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Editor's Introduction

The Third International Conference on Economics of the Turkish Economic Association, ICE-TEA 2012, was held in the Turkish resort of Çeşme, İzmir, during 1-3 November 2012.

Like its predecessors, this third ICE-TEA was organized with the intellectual support of the International Economic Association (IEA). The Organization/Scientific Committee of the Conference would like to thank the Executive Committee of the IEA, particularly President Professor Joseph E. Stiglitz and Secretary General Professor Joan Esteban, for their contributions to making the event the success that it was.

We set the main theme of ICE-TEA 2012 as **"Debt Dynamics, Financial Instability, and the Great Recession."** This overarching title encompasses the many permutations that arose from the 2008 global crisis, which is still not totally over and so is in need of further examination and debate.

Clearly, the Conference program, posted on the website http://teacongress.org, was dominated by various perspectives on the lingering effects of that crisis; indeed, an overwhelming proportion of some 300 invited and contributed papers that were presented concerned themselves with this very issue. The worldwide profile of those in attendance certifies—to our delight—that ICE-TEA 2012 was truly an international gathering, drawing experts from 34 countries, including Turkey.

This third issue of *Ekonomi-tek* features two papers presented at ICE-TEA 2012. The first of these is an invited paper by Paul Davidson, editor of *the Journal of Post-Keynesian Economics*. He explains, with frequent references to J. M. Keynes, why free financial markets cannot be efficient. In making his case, he enlists such notions as "uncertainty about the future", "ergodicity", "neutrality of money", and "liquidiy/illiquidity".

In addition, he analyzes key developments in international capital flows, flexible exchange rates, and the international payments system. Competitive devalutions also come in for some grilling, reminding us of recent debates over so-called "currency wars". The author goes on to suggest unique policies

and institutions to reduce the danger of financial market instability. Specifically, he calls for an international monetary clearing union (IMCU), which he details as having eight major provisions in support of his envisioned IMCU clearing system.

The second paper in this issue is by Wen-Yao Grace Wang, Paula Hernandez-Verme, and Raymond A. K. Cox. It offers a Dynamic Stochastic General Equilibrium (DSGE) Model on micro-foundations in order to replicate an emerging small open economy with a banking system. With this model, the authors seek to predict volatility and stability along dynamic paths and the likelihood of cyclical fluctuations. Toward this end, they introduce demands for multiple currencies and money, which enters the model through domestic and foreign reserve requirements (under which banks must hold a fraction of their deposits as unremunerated currency reserves).

Sudden stops and bank panics are assumed to be possible and are instrumental in evaluating alternative exchange-rate regimes. The model is used with an infinite horizon to represent overlapping generations and to compare stability and volatility under different exchange-rate regimes. The goals of the monetary authority are assumed to be maximization of the likelihood of non-panic equilibria and minimization of panic equilibria. Under a floating regime, the policy consistent with these goals entails a high rate of domestic money growth and high reserve requirements. Under a hard peg, these goals are accomplished by instituting low reserve requirements.

In the third paper of this issue, Hans J. Blommestein, head of the Bond Market and Public Debt Management Unit of the OECD and an invited spekaer at ICE-TEA 2012, starts by explaining “sovereign risk” and related concepts, such as “safe assets” and “the risk-free interest rate”. He believes there is confusion in the very definition and measurement of these concepts, and this confusion, in turn, undermines the correct assessment of sovereign stress in OECD countries, particularly in certain European countries.

In his view, the track record of sovereign-risk pricing is far from impressive, and, therefore, the prevailing market evaluations of this risk, including ratings issued by certain agencies, should be regarded as highly dubious. This is obvious from the prolonged periods of risk under-pricing (compressed spreads) that have been followed by risk overpricing (widening of spreads). Thus, market measurements, including ratings, are anything but reliable. Moreover, debt-quality downgrades by the market, particularly by the rating agencies, and changes in the interest rates attached to borrowings of several OECD countries have often given self-contradictory signals.

This third issue completes the first volume of *Ekonomi-tek*. Issues of the second volume will also contain papers, including that of Joseph E. Stiglitz, recipient of the Nobel Prize in Economics, presented at ICE-TEA 2012. We look forward to providing you with additional stimulating articles in the future.

Ercan Uygur
Editor
Ekonomi-tek

Editörün Sunuşu

Türkiye Ekonomi Kurumu'nun Üçüncü Uluslararası Ekonomi Konferansı, UEK-TEK 2012, 1-3 Kasım 2012 tarihlerinde İzmir, Çeşme'de düzenlendi.

Öncekiler gibi, bu üçüncü UEK-TEK'i de Uluslararası Ekonomi Birliği'nin (International Economic Association: IEA) düşünsel desteği ile gerçekleştirdik. Konferansın Düzenleme/Bilim Kurulu olarak, IEA Yönetim Kuruluna, özellikle Başkan Prof. Dr. Joseph E. Stiglitz ve Genel Sekreter Prof. Dr. Joan Esteban'a, UEK-TEK 2012'nin başarısı yönünde yaptıkları katkılar için teşekkür ederiz.

UEK-TEK 2012'nin ana temasını **"Borç Dinamikleri, Finansal İstikrarsızlık ve Büyük Durgunluk"** olarak belirledik. Bu genel başlık, 2008'de başlayan küresel bunalımın getirdiği çok boyutlu sorunların hala sona ermediğini, bu konuda daha çok incelemeye ve tartışmaya gerek duyduğumuzu göstermektedir.

http://teacongress.org adresindeki web sitesinde yer alan konferans programından açıkça görüleceği üzere, konferansta sunulan yaklaşık 300 davetli ve seçilmiş bildirinin çok büyük bölümünde bu bunalımın süregelen etkileri ve sorunları değişik yönleriyle incelenip araştırılmaktadır. Sevinerek belirtelim ki, aynı program, Türkiye dahil 34 ülkeden gelen katılımcılarıyla, UEK-TEK 2012'nin gerçek anlamda bir uluslararası toplantı olduğunu belgelemektedir.

Ekonomi-tek'in bu üçüncü sayısında UEK-TEK 2012'de sunulan iki makale yer almaktadır. Bunlardan birincisi, "Journal of Post-Keynesian Economics" dergisinin editörü Paul Davidson'un davetli konuşmacı olarak sunduğu bildirinin genişletilmiş metnidir. Yazar burada, J. M. Keynes'i de sık sık kaynak göstererek, serbest finansal piyasaların neden etkin olamayacağını açıklamaktadır. Görüşlerini ifade ederken de, "gelecek hakkında belirsizlik", "durumların aynılığı (ergodicity)", "paranın yansızlığı", "nakit olma/nakit olmama" gibi kavramlara yer vermektedir.

Ek olarak, sermaye hareketleri, esnek döviz kurları, uluslararası ödemeler sistemi gibi konularda gelişmeleri dikkate alarak irdeleme yapmaktadır. Yakın zamandaki "kur savaşları" konulu tartışmaları hatırlatacak biçimde, rekabetçi

devalüasyonları da ele almaktadır. Yazar ayrıca, finansal piyasalardaki istikrarsızlık olasılığını düşürmek için nasıl ve hangi politikalar ve kurumlar geliştirilebileceğini açıklıyor. Bu çerçevede özellikle bir "uluslararası parasal kliring birliği" (international monetary clearing union: IMCU) kurulmasını öneriyor ve bu IMCU kliring sisteminin sekiz ana maddede ayrıntısına iniyor.

Bu sayıdaki ikinci makale, Wen-Yao Grace Wang, Paula Hernandez-Verme ve Raymond A. K. Cox tarafından kaleme alınmıştır. Bu makalede, bankacılık sistemi de olan küçük bir yükselen açık ekonominin işleyişini göstermek üzere mikro-temeller üzerine kurulan bir Dinamik Olasal Genel Denge (Dynamic Stochastic General Equilibrium: DSGE) Modeli oluşturulmuştur. Bu model ile yazarlar, dinamik patikalar üzerinde oynaklıklarla birlikte istikarı ve döngüsel dalgalanmaları öngörebilmek istiyorlar. Buna yönelik olarak DSGE modelinde çoklu para talebi var ve para modele bankaların mevduatlarının bir bölümünü tutmak zorunda oldukları yerli ve yabancı faizsiz karşılıklar yolu ile giriyor.

Modelde sermaye hareketlerinde ani duruşlar ve banka panikleri olabiliyor ve bunlar farklı döviz kuru rejimlerinin değerlendirilmesinde kullanılıyor. Aynı modelde sonsuz zaman ufkunu temsil eden ardışık nesiller kullanılıyor ve değişik kur rejimlerinde istikrar ve oynaklık karşılaştırmaları yapılıyor. Bu ekonomide para otoritesinin amacı, panik içermeyen denge olabilirliğini en yüksek, panik denge olabilirliğini en düşük yapmak olarak varsayılmıştır. Dalgalı kur rejiminde, bu amaçla tutarlı olacak şekilde, para artışı ve zorunlu karşılıklar yüksektir. Sabit kurda ise düşük zorunlu karşılıklar bu amaçla tutarlı ve uyumludur.

Derginin bu sayısındaki üçüncü makalenin yazarı, OECD Tahvil Piyasası ve Kamu Borcu İdaresi Biriminin Başkanı ve UEK-TEK 2012'nin bir diğer davetli konuşmacısı Hans J. Blommestein'dır. Bu makale, "ülke riski"ni ve bununla ilgili "risksiz varlıklar" ve "risk içermeyen faiz oranı" gibi kavramları açıklayarak ve tartışarak başlıyor. Yazar, bu kavramların tanımlanmasında ve ölçülmesinde karışıklık olduğuna inanmakta, bu karışıklığın da OECD ülkelerindeki ve özellikle bazı Avrupa ülkelerindeki risklerin ve finansal gerginliklerin doğru olarak saptanmasını engellediğini düşünmektedir.

Yazara göre, ülke riskleri fiyatlamasının pek parlak bir geçmişi yoktur ve, öyleyse, derecelendirme kuruluşları dahil, piyasada belirlenen ülke riskleri ölçütlerinin ihtiyatla karşılanması gerekmektedir. Bu durum, uzun süreli düşük risk fiyatlamasını (daraltılmış faiz farklarını), yüksek risk fiyatlamasının (genişletilmiş faiz farklarının) izlemesi ile görülmektedir. Böylece, derecelendirme kuruluşlarınınki dahil olmak üzere, verilen piyasa notları güvenilir değildir. Ek olarak, OECD ülkeleri için borç kalitesi konusunda derecelendirme

kuruluşları başta olmak üzere piyasanın yaptığı ölçümler ve bunların sonucu olan borçlanma faiz oranları çelişkili sinyaller verebilmektedir.

Bu üçüncü sayı ile, *Ekonomi-tek*'in birinci cildi tamamlanmış olmaktadır. İkinci cildin bazı sayıları da, Ekonomi Nobel Ödülü sahibi Joseph E. Stiglitz dahil olmak üzere, UEK-TEK 2012'de sunulmuş olan makaleleri içerecektir. Sizlere gelecekte de ufuk açan makaleler sunmayı sürdüreceğiz.

Ercan Uygur
Editör
Ekonomi-tek

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Post-Keynesian Theory and a Policy for Managing Financial Market Instability and its Relevance to the Great Recession*

*Paul Davidson***

Abstract

For more than three decades, orthodox economists and policymakers, motivated by some variant of classical economic theory, have insisted that (1) government regulation of markets and large government spending policies are the cause of all our economic problems and (2) ending big government and freeing especially financial markets from government regulatory controls is the solution to those problems. In response, governments around the world have been freeing up financial markets and trying to reduce their involvement in economic matters. Yet, in 2007-8, the global economy experienced an alarming financial market meltdown that led to the Great Recession in which we are still enmeshed.

To those who profess the belief that free markets produce socially optimum solutions, this paper explains why the facts do not support this conclusion. Keynes's liquidity theory and the Post-Keynesian theory that developed from Keynes's analysis can explain (a) why free financial markets cannot be efficient and (b) how to develop policies and institutions to reduce the possibility of financial market instability.

JEL Codes: E1, E4, F2, F3

Keywords: Post-Keynesian theory, efficient market theory, financial market instability, uncertainty, international payments system, international monetary clearing union.

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* This paper was presented at the Third International Conference on Economics of the Turkish Economic Association, held on November 1-3, 2012 at Altin Yunus Hotel, Çeşme, Izmir, Turkey.

** Editor, the Journal of Post-Keynesian Economics.

1. Introduction

For more than three decades, orthodox economists, policymakers in government, and central bankers and their economic advisors, motivated by some variant of classical economic theory, have insisted that (1) government regulation of markets and large government spending policies are the cause of all our economic problems and (2) ending big government and freeing markets, especially financial markets, from government regulatory controls is the solution to those problems, both domestically and internationally. In response, governments around the world have been freeing up financial markets and trying to reduce their involvement in economic matters. Yet, in 2007-8, the global economy experienced an alarming financial market meltdown that led to the Great Recession in which we are still enmeshed.

In testimony before Congress, Alan Greenspan once stated that he had overestimated the ability of free financial markets to self-correct and likewise missed the possibility that deregulation could unleash such a destructive force on the economy.[1] Greenspan admitted, "I still do not fully understand why it happened, and, obviously, to the extent that I figure it happened and why, I shall change my views."[2]

To Greenspan and others who profess the belief that free markets produce socially optimum solutions, this paper explains why the facts do not support this conclusion. Keynes's liquidity theory and the Post-Keynesian theory that developed from Keynes's analysis can explain (1) why free financial markets cannot be efficient and (2) how to develop policies and institutions to reduce the possibility of financial market instability.

As nations deregulated domestic and international markets, events occurred that were just not supposed to happen in a world of efficient markets. For example, (1) starting in the 1970s, the United States continued to run deficits in its trade balance; (2) countries that pursued export-led growth policies to obtain persistent (Mercantilist) favorable trade balances and accumulate huge foreign reserves in the process were considered economic miracles (e.g., Japan in the 1980s, China in the 1990s and 2000s, etc.); (3) financial markets continually suffered from "bubbles," e.g., in the United States, the

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[1] Greenspan stated: "This crisis, however, has turned out to be much broader than anything I could have imagined.... In recent decades, a vast risk-management and pricing system has evolved, combining the best insights of mathematicians and finance experts supported by major advances in computer and communications technology.

[2] A Nobel Prize was awarded for the discovery of the [free market] pricing model that underpins much of the advance in [financial] derivatives markets. This modern risk-management paradigm held sway for decades. The whole intellectual edifice, however, collapsed.

dot.com bubble of the 1990s and the real-estate bubble in the 2000s, where a small number of subprime mortgage defaults in the US spread to create a global banking and economic crisis; and (4) outsourcing and off-shoring created unemployment in the US, thereby limiting (if not actually lowering) real income for domestic workers—in contrast to the gains that should have accrued to labor according to the conventional wisdom of the law of comparative advantage.

At best, mainstream economists would claim these events are merely short-run exogenous disturbances, and, in the long run, if we maintain our *laissez-faire* faith in free markets, then the economies of all nations will experience global full-employment prosperity. Keynes [1936, p. 192] noted that such theorists "offer us the supreme intellectual achievement ... of adopting a hypothetical world remote from experience as though it were the world of experience and then living in it consistently."

The fundamental principles underlying Keynes's liquidity theory, and in his "Keynes Plan" proposal presented at the 1944 Bretton Woods meeting, explain why free trade, freely flexible exchange rates, and free international capital-funds mobility are ultimately incompatible with global full employment and rapid economic growth. Keynes's liquidity theory suggests policies that will prevent or at least alleviate the distress caused by financial market instabilities and bubbles. It also can explain why devaluing a nation's currency to make its industries "more competitive" is a self-defeating tactic.

Classical economic theory on the one hand and Keynes's serious monetary theory of an entrepreneurial economy on the other provide differing explanations of debt dynamics and financial instability. The audience for this paper will have to decide whether the classical theory that most economists subscribe to is, as Keynes claimed, "a theoretical world remote from the real world in which we live" and whether Keynes's theory is more descriptive of the world of experience.

2. Time and The Future

Time is a device that prevents everything from happening at once. All decisions that are made today will have their results or payoff at some time in the future. This is most obvious in investment decisions in plant and equipment, where the realized rate of return will be achieved only years after the decision to invest is made. But once the decision is made, the decision maker is stuck with the investment over its useful life. Investment in plant and equipment is like most marriages—till death do us part. Will the rate of return actually received over the life of the investment be the same as that the entre-

preneur expected at the moment the investment decision was made? And how was the entrepreneur's expected rate of return obtained?

For the purchase of financial assets, the realized rate of return of the asset will only be known at the end of that asset's life. If, however, the financial asset is liquid, i.e., traded in a liquid market (characteristics to be defined below), then the moment the holder decides something is going wrong and his/her expected return is unlikely to be achieved, the holder can make a fast exit by selling the asset for money at a price close to the last transaction price and thereby limit the potential anticipated loss. Divorce is not only possible before death, but it occurs often in the world of liquid assets. If a financial asset is illiquid, however, then the holder is stuck with the asset until death does them part.

In our world, little is known with certainty about future payoffs of investment decisions made today. How, then, can managers make optimal decisions on where to put their firm's money and householders where to put their savings?

3. Knowing The Future

For most of the history of mankind, it was believed that the design of God or the gods was the cause of anything that happened in the world of experience. In the 17th century, philosophers began arguing that events could be explained on the basis of reasoning of the mind rather than religious belief. This was the beginning of the intellectual movement historians call The Age of Reason. The power of reason was not in the possession, but in the acquisition, of truth.

Reasoning involves the human mind creating a theory to explain events we observe. For example, Newton saw an apple fall from the bough of a tree to the ground and developed the scientific theory of gravity. Darwin created the scientific theory of evolution to explain the different species that he observed inhabiting the earth. Today, most civilized societies believe that understanding of real-world phenomena comes in the wake of scientific theories. Do we have a scientific theory, or is it the will of God, that explains the change in financial prices and the possibility of instability in financial markets?

What is a scientific theory? A theory attempts to explain events on the basis of a logical model that starts with a few axioms. An axiom is an assumption accepted as a universal truth that does not need to be proved. From this axiomatic foundation, the laws of logic are used to reach conclusions to explain the events we observe. All theories are generally accepted in some ten-

tative fashion; theories are never conclusively established. Furthermore, we must recognize that the aim of scientific theories is to explain processes that are occurring in the external world. Prediction of future events may be a tool of certain scientific methodologies, but it is not the goal of science itself. Nor can all scientific theories provide the basis for making accurate predictions. At best, prediction may be regarded as a useful byproduct if it can be attained under the theory being developed.

Economic theorists build a theory or model based on some fundamental axioms. The logical conclusions are then presented to the public as the explanation of economic events. If the facts of experience conflict with the economic theory, then one or more of the theory's fundamental axioms are flawed and should be discarded so a different theory can be built. [The alternative would be to change the facts to fit the unrealistic theory, as, I must admit, sometimes happens in academia and in Washington.]

Keynes [1936, p. 3] stated that the fundamental axioms of classical theory were applicable to a "special case....[that] happen[s] not to be those of the economic society in which we live, with the result that its teaching is misleading and disastrous if we attempt to apply it to facts of experience." This statement is especially applicable today, given the ongoing economic austerity discussions in Washington, the UK, Euroland, and, perhaps, even in Turkey.

For Keynes [1936, p. 16, emphasis added], classical economic theorists are "like Euclidean geometers in a non-Euclidean world who discover that apparent parallel lines collide, then rebuke these lines for not keeping straight. Yet, in truth, there is no remedy except to throw over the axiom of parallels and to work out a non-Euclidean geometry. Something similar is required today in economics."

A theory is more "general" if it has fewer restrictive axioms than any alternative theory. To create his general theory (of non-Euclidean economics) to explain why recessionary "collisions" occur, Keynes rejected three restrictive classical axioms. Nevertheless, these axioms still underlie the textbook treatment of conventional economic theory, whether it is called New Classical economics or New Keynesian economics. These axioms are (1) the ergodic axiom, (2) the neutrality of money axiom, and (3) the gross substitution axiom.

The Ergodic Axiom. Any statistician will tell you that to draw any statistical inferences regarding the properties of a population universe, one should draw a sample from that universe. Since drawing a sample from the financial markets that will exist in the future is impossible, the ergodic axiom presumes that the future is already predetermined by an unchanging probability distri-

bution. [Stationarity is a necessary condition for ergodicity.] Simply stated, a sample from the past is considered equivalent to drawing a sample from the future. This ergodic axiom is an essential foundation for all the risk-management models developed by the "quants" on Wall Street as well as the rational-expectations assumption most economists profess. How do decision makers obtain rational expectations except by analyzing past and current samples of market-data fundamentals?

Acceptance of the ergodic axiom by today's economists makes a difference in determining the proper role of government in the economy. Samuelson (1969), Lucas (1981) and others have adopted, either explicitly or implicitly, the ergodic axiom because they want economics to be in the same class as the "hard sciences," such as astronomy. The science of astronomy is based on the presumption of an ergodic stochastic process that governs the movement of all the heavenly bodies from the moment of the "Big Bang" to the day the universe ends. Accordingly, statistical analysis using past measurements of the movements of heavenly bodies permits astronomers to predict future solar eclipses within a few seconds of when they actually occur.

However, nothing Congress, the President of the United States, the United Nations, or environmentalists can do will alter the predetermined dates and times for future solar eclipses. For example, Congress cannot pass an enforceable law outlawing solar eclipses in order to provide more sunshine and thereby enhance crop production. In an ergodic world, all future events are already predetermined and beyond change by human action today. Consequently, if one asserts economics is an ergodic process, then there is no role for government to alter the already predetermined future path of the economy. Government must adopt a *laissez-faire* philosophy towards economic outcomes if economics, like astronomy, is an ergodic science. If, however, economics is a nonergodic science, then proper government policies can create—and thereby alter—the economic future to improve the human standard of living relative to what would occur under a *laissez-faire* system of government.

Textbook economic models implicitly assume people know the future, or at least have rational expectations that provide actuarial certain knowledge of the future. Consequently, people make "real" decisions and are not "fooled" by nominal values in their business and consumption decisions, i.e., a fundamental classical axiom is that money is neutral. But if money is neutral, financial-market crashes in nominal terms (as the global economy experienced in 2007-8) should have no effect on the real economy, since the marginal physical productivity of the underlying real capital assets are unchanged, and,

therefore, their real productivity value should be unchanged.[3] So these facts seem to be incompatible with the neutral money axiom!

4. Money Contracts and Uncertainty

In their book, Arrow and Hahn [1971, pp. 256-7, emphasis added] wrote "The terms in which contracts are made, matter. In particular, if money is the goods in terms of which contracts are made, then the prices of goods in terms of money are of special significance. This is not the case if we consider an economy without a past or future. . . . if a serious monetary theory comes to be written, the fact that contracts are made in terms of money will be of considerable importance."

Keynes provided a new way of economic thinking to explain the operations of a monetary economy where entrepreneurs and households enter into money-denominated contracts in order to organize all market production and exchange activities.[4] Keynes's general theory provides, in Arrow and Hahn's words, a "serious monetary theory."

In our world, decision makers know that they do not, and cannot, know the future. Yet they wish and strive for some way to have control of their economic future so as to protect themselves from possible adverse outcomes. Accordingly, the capitalist system has developed (1) the institution of money contracts to provide decision makers, operating in an uncertain world, with some legal certainty about future cash inflows and outflows arising from today's decisions and (2) the liquidity concept, which is the ability to meet one's money contractual obligations as they come due. This liquidity concept is an essential aspect of individual decision-making in a capitalist economy and a financial-market system–exemplified by the fact that everyone in this room examines his or her liquidity position almost every day of their lives. The sanctity of money contracts is the essence of the capitalist system and Keynes's analysis. In the Keynes –Post-Keynesian analysis, liquidity, i.e., the ability to meet one's money contractual commitments domestically and internationally becomes an essential foundation for understanding decision-making in an entrepreneurial economy.

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[3] Yet the Great Depression of the 1930s was preceded by a real-estate monetary value market bubble and a stock-market nominal bubble. Moreover, the Great Recession of 2007-10 was preceded by a dot.com monetary bubble and a subprime mortgage real-estate bubble. How is this possible?

[4] In mainstream macroeconomics, contracts are always made in real terms as no agent is suffering from "the money illusion."

In an uncertain world, by entering into money contracts, decision makers can gain some control over their future cash inflows and outflows. If individuals suddenly believe the future is more uncertain than it was yesterday, then they will try to reduce their contractual cash outflow payments for goods and services today (save more) in order to increase their liquidity position so as to be better able to cope with the more feared uncertain future. If, however, many people suddenly think the future is more uncertain, then the cumulative effects of them all reducing their spending on the products of industry will create a significant market decline for the output of business firms. Faced with this decline in market demand, businesses are likely to reduce their hiring of workers.

The primary function of well organized and orderly financial markets is to provide liquidity so that holders of financial assets traded on such markets "know" they can make a fast exit and liquefy their portfolio holdings at a price close to the previous market price. For business firms and households, the maintenance of one's liquid position is of prime importance if insolvency and bankruptcy are to be avoided. In our world, bankruptcy is the economic equivalent of a walk to the gallows.

In our society, no one can be too handsome or too beautiful or too liquid. As long as the future is uncertain, enhancing our liquidity position now to cushion the blow of any unanticipated adverse events that may occur down the road is an understandable human activity. The more one fears the uncertain future, the bigger the size of the cushion desired.

Post-Keynesian theory emphasizes that for a financial market to be a truly liquid market, the market must be well organized AND orderly. For orderliness, there needs to be an institution—a market maker—that has sufficient resources to continue buying and thus maintain orderliness when all others are making a fast exit. Often the market maker is a private-sector institution. If this market maker's own resources are insufficient to maintain orderliness when there is a "herd behavior" rushing for the exits, then trading is suspended for a time (called a circuit breaker) to let the market maker obtain additional resources and/or the panic recedes. Finally, the central bank may have to become the market maker of last resort, either directly or through providing resources to the market maker to restore orderliness.

In 2007, the American markets for mortgage-backed derivative financial assets were well organized by private investment bankers, but these derivative markets lacked any market maker that was willing to stay the course to maintain orderliness. Nevertheless, these mortgage-backed instruments had been advertised to be "as good as cash," i.e., perfectly liquid (and triple-A rated).

Banks and other financial institutions around the globe held these "liquid" derivatives for their potential higher yields and alleged safety. When the subprime mortgages in some of these derivatives went into default, the market for mortgage-backed derivatives collapsed. Holders of these financial derivative assets tried to make a fast exit at a time when no one would buy what they were so eager to unload. The loss of liquidity initially for a few of these derivative securities panicked the market, causing a cascading effect for other derivative securities that had been previously thought to be very liquid. There were not enough remaining bulls to offset the rush of the bears. With no apparent market value, the mark-to-market accounting rule threatened the balance sheets of many financial institutions with insolvency and bankruptcy. The result was financial collapse and crisis. In such a scenario, without the market maker of last resort, i.e., the central bank, stepping in, financial collapse is inevitable.

In contrast, according to orthodox theory, financial markets are always efficient, since households, business firms, and nations have statistically reliable knowledge of the future, including their commitments regarding all future contractual cash inflows and outflows. Self-interested and efficient decision makers, therefore, would never enter into a contract that requires a future payment obligation that they could not meet.[5] No one in such a classical economic world would ever default on his contractual obligations. Yet in the real world, households and companies, and even local (sovereign) governments, do default on their contractual obligations.

Since efficient-market theory, by assumption, eliminates the possibility of people defaulting on their contractual obligations, it should be obvious that this theory (1) can neither logically explain what the relationship was between the US subprime-mortgage default meltdown and the global financial crisis that began in 2007, nor (2) can it provide any policy guidelines to resolve the problem, other than to recommend leaving the problem to the free market and flexible exchange rates to work out, all the while proclaiming that in the long run, the global economy will right itself—even if "In the long run, we are all dead."

5. The International Setting

In an international setting, such as that of the Euro, if the ECB does not act as the market maker of last resort to restore order in the markets where Eurozone government bonds are traded, then whichever government is under at-

[5] Thus the Walrasian system presumes all spot and forward contracts are settled and paid for at the initial period of time, and all spot and forward market prices are market clearing.

tack will find its cost of borrowing excessively high. To avoid this problem, such a nation must strive for an over-abundant accumulation of foreign reserves if it wants to be sure of having enough liquidity to meet all possible future international contractual obligations.

Let us explore further this debt-liquidity problem on an international basis. Suppose a nation is running persistent trade deficits that are quickly depleting its foreign reserves. If the nation has its own currency, then, it is argued, the free market will force devaluation. This will make the deficit country's industries "more competitive," and exports will rise and imports decline. Accordingly, some argue the solution to the Greek deficit problem is for it to exit the Euro and bring back the drachma, only to devalue it soon afterward in order to make Greek industries more competitive. [Alternatively, if Greece does not exit the Euro, then it should adopt a stringent austerity program that will cause much worse domestic unemployment. The average Greek wage in Euros will drop significantly, making national industries more competitive.]

In this international classical economics view, countries should solve their debt problems and stimulate growth by making their industries more competitive vis-a-vis foreign counterparts. This will up exports and reduce imports, stimulating growth in domestic industries. Unfortunately, industries in the former trade-surplus nation(s) must become less competitive as they lose markets at home and abroad to the now more competitive Greek companies. These less competitive enterprises may even become so unprofitable that they end up going bankrupt merely because the Greeks have devalued. To help its now less internationally competitive businesses, the former trade-surplus nation may also lean toward devaluation. Such competitive devaluation wars marked the 1930s and were known as "exporting your unemployment."

Keynes noted [1936, pp. 338-339] that the argument for free trade is likely to encourage policies that promote "an immoderate competition for a favorable balance that injures all alike." [6]So, just as oversaving by individuals in a closed economy can lead to economic depression, attempts to run a favorable balance of trade that leads to excessive accumulation of foreign reserves (nation's savings) can depress the global economy.

Let me further remind you of some comments Keynes made about trade and the international payments system. First, what is necessary for each nation if it is to pursue a full- employment prosperity policy is an autonomous rate of interest domestically set without any preoccupation with international compli-

[6] President Obama has indicated that he would adopt policies to double US exports by the year 2014 by making US industries more competitive. At whose expense?

cations [Keynes, 1936, p. 349]. Consequently, a policy of capital controls may be required in order to pursue a domestic full-employment target. No country should let other countries' economic conditions and policies adversely affect its own striving for full employment.

Second, Keynes declared that, except for natural resources and climate-related industries, the law of comparative advantage is not important. For "an increasingly wide range of industrial products....[e]xperience accumulates to prove that most mass-production processes can be performed in most countries and climates with equal efficiency" [Keynes, 1933, p. 238]. Therefore, off-shoring and outsourcing may be detrimental to the real income of a nation's workers.

6. Reforming The World's Money: The Bretton Woods Experience And The Marshall Plan

Too often, economic discussions over what would constitute an ideal international payments system, one that would eliminate persistent trade and international payment imbalances, have been limited to the pros and cons of fixed vs. flexible exchange rates. US Treasury Secretary Geithner apparently believes if the Chinese would only let the free market decide the value of the yuan versus the US dollar, the problem of the US's huge trade deficit with China would disappear. In championing the argument for flexible exchange rates, classical theorists assume that the price elasticities of the demand for imports and exports will meet the Marshall-Lerner condition, at least in the long run. For example, in the book by Abel and Bernanke [1992, p. 50, emphasis added] it is stated that

"[a] fall in the exchange rate tends to reduce net exports in the short run....After consumers and firms have had more time....the Marshall-Lerner condition is likely to hold, and a fall in the exchange rate is likely to lead to an increase in net exports."

The question of whether the Marshall-Lerner condition is "likely" to hold may have some importance in deciding whether a pro-flexibility exchange-rate policy is warranted, even in the long run. Financial and economic history since the end of the Second World War, plus Keynes's revolutionary liquidity analysis, indicates that more is required if a mechanism is to be designed to do away with constant trade and international payments imbalances while simultaneously promoting global full employment, rapid economic growth, and a long-run stable international standard of value.

For more than a quarter of a century (1947-73) after the war, nations operated under the Bretton Woods Agreement, which was a fixed, but adjustable, exchange-rate system where, when necessary, nations could invoke widespread limitations on international financial movements (i.e., capital controls). However, since 1973, the conventional wisdom of economists and politicians has been that governments should liberalize all the financial markets under their control to permit international capital to flow unfettered within the framework of freely flexible exchange rates.

In contrast to this belief in the desirability of liberalized international financial markets, Keynes's position at the Bretton Woods conference suggested an incompatibility thesis. Keynes argued that free trade, flexible exchange rates, and free capital mobility across international borders would be incompatible with the economic goal of global full employment and economic growth.

Indeed, between 1947 and 1973, policymakers in their actions implicitly recognized Keynes's 'incompatibility thesis." This period was a "golden age" of sustained economic growth in both developed and developing countries. Indeed, during the 1947-73 period of fixed, but adjustable, exchange rates, the free world's economic performance in terms of both real growth rates per capita and price-level stability was historically unprecedented.[7] Moreover, global economic growth rates during the earlier gold standard-fixed exchange rate period, although worse than this Bretton Woods record, generally were better than the post-1973 global experience, when the conventional wisdom became "liberalize markets to achieve flexible exchange rates." The contrast could not be starker: the economic calmness and stability before 1973 versus the troubled picture after 1973, when many OECD member countries struggled with stubbornly high rates of unemployment and wrestled with bouts of inflation and slow economic growth, while their counterparts in the developing world faced heavy debt burdens constricting growth and/or outright stagnation (and even falling real GNP per capita), culminating most recently in a rapid international financial collapse.

The significantly superior performance of the free world's economies during the 1947-73 fixed exchange-rate period compared to the earlier gold standard fixed-rate period suggests that there must have been an additional condition besides exchange-rate fixity that contributed to the unprecedented growth during the latter period. That additional condition, as Keynes explained in developing his "Keynes Plan", required that any creditor nation that regularly ran trade surpluses had primary responsibility for reversing such imbalances.

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[7] See Adelman [1991].

The Marshall Plan (as explained below) was an instance where the creditor nation adopted the responsibility that Keynes had suggested was required.

7. Keynes, Free Trade, And An International Payments System That Promotes Full Employment

To reduce both entrepreneurial uncertainties and the possibility of massive currency misalignments in any fixed exchange-rate system, Keynes recommended the adoption of a fixed, but adjustable, exchange-rate system. More importantly, Keynes argued that the "main cause of failure" of any traditional international payments system—whether based on fixed or flexible exchange rates—was its inability to actively foster continuous global economic expansion whenever repeated trade imbalances arose among trading partners. This failure, Keynes [1941, p. 27] wrote,

> "can be traced to a single characteristic. I ask close attention to this, because I shall argue that this provides a clue to the nature of any alternative that is to be successful.
>
> It is characteristic of a freely convertible international standard that it throws the main burden of adjustment on the country that is in the debtor position on the international balance of payments".

Accordingly, any essential improvement in any international payments system demands transferring the onus of adjustment from the debtor to the creditor position. This transfer would substitute an expansionist pressure on world trade for a contractionary one [Keynes, 1941, pp. 29-30]. Specifically, to achieve a golden era of economic development, Keynes called for combining a fixed, but adjustable, exchange-rate system with a mechanism for requiring any nation frequently “enjoying” a favorable balance of trade to undertake most of the effort necessary to eliminate this imbalance, while “maintaining enough discipline in the debtor countries to prevent them from exploiting the new ease allowed them” [Keynes, 1941, p. 30].

After World War II, the war-torn capitalist nations of Europe had sustained so much damage that they found themselves unable to feed their populations with their own remaining resources; nor could they begin to rebuild their economies. To accomplish those goals, they would have had to run huge import deficits with the United States to get the necessary imports. For this to happen, under a *laissez-faire* system, it would have been necessary for the US to provide enormous loans to finance the required shipments of US exports to Europe. The resulting European indebtedness would have been so burdensome that it was unlikely that, even in the long run, the European countries could ever have serviced it.

The Keynes Plan required the United States, as the obvious leading creditor nation, to accept the lion's share of responsibility for curing the international financial ills associated with Europe's postwar need for American goods. Keynes estimated that the European nations might need imports in excess of $10 billion to rebuild their economies. However, the US representative to the Bretton Woods Conference, Harry Dexter White, rejected the Keynes Plan, arguing that Congress would only be willing to provide, at most, $3 billion toward this rebuilding effort.

Instead, the White Plan created the International Monetary Fund (IMF), whose function it would be to provide short-term loans to nations running trade deficits. These loans were supposed to give the debtor nation time to tighten its belt and get its economic house in order. Under the White Plan, the US was to contribute a maximum of $3 billion to the IMF's lending facilities. White's plan also established another lending institution, now called the World Bank, that would borrow funds from the private sector. These funds would then be used to provide long-term loans for rebuilding capital facilities and making capital improvements, initially in the war-torn countries of Europe and later in the less developed countries. White's plan was basically the institutional arrangements later adopted at the Bretton Woods Conference.

Immediately after World War II, out of a fear of Communism finding fertile ground to spread in Western Europe among desperate electorates leery of servicing huge loans to the IMF and the World Bank, the US came up with the now-legendary Marshall Plan. In essence, the Americans had accepted the central point of the Keynes Plan, namely, that it is in the best interest of all nations if the leading creditor nation bears the biggest burden of reducing trade imbalances and international payments adjustments. As a result of the Marshall Plan, the US and its major trading partners experienced unprecedented and long-lasting rates of real economic growth from the end of the Second World War until the early 1970s. Despite White's declaration that Washington would not be willing to come up with more than $3 billion to straighten out the international payments mess, the Marshall Plan ended up providing $5 billion in foreign aid over 18 months and a total of $13 billion over four years. The Marshall Plan was essentially a four-year gift of $13 billion worth of US exports to the war-devastated countries of Western Europe.

The gift to Europe represented by the Marshall Plan amounted to approximately 2 per cent of the Gross Domestic Product of the United States for the four years spanning 1947 to 1951. Despite this giveaway of national income, however, there was no real sacrifice required of Americans, as the remaining per capita income was significantly greater than pre-war levels. In fact, the

resulting boost in exports of US-made products (that were enabled by the Marshall Plan funds that had been handed to the Europeans) led to strong boosts in employment in American export industries just as several million men and women were being discharged from the US armed forces and entering the national labor force looking for jobs. For the first time in its history, the United States did not suffer from a severe recession immediately after the cessation of a major war. On the contrary, the US and most of the rest of the world experienced an economic "free lunch" as both the potential debtor nations and the creditor nation scored tremendous real economic gains on the back of the Marshall Plan.

By 1958, however, although the US still had an annual surplus in its exports of goods and services, to the tune of more than $5 billion, the federal government's foreign-policy commitments led to outflows of funds in the form of foreign and military aid exceeding $6 billion, while there was a net private capital outflow of $1.6 billion.[8] The postwar US assumed perpetual surplus on international payments was at an end.

As the US's current account swung into the red in 1958, other nations began to experience payments surpluses. These credit-surplus nations did not spend their entire dollar windfalls on foreign goods and services. Instead, they used a portion of it to build up international liquid assets in the form of gold reserves obtained from the US.[9] This trend accelerated in the 1960s, partly as a result of ever-rising American military and financial-aid budgets in reaction to the construction of the Berlin Wall in 1961 and later because of the US's involvement in Vietnam. At the same time, a rebuilt Europe and Japan became important producers of exports in their own right, making the rest of the world less dependent on US products.

Still, the United States managed to maintain a positive merchandise trade balance until the first oil price shock in late 1973. More than offsetting this for most of the 1960s, however, were foreign and military aid plus net capital outflows, yielding an overall deficit for the United States in its balance of payments. The Bretton Woods system had no way of automatically forcing the emerging surplus nations to stop accumulating dollar foreign reserves and instead step into the creditor adjustment role that the US had been playing since 1947. None of them volunteered to play this altruistic role, either. Instead, the governments lucky enough to be earning surpluses internationally went on converting a portion of their annual dollar earnings into demands for gold bullion from the US government, which it was legally bound to meet.

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8 Figures obtained from the US Bureau of Census [1959, p. 870].

9 For example, in1958, the US lost over $2 billion in gold reserves to foreign central banks.

The seeds of the destruction of the Bretton Woods system and the golden age of economic development were now being sown as the surplus nations drained gold reserves from the United States.

When the US suddenly closed its gold window and unilaterally withdrew from Bretton Woods in 1971, the last vestige of Keynes's enlightened international monetary approach was lost.

8. Changing The International Payments System

The 1950-73 global golden age of economic development required international institutions and US foreign-aid policies that operated on principles inherent in the Keynes Plan, i.e., with the creditor nation accepting prime responsibility for righting international payments imbalances. The formal Bretton Woods agreement, however, did not require creditor nations to take such actions. Moreover, since 1973, the world's financial system has evolved into one where international payments considerations are often paramount and thus impede the prospects for rapid economic growth in many of the developed countries while severely constraining the growth of the least developed countries (LDCs).

It is possible to update Keynes's original plan while retaining his principles for a postwar international monetary scheme that will promote global economic prosperity. For Keynes wrote [1941, pp. 21-2]: "to suppose [as classical theorists do] that there exists some smoothly functioning automatic [free market] mechanism of adjustment that preserves equilibrium if only we trust to methods of *laissez-faire* is a doctrinaire delusion that disregards the lessons of historical experience without having behind it the support of sound theory."

In the 21st century's interdependent global economy, a substantial degree of economic cooperation among trading nations is essential. The original Keynes Plan for reforming the international payments system called for the creation of a single Supranational Central Bank. In the past few years, the ECB has shown that such a supranational bank's management may not understand what policies are called for. For my part, I have developed a proposal for an international monetary clearing union [IMCU] institution. This is a more modest proposal than the original Keynes Plan, although it operates under the same economic principles laid down by Keynes.

My IMCU plan is aimed at obtaining an acceptable international agreement (given today's political climate in most countries) that does not require any nation to surrender control of either its local banking system or its domestic monetary and fiscal policies. Each nation will still be able to chart the

economic destiny that it considers best for its citizens without fear of importing deflationary repercussions from trading partners. No country, however, will be able to export any domestic inflationary forces to its international partners.

What is required is a closed, double-entry bookkeeping clearing institution to keep the payments "score" among the national trading parties; to make this work, there would have to be a set of mutually agreed-upon rules that would outline the creation and redirection of international liquidity while maintaining the purchasing power of the institution's synthetic international currency. The eight provisions of the international clearing system suggested below are designed:

[1] to prevent a lack of global effective demand[10] due to a liquidity problem arising whenever any nation(s) accumulates excessive idle reserves.

[2] to provide an automatic mechanism for placing the major burden of correcting international payments imbalances on the surplus nations,

[3] to provide each nation with the ability to monitor and, if desired, to control movements of flight capital, tax-evasion money movements, earnings from illegal activities, and even funds that finance terrorist operations,[11] and finally

[4] to expand the quantity of the liquid assets used in settling international contracts (the asset of ultimate redemption) as global capacity warrants while protecting the purchasing power of this asset.

There are eight major provisions in this clearing-system proposal. Although I probably will not have enough time to discuss them all in my oral presentation, I note here that the most important proposal is number 6.

The eight provisions are:

1. The unit of account and ultimate reserve asset for international liquidity is the International Money Clearing Unit (IMCU). All IMCU's can be held only by the central banks of nations that abide by the rules of the clearing union system. IMCUs are not available to be held by the public.

2. Each nation's central bank or, in the case of a common currency (e.g., the Euro), a currency union's central bank, is committed to guarantee one-way

[10] Williamson [1987] recognizes that when balance of payments "disequilibrium is due purely to excess or deficient demand," flexible exchange rates *per se* cannot facilitate international payments adjustments.

[11] This provides an added bonus by making tax avoidance, profits from illegal trade, and funding terrorist operations more difficult to conceal.

convertibility from IMCU deposits at the clearing union into its domestic currency. Each central bank will set its own rules regarding making available foreign monies (through IMCU clearing transactions) to its own bankers and private-sector residents.[12] Ultimately, all major private international transactions clear between central banks' accounts in the books of the international clearing institution.

The guarantee of only one-way convertibility permits each nation to institute controls and regulations on international capital fund flows if necessary. There is a spectrum of different capital controls available. Each nation is free to determine which capital controls is best for its residents.

The IMF, as lender of last resort during the 1997 East Asian contagion crisis, imposed the same conditions on all nations requiring loans for international liquidity purposes. The resulting worsening of the situation should have taught us that in policy prescriptions, one size does not fit all situations. Accordingly, the type of capital regulation a nation should choose from the spectrum of tools available at any time will differ depending on the specific circumstances involved. It would be presumptuous to attempt to catalog what capital regulations should be imposed for any nation under any given circumstances. Nevertheless, it should be stressed that regulating capital movements may be a necessary but not sufficient condition for promoting global prosperity. Much more is required.

3. Contracts between private individuals in different nations will continue to be denominated in whatever domestic currency is permitted by local laws and agreed upon by the contracting parties. Contracts to be settled in terms of a foreign currency will therefore require some publicly announced commitment from the central bank (through private-sector bankers) to make available foreign funds to meet such private contractual obligations.

4. The exchange rate between the domestic currency and the IMCU is set initially by each nation’s central bank—just as it would be if one reinstituted an international gold standard. Since private enterprises that are already engaged in trade have international contractual commitments that would span the changeover interval from the current system, then, as a practical matter,

[12] Correspondent banking will have to operate through the International Clearing Agency, with each central bank regulating the international relations and operations of its domestic banking firms. Small-scale smuggling of currency across borders, etc., can never be completely eliminated. But such movements are merely a flea on a dog's back—a minor, but not debilitating, irritation. If, however, most of the residents of a nation hold and use (in violation of legal tender laws) a foreign currency for domestic transactions and as a store of value, this is evidence of a lack of confidence in the government and its monetary authority. Unless confidence is restored, all attempts to restore economic prosperity will fail.

one would expect, but not demand, that the existing exchange-rate structure (with perhaps minor modifications) would provide the basis for initial rate-setting.

Provisions #7 and #8 below indicate when and how this nominal exchange rate between the national currency and the IMCU would be changed in the future.

5. An overdraft system should be built into the clearing-union rules. Overdrafts should make available short-term unused creditor balances at the Clearing House to finance the productive international transactions of others who need short-term credit. The terms will be determined by the *pro bono publico* clearing-union managers.

6. There would be a trigger mechanism to encourage any creditor nation to spend what is deemed (in advance) by agreement of the international community to be accumulated "excessive" credit balances. These excessive credits can be spent in three ways: (1) on the products of any other member of the clearing union, (2) on new direct foreign-investment projects, and/or (3) to provide unilateral transfers (foreign aid) to deficit members. Spending via (1) forces the surplus nation to make the adjustment directly by way of the trade balance on goods and services, while (2) provides adjustment by the capital accounts (without setting up a contractual debt that will require reverse current-account flows in the future) and (3) allows for adjustment directly by the capital-account balance.

These three spending alternatives force the surplus nation to accept the main responsibility for correcting the payments imbalance. Even so, this provision gives the surplus country considerable discretion in deciding how to accept the onus of adjustment; the guiding principle is what it believes is in the best interests of its residents. The provision does not permit the surplus nation to shift the burden to the deficit nation(s) via contractual requirements for debt-service charges independent of what the deficit nation can afford. The important thing is to make sure that continual oversaving[13] by the surplus nation in the form of international liquid reserves is not permitted, since it could unleash depressionary forces and/or a build-up of international debts so overwhelming as to cripple the global economy of the 21st century.

In the unlikely event that the surplus nation does not spend or give away these credits within a specified time, the clearing agency would confiscate (and redistribute to debtor members) the portion of credits deemed exces-

[13] Oversaving is defined as a nation persistently spending less on imports plus direct equity foreign investment than the nation's export earnings plus net unilateral transfers.

sive.[14] This last-resort confiscatory action (a 100% tax on excessive liquidity holdings) would be made as a payments adjustment in the form of unilateral transfer payments in the current accounts.

Under either a fixed- or a flexible-rate system, with each government free to decide on how much it will import, some countries will, at times, experience continuing trade deficits merely because their trading partners are not living up to their commitments—in other words, certain other nations may be illegally hoarding a portion of their foreign export earnings (plus net unilateral transfers). By so doing, these oversavers are creating a lack of global effective demand. Under provision #6, deficit countries would no longer have to deflate their real economies in an attempt to reduce imports and thereby reduce their payment imbalances just because others are excessively saving. Instead, the system would seek to remedy the payment deficit by increasing opportunities for deficit nations to sell abroad and thereby work their way out of their deteriorating debtor position.

7. A system to stabilize the long-term purchasing power of the IMCU (in terms of each member nation's domestically produced market basket of goods) can be developed. This requires a system of fixed exchange rates between the local currency and the IMCU that changes only to reflect permanent increases in efficiency wages.[15] This assures each central bank that its holdings of IMCUs as the nation's foreign reserves will never lose purchasing power in terms of foreign produced goods. If a foreign government permits wage-price inflation to occur within its borders, the exchange rate between the local currency and the IMCU will be devalued to reflect the inflation in the local money price of the domestic commodity basket. For example, if the rate of domestic inflation is 5 per cent, the exchange rate would change so that each unit of IMCU could purchase 5 per cent more of the nation’s currency.

If, on the other hand, increases in productivity lead to declining production costs in terms of the domestic currency, then the country with this fall in effi-

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[14] Whatever "excessive" credit balances that are redistributed shall be apportioned among the debtor nations (perhaps based on a formula that is inversely related to each debtor's per capita income and directly related to the size of its international debt) to be used to reduce debit balances at the clearing union.

[15] The efficiency wage is related to the money wage divided by the average product of labor; it is the unit-labor cost modified by the profit mark-up in domestic money terms of domestically produced GNP. At the preliminary stage of this proposal, it would serve no useful purpose to decide whether the domestic market basket should include both tradeable and non-tradeable goods and services. (With the growth of tourism, more and more non-tradeable goods become potentially tradeable.) I personally prefer the wider concept of the domestic market basket, but it is not obvious that any essential principle is lost if a tradeable-only concept is used, or if some nations use the wider concept while others the narrower one.

ciency wages [say, of 5 per cent] would have the option of choosing either [a] to permit the IMCU to buy [up to 5 per cent] fewer units of domestic currency, thereby capturing all (or most of) the gains from productivity for its residents while maintaining the purchasing power of the IMCU, or [b] to keep the nominal exchange rate constant. In the latter case, the gain in productivity is shared with all trading partners. In exchange, the export industries in this productive nation will receive a greater relative share of the world market.

By devaluing the exchange rate between local monies and the IMCU to offset the rate of domestic inflation, the IMCU's purchasing power is stabilized. By restricting use of IMCUs to central banks, private speculation with IMCUs as a hedge against inflation is avoided. Each nation's rate of inflation of the goods and services it produces is determined solely by (a) the local government's policy toward the level of domestic money wages and profit margins vis-a-vis productivity gains, i.e., the nation's efficiency wage. Each nation is, therefore, free to experiment with policies for stabilizing its efficiency wage to prevent inflation as long as these policies do not lead to a lack of global effective demand. Whether the nation is successful or not in preventing domestic price inflation, the IMCU will never lose its international purchasing power in terms of any domestic money. Moreover, the IMCU has the promise of gaining in purchasing power over time, if productivity grows more than money wages and each nation is willing to share any reduction in real production costs with its trading partners.

Provision #7 produces a system designed to, at least, maintain the relative efficiency wage parities among nations. In such a system, the adjustability of nominal exchange rates will be primarily done (but not always, see Provision #8) to offset changes in efficiency wages among trading partners. A beneficial effect that follows from this proviso is that it eliminates the possibility that a specific industry in any nation can be put at a competitive disadvantage (or secure a competitive advantage) against foreign producers solely because the nominal exchange rate changed independently of changes in efficiency wages and the real costs of production.

As a result, nominal exchange-rate variability can no longer create the problem of a loss of competitiveness due solely to the overvaluing of a currency as, for example, was suffered by the industries in the American "Rust Belt" during the period 1982-85. Even if temporary, currency appreciation independent of changes in efficiency wages can do significant and permanent damage as local industries abandon export markets and lose domestic markets to foreign competitors, and the resultant excess plant and equipment are cast aside as too costly to maintain.

Proviso #7 also prevents any nation from engaging in a beggar-thy-neighbor, export-thy-unemployment policy by pursuing a real exchange-rate devaluation that does not reflect changes in efficiency wages. Once the initial exchange rates are chosen and relative efficiency wages are locked in, reduction in real production costs that are associated with a relative decline in efficiency wages is the main factor (with the exception of provision #8) justifying an adjustment in the real exchange rate.

Although provision #6 prevents any country from piling up chronic excessive surpluses, this does not mean that it is impossible for one or more nations to run persistent deficits. Hence, proposal #8 below provides a program for addressing the problem of recurring international payments deficits in any one nation.

8. If a country is at full employment and still has a tendency toward registering deficits on its current account, then this is *prima facie* evidence that it does not possess the productive capacity to maintain its current standard of living. If the deficit nation is a poor one, then surely there is a case for the richer nations that are in surplus to transfer some of their excess credit balances to support the poor one.[16] If the deficit runner is a relatively rich country, then it must alter its standard of living by reducing its relative terms of trade with its major trading partners. Rules, agreed upon in advance, would require such a case to devalue its exchange rate by stipulated increments per period until the evidence shows that the export-import imbalance has been eliminated without unleashing strong recessionary forces.

If, on the other hand, the payment deficit persists despite a continuous positive balance of trade in goods and services, this indicates that the deficit nation might be carrying too heavy an international debt-service obligation. The *pro bono* officials of the clearing union should bring the debtor and creditors into negotiations to reduce annual debt-service payments by [1] lengthening the repayment period, [2] reducing the interest charges, and/or [3] debt forgiveness.[17]

It should be noted that proviso #6 embodies Keynes's innovative idea that whenever there is a persistent (and/or large) imbalance in current-account flows, whether due to capital flight or a stubborn trade imbalance, there must be a built-in mechanism that induces the surplus nation(s) to bear most of the

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[16] This is equivalent to a negative income tax for poor fully employed families within a nation. (See Davidson [1987-8]).

[17] The actual program adopted for debt-service reduction will depend on many parameters including: the relative income and wealth of the debtor vis-a-vis the creditor, the ability of the debtor to increase its per capita real income, etc.

responsibility for eliminating the imbalance. A surplus nation must be willing to accept this burden, for only it has the wherewithal to ease the situation.

In the absence of proviso #6, under any conventional system, whether it has fixed or flexible exchange rates and/or capital controls, there can ultimately be an international liquidity crisis (as any country that always has a current-account deficit will see its foreign reserves depleted) that unleashes a global depressionary whirlwind. Thus, proviso #6 is necessary to assure that the international payments system will not have a built-in depressionary bias. Ultimately then, it is in the self-interest of the surplus nation or nations to accept this responsibility, for its actions will create conditions for global economic expansion, some of which must redound to its own citizens. Failure to act, on the other hand, will make a global depression more likely, which will hurt those same citizens anyway.

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Financial Fragility, Exchange-Rate Regimes, and Sudden Stops in a Small Open Economy[♦]

Wen-Yao Grace Wang[♣]

Paula Hernandez-Verme[♣♣]

Raymond A. K. Cox[♣♣♣]

Abstract

We model a typical Asian economy in crisis using a dynamic general equilibrium technique and establishing exchange rates from nontrivial fiat-currency demands. Sudden stops/bank panics are possible and are essential for evaluating the merits of alternative exchange-rate regimes. Strategic complementarities contribute to the severe indeterminacy of a continuum of equilibria. Social welfare and the scope of equilibria are also associated with the underlying policy regime and the built-in Sequential Checking Mechanism, including liquidity, solvency, and incentive-compatibility constraints in the model. Combining domestic and foreign reserve requirements promotes stability under a floating exchange-rate regime; however, this increases the scope for panic equilibria under both floating and fixed regimes. While backing the money supply reduces financial fragility under both systems, it only acts as a stabilizer in a fixed regime.

JEL Codes: E31, E44, F41

Keywords: Sudden stops; exchange-rate regimes; multiple reserve requirements.

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♣ Texas A&M University at Galveston. wangw@tamug.edu

♣♣ Universidad de Guanajuato. paulaherver@gmail.com

♣♣♣ Corresponding author: University of Northern British Columbia. rcox@unbc.ca

1. Introduction

A financial crisis in emerging markets could arise out of a major reversal in the international capital markets, a panic initiating a bank-run scenario, or a sharp swing in exchange rates. The prevalent view in studies of the Asian crisis of the '90s includes: 1) increased risky lending behavior by banks leading to a boom in private borrowing; 2) lack of a sound financial structure in the process of financial and capital liberalization[1]; 3) borrowed money from foreign banks that enabled a significant portion of domestic banks' lending[2]; 4) the credit crunch among foreign creditors that directly impacted banks' solvency; and 5) fluctuation in foreign-exchange values that led to regime switching.

According to the accepted chronology, the floating of the Thai baht in July 1997 triggered the crisis. During the 1980s and the early 1990s, Indonesia, South Korea, Thailand, and Malaysia had managed floating arrangements. However, after the 1997 crisis, Indonesia, South Korea, and Thailand moved from intermediate pegs to free floating, while Malaysia turned to a very hard peg. See Table 1 for details.

Table 1. Exchange-Rate Regimes in the East Asian Countries Before the Crisis and After the Crisis

Country	Before/During the crisis	After the crisis
Japan	Free floating	Free floating
Philippines	Free floating	Free floating
China	Managed floating	Managed floating
Indonesia	Managed floating	Floating
Korea	Managed floating	Floating
Singapore	Managed floating	Managed floating
Thailand	Managed floating	Managed floating →floating
Malaysia	Managed floating	Fixed
Hong Kong	Fixed	Fixed

Source: Frankel et al. (2002)

[1] The extensive literature on financial liberalization can go as far as Goodhart and Delargy (1998), Kaminsky and Reinhart (1999), Lindgren et al.(1999), Summers (2000), Boyd et al. (2000), Kishi and Okuda (2001), and Kaminsky (2003).

[2] The global capital-flow cycle was instrumental in the defaults of the financial intermediaries and in the severe financial turbulence in the emerging countries. See Calvo, Izquierdo, and Meija (2004), Calvo and Talvi (2005), Calvo, Izquierdo, and Talvi (2006), Bordo (2006), and Reinhart and Rogoff (2008).

Considering this information, our main goal was to develop a model to capture a stylized view that would deliver the stability to weather future financial crises through effective policy tools.

Building on the template of a small open economy, this paper is related to two broad areas of research on 1) the micro-foundations of banks and 2) monetary-policy rules. The former emphasizes depositors' preference shock, liquidity risk, and financial fragility. This framework, described by Diamond and Dybvig (D&D) in 1983, has been applied by Cooper and Ross (1998), Diamond and Rajan (2001), Peck and Shell (2003, 2010), Green and Lin (2003), and Ennis and Keister (2003, 2006, 2010). Chang and Velasco (C&V) (2000 (a), 2000 (b), and 2001) are of particular relevance. In discussing the effects of international capital inflows, multiple equilibria, external debts with various term structures and interest rates, and international reserves, C&V show how self-fulfilling prophecies of bank runs could bring on a crash following an asset price boom, and how coordination failure among foreign lenders may also contribute to a financial crisis.

This paper seeks to fill the gap left by the unsuitability of the Diamond-Dybvig (1983) framework for an overlapping generation model and builds on C&V. We build a Dynamic Stochastic General Equilibrium Model (DSGE) from the micro-foundation in order to replicate a small open economy (SOE) with a nontrivial banking system. Given the complexity of the interaction between policy parameters, this model is suitable for predicting volatility and stability along dynamic paths, the likelihood of cyclical fluctuations, and the endogenously-arising volatility (Wang and Hernandez, 2011). We distinguish this study from the literature in three ways. First, while C&V assume money in the utility function, we introduce non-trivial demands for multiple fiat currencies. Fiat money enters the model through domestic and foreign reserve requirements under which banks must hold a fraction of their deposits as unremunerated currency reserves. Second, we use a DSGE model with an infinite horizon to represent the Overlapping Generations. Thus, we are able to compare stability and volatility under each type of exchange-rate regime. Third, we provide an equilibrium selection process rather than a sunspot variable. Informational and institutional frictions may exacerbate credit rationing and endogenously arising volatility. In this respect, we reformulate the sequential checking algorithm and devise a re-optimization problem that can lead to different welfare-ranked equilibria.

In addition, our paper is related to the literature on monetary-policy rules, exchange-rate regimes, and the effect of a sudden stop in emerging countries' financial markets. Calvo and Reinhart (1999) show that fear of floating motivates many emerging markets to choose capital controls rather than dollariza-

tion, but the latter is a better market-oriented option for reducing the severity of sudden stops in capital inflows and the incidence of crises. Bordo and Meissner (2006) and Bordo (2006) review the effect of such sudden inflow stops on emerging markets and provide evidence that backing hard-currency debt with foreign reserves reduces the likelihood of currency and banking crises. On the other hand, Curdia (2008) examines the impact of monetary-policy responses to a sudden fall-off in foreign credits and finds that a currency peg is not the most desirable regime. A fixed exchange-rate regime performs better in an environment with low nominal rigidities or high elasticity of foreign demand. Devereux, Lane, and Xu (2006) study the effect of exchange-rate flexibility on monetary policy and find a clear trade-off between real stability and inflation stability under both fixed exchange rates and inflation-targeting rules. Braggion, Christiano, and Roldos (2009) study the optimal monetary response to a financial crisis similar to the Asian crisis of the '90s in a dynamic general equilibrium setup, but their focus is primarily on interest-rate policy and the consequence of a reverse monetary transmission mechanism.

Given the disagreement among the studies, the new results add to the literature a trade-off for policymakers for each exchange-rate regime when they seek to reconcile the goal of high welfare with the scope for non-panic equilibria. Uniting domestic and foreign reserve requirements promotes high welfare under a fixed exchange-rate regime but increases the scope for panic equilibria under both regimes. Alternatively, backing the domestic money supply decreases welfare under a floating regime but increases the scope for non-panic equilibria under both regimes.

The remainder of this paper is organized as follows. Sections 2 and 3 analyze the properties of equilibria under the alternative exchange-rate regimes, assuming that no crises are possible in equilibrium. Section 4 examines the possibility of crises by introducing extrinsic and intrinsic uncertainties. Section 5 is the conclusion.

2. Floating Exchange Rates

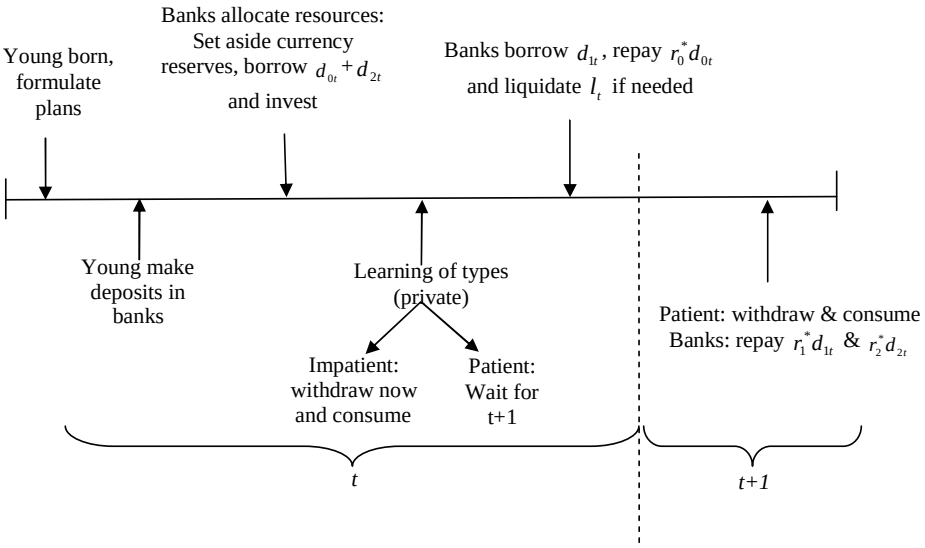
The model consists of an infinite sequence of two-period-lived, overlapping generations. Time is discrete and indexed by t=0, 1, 2, ….

2.1 The Model

There are four groups of players: households/depositors, domestic banks, foreign banks, and the domestic monetary authority. Foreign banks will lend to domestic banks inelastically up to an exogenous upper limit. The domestic

banks, a net debtor to the rest of the world, are subject to domestic and foreign reserve requirements. The timing of the event is described in Figure 1. Deposit Contracts announce a state-contingent consumption $(c_{1,t}, c_{2,t+1})$ that maximizes the households' expected lifetime utility described in (1) and is subject to the truth-telling constraint (2), borrowing constraints (3)-(4), and resources and budget constraints (8)-(10). The state-contingent pair $(c_{1,t}, c_{2,t+1})$ satisfies the condition $r \cdot (w+\tau_t) < c_{1,t} < c_{2,t+1} < R \cdot (w+\tau_t)$, which brings $c_{1,t}$ and $c_{2,t+1}$ closer together.

Figure 1. Sequence of Events



Households

A continuum of households with unit mass born at period t is young and is old at period *t+1*. As in the D&D framework, households within a generation are *ex ante* identical but experience a preference shock by the end of their youth. They can be impatient with probability $\lambda \in (0,1)$ or patient otherwise. Impatient households consume when young ($c_{1,t}$), while patient households consume only when old ($c_{2,t+1}$). A typical household's expected lifetime utility at the beginning of *t* is:

$$E_t\left[u\left(c_{1,t}, c_{2,t+1}\right)\right] = \lambda \cdot \ln\left(c_{1,t}\right) + (1-\lambda) \cdot \ln\left(c_{2,t+1}\right). \quad (1)$$

Early in the morning of youth, each household receives an endowment of w together with the monetary transfer τ_t from the monetary authority, regardless of types. At the same time, households deposit recourse with the banks that have access to a long-term investment technology that yields a return of $R>1$ at the end of $t+1$. However, this investment will yield only the return $0<r<1$ in the case of early liquidation at *t*, where $R>r$. Households Patient consumers may credibly choose to misrepresent their types by withdrawing and reinvesting. To induce self-selection and truth-telling, the following condition must be met

$$c_{2,t+1} \geq r \cdot c_{1,t}. \tag{2}$$

Regarding the initial conditions for the dynamic, infinite-horizon economy, (1-λ) patient initial old households at $t=0$ wish to consume $c_{2,0}$ goods. This consumption is financed by distributing the initial money supplies $M_0 > 0$ and $Q_0 > 0$ equally among the patient initial old.

Financial Intermediation

The financial market provides liquidity at a variety of terms and/or dates of maturity, thus contributing to consumption smoothly. In this economy, only banks have access to the world credit markets by trading in several debt markets: early intra-period debt, $d_{0,t}$, late inter-period debt, $d_{1,t+1}$, and long-term debt, $d_{2,t+1}$. The first two are short-term debts; one is borrowed at the beginning of period t and repaid at the end of the same period; the other is borrowed at the end of period t and repaid at the beginning of the next period. In addition, to invest in the long-run domestic technology, the purpose of $d_{2,t+1}$ is to show that domestic banks have access to foreign capital markets. The gross real interest rates associated with these debt instruments are $\left(r_0^*, r_1^*, r_2^*\right) >> 1$. As stated in Chang and Velasco (2000ab, 2001), the banks are constrained by an upper limit set by foreign banks.

$$0 < d_{0,t} + d_{2,t+1} \leq f_0, \tag{3}$$

$$0 < d_{1,t+1} + d_{2,t+1} \leq f_1. \tag{4}$$

$f_1 > f_0 > 0$ are exogenous and time-invariant structural parameters representing the maximum amount that foreign banks are willing to lend to domes-

tic banks. We focus on situations where foreign credit is rationed, which transpire when (3) and (4) are equal.

Monetary Authority

Two fiat national currencies circulate in the economy at any point in time. M_t and Q_t represent the outstanding nominal stock of domestic currency and foreign currency at *t*. The monetary authority sets the rate of money growth to be $\sigma > -1$, and the supply follows the rule

$$M_{t+1} = (1+\sigma)\cdot M_t, \quad \forall t > 0, \tag{5}$$

with $M_0 > 0$ given. The domestic monetary authority accomplishes all injections and/or withdrawals of domestic currency through the *ex ante* lump-sum transfers τ_t at the beginning of period *t*.

The monetary authority also backs the domestic money supply by holding B_t foreign currency, in the form of foreign-reserve assets that yield the world interest rate $\varepsilon > 1$ from *t* to *t+1*. These reserve holdings are set to follow the rule

$$B_t = \theta \cdot \left(\frac{M_t}{e_t} \right), \tag{6}$$

where $\theta \in [0,1]$ is the policy parameter that represents the fraction of the domestic money supply backed by the central bank, and e_t denotes the number of domestic-currency units exchanged for one foreign- currency unit. p_t and p_t^* are the associated prices. p_t / p_{t+1} is the gross real return realized by holding domestic currency, and $p_t^* / p_{t+1}^* = (1+\sigma^*)^{-1}$ represents the comparable gross real return on foreign currency, where $\sigma^* > -1$ is the exogenous net inflation rate in the rest of the world. The financial position of the government is summarized by the budget constraint

$$\tau_t = \frac{M_t - M_{t-1}}{p_t} - \frac{B_t - \varepsilon \cdot (1+\sigma^*) \cdot B_{t-1}}{p_t^*}, \tag{7}$$

where the first term on the right-hand side of (7) indicates the change in the real-money balance and the second term accounts for variations in the foreign-reserve position backing the domestic money supply.

In addition, the central bank sets the reserve requirements as policy parameters. The parameters $\phi_f, \phi_d \in (0,1)$ designate the fraction of total deposits that banks must hold as currency reserves in the form of domestic and foreign currency, respectively. The situation $\phi_d + \phi_f < 1$ must be present.

Budget Constraints of Households

It is assumed that all transactions take place through banks. Young households receive $w+\tau_t$ goods when born, and banks receive these deposits and borrow $d_{0,t} + d_{2,t+1}$ goods from the rest of the world. At the same time, banks set aside the required currency reserves of $\phi_d \cdot (w+\tau_t)$ as domestic currency and $\phi_f \cdot (w+\tau_t)$ as foreign currency; these currency reserves are deposited in the banks' reserve accounts held within the monetary authority. The banks also invest in the long-term asset, k_{t+1} , which is financed by a combination of their resources and leads to the budget constraint

$$k_{t+1} \le d_{0,t} + d_{2,t+1} + (1-\phi_d - \phi_f) \cdot (w+\tau_t) . \tag{8}$$

Household types are realized at the end of *t*. Under the truth-telling constraint, households behave as the true type. Accordingly, banks pay a total of $\lambda \cdot c_{1,t}$ goods to impatient depositors following a sequential-service constraint, on a first-come, first-served basis, and repay their early intra-period debt $r_0^* \cdot d_{0t}$ to foreign banks. At the end of *t*, banks can access a loan/bail-out inter-period debt, $d_{1,t+1}$. If more funds are required, banks liquidate prematurely the long-term investment by the amount l_t, but this is a last resort, since early liquidation is costly[3]. As mentioned in the Household's decision, long-term investment will yield only the return $0 < r < 1$ in the case of early liquidation at *t*, where $R > r$. The budget constraint that summarizes this state is given by

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[3] One could think of $d_{1,t+1}$ and l_t as substitute sources of liquidity for banks, but $d_{1,t+1}$ is cheaper, since $r_0^* < R$ is true at equilibrium. If the bank were to exhaust its resources before covering all liabilities, it would close, and any future payments contracted by that bank would be lost.

$$\lambda \cdot c_{1,t} + r_0^* \cdot d_{0,t} \le r \cdot l_t + d_{1,t+1}. \tag{9}$$

There is no action until late in the end of *t+1*, when the patient households withdraw a total of $(1-\lambda)\cdot c_{2,t+1}$ from banks. By then, banks have repaid the amounts of the inter-period debt, $r_1^* \cdot d_{1,t+1}$, and the long-term debt, $r_2^* \cdot d_{2,t+1}$, to foreign creditors. With regard to the sources of income, banks receive the return of the long-term investment unliquidated, $R \cdot (k_{t+1} - l_t)$ and the gross real return on their currency reserves. Patient households take reserve requirements into account when forming their expectations, reducing the likelihood of their starting a bank run to a given set of circumstances. The resulting budget constraint is given by

$$(1-\lambda)\cdot c_{2,t+1} + r_2^* \cdot d_{2,t+1} + r_1^* \cdot d_{1,t+1} \le R \cdot (k_{t+1} - l_t) + (w + \tau_t) \cdot \left[\phi_d \cdot \left(\frac{p_t}{p_{t+1}} \right) + \frac{\phi_f}{(1+\sigma^*)} \right]. \tag{10}$$

2.2 General Equilibrium with Floating Exchange Rates

We use the notation $\hat{x}_t$ to represent the value that the variable *x* takes at time *t* under floating exchange rates and report the result of the interior solution.

First, two conditions for international transactions are assumed: the purchasing power parity $\hat{e}_t \cdot p_t^* = \hat{p}_t$ and the no-arbitrage condition $R = r_2^* = r_0^* \cdot r_1^*$. Without restrictions on international capital flows, there is no arbitrage between the gross real domestic interest rate and the world-determined interest rate, after we control for the different length of the maturity periods. The cost of long-term debt is compensated for by the long-term domestic investment. Second, domestic and foreign real-money balances, $\hat{z}$ and $\hat{q}$, are dominated by the long-term investment in rate of return, which occurs only when both $p_t / p_{t+1} < R$ and $p_t^* / p_{t+1}^* < R$. Given that, the reserve requirements combine, and the demand for real-money balances is determinate. Third, the core dynamic reduced-form system is obtained, incorporating the five endogenous variables that are determinate in equilibrium, including the domestic and foreign real-money balances, $\hat{z}$ and $\hat{q}$, monetary transfers, $\hat{\tau}_t$, real balances of foreign-asset reserves, $\hat{b}_t$, and banks' long-term investment, $\hat{k}_{t+1}$. We establish the core dynamic system and solve the equilibrium in Appendix A.

Stationary Equilibria and Social Welfare

A stationary equilibrium for this economy is defined as the set of vectors $\left(\hat{z},\hat{\tau},\hat{q},\hat{b},\hat{k}\right)\in\mathbf{R}^5$, $\left(\hat{d}_0,\hat{d}_1,\hat{d}_2\right)\in\mathbf{R}^3_+$ and $\left(\hat{c}_1,\hat{c}_2\right)\in\mathbf{R}^2_{++}$, $\hat{l}=0$, and all conditions in the previous section are met. The stationary equilibrium values are determined uniquely by the real-money balance.

Proposition 1. Defining the set $\mathrm{P}=\left\{\sigma,r_0^*,r_1^*,r_2^*\right\}\in\mathbf{R}^4$ to be the space of bifurcation parameters under a floating exchange-rate regime, we observe multiple stationary equilibria in the model economy. The indeterminacy of equilibria is that for a given vector $\left(\hat{d}_0,\hat{d}_1,\hat{d}_2\right)$ there is a continuum of vectors $\left(r_0^*,r_1^*,r_2^*\right)$ consistent with equilibrium conditions.

Stationary allocations are characterized by a debt-structure vector of the form $\left(\hat{d}_0,\hat{d}_1,\hat{d}_2\right)=\left(f_0-\hat{d}_2,\,f_1-\hat{d}_2,\hat{d}_2\right)>>0$. An increase in the policy parameters $\left(\sigma,\phi_d,\theta\right)$ will increase the steady-state values $\left(\hat{z},\hat{q},\hat{b}^*\right)$ in the core. In a small open economy, monetary transfers are tied to the growth of the domestic real-money balance, and they depend on the variations in the foreign-reserve position backing the domestic money supply. The growth of the real-money balance affects domestic long-term investment in a positive way. $\hat{\tau}$ is nonlinear in both σ and ϕ_d but monotonically increasing in θ. $\hat{k}$ is increasing in σ but nonlinear in $\left(\phi_d,\phi_f\right)$. The steady-state consumption vector and the steady-state expected utility follow $\hat{U}=\lambda\cdot\ln\left(\hat{c}_1\right)+\left(1-\lambda\right)\cdot\ln\left(\hat{c}_2\right)$. Increasing both types of currency reserves, provided that $\phi_d=\phi_f$, and augmenting the backing of the domestic money supply, θ, reduce the expected utility[4]. The intuition is straightforward. A rise in ϕ_d,ϕ_f,θ will reduce the resources available for financial intermediