloud of contagion to more countries and more asset classes.[17]

In the European financial sector, the credit crisis was manifested as a shortage of liquidity in the same way as in the US. The fear of banking credit risk soon infected simultaneously the interbank, repo, and certificates of deposit markets. It also spread to the credit-default swaps and money-market funds markets. However, one can identify the first domino to fall in both the US and Europe as the run on repo in the interbank lending market, defined as the subset of bank-to-bank transactions that take place in the money market. So, the risk of a run on the banks and on the entire European financial system, whether traditional or shadow, became systemic.

The origins of the European crisis can be directly traced back to the global financial meltdown of 2008-09, which spilled over into a sovereign debt panic in several Euro-area countries in early 2010. To offset sharp falls in output, governments in the Euro area (like governments in the rest of the world) responded with counter-cyclical policies that expanded fiscal deficits. Moreover, fiscal positions worsened as tax revenues fell and transfer payments soared due to rising unemployment in the economic downturn. In many coun-

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[15] According to McKibbin et al. (2012), the emergence of substantial fiscal deficits and a large build-up of government debt in major advanced economies will inevitably lead to a period of fiscal consolidation in coming years.

[16] In the Euro area, the shadow banking system is less developed than in the US (Bakk-Simon et al., 2011). This explains why the European financial crisis arrived some years after it first hit the US.

[17] The potential mutation of the financial crisis into a sovereign debt one in Euro area countries is investigated by Candelon and Palm (2010), and De Grauwe (2010). More in general, Sturm and Sauter (2010) analyze the impact of the financial crisis on Mediterranean countries, while Wyplosz (2010) contrasts the United States and European situations during the crisis and examines how much of the crisis has been imported by Europe from the US. The paper argues that Europe never had a chance to avoid contagion from the US.

tries, government bailouts of banking systems also contributed to a run-up in their public debt. In effect, private debt became public debt, be it through bank bailouts or the burst of housing bubbles, leading to a full-blown sovereign crisis. So traumatic has the situation become that several member states of the Euro area have gone so far as to raise doubts about the very viability of the European Economic and Monetary Union (EMU) and the future of the Euro. Clearly, this crisis has highlighted the problems and tensions that inevitably arise within a monetary union when imbalances build up and become unsustainable (Volz, 2012).

The financial crisis mutated into a sovereign crisis within the Eurozone in early 2010. A year before, in the first months of 2009, the tense situation in several Central and Eastern European countries appeared to have stabilized, thanks to the energetic efforts of policymakers to push through economic reforms, tighten government budgets, and coordinate with international partners (in the form of the so-called Vienna Initiative) to maintain liquidity in the local banking systems (Véron, 2011). Unfortunately, that encouraging picture darkened when the government of Greece, newly elected in October 2009, revealed that its predecessor had misled its Eurozone neighbors and its own public about the true state of the country's public finances. The budget deficit for 2009 was 14.7% of GDP, more than double the previously published figure. This raised serious doubts about the country's ability to repay its debt. This was the start of the sovereign debt crisis in the Eurozone. In December 2009, the rating agencies downgraded Greek government debt below investment grade. Government bond yields rose to unsustainable levels, and, by the end of April 2010, Greece had turned to the European Union and the International Monetary Fund to activate a €45 billion bailout package. In early May 2010, the EU-IMF rescue package had to be increased to €110 billion over three years.

Soon after Greece's bailout, the EU decided to set up a European Financial Stabilization Facility (EFSF) with €440 billion financial firepower to intervene in similar situations. Simultaneously, the ECB initiated a "Securities Markets Program" under which it would buy up the sovereign debt of troubled countries in secondary markets. Subsequently, the EFSF and the IMF jointly agreed to provide conditional assistance packages to Ireland (November 2010) and Portugal (April 2011). In July 2011, further assistance to Greece was agreed to by the Eurozone governments. A relatively mild debt-restructuring scheme, euphemistically known as "private-sector involvement" (PSI), was made a condition for this additional lifeline, announced on July 21, 2011. Then, in March 2012, a new package of €130 billion for Greece was approved by the EU and IMF, Greece's creditors having accepted PSI demands for re-

structuring of Greek government bonds. This implied losses for the creditors of up to 75%. More than 85% of private bondholders agreed to the deal; had they not done so, it could have ended Greece's chances of getting any more bailout funds and pushed it into default (Kirkegaard, 2012).

The bailout, however, failed to restore market confidence in the Greek economy. Even worse, it failed to halt the contagion of panic from spreading to certain other Euro member countries that were perceived as economically weaker, with structural and competitiveness issues in addition to overly burdensome debt loads. As a consequence, the borrowing costs for these PIIGS countries jumped, as did the cost of insuring sovereign debt against default, in the face of the growing fears of eventual sovereign defaults occurring. At this point, Eurozone banks found themselves sitting on large amounts of Eurozone sovereign-debt assets, with a preponderance of bonds of the country in which a bank was headquartered. In retrospect, it is clear that this situation was due to questionable policy choices in the past, particularly the risk-weighting at zero of Eurozone sovereign bonds in regulatory capital calculations, the long-standing acceptance of such bonds with no haircut by the ECB as collateral in its liquidity policies, and possible instances of arm-twisting by home-country public authorities (Véron, 2011).

Between 2007 and 2010, the debt-to-GDP ratio of the Euro area rapidly climbed upward, from 66.3% to 85.4%. Greece is a special case: in 2007, its outstanding debt stood at an alarming 107.7% of GDP; continuously rising since 2003, the overall Greek indebtedness would go on to break all records, reaching a level of 144.9% of GDP in 2010. Like Greece, Italy had a debt level above 100% of GDP prior to the crisis, but the ratio fell back to a less worrisome level in the period between Italy's adoption of the Euro in 1999 and 2007.[18]

Among all Euro area countries, the most dramatic run-up in public debt occurred in Ireland, and this can be clearly ascribed to the country's banking crisis. Ireland did not have a fiscal or debt problem until 2008. Indeed, between 1997 and 2007, the country ran a fiscal surplus every year (except for 2002, when the government recorded a tiny deficit of 0.4% of GDP). Accordingly, the Irish debt-to-GDP ratio declined steadily over this period, from 64.3% in 1997 to 24.9% in 2007, giving Ireland one of the lowest public-debt burdens in the entire EU. The situation changed dramatically, however, in the course of the Irish banking crisis in September 2008, when the Irish government, under international pressure, guaranteed most of the liabilities of Irish-owned banks (Regling and Watson, 2010; McMahon, 2010). The government

[18] On the sustainability of Italian fiscal policy in the long run, see Bartoletto et al. (2012).

guarantee was initially for €400 billion but was later raised to €440 billion. As a consequence, the Irish deficit ballooned, and the debt-to-GDP ratio shot up from 24.9% in 2007 to 94.9% in 2010. The later disappearance of Ireland's access to capital markets in the autumn of 2010 led it in November 2010 to seek an international financial rescue package from the IMF and the EU; this amounted to over €90 billion and was needed to help it to recapitalize its banks, among other purposes.

Like Ireland, Spain had no fiscal or debt problems before 2008. In the 1999-2007 period, Spain had an average annual budget surplus of 0.3% of GDP. In fact, 2007 was a banner year, when the country recorded a fiscal surplus of 1.9%. Moreover, until the outbreak of the global financial crisis, Spain did not even once violate the EU's Stability and Growth Pact (SGP) provisions.[19] But the global financial crisis put an abrupt end to the long cycle of Spanish high growth (which had started in 1996), marked by a construction and real-estate boom (Suarez, 2010). When the economy contracted in 2008, the Spanish housing bubble burst and destabilized the banking system. The Spanish fiscal position also deteriorated, producing deficits of 4.5% in 2008, 11.2% in 2009, and 9.3% in 2010. Spain's public debt skyrocketed from 36.5% of GDP in 2007 to 61.0% of GDP in 2010.

In Portugal, too, whose track record had been less than sterling in the years leading up to the crisis, the by far greatest expansion of the public debt occurred during and following the 2008-09 turmoil: it rose from 63.8% in 2007 to 94.9% in 2010. Portugal had been the first country to breach the SGP in 2002 after having experienced a steady increase in its debt-to-GDP ratio since joining the Euro area in 1999 (when debt stood at 49.6% of GDP).

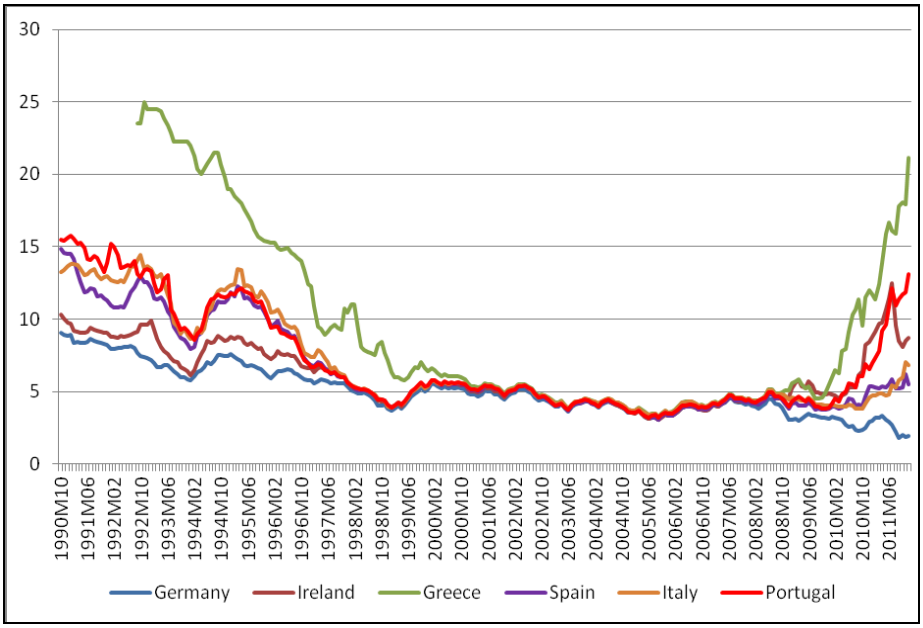
8. Mispricing of Risk and Imbalances in the Euro Area

In the decade leading up to the outbreak of the European market meltdown, a key causative factor was at work: widespread mispricing of risk by capital markets and an ensuing misallocation of capital. European monetary unification brought about a convergence of interest rates among Euro area members. Countries with weaker positions that signed up to the Euro could refinance themselves roughly at the same cost as the most solvent states. Interest-rate spreads on the sovereign bonds of the PIIGS compared to Ger-

[19] The SGP requires EU member countries to have an annual budget deficit no higher than 3% of GDP and a national debt lower than 60% of GDP or approaching that value.

many's narrowed rapidly in the run-up to EMU membership and almost disappeared once they had become members of the Euro area (Figure 2).[20]

Figure 2. 10-Year Government Bond Yields (% per annum), October 1990–December 2011



Source: Volz (2012), with data from Eurostat.

By January 2001, when Greece was welcomed into the Euro area, the yields on 10-year Greek bonds had fallen to 5% from 25% in 1992. The sovereign risk of virtually all Euro area countries, including the PIIGS, as shown in Figure 2, was priced more or less the same as German sovereign debt. This

[20] According to Blommestein (2012), the pricing of risky assets involves assessing the risk dimensions of relative asset safety. Safe assets are considered to be those that are virtually default-free. These so-called safe assets function as "informationally-insensitive" instruments, serve as "money," and have the associated basic functions of money. The return on these assets is the relatively risk-free rate. The proper pricing of sovereign risk has implications for the economy as a whole, via the impact on risk-weight rules for capital adequacy of banks, posting sovereign debt as collateral, the pricing of bonds issued by banks and other non-governmental entities. The transition from a relatively "risk-free asset" environment, as, in fact, it was for Euro area countries' sovereign debt during the first decade of the 2000s, to a relatively "risky asset" situation after 2010, has therefore had major macro- and micro-financial implications. Propounding the same argument, Panetta's (2011) *Report* outlines the impact of sovereign-risk concerns over the cost and availability of bank funding. It also describes the channels through which sovereign risk affects bank funding.

reflected financial markets' irrational optimism, which was underpinned by the zero weighting awarded in regulatory capital calculations to Euro area central government bonds. Another false assurance was derived from the ECB's policy of treating such debt as haircut-free, i.e., risk-free, when it was offered as collateral for repos and other financing trades (Véron, 2011).[21]

Mersch (2011) points to flaws in the Maastricht Treaty. At the very heart of that framework were the no-bail-out clause and the SGP. The first should have excluded free rider incentives, and the second should have aligned national fiscal policies to prevent negative spillover effects to the currency union as a whole. The SGP was a compromise: it quantified fiscal soundness without interfering with the budgetary and fiscal policies of sovereign states. Its purpose was to maintain fiscal discipline within the EMU. Member states adopting the Euro had to meet the Maastricht convergence criteria, while the SGP would make sure that they continued to observe them. The context for Maastricht was the strong belief of the time that governments would be reactive to market discipline and that the power of free markets to act as a check on government profligacy was paramount. Indeed, this was the prevailing paradigm in economics at that time. Of course, with hindsight, it is now obvious that the availability of cheap credit led to an unrestrained and unsustainable accumulation of private debt (as in Ireland, Portugal, and Spain) and public debt (as in Greece and Portugal) in today's crisis countries.

The drop in real interest rates in the periphery countries after their entry into the Euro area and the inflowing capital that followed entry fueled unsustainable development, including distorted credit dynamics and real-estate bubbles in Spain (Moro and Nũno, 2012) and excessive government spending in Greece. It also reduced the pressure for economic reform, which was sorely needed to improve the competitiveness of the weaker members of the monetary union; now they could easily finance their current-account deficits through an abundance of inflowing capital. A high level of public debt is not a problem *per se*, as long as the government is able to refinance itself and roll over its debt. However, this requires total public debt and the interest burden to grow more slowly than the economy and the tax base. This is not the case in the PIIGS anymore. Today's debt crisis in the PIIGS is therefore not merely a debt crisis; it is first and foremost a competitiveness and growth crisis that has led to structural imbalances within the Euro area (Bergsten and Kirkegaard, 2012; Mayer, 2011). In fact, below the surface of the sovereign

[21] Buiter and Siebert (2005) early highlighted this problem, maintaining that the ECB's open-market operations created moral hazard by not discriminating levels of sovereign risk within the Euro area.

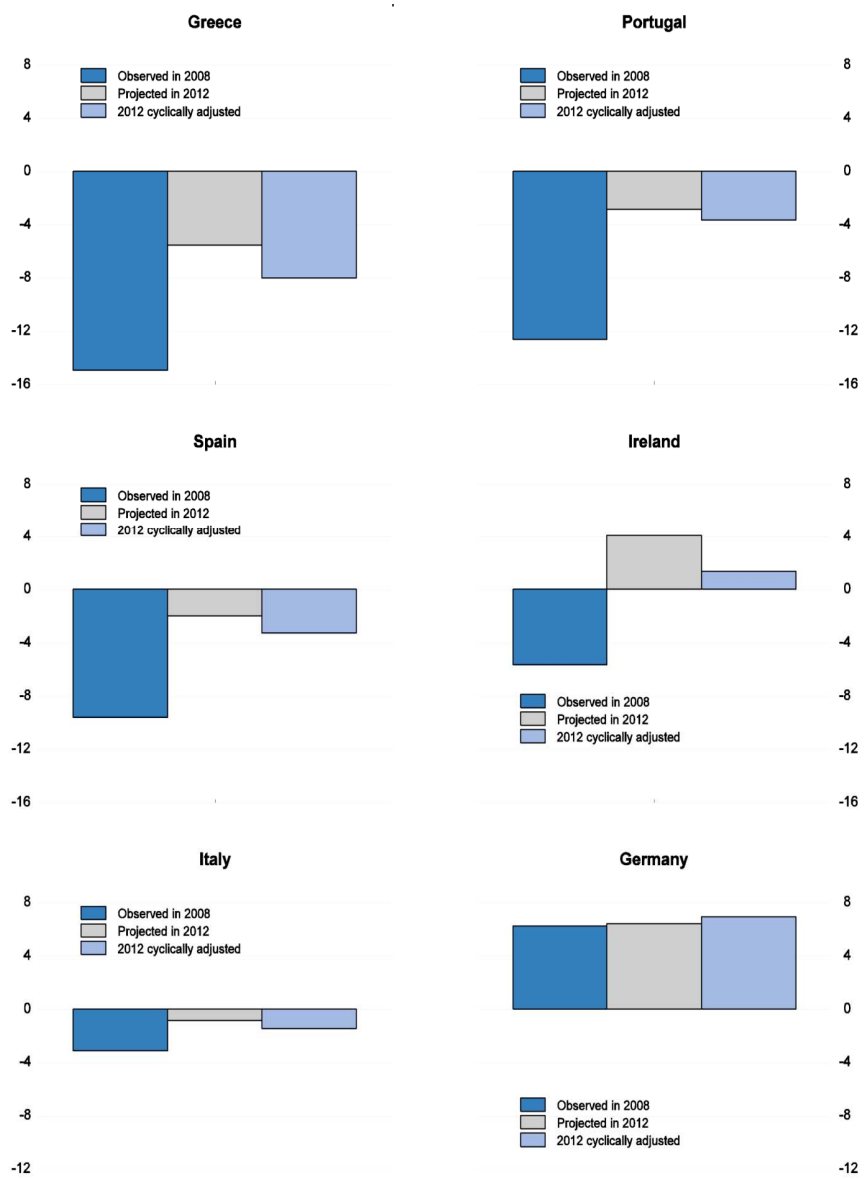
public debt and banking crises lies a balance-of-payments crisis, caused by a misalignment of internal real exchange rates.

According to Mayer (2011), before they found themselves in the midst of a Europe-wide crisis, EU officials tended to ignore the current-account imbalances in certain EMU member countries (Figure 3). Some of them, unfortunately, failed to grasp the difference between a common currency area within a political union and a currency union of politically sovereign states, leading a few to insist that these imbalances were irrelevant. As long as the financial markets remained buoyant and credit was easily available at rock-bottom cost for borrowers of differing quality, the flaw in this argument was not laid bare. This changed abruptly when the appetite for risk in credit markets suddenly dried up as panic began to roil the markets; Euro member countries with high government deficits or debt and a bleak economic outlook experienced a "sudden stop" of capital inflows, with a few suffering net capital outflows. On the surface, the "sudden stop" triggered a government funding and banking crisis. In response, EU authorities offered relief—conditioned on the imposition of budgetary austerity in the afflicted country—while the ECB stepped in to support the banks there. Below the surface, however, has lain a balance-of-payments crisis, which has so far received only scant attention. Recall that the balance of payments is defined as the sum of the current and capital accounts.[22] With floating exchange rates, the balance of payments is always zero, as the exchange rate adjusts so as to balance the current with the capital account. With fixed exchange rates, however, balance-of-payments imbalances will emerge when the exchange rate is above or below its equilibrium value.

In the first case, when the exchange rate is overvalued, a country imports more than it exports, pushing the current account into deficit. At the same time, domestic asset prices in foreign currency are higher than foreign asset prices, inducing investors to sell the former and buy the latter. This, in turn, leads to net capital outflows and hence a deficit in the capital account. The combined deficits of the current and capital accounts then produce a deficit in the balance of payments. Traditionally, balance-of-payments deficits have been funded by the sale of international reserves from the central bank. When the stock of reserves is depleted and the central bank can no longer fund the balance-of-payments deficit, the exchange rate drops so as to restore both the current and capital accounts to the black.

[22] In fact, the IMF balance-of-payments concept consists of the current account, the capital account, and the financial account. In Mayer's reasoning, however, the financial account is mixed with the capital account.

Figure 3: Current-Account Balances in Euro-area Countries: in Per cent of GDP



Note: Cyclical adjustment assumes that the economy's cyclical position is the same as that of its (trade weighted) trading partners.
Source: OECD Economic Outlook 92 database, and OECD calculations.

In the second case, when the exchange rate is undervalued, the current and capital accounts (and hence the balance of payments) are in surplus, and the central bank accumulates international reserves. This process comes to an end only when reserve accumulation has increased the money supply to the extent that domestic inflation rises to intolerable levels, at which point the authorities up-value the exchange rate in an effort to regain price stability.

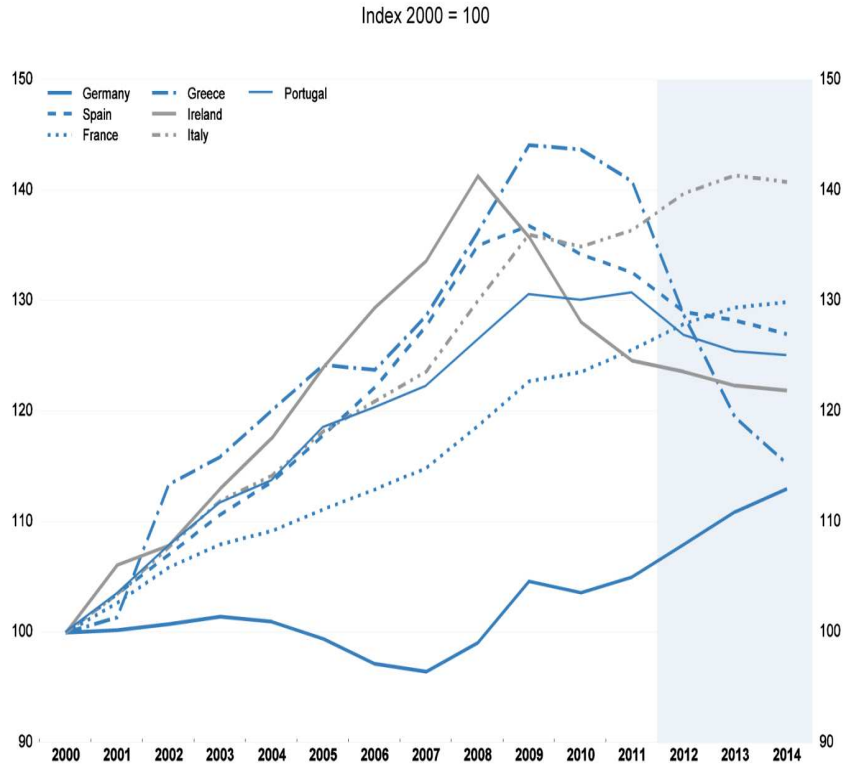
Officially being a union of sovereign states, the EMU had each member state retain its own national central bank, all of which then went on to become members of the so-called Eurosystem, with the ECB at the top. National interbank payment systems were merged into a Euro area interbank payment system (TARGET2), where national central banks assumed the role of operating the financial links between countries. A key consequence of this system was that each Euro area country had a national balance of payments in the form of the net position of its central bank within TARGET2. This net position could result in a claim (balance-of-payments surplus) or liability (balance-of-payments deficit) against the ECB, which sits in the center of the payment system. One unforeseen result of this setup was it allowed any country with a balance-of-payments deficit to automatically receive unlimited funding.

Take the example of a country that, due to an overvalued internal real exchange rate and a large government budget deficit, is running both a current-account and a capital-account deficit (Figure 3). As the banks extend credit to the overindebted government and the country's uncompetitive private sector, they are considered unsafe by international investors and lenders and are therefore cut off from private sources of funding. To ensure their continued solvency, the banks in this country receive credit from their national central bank, which acts on behalf of the ECB. Thus, reserve money flows from the ECB to fund payment outflows induced by the current- and capital-account deficits. In contrast to this scenario of local banks relying on their country's central bank and the ECB to fund their balance sheets, their counterparts in a Euro member with an undervalued real exchange rate have plenty of liquidity and therefore do not need ECB funds. Hence—according to Mayer (2011)—the ECB's funding operations become tilted towards the countries with overvalued exchange rates.[23]

[23] Mayer's idea that TARGET2 provides unlimited funding of the balance-of-payments deficits is questionable. TARGET 2 flows reflect a kind of lender-of-last-resort intervention by the ECB through the free allotment program. They just reflect the funding necessity of banks in different regions: periphery banks were the most in need, not because they lent to overindebted governments (except in Greece), but because they were the ones in dire straits due to their large positions in, for instance, real-estate markets, as in Spain.

The result of this tilt has been the lackluster growth performance in the periphery of the Euro area over the past several years, since that tilt only reinforced the erosion in those countries' competitiveness, both vis-a-vis other Euro area countries and the rest of the world. Notable features of this erosion were the domestic booms resulting from low real interest rates and strong capital inflows after accession to the EMU; hefty wage increases in excess of productivity growth, causing ever-higher unit-labor costs (Figure 4); and higher price inflation than in Germany and other "core countries" of the Euro area.

Figure 4. Unit Labor Costs



Note: The figures shown are for whole economy unit labour costs. If wage developments in the public sector diverge from those in the rest of the economy, changes in private sector costs may differ from those shown. This may mean that economy-wide labour costs are falling more sharply private sector costs in the EU/IMF programme countries.
Source: OECD Economic Outlook 92 database.

At the heart of the current difficulties in Europe are the severe structural imbalances in the distressed member countries, reflected by high current-account deficits in the periphery states and matching surpluses in the so-called core members. The prospect of the troubled countries growing economically out of their predicament is not encouraging, given their lack of competitiveness. Nor can they resort to currency devaluation as a quick fix to restore competitiveness, since they are members of a monetary union. Therefore, their necessary adjustment is going to be much more painful, involving such harsh measures as real wage cuts to push down costs. Such austerity is politically much more difficult to administer than a one-off currency devaluation. As emphasized by Véron (2011), besides budgetary belt-tightening and bank restructuring, structural reforms that enhance the crisis-hit countries' growth potential will be an indispensable part of any successful crisis resolution. Indeed, cash-strapped European governments' understandable reluctance to grapple with required economic adjustments, which demand politically unpopular policies, is what has caused markets to doubt the resolve—and therefore the future solvency—of the European periphery countries.

9. Concluding Remarks

The European experience has shown that a crisis can quickly spread among closely integrated economies, either through the trade channel, or the financial channel, or both. In an integrated world, no country can isolate itself from surrounding troubles (Rodrik, 2012). Since effective regulation, surveillance, and monitoring are the best crisis prevention, the way forward is clear: political leaders should redouble their efforts to strengthen the regional financial architecture, in tandem with bolstering domestic regulatory capacities and global financial cooperation.

In this context, it is worth stressing once more that any fixed exchange-rate arrangement (including monetary union) is prone to unsustainable stresses if the participating countries do not adjust their economies internally and their imbalances are allowed to grow well beyond the envisioned limits. If economic policies are not able to keep the domestic price level competitive vis-à-vis the rest of the integrating area, and external adjustment via the exchange rate is precluded, real exchange-rate appreciation will erode a country's competitiveness. In most cases, this will lead to current-account deficits that at some point will trigger a balance-of-payments crisis. Peripheral European countries are currently experiencing what a large number of developing and emerging countries went through over the past decades: a period of strong, yet unsustainable, output growth fueled by capital inflows comes to a halt at some

point, culminating in a "sudden stop" or reversal of capital flows (Kaminsky and Reinhart, 1999; Reinhart and Reinhart, 2009).

Since regional financial integration would require at least partial liberalization of domestic financial regulations and cross-border restrictions on financial services and financial flows, the regulatory architecture needs to keep pace with financial integration. In financially integrated areas, close cooperation between national regulators is needed. As realized possibly too late in Europe, once a certain level of regional financial integration has been reached, a regional regulatory body is needed to supervise financial institutions whose activities stretch across borders.[24]

An important lesson of both the European financial crisis and the overarching global hysteria of which it was a part is that regulatory authorities must not focus only on micro-prudential regulation and supervision of individual financial firms. Rather, they ought to identify and manage systemic risk, i.e., the risks brought on by the myriad interlinkages and interdependencies in a market, where a triggering event, such as the failure of a major investment bank, could seriously impair the functioning of financial markets and harm the broader economy (Volz, 2012).

In conclusion, the key points to focus on of both the European sovereign debt crisis and the banking panic are the following**. First**, Europe's banking system has been in a rut of systemic fragility since 2007. This is in contrast with the US, where resolution of the mess in the banking sector was swifter and essentially completed by end-2009. **Second**, had Western Europe's banks been in better shape three years ago, the policy approach to the Greek debt crisis would have been entirely different, possibly allowing for a much earlier sovereign debt restructuring. **Third**, the crisis has exposed a major deficiency in executive decision-making capability within the EU and Eurozone institutional framework, which helps to explain the insufficient policy response (Véron, 2011). In fact, the banking and sovereign debt crises are compounded by a crisis within the EU institutions themselves. Specialized European bod-

[24] Steps towards the creation of pan-European supervisory authorities for the Continent's financial sector were taken only in late 2008, when the president of the European Commission mandated a high-level expert group for that purpose. This expert group, led by Jacques de Larosière, proposed three new supervisory authorities, which were established in November 2010 and started operation in January 2011: the European Banking Authority (EBA) based in London, the European Securities and Markets Authority (ESMA) based in Paris, and the European Insurance and Occupational Pensions Authority (EIOPA) based in Frankfurt. These three supervisory authorities were complemented by the creation of the European Systemic Risk Board (ESRB), which is responsible for the macro-prudential oversight of the financial system within the EU and which has a secretariat hosted by the ECB.

ies, primarily the European Central Bank (ECB), have partly bridged this gap with policy initiatives that go beyond a narrow reading of their mandate, but they have been able to do so only to a limited extent. Thus, nothing has yet been introduced to stop the contagion in its tracks.

Therefore, a successful resolution of the current dysfunction in the markets will have to include at least the following four components: *i*) a fiscal union, i.e. a mechanism that ensures that fiscal policies in the Eurozone are partly centralized, with shared backing across countries so as to meet the requirements of a monetary union; *ii*) a banking union, i.e., a framework for banking policy and banking supervision at the European level that credibly supports the vision of a single European market for financial services; *iii*) an overhaul of EU/Eurozone institutions that would enable fiscal and banking unions to be sustainable, by allowing centralized executive decision-making to the extent necessary and by guaranteeing democratic accountability; and, finally, *iv*) short-term arrangements that chart a path towards the achievement of the above three points.

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Ekonomi-tek Volume / Cilt: 2 No: 1 January / Ocak 2013, 79-114

Determinants of the Allocation of Funds Under the Capital Purchase Program

Varvara Isyuk[*]

Abstract

During 2008-09, as part of a wide-ranging rescue operation, the US Treasury poured capital infusions into a great many domestic financial institutions under the Capital Purchase Program (CPP), thus helping to avert a complete collapse of the US banking sector. In carrying out this effort, government regulators had to distinguish between those banks deserving of being bailed out and those that should be allowed to fail. The results of this study show that the CPP favored larger financial institutions whose potential failure represented higher degrees of systemic risk. This allocation of CPP funds was cost-effective from the point of view of taxpayers, as such banks reimbursed the government for their CPP bailouts sooner than expected. In contrast, smaller banks that were heavily into mortgage-backed securities, mortgages, and non-performing loans were less likely to be bailed out and, if they did receive CPP help, took longer to repurchase their shares from the Treasury. Several explanations of such allocation decisions are proposed in this paper, including adverse selection of the mortgage products kept on banks' books and the Treasury's approach to distinguishing between insolvent and temporarily illiquid institutions.

JEL Codes: E52, E58, G21

Keywords: Capital Purchase Program, bank recapitalization, systemic risk

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1. Introduction

The global financial crisis that began in the US in 2007 dealt a severe blow to the American economy as a whole. Financial institutions, corporations, and households all felt the strain, while government interventions across the world imposed heavy burdens on the taxpayers in their societies. These interventions included such measures as loan guarantee schemes for newly issued senior unsecured debt and bank recapitalizations. In the US, between October 2008 and December 2009, the US Treasury injected huge amounts of liquidity into 707 banks[1] in 48 states through the purchases of preferred equity stakes under the voluntary Capital Purchase Program (the CPP; for more details, see Acharya and Sundaram, 2009; Panetta *et al.*, 2009; King, 2009; Cooley and Philippon, 2009; Khatiwada, 2009).

The Federal Reserve and US Treasury had to develop criteria for deciding whether to bail out a given bank or allow it to go under. Many such judgments were made on a case-by-case basis during the height of the crisis, and the debate over the effectiveness of the entire rescue program for the country's commercial banks continues to this day. On the one hand, regulators were leery of entering into "moral hazard" territory (Dam and Koetter, 2011; Gale and Vives, 2002; Stiglitz, 2012); on the other hand, bank recapitalizations were obviously necessary to support solvent but illiquid banks and thus avert a catastrophic collapse of the entire financial system (Fender and Gyntelberg, 2008).

Compared with other types of government support, the purchase of preferred or common shares is often seen as one of the most efficient types of capital infusions (see Wilson and Wu, 2010). Another argument in favor of the CPP is that the program did not end up costing taxpayers much. Specifically, it spent only $204.9 billion of its $250 billion budget (more than a third of the total Troubled Asset Relief Program). The largest investment was $25 billion and the smallest was $301,000.

By April 30, 2013, the Treasury had recovered more than $222 billion of what it had disbursed through the CPP in the form of repayments, dividends, interest, and other income (according to the US Department of the Treasury website). (It should be noted that not all bank stakes taken up under the CPP at that time were held by the Treasury.) In March 2012, the Treasury started to wind down its remaining bank investments through public auctions. This process accelerated during the fall of 2012.

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[1] Including more than 450 small and community banks and 22 certified community development financial institutions (CDFIs).

This paper focuses on the determinants of the liquidity provisions under the CPP. It first defines the factors that contributed to the final bailout allocation and to bailout repayments[2]. Based on that, it is possible to assess the effectiveness of the allocation of CPP funds according to the goals of the program and the realized risks for taxpayers.

The presented analysis rests on four main hypotheses. The first hypothesis is that the distribution of CPP funds and their repayments were geared to the perceived financial fragility of commercial banks just before the crisis. Regulators were expected to provide liquidity to more financially vulnerable banks as well as to those banks exposed to the so-called "tail risk" that materialized after a secular collapse in the housing market.

The second hypothesis is that the CPP was designed to minimize the spreading of the crisis. First, there was the risk of a drying up of credit availability due to the deterioration in the intermediary role of the banking sector. Second, there was significant counterparty risk, mostly from the side of LCFIs (Large Complex Financial Institutions), which proved to be "too big to fail" due to their size, complexity, interconnectedness, and other factors. Several indicators are used in this paper to identify systemically critical institutions: Marginal Expected Shortfall (MES) (Acharya *et al.*, 2010), $\Delta CoVaR$ (Adrian and Brunnermeier, 2011), bank size, and beta.

Another hypothesis underlying this study is that political contributions (including lobbying activities) and a bank's location could have caused a more generous distribution of CPP funds towards specific financial institutions. In this vein, Duchin and Sosyura (2012) find evidence of politically connected firms having priority in being funded.

A bank's excessive risk-taking before the crisis might be one more reason for its participation in the CPP. The higher the degree of risk taken by such an enterprise (indicated by the change in the bank's share value), the larger its losses should be during the crisis and thus the greater its need for CPP funds vis-à-vis other banks (Kibritcioglu, 2002).

The paper contributes to the literature on bailouts and on the effectiveness of liquidity provisions. The allocation of CPP funds is investigated and evaluated by analyzing bailout repayments over the four years following the disbursement of CPP funds (2009-12). In this regard, it is an important source of information on the realized risks of funding allocations. Methodologically, polytomous and duration models are applied to analyze capital injections under the CPP and their reimbursement.

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[2] The bailout repayments under the CPP mean the repurchase of the Treasury's equity stake.

Not all banks were automatically eligible for the CPP. First, a bank had to request participation in the CPP by applying to the appropriate Federal banking agency (FBA). Second, the Treasury had to approve the bank's application. Then, the bank had 30 days from the date of that notification to accept the Treasury's terms and conditions and to submit investment agreements and related documentation. This being the case, if a particular bank was not bailed out, two distinct scenarios were possible to explain why.

First, that bank either did not apply for CPP funds in the first place or did not accept the Treasury's conditions after receiving preliminary approval, perhaps because of the availability of cheaper alternative financing or the absence of the need to recapitalize. Second, such a bank could have been refused CPP funds by the Treasury for two main reasons: (i) it was considered to be insolvent or (ii) its financial situation was deemed superior to those of other applicants (given that the amount to be disbursed under the CPP was limited). Of these, the first reason seems to be more realistic, as not all CPP funds were disbursed and most banks were suffering from liquidity shortages equally.

According to a report by the US Government Accountability Office (GAO, 2009), the Treasury had received over 1,300 CPP applications from regulators by June 12, 2009, while more than 220 applications had not yet been forwarded to the Treasury by bank regulators[3]. Further, approximately 400 financial institutions that had received preliminary approval had withdrawn their CPP applications by June 12, 2009 because of the uncertainty surrounding future program requirements. However, in this paper, no distinction is made between these two situations, as no data on individual bank applications are freely available. This limitation has been taken into account when interpreting the results.

The results of multinomial logit regression analysis confirm that the CPP was designed to provide liquidity to systemically critical and "too big to fail" commercial banks. At the same time, these banks tended to exhibit a higher probability of repurchasing their shares from the Treasury than other banks. Thus, saving these banks helped avoid large external costs for the other sectors of the economy in the event of a total collapse of the banking sector, while taxpayers' money was returned in relatively short order. However, such an allocation of CPP funds might have contributed to the creation of moral hazard and triggered more future bailouts of large and "too interconnected" banks. In addition, while financially distressed banks (according to their Z-scores) were more likely to be bailed out, this was not the case for banks with

[3] The deadline for applications by small banks was then extended until November 21, 2009.

portfolios overweighted with mortgage-backed securities (MBSs), mortgages, and non-performing loans.

There are several interpretations of these results, depending on whether a bank decided not to apply for CPP funds or the Treasury rejected the bank's application. A bank may have decided not to apply for CPP funds if the mortgages and MBSs on its books were of primary loan type. This means that banks preferred to leave high-quality loans on their balance sheets and to securitize and sell off less safe ones (including subprime loans) to other entities via off-balance-sheet vehicles. However, if the Treasury decided not to bail out a commercial bank, it may have been due to its specializing in mortgage lending and MBSs rather than commercial lending.

Banks that specialized in commercial and industrial loans might have been viewed as more viable and temporarily illiquid through no fault of their own (the cause being deterioration of the interbank market), unlike their counterparts that had been wallowing in mortgage lending, which were now insolvent after engaging in predatory lending before the crisis. Moreover, the former group of banks had a higher probability of repaying CPP funds in full before July 2012.

The remainder of the paper is structured as follows. Section 2 presents the estimation methodology. Section 3 introduces the data and describes the dependent and explanatory variables. The empirical results for the polytomous and time-to-repayment regressions analyzing the factors that determined the disbursement of CPP funds and their repayments are presented in Section 4. Section 5 contains the conclusion.

2. Estimation Methodology

2.1 Multinomial (Polytomous) Logistic Regression

Multinomial logistic regression uses the maximum likelihood method to predict a categorical dependent variable that takes on more than two outcomes that have no natural ordering. The discrete dependent variable in that model represents a bank's progress in CPP funds repayment by July 31, 2012.

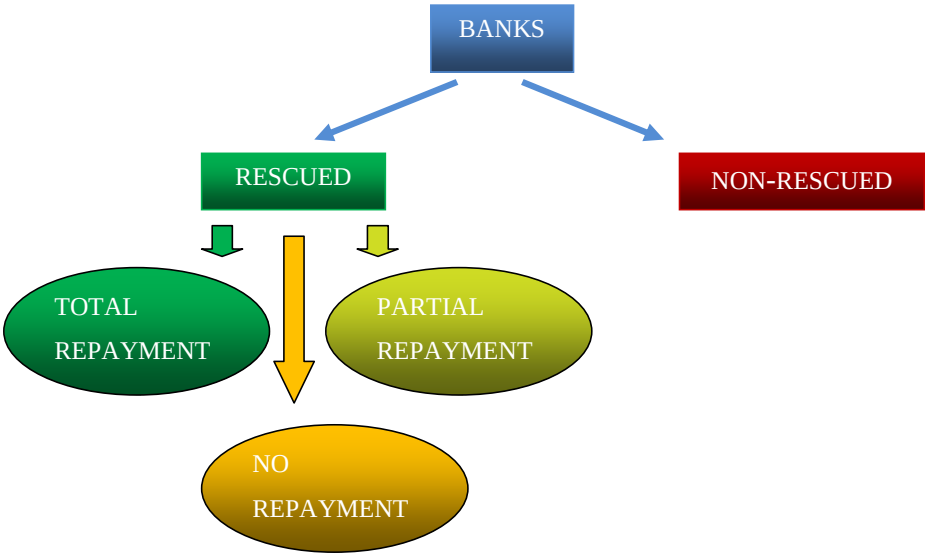
The set of coefficients for explanatory variables is estimated for each outcome: no bailout, $y = 0$; bailout and total repayment, $y = 1$; bailout and partial repayment, $y = 2$; bailout and no repayment, $y = 3$ (Figure 1).

The model requires setting the base outcome. The coefficients associated with that base outcome are zero. That is, when the setting outcome is "bailout and total repayment" ($y = 1$), the coefficients for the remaining outcomes measure the change relative to that base group.

Duration analysis

Under the CPP, financial institutions received the funds in the period between October 2008 and December 2009, while the date of each bank's exit from the CPP depended on its ability to repurchase the Treasury's stake. The time until the bailout repayment is another measure quantifying the realized risks of funding allocations.

Figure 1. Bailout and Repayment Decision



A central component of the analysis in this section is the hazard rate, which is the probability of the CPP refund at time t_i, conditional on not having repaid the bailout before (or having survived to time t_i).

One of the issues of the duration analysis is to define the shape of the hazard rate. The Semiparametric Cox proportional-hazards model allows us to leave the baseline hazard $h_0(t)$ without particular parametrization, while the effects of the covariates are parametrized to alter the hazard function in a certain way:

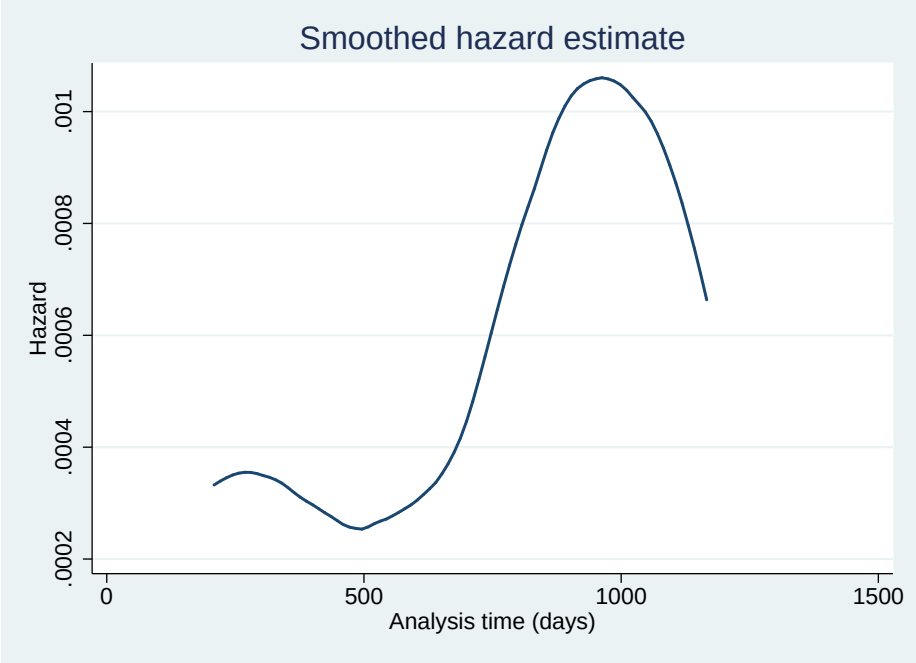
$$h(t|x_j) = h_0(t)\exp(x_j\beta_x) \quad (1)$$

where β_x are regression coefficients and are to be estimated from the data.

However, when a correct form of the $h_0(t)$ is chosen, the model could fit the data better and produce better results. Figure 2 presents smoothed estimates of the hazard function, which has a monotonically increasing shape until around 2.7 years after the bailout and then starts to decline. Thus, the

plot suggests that there is an increased rate of repayment in the period between 1.5 and 2.8 years after the CPP funds disbursement, while this repayment hazard rate diminishes after 2.8 years following the bailout.

Figure 2. Estimates of the Hazard (Probability of CPP Funds Repayment) Function



Parametric models can be based, on the one hand, on the proportional-hazards assumption, and, on the other hand, on accelerated-failure-time (AFT) assumption. To capture the monotonically increasing shape of the hazard function (Figure 2), the Weibull distribution is chosen.

The declining shape of the hazard function at the end of distribution, however, suggests a possibility of a non-monotonic pattern-of-duration dependence. The log-logistic distribution is chosen from among other AFT models.

The choice between the parametric models is made using the Akaike Information Criterion (AIC) and log-likelihood. The AIC scores are compared between the parametric models. The lowest value of the AIC is found for the Weibull model of baseline hazard, even though Figure 2 suggests a greater resemblance to log-logistic and log-normal models. Log-logistic distribution

of the hazard function is preferred to the log-normal one, according to the AIC criterion; anyway, it is commonly used when fitting data with censoring.

Thus, three duration models are finally fitted: the Cox proportional-hazards model (no specific parametrization), the Weibull proportional-hazards model (monotonically increasing hazard function), and the log-logistic model (non-monotonic unimodal hazard).

3. Data and Summary Statistics

3.1 Data Description

To construct the sample of firms, US domestically controlled commercial banks were selected from DataStream. These financial companies operated in the US market in US dollars and were still active in December 2008. After variables needed for estimation were selected, around 650 commercial banks were left in the sample.

The data on bailouts (promised amount, actual disbursed amount, date of entering the program) and bailout reimbursement (amount repaid, date of repayment) were obtained from the Treasury's Office of Financial Stability. The data on political contributions and lobbying expenditures of PACs (Political Action Committees) related to banks came from the website of the US Federal Election Commission.

The data from these three sources were merged. Bailouts under CPP were provided to domestically controlled banks, bank holding companies, savings associations, and savings and loan holding companies. Only actual disbursed amounts were considered as evidence of a bank bailout.

After outlier cleaning, 597 banks were left in the sample.

3.2 Dependent Variables

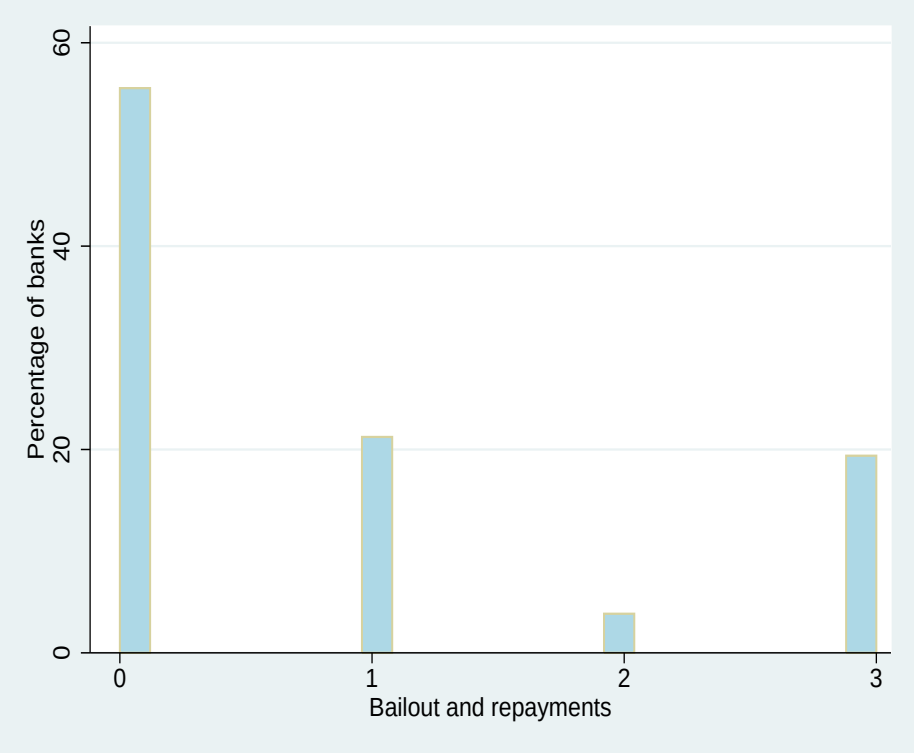
3.2.1 CPP Funds Allocation and Repayment

This discrete dependent variable classifies the banks into four groups: banks that did not receive the CPP funds, $y = 0$; banks that received the CPP funds and reimbursed them totally, $y = 1$; banks that received the CPP funds and reimbursed them partly, $y = 2$; and banks that received the CPP funds but did not pay back anything, $y = 3$.

Slightly more than half of the represented banks did not receive the CPP funds in 2008-09 (Figure 3). Around 20% of the banks from the sample received the CPP funds and repaid them totally; another 20% of them received the CPP funds but did not pay back anything by July 31, 2012; and a small

fraction of the banks (less than 5%) repaid the CPP funds partly (the majority of which repaid at least 50% of the total amount).

Figure 3. Distribution of the Ordinal Variable on CPP Funds Allocation and Their Repayment by July 2012



3.2.2 Time-to-Repayment

The time at risk or time until the event occurs (here the CPP funds repayment) is analyzed in this duration model.

Only bailed out banks were considered for the estimation. Thus, around half of the observations were left in the sample, around 280 banks. The analyzed period was limited to between the distribution of the CPP funds in 2008-09 and July 31, 2012. In that period, approximately half of these banks repaid the bailouts.

A bank was said to have repaid the CPP funds if it managed to repurchase the total amount of preferred shares from the Treasury by the end of the analyzed period (total refund). Time-to-repayment was counted in days.

The data and the repayment announcements suggested the first repayments would take place in March 2009, around half a year after the start of the CPP program. Starting from that period, the probability of CPP refunds increases with time (see Section 2.2 for details).

3.3 Bank Balance-Sheet Characteristics

Bank balance-sheet characteristics are financial-statement variables that define the "financial health" of a bank, or, in other words, determine the probability of the bank's default (Duchin and Sosyura, 2012; Ratnovski and Huang, 2009). Here indicators from the next three models were included: Altman's Z-score, KMV Moody's RiskCalc for US banks, and the BondScore (Credit Sights) model. Some indicators appeared to be highly correlated with each other and needed to be excluded from the final estimation.

The bailout dummy BD_i is introduced in correlation tables, allowing us to make assumptions about the impact of explanatory variables on disbursement of CPP funds. The bailout dummy takes a value of one if the bank received the CPP funds, zero otherwise.

3.3.1 Altman’s Z-score

Altman's bankruptcy model proposes a Z-score indicator for each firm, representing the level of distress of that firm. Five financial ratios are used to calculate that score (see details in Appendix A.1). A higher Z-score is interpreted as an indicator of a "safer" or, in other words, more financially healthy firm, while a lower Z-score indicates a high level of distress for that organization.

It is expected that safer financial firms would show they had suffered less from the capital shortage and had had a smaller probability of receiving the CPP funds.

3.3.2 Moody's KMV RiskCalc™ V3.1 US Banks

More recently, Moody's rating agency came out with its KMV RiskCalc V3.1 model for predicting probability of a bank’s default. It comprises financial-statement variables and equity-market information on a bank's prospects and business risk.

As expected, default frequency measures as well as the formula for computing them are not available to the public, so the input variables of the Moody's model are plugged directly into the regressions (taking into account the probability of multicollinearity between indicators from different models). Each category is represented by at least one variable; descriptive statistics are provided in Table 1. The main variables are discussed below.

Table 1. Summary of Dependent Variables and Balance-Sheet Characteristics from Altman's and Moody's Models For US Commercial Banks

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
Bailout dummy	BD_i	644	0.44	0.5	0	1
Bailout and repayment categorical variable	R_i	644	0.87	1.16	0	3
Time-to-repayment (in days)	TR_i	280	1004.22	355.34	89	1355
Z-score, standardised	Z	597	0	1	-2.92	4.27
Moody's RiskCalc U.S. Banks						
Total equity to total assets, winsorised at 2% level, standardised	CS_1	661	0	1	-1.20	3.54
Total deposits to total assets, winsorised at 1% level, standardised	CS_2	642	0	1	-1.67	2.80
Net revenues to total assets, winsorised at 1% level, standardised	P_1	654	0	1	-2.25	3.68
Cash flow per share, winsorised at 2% level, standardised	P_2	640	0	1	-0.84	3.50
Mortgage Real-Estate Loans to total loans ratio (in Percentage), standardised	AC_1	661	0	1	-3.56	2.02
Consumer and Industrial Loans to total loans ratio (in percentage), winsorised at 2% level, standardised	AC_2	653	0	1	-1.22	3.21
Treasury Securities to total assets ratio (in percentage), winsorised at 2% level, standardised	Liq_1	607	0	1	-0.56	3.59
Mortgage-Backed Securities to total assets ratio (in Percentage), winsorised at 2% level, standardised	Liq_2	641	0	1	-1.04	3.36
Non-performing loans to total loans ratio (in Percentage), winsorised at 2% level, standardised	AQ	661	0	1	-0.91	3.69

The **Asset Concentration** group consists of two variables: **real-estate mortgage loans** (AC_1 in tables) and **commercial and industrial loans** (AC_2 in tables), normalized by total loans.

Real-Estate Mortgage Loans (AC_1) include commercial and construction mortgages; thus, the relative size could be positively correlated with the size of commercial and industrial loans (AC_2). It appears, though, that these groups of loans are highly but negatively correlated with each other (the correlation coefficient is -0.89; Table 2). It means that if a bank is concentrated in real-estate mortgage lending, it provides fewer loans for commercial and industrial purposes[4]. That can be interpreted as a bank's loan portfolio "specialization."

Liquidity-related variables (**Liquidity group)** measure the share of liquid assets on the balance sheet of a bank. Moody's RiskCalc v3.1 US Banks model (2006) and the Basel II regulation classified mortgage-backed securities (MBS) as safe and liquid holdings. That was indeed the case at the time; MBSs also included government mortgages offered by the Government National Mortgage Association or other US Federal agencies.

In the recent crisis, MBSs became highly risky and illiquid assets. That is why the initial indicator proposed in Moody's RiskCalc model that brought together Treasury securities and mortgage-backed securities (as both representing liquid groups of assets) has been replaced by two separate ratios.

The **Asset Quality group** is represented by the **share of non-performing loans in total loans**. Lower asset quality is expected to increase the probability of default and, consequently, the probability of the bailout. Nevertheless, the correlation coefficient between the bailout dummy and normalized non-performing loans in 2007 is negative (-0.11, Table 2).

3.3.3 BondScore Model

The BondScore Credit Model is another model that calculates credit risks for publicly traded US non-financial corporations with total assets in excess of $250 million.

Three variables from the BondScore Model are analyzed (the others are similar to the indicators from Moody's RiskCalc Model): the ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA) to a bank's net revenues (EBITDA margin,EM); leverage (Lev); and the volatility of EBITDA (Vol). It is expected that commercial banks with higher margins,

[4] Commercial and industrial loans represent a general amount of loans made to business and industry, excluding commercial mortgages and including consumer loans.

Table 2. Correlation Between Dependent Variables and Explanatory Balance Sheet Variables for US Banks

Model	Var	BD	R	TR	Z	CS_1	CS_2	P_1	P_2	AC_1	AC_2	Liq_1	Liq_2	AQ	EM	Lev	Vol
Bailout dummy	BD	1.00															
Repayment	R	0.82	1.00														
Time	TR	-0.09	0.57	1.00													
Altman's Z-score	Z	-0.20	-0.22	-0.16	1.00												
Moody's	CS_1	-0.15	-0.15	-0.06	**0.66**	1.00											
RiskCalc	CS_2	0.11	0.06	-0.06	-0.06	-0.19	1.00										
	P_1	-0.05	-0.03	0.03	0.24	-0.07	-0.08	1.00									
	P_2	0.04	0.04	0.14	0.11	-0.02	-0.03	0.15	1.00								
	AC_1	-0.16	-0.05	0.22	0.01	0.06	0.10	-0.19	-0.08	1.00							
	AC_2	0.15	0.06	-0.15	-0.04	-0.06	-0.12	0.20	0.08	**-0.89**	1.00						
	Liq_1	-0.17	-0.14	0.04	0.00	0.07	-0.08	-0.15	-0.02	-0.01	-0.03	1.00					
	Liq_2	-0.10	-0.15	-0.14	0.03	0.00	0.26	-0.31	-0.05	-0.01	-0.02	-0.02	1.00				
	AQ	-0.11	0.03	0.21	-0.24	-0.08	0.04	0.15	0.13	0.07	-0.03	0.03	-0.11	1.00			
Bond	EM	0.05	-0.05	-0.18	**0.56**	0.12	0.29	0.02	-0.02	0.03	-0.05	-0.03	0.11	-0.43	1.00		
	Lev	0.15	0.20	0.25	**-0.77**	-0.44	0.14	-0.22	-0.11	0.07	-0.08	0.02	-0.03	0.19	-0.37	1.00	
	Vol	0.02	0.07	0.09	-0.15	-0.12	0.12	0.22	-0.02	0.10	-0.01	-0.11	-0.06	0.18	-0.14	0.02	1.00

lower leverage, and less volatility would exhibit a smaller probability of default and, consequently, would suffer less from liquidity shortages during the crisis.

However, the first two BondScore variables cannot be kept in regressions due to the high risk of multicollinearity.

3.4 Systemic Risk Variables

One of the goals of the CPP was to prevent the crisis spreading from one big institution to another and from the financial sector to the economy at large. Thus, regulators were focused on rescuing those financial institutions they believed were critical to the survival of the entire system.

One of the most frequently used proxies for systemic risk is a firm's **size** (standardized, $Size_{i,2007}$, Table 3). It supports the "too big to fail" argument: the lender of last resort cannot deny support to large financial institutions whose closure would significantly affect the rest of the market (Freixas and Parigi, 2008). Correlation coefficients are presented in Table 4. A bank's size is indeed highly and positively correlated with bailout dummy BD_i.

The second variable that represents the systemic risk is $\boldsymbol{Beta_{i,2007}}$. It is the correlation between the share value of a financial institution and the overall market. The details on the construction of systemic risk variables are presented in Appendix A.2. During the crisis period, the stock market in general performed abominably; thus, a company with a higher beta should exhibit a higher probability of default and, accordingly, require government intervention.

$\boldsymbol{\Delta CoVaR}$ was developed by Adrian and Brunnermeier (2009). $\Delta CoVaR$ represents the difference between the Value-at-Risk of the financial sector—conditional on institution "i" being in distress—and the unconditional Value-at-Risk of the financial sector.

The **Marginal Expected Shortfall** (MES) is the expected percentage loss in market value faced by a financial institution when a shock drives the market beyond some threshold.

(MES) is calculated over three different periods (it could not be done with $\Delta CoVaR$ as there are not enough observations): for the year 2007 ($MES_{i,2007}$), for the period of eight years preceding the crisis (from 2000 to 2007, $MES_{i,2000-2007}$), and for the periods surrounding the Bear Stearns and Lehman Brothers bankruptcies (February, March, September, and October of 2008, MES_{BSLB}).

Table 3. Summary of BondScore Balance-Sheet Characteristics, Systemic Risk, Political Involvement, and Individual Risk-Taking Related Variables

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
BondScore U.S.						
$\frac{EBITDA_{2007}}{Sales_{2007}}$, winsorized at 2%level, standardized	EM	632	0	1	-3.24	1.83
$\frac{Debt_{2007}}{MarketCap+BookValueDebt_{2007}}$, winsorized at 1% level, standardised	Lev	604	0	1	-3.57	2.52
$Volatility_{2007}$, standardized	Vol	502	0	1	-1.88	3.43
Systemic Risk						
Size (logarithm of total assets), standardized	$Size_{i,2007}$	661	0	1	-2.84	3.49
Beta, standardized	$Beta_{i,2007}$	621	0	1	-1.76	2.78
Marginal expected shortfall (MES) for 2007, standardized	$MES_{i,2007}$	626	0	1	-2.41	2.95
Marginal expected shortfall (MES) over 8 years between 2000 and 2007, winsorized at 1% level, standardized	$MES_{2000-2007}$	632	0	1	-1.87	3.65
Marginal expected shortfall (MES) for the Bear Stearns and Lehman Brothers near-collapse, winsorised at 1% level, standardized	MES_{BSLB}	608	0	1	-1.81	2.51
Conditional Value-at-Risk, standardized	$\Delta CoVaR_{i,1990-2007}$	628	0	1	-3.13	1.97
Political influence and location						
Political influence dummy	$PD_{2006-2008}$	658	0.03	0.18	0	1
State	$State$	661	25.90	14.39	1	51
Individual risk-taking						
Change in log stock prices during 2003-2006, winsorised at 1% level, standardised	$\ln(q_{i,2003-2006})$	525	0	1	-3.09	2.64

Table 4. Correlation Between Dependent Variables and Explanatory Systemic Risk, Political Influence, Location, and Individual Risk Variables For US Banks

Model	Var	BD	R	TR	$Size$	$Beta$	$MES_{i,2007}$	$MES_{i,2000-2007}$	$MES_{i,ESLE}$	$\Delta CoVaR$	PD	$State$	$\ln(q_{i,2002-2006})$
Bailout dummy	BD	1.00											
Repayment	R	0.82	1.00										
Time	TR	-0.09	0.57	1.00									
Systemic	$Size$	0.24	018	-0.24	1.00								
Risk	$Beta$	0.26	0.19	-0.09	**0.62**	1.00							
	$MES_{i,2007}$	0.12	-0.02	-0.22	**0.74**	**0.62**	1.00						
	$MES_{i,2000-2007}$	0.16	0.00	-0.28	**0.78**	**0.61**	0.80	1.00					
	$MES_{i,ESLE}$	0.15	0.00	-0.20	**0.68**	**0.59**	0.90	0.74	1.00				
	$\Delta CoVaR$	0.05	0.00	0.01	0.25	0.14	0.19	0.20	0.17	1.00			
Political inf-ce	PD	0.12	0.08	-0.07	0.39	0.20	0.19	0.24	0.18	0.15	1.00		
State	$State$	-0.04	-0.03	-0.05	-0.01	-0.06	0.02	0.02	0.02	0.01	0.01	1.00	
Risk-taking	$\ln(q_{i,2002-2006})$	-0.04	-0.04	-0.05	-0.12	-0.09	-0.09	-0.09	-0.08	-0.11	-0.02	-0.03	1.00

All the measures of systemic risk are calculated in such a way that the higher value of the variable indicates a higher contribution of the commercial bank in question to systemic risk. The correlation coefficients from Table 4 are positive, confirming that a higher contribution to systemic risk is associated with the higher probability of CPP funds disbursement.

3.5 Political Involvement and Location Indicators

Wall Street is one of the largest contributors to Federal political campaigns. Monetary contributions to political campaigns and lobbying activities on behalf of the industry are carried out through political action committees (PACs). The data on PAC contributions contain information on official contributions of bank-related PACs. Surprisingly, only 3.3% of financial firms were found to be official contributors between 2006 and 2008. Lobbying expenditures are another way for the private sector to curry favor with those in power.

The political-involvement dummy is then constructed, $PD_{2006-2008}$. The dummy takes on a value of one if, in the underlined period, the PAC related to the bank made a political campaign or lobbying contribution, zero otherwise. The correlation of the political-involvement dummy with the bailout dummy suggests a positive influence of the former on the latter (the correlation coefficient is 0.12, Table 4). To control for bank location, the state dummy is then included into regressions.

3.6 Bank's Excessive Risk-Taking

The literature describes several attempts to discern from the past performance of financial institutions whether those who had pursued riskier strategies had learned from financial crises to be more careful or continued in the same vein.[5]

The representative variable from this group aims to account for individual risk-taking of a bank. It is calculated as the difference in log stock prices of the bank between 2003 and 2006, $\ln(q_{i,2003-2006})$.

Firms that take on more risk and follow more aggressive investment strategies to achieve higher returns are expected to have experienced a major run-up in their stock prices during that period. These should also be the same entities that sustained the most damage during the crisis and that required government intervention to survive.

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[5] For instance, through the performance of the banks during the LTCM crisis in 1998, Fahlenbrach *et al.* (2011)..

4. Results

4.1 Polytomous Logistic Model

The multinomial (polytomous) logistic model is used to define the factors that determined the probability of the bank bailouts under CPP and their repayment/non-repayment in the period between 2009 and 2012. The dependent variable indicates if a bank was bailed out or not, and, if it was, how much did it repay to the Treasury by July 2012: the total amount, a part of the disbursed amount, or nothing at all (see Figure 1 and Section 3.2.1 for details).

The results for the multinomial regressions are presented in Table 5. The base outcome is disbursement of the CPP funds to bank *i* and total repayment by July 2012.

The coefficients presented in Table 5 are multinomial log-odds (logits)[6]. They are interpreted as a change in the logit of outcome m ("no bailout," "bailout and partial repayment," "bailout and no repayment") relative to the reference group ("bailout and total repayment") for a unit change in the predictor variable, if the other variables in the model are held constant.

Table 5 reports the results for three model specifications with distinct measures of systemic risk: beta ($Beta_{i,2007}$) in Column 3; bank size ($Size_{i,2007}$) in Column 4, and Marginal Expected Shortfall measured over eight years, from 2000 to 2007 ($MES_{i,2000-2007}$), in Column 5.

Balance-sheet characteristics, systemic risk, and individual excessive risk-taking indicators are standardized. The standard deviation of each of these indicators is then equal to one, which makes the size of the parameters comparable within each column.

The first section in Table 5 (Section "no bailout" of Table 5) reveals factors that affect the probability of a bank having received no bailout (group "0"), as opposed to the group of banks that received the bailout and repaid it totally (group "1"). Bear in mind that the "no bailout" outcome could have been caused by the bank's own decision not to apply for the CPP funds or by the Treasury's rejection of the bank's application.

The empirical evidence suggests that the CPP funds were provided to financially distressed firms. A one-unit increase in a bank's Z-score (Z) is associated with a 0.489 rise in the multinomial log-odds for the "no bailout" outcome relative to the "bailout and total repayment" outcome (Column 3, Section "no bailout", Table 5).

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[6] Another possibility would be to present the coefficients in terms of relative risk ratios.

Table 5. Determinants of the Bank Bailout and its Repayment Under TARP's Capital Purchase Program Between 2008 and 2012, US Commercial Banks, Polytomous Logistic Regressions. Base Outcome: Bailout and Total Repayment

Type of var	Name	Polytomous logit with *Beta*	Polytomous logit with *Size*	Polytomous logit with *MES*
No bailout				
Balance-sheet characteristics				
Altman's	Z	**0.489****	**0.681*****	**0.617*****
Z-score		(2.912)	(3.640)	(3.594)
Moody's	CS_2	-0.165	0.036	-0.225
RiskCalc		(-1.18)	(0.24)	(-1.67)
	P_1	0.368*	0.272	0.251
		(2.252)	(1.641)	(1.632)
	P_2	-0.035	0.244	-0.014
		(-0.211)	(1.380)	(-0.093)
	AC_1	**0.598*****		**0.572*****
		(4.428)		(4.274)
	AC_2		**-0.451*****	
			(-3.450)	
	Liq_1	**0.321***	**0.334***	**0.343***
		(2.092)	(2.100)	(2.245)
	Liq_2	**0.456****	**0.534****	**0.437****
		(2.840)	(3.144)	(2.748)
	AQ	**0.709*****	**0.813*****	**0.674*****
		(3.911)	(4.062)	(3.736)
BondScore	Vol	0.337*	0.308	0.263
Model		(1.987)	(1.853)	(1.597)
Systemic Risk	$Beta_{i,2007}$	**-0.731*****		
		(-5.042)		
	$Size_{i,2007}$		**-1.243*****	
			(-6.765)	
	$MES_{i,2000-2007}$			**-0.625*****
				(-4.577)

	$\Delta CoVaR_{i,1990-2007}$	0.135	0.241	0.178
		(1.040)	(1.78)	(1.385)
Political inv-t	$PD_{2006-2008}$	-0.379	1.091	-0.210
and location		(-0.495)	(1.330)	(-0.306)
	$State$	0.005	0.007	0.009
		(0.607)	(0.86)	(1.05)
Individual	$\ln(q_{i,2003-2006})$	0.118	0.048	0.039
risk-taking		(0.732)	(0.286)	(0.254)
	Constant	1.003***	1.113***	0.967***
		(3.802)	(4.140)	(3.748)
Bailout and partial repayment				
Balance-sheet characteristics				
Altman's	Z	0.134	0.236	0.140
Z-score		(0.385)	(0.619)	(0.381)
Moody's	CS_2	-0.013	0.104	0.033
RiskCalc		(-0.041)	(0.334)	(0.114)
	P_1	-0.091	-0.193	-0.147
		(-0.255)	(-0.541)	(-0.444)
	P_2	**0.595****	**0.756*****	**0.636****
		(2.913)	(3.410)	(3.160)
	AC_1	0.525		0.388
		(1.748)		(1.358)
	AC_2		-0.269	
			(-0.988)	
	Liq_1	-0.194	-0.202	-0.188
		(-0.539)	(-0.555)	(-0.523)
	Liq_2	0.059	0.047	0.033
		(0.173)	(0.128)	(0.101)
	AQ	**0.592***	**0.821****	**0.657***
		(2.006)	(2.640)	(2.288)
BondScore	Vol	0.472	0.573	0.538
Model		(1.445)	(1.869)	(1.753)
Systemic Risk	$Beta_{i,2007}$	0.305		
		(1.017)		
	$Size_{i,2007}$		-0.237	
			(-0.675)	

	$MES_{i,2000-2007}$			-0.028
				(-0.105)
	$\Delta CoVaR_{i,1990-2007}$	-0.081	-0.043	-0.058
		(-0.291)	(-0.155)	(-0.213)
Political inv-t	$PD_{2006-2008}$	1.603	1.815	1.747*
and location		(1.816)	(1.665)	(1.995)
	$State$	-0.021	-0.021	-0.022
		(-1.156)	(-0.179)	(-1.222)
Individual	$\ln(q_{i,2003-2006})$	0.370	0.297	0.283
risk-taking		(1.245)	(1.023)	(1.009)
	Constant	-1.673**	-1.402**	-1.484**
		(-3.109)	(-2.748)	(-2.932)
Bailout and no repayment				
Balance-sheet characteristics				
Altman's	Z	-0.254	-0.088	-0.120
Z-score		(-1.207)	(-0.392)	(-0.560)
Moody's	CS_2	-0.157	0.082	-0.106
RiskCalc		(-0.985)	(0.466)	(-0.665)
	P_1	0.047	-0.019	-0.023
		(0.250)	(-0.101)	(-0.117)
	P_2	0.140	0.364	0.168
		(0.832)	(1.920)	(0.990)
	AC_1	**0.415****		**0.364***
		(2.666)		(2.328)
	AC_2		**-0.301***	
			(-2.004)	
	Liq_1	-0.076	-0.044	-0.067
		(-0.393)	(-0.229)	(-0.350)
	Liq_2	-0.347	-0.211	-0.304
		(-1.639)	(-0.984)	(-1.436)
	AQ	**0.543****	**0.695****	**0.571****
		(2.797)	(3.281)	(2.945)
BondScore	Vol	0.251	0.293	0.303
Model		(1.351)	(1.597)	(1.649)
Systemic Risk	$Beta_{i,2007}$	**-0.338***		
		(-2.075)		

	$Size_{i,2007}$		**-1.040*** **	
			(-4.886)	
	$MES_{i,2000-2007}$			**-0.757*** **
				(-4.303)
	$\Delta CoVaR_{i,1990-2007}$	-0.014	0.160	0.148
		(-0.102)	(1.024)	(0.963)
Political inv-t	$PD_{2006-2008}$	0.229	1.327	0.258
and location		(0.290)	(1.465)	(0.312)
	$State$	0.004	0.004	0.005
		(0.381)	(0.408)	(0.458)
Individual	$\ln(q_{i,2003-2006})$	0.157	0.099	0.067
risk-taking		(0.878)	(0.551)	(0.369)
	Constant	-0.146	-0.004	-0.173
		(-0.460)	(-0.008)	(-0.555)
	Pseudo R^2	0.156	0.168	0.153
	Obs	505	514	519

Notes: t-statistics in parentheses; ***, ** and * denote p-value less than 0.1%, 1%, and 5%, respectively.

Safer or financially stable banks (with a higher Altman's Z-score in 2007) are less likely to have applied for the CPP funds, as they had easier access to alternative sources of financing. Besides, they were less likely to be approved by the Treasury for participation in the CPP as the stipulated amount was limited ($250 billion, later reduced to $218 billion), and the program was aiming at illiquid financial institutions.

Recall that real-estate mortgage loans (AC_1) and commercial industrial loans (AC_2) normalized as total loans, are negatively correlated (the correlation coefficient is -0.89, Table 2). This can be assumed to mean that many banks either specialized in mortgage lending or in commercial and industrial lending. When thinking of these specializations in relation to the origin of the financial crisis (the boom-and-bust housing market and, particularly, the excesses in the subprime-mortgage market), one might understandably assume that those banks highly active in mortgage lending were the ones left holding a disproportionate share of illiquid assets and having to apply for the CPP. After all, wasn't the government intent on helping American homeowners by supporting mortgage lending and preventing massive residential defaults?

However, the results show the opposite. Banks well known for their mortgage lending (AC_1) were more likely not to receive the CPP funds, as

suggested by the coefficients from Section "no bailout." A one-percentage-point increase in the share of real-estate mortgage loans leads to a 0.598 rise in multinomial log-odds for a "no bailout" outcome relative to a "bailout and total repayment" outcome (Column 3, Section "no bailout," Table 5).

In any case, even if the banks that were heavily into that sort of loans had received the bailout, they were more likely not to have repaid it (Section "Bailout and no repayment," Table 5). A one-percentage-point increase in the share of real-estate mortgage loans in total loans leads to a 0.415 rise in multinomial log-odds for the bailed-out banks that did not repay the CPP funds relative to the bailed-out banks that totally repaid the CPP funds by July 2012 (Column 3, Section "bailout and no repayment," Table 5).

An opposite effect is found for the banks that were more exposed to commercial and industrial loans (AC_2): they were more likely to be bailed out and less likely to fail to repay the funds before July 2012. All these findings confirm the results for logit and OLS regressions, with the dependent variables being, respectively, a binary outcome regarding the CPP funds disbursement ("bailout"/"no bailout") and the relative size of the disbursed amount (for more details, see Isyuk, 2012).

If the reason for no bailout was the bank's own decision (no application or the last-stage refusal of the Treasury's conditions), then those specializing in mortgages must have found Treasury's conditions too strict (and looked for alternative financing) or they did not need to be recapitalized. The former explanation does not seem to be very plausible, as CPP conditions were relatively lenient. Most financial institutions participating in the CPP had to pay Treasury a 5% dividend on preferred shares for the first five years and a 9% rate thereafter[7]. In the United Kingdom, the dividend to be paid to the Treasury was set at 12% for the first five years and the three-month London Interbank Offered Rate (LIBOR) plus 700 basis points thereafter[8].

The latter explanation suggests that the banks leaning toward mortgage activity were not willing to apply for the CPP, perhaps because the pre-crisis assets on their books were of a good quality. If so, such banks preferred to leave the high-quality loans on their balance sheets and to securitize and sell off the less safe ones (including subprime loans) to other entities via off-balance-sheet vehicles. (for more information on adverse selection practices, see Acharya *et al*., 2010).

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[7] In addition, Treasury received warrants to purchase common shares or other securities from the banks at the time of the CPP investment.

[8] Not mentioning restrictions on executive compensation, dividends, lending commitments, and board appointments.

In cases where the Treasury decided to bail out a commercial bank, it seems as though the regulators had a bias for petitioners specializing in commercial lending (in order to avoid the drying up of liquidity for businesses). One of the explanations for this could be the relative risk weight of corporate and mortgage loans—if the Treasury was basing its decision on pre-crisis indicators. According to both Basel I and Basel II, the weight of mortgage loans in risk-weighted assets was smaller than that of corporate loans.

Another possibility is that banks that specialized in commercial and industrial loans could have been regarded as more viable and only temporarily illiquid due to the deterioration of the interbank market, while those that were predominantly mortgage lenders were seen as insolvent due to their predatory behavior before the crisis. Moreover, the former group of banks had a higher probability of repaying CPP funds in full before July 2012, minimizing the risk of non-repayment of CPP investments.

The coefficients for the relative size of non-performing loans (AQ) have to be interpreted in a similar way. The results show that a one-unit rise in the share of non-performing loans in total loans leads to a 0.709 rise in multinomial log-odds for the not-bailed-out banks relative to the bailed-out banks that totally repaid the CPP funds by July 2012 (Column 3, Section "no bailout," Table 5).

Thus, the banks more exposed to non-performing loans had a higher probability of not being bailed out, while they also exhibited a higher probability of not repaying the CPP funds. A one-unit larger share of non-performing loans in total loans is associated with a 0.543 rise in multinomial log-odds for the bailed-out banks that did not repay the CPP funds relative to the bailed-out banks that totally repaid the CPP funds by July 2012 (Column 3, Section "Bailout and no repayment," Table 5).

This result correlates with findings of the US Government Accountability Office (GAO) in March 2012. The GAO reported that the institutions remaining in the CPP tended to hold riskier assets than other institutions of similar asset size (US GAO report, 2012).

It is possible that banks that were more exposed to non-performing loans did not apply for CPP funding because they found the program’s conditions too onerous. However, it is more probable that it was the Treasury's decision to reject the applications of these banks. A higher share of non-performing loans could be considered an indicator of a bank's insolvency, which would also be associated with greater risks of CPP funds non-repayment.

Banks with stronger positions in Treasury securities (Liq_1) and MBSs (Liq_2) before the crisis are less likely to have been bailed out in 2008-09. The

first relationship is justified by the high safety and liquidity of Treasury bills, especially in a time of crisis (the "flight to safety" argument). The banks with the highest level of such liquid assets had a lesser need for external financing and tended not to apply for the CPP. For its part, the Treasury apparently selected temporarily illiquid banks that were holding few Treasury bills.

The second relationship is less clear, as a significant part of MBSs became illiquid during the crisis. Potential explanations are similar to those given for mortgage loans. First, the adverse selection argument suggests that the MBSs kept on the books of the banks were of a prime loan type and thus remained liquid during the crisis. Second, regulators were able to make their decision based on the pre-crisis risk weights of assets (as in regulatory capital ratios). In that case, larger shares of MBSs in banks' portfolio would be an indicator of higher liquidity.

The last possibility is that the Treasury classified the banks having greater amounts of MBSs as less viable than other banks or even insolvent. If so, then such a bank was considered an excessive risk taker that was in trouble due to its own faulty strategy and not due to temporary market factors. In addition, a bank in this category would be seen as being less likely to repurchase its shares from the Treasury (even though this scenario is not confirmed by the coefficients from Section "bailout and no repayment," Table 5).

Analysis of the repayments of the CPP funds from the point of view of the taxpayers reveals that the investment risks were minimized. This is because the CPP funds were provided to the banks with the highest probability of repaying them in the short term: those that were less exposed to MBSs, mortgages, and non-performing loans and those specializing in commercial loans.

However, from the perspective of consumers and borrowers, the program had a potentially counterproductive effect. Since banks with disproportionnately large positions in MBSs, mortgages, and non-performing loans were not helped by the government, which regarded them as less viable than others or more likely to fold, they faced severe liquidity problems. Many mortgage lenders, in particular, couldn’t restructure much of their portfolios and were hit by a record number of foreclosures; finding themselves with cash shortfalls, these institutions were forced to raise the interest rates on their mortgages, thus putting the squeeze on even the most creditworthy of homeowners.

All systemic risk variables are significant with negative coefficients when predicting "no bailout" and "bailout and no repayment" outcomes. Larger

banks that correlated more with the market ($Beta_{i,2007}$) and with greater contribution to systemic risk ($MES_{i,2000-2007}$) were more likely to apply for CPP assistance (as they experienced greater losses during the crisis) and to be accepted into the CPP by the Treasury. This confirms the assumption that the CPP was designed to provide liquidity to systemically critical and "too big to fail" commercial banks in order to restore financial stability and avoid negative spillover effects, as happened when Lehman Brothers imploded.

Moreover, these banks tended to exhibit a higher probability of repurchasing their shares from the Treasury compared with other banks. This should not be surprising: it should not be forgotten that the leading banks in the US always had a greater capacity to restore themselves to financial health, given their multiplicity of business lines and ability to attract alternative sources of financing—partly a result of the conventional wisdom that they were too big for the government to allow them to fail.

Nevertheless, the justification for the CPP remains: saving these banks helped head off damage to other sectors of the economy and, in any case, the taxpayers got their money back relatively quickly.

4.2 Time-to-Repayment Analysis

Another way to look at the factors that brought about the CPP funds repayments is to analyze the time it took for a bank to exit the program. The choice of parametrizations for that analysis is described in Section 2.2. Each continuous variable that enters the model is checked for correlation with a dependent variable. In addition, the models with single continuous predictors are considered as well as the results of the Chi-squared tests in order to choose predictors for the final model.

Results for three types of regressions (with Cox PH, Weibull, and log-logistic parametrizations) are presented in Table 6. Similar to the results from the previous section, model specifications include different systemic risk measures: beta ($Beta_{i,2007}$) and Marginal Expected Shortfall ($MES_{i,2000-2007}$).

The coefficients for proportional-hazard models (Cox PH and Weibull PH, Columns 3, 4, 5, and 6, Table 6) have to be interpreted differently from those for accelerated failure time models (log-logistic AFT, Columns 7 and 8, Table 6). The coefficients from the first pair of models indicate how covariates affect the hazard rate. Positive coefficients increase the hazard rate and, therefore, reduce the expected duration. The positive coefficients from AFT models indicate how covariates influence the logged survival time and, hence, increase the expected duration.

Table 6. Time-To-Repayment Analysis, US Commercial Banks, Proportional Hazards (PH) and Accelerated Failure Time (AFT) Models

Type of var	Name	Cox PH With $Beta$	Cox PH With MES	Weibull PH With $Beta$	Weibull PH With MES	Log-logistic AFT With $Beta$	Log-logistic AFT With MES
Balance-sheet characteristics							
Altman's	Z	0.199**	0.128	0.212***	0.143*	-0.143**	-0.103
Z-score		(2.562)	(1.569)	(2.693)	(1.775)	(-2.294)	(-1.610)
Moody's	P_2	-0.108**	-0.113***	-0.107**	-0.114***	0.073**	0.085***
RiskCalc		(-2.468)	(-2.625)	(-2.468)	(-2.653)	(2.260)	(2.708)
	AC_1	-0.315***	-0.301***	-0.303***	-0.289***	0.206***	0.177***
		(-3.488)	(-3.209)	(-3.415)	(-3.171)	(2.862)	(2.659)
	AQ	-0.366***	-0.418***	-0.381***	-0.434***	0.250***	0.264***
		(-2.919)	(-3.131)	(-2.986)	(-3.196)	(2.910)	(3.062)
Systemic Risk	$Beta_{t,2007}$	0.221**		0.213**		-0.134**	
		(2.364)		(2.275)		(-2.018)	
	$MES_{t,2000-2007}$		0.395***		0.392***		-0.291***
			(4.639)		(4.611)		(-4.384)
	Constant			-11.796***	-12.108***	7.040***	7.010***
				(-12.849)	(-12.979)	(74.831)	(73.900)
	$Ln(p)$			0.483***	0.510***		
				(5.976)	(6.372)		
	$Ln(gamma)$					-0.654***	-0.701***
						(-7.690)	(-8.339)
	AIC	1406.630	1406.519	546.147	536.265	549.771	537.188
	Obs	275	279	275	279	275	279

Notes: t-statistics in parentheses; ***, ** and * denote p-value less than 0.1%, 1%, and 5%, respectively.

For the models with Weibull parametrization, the logarithm of the shape parameter p is 0.483 and 0.510 (for the regressions with beta and MES as systemic risk indicators, respectively), which means that the value of the parameter is larger than one, and the hazard is monotonically increasing with time. These results fit the observations made from Figure 2. The more time that passes following disbursement of the CPP funds, the more banks repurchase their stakes from the Treasury.

Moreover, the logarithm of the shape parameter γ estimated for log-logistic regressions is negative (-0.654 and -0.710, respectively); thus, the value of the parameter is less than one, and the conditional hazard function first rises and then starts to fall. The more banks exit the CPP program, the fewer banks are left in the sample, and those remaining in the CPP experience difficulties with repaying CPP funds.

As the lowest value of AIC criteria is found for the Weibull model (Columns 5 and 6, Table 6), the more detailed interpretation of results is given for that model.

The rate of repayment (i.e. hazard rate) increases by 21.2% for the specification with beta ($Beta_{i,2007}$) and by 14.3% for the specification with MES ($MES_{i,2000-2007}$) with a unit increase in Altman's Z-score. Thus, more financially stable banks repurchase their preferred shares faster. These results are in line with the findings of the US Government Accountability Office (US GAO report, 2012). They report that the institutions remaining in the CPP by March 2012 were financially weaker than the ones that had exited the program.

Both the relative size of non-performing loans (AQ) and mortgage loans (AC_1) negatively affect the repayment hazard: a one-unit increase in the former one is associated with a drop in rate of repayment by 38.2% (43.4% for the regression with MES); a one-unit increase in the latter one is associated with a 30.3% decline in the repayment hazard rate (28.9%).

Higher systemic risk values, vice versa, have a positive influence on the repayment hazard: with a one-unit increase in beta, rate of repayment increases by 21.3%. In the case of a rise in MES, the repayment hazard rises by 39.2%.

These results are in line with those presented in the previous section. More systemically risky banks managed to repurchase their preferred shares faster than the rest, while those with larger shares of non-performing and mortgage loans experienced more difficulties with repayments.

These findings can be thought of as the realized risks of the CPP investments. As was reported in the previous section, the banks exposed to non-performing and mortgage loans were less likely to be bailed out, while larger banks with a greater potential for contributing to systemic risk were more likely to receive the CPP funds. In terms of probability of repayment and time until repayment, the allocation decision is seen as having been correct, as it allowed regulators to select those banks that would be able to repurchase their shares from the Treasury in the shortest time.

Interestingly, higher cash flow per share (P_2) becomes significantly negative when explaining the repayment hazard rate. There can be several explanations of why the banks with higher cash flow repurchased their shares later. One of them is that these banks had higher cash flows due to their exposure to risky assets such as subprime loans. Thus, during the crisis, such bailed-out banks had greater difficulty repaying the CPP funds.

Another possibility is that the banks with higher cash flow per share did not wish to repurchase their shares from the Treasury too fast (this predictor also has a positive impact on the probability of partial repayment, Section "bailout and partial repayment," Table 5), as it was a comfortable and relatively cheap source of external funding compared to market financing costs.

5. Conclusion

Conventional wisdom today holds that the Capital Purchase Program of the US government was an unalloyed success. However, looking back, we perceive a number of flaws in the methodology of the program and their effects. Smaller banks that were heavily into mortgage-backed securities, mortgages, and non-performing loans were less likely to be bailed out relatively to the banks specialized in commercial and industrial lending. That could become a reason of a low number of loan restructurings and welfare loses for the homeowners. Most importantly, the overall positive impression of the efficacy of the CPP does not confirm the soundness of the "too big to fail" principle. In fact, such a philosophical driver of the allocation of CPP funds might have contributed to the creation of moral hazard and triggered more future bailouts of mammoth and “too interconnected” banks. Thus, more reforms should be introduced (expanding the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010, see Acharya *et al.*, 2011 for discussion) in order to limit the propensity of the financial sector to put the entire system at risk and to benefit from its "too big to fail" position.

More accuracy in the assessment of the effectiveness of the CPP funds could be achieved if the Treasury reported individual information on the status of CPP applications for each stage of the selection procedure. Distinguishing between financial institutions that did not apply for CPP funds, were rejected by the Treasury, or did not accept the Treasury's conditions would clarify the conclusions.

Appendices

A. Construction of Variables

A.1 Altman's Z-score

Altman's Bankruptcy model suggests an index based on five main financial ratios where the weight of each variable is determined through discriminant analysis:

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5,$$

where X_1 is the difference between current assets and current liabilities normalized by total assets; X_2 are retained earnings normalized by total assets; X_3 are earnings before interest and taxes (EBIT) normalized by total assets; X_4 is the ratio of market value of equity to total liabilities; $X_5$are sales (revenues) normalized by total assets.

A.2 Systemic Risk Indicators

Bank size ($Size_{i,2007}$) is the logarithm of total assets of the bank.

Beta ($Beta_{i,2007}$) is obtained from DataStream and represents the measure of the asset's risk with respect to the market (correlation with the market) over the past five years. Thus, ($Beta_{i,2007}$) is calculated for the period from 2002 to 2007.

$\Delta CoVaR_p$ measures the marginal contribution of a separate financial firm to the risk of the whole financial sector (Adrian and Brunnermeier, 2011). It is calculated as a difference between Value-at-Risk of the financial sector conditional on institution i being in distress $VaR_p^{FS|"i"\ distress}$ and the unconditional Value-at-Risk of financial sector VaR_p^{FS}:

$$\Delta CoVaR_p^i = VaR_p^{FS|"i"\ distress} - VaR_p^{FS}.$$

Institution *i* is said to be in distress when it exhibits the lowest growth rates of its market-valued total assets. VaR_p^{FS} is the mean growth rates of the financial sector at the p^{th} percentile (5^{th} percentile here) of its distribution unconditionally on other institutions.

The growth rate of market-valued total assets X_t^i is calculated in the following way:

$$X_t^i = \frac{ME_t^i \cdot Lev_t^i - ME_{t-1}^i \cdot Lev_{t-1}^i}{ME_{t-1}^i \cdot Lev_{t-1}^i} = \frac{A_t^i - A_{t-1}^i}{A_{t-1}^i}.$$

Knowing that

$$A_t^i = ME_t^i \cdot Lev_t^i = BA_t^i \cdot \left(\frac{ME_t^i}{BE_t^i}\right),$$

where ME_t^i is the market value of a bank *i*'s total equity, Lev_t^i is the ratio of total assets to book equity, A_t^i are market-valued total assets, BA_t^i are book-valued total assets, and $\frac{ME_t^i}{BE_t^i}$ is market-to-book ratio of institution *i*.

According to Adrian and Brunnermeier (2011), the growth rate of the financial sector is calculated as a weighted average of market-valued returns of all financial institutions in the sample:

$$X_t^{FS}=\sum_i (X_t^i \cdot w_{t-1}^i),$$

where w_{t-1}^i is the weight of financial institution *i* in banking sector at period *t-1*.

The (unconditional) Value-at-Risk of the financial sector is then defined as the bottom 5% growth rates of the financial sector between July 1990 and July 2008 (quarterly data from Compustat). The Value-at-Risk of the financial system conditional on institution *i* being in distress is calculated as the mean growth rates of the financial sector in the periods when institution *i* was found to be in distress. The difference between the two measures is $\Delta CoVaR_p^i$.

Marginal Expected Shortfall (MES_α) is expected percentage loss in market value faced by institution *i* given that a shock drives the market beyond the threshold C (market drop by more than a certain threshold).

Expected shortfall is the average of financial market returns on days when the portfolio's loss exceeds its VaR limit. Financial market return R is a weighted sum of each bank's return r_i:

$$R = \sum_i w_i \cdot r_i,$$

where w_i is the weight of bank *i* in the banking system. Expected shortfall of the financial sector can be then represented as a weighted sum of individual banks' expected shortfalls:

$$ES_\alpha = -\sum_i w_i E[r_i | R \leq -VaR_\alpha] .$$

The Marginal Expected Shortfall of the bank *i* can be expressed as the derivative of the expected shortfall of the banking sector with respect to the bank's weight w_i:

$$\frac{\partial ES_\alpha}{\partial w_i} = -E[r_i | R \leq -VaR_\alpha] = MES_\alpha^i.$$

The threshold is defined at the 5th percentile of market returns. Marginal Expected Shortfall of the bank i ($MES^i_{5\%}$) is computed in the following way:

$$MES^i_{5\%} = \frac{1}{N}\sum_{t:R-in-its-5\%-tail} r^i_t,$$

where $\frac{1}{N}\sum_{t:R-in-its-5\%-tail} r^i_t$ are average returns of financial firm i when the banking sector returns are in their 5% tale (measured on a daily basis using the S&P 500 index). $MES^i_{5\%}$ is calculated for 2007, over eight years, between 2000 and 2007, and for the periods surrounding the Bear Stearns and Lehman Brothers collapses (February, March, September, and October of 2008).

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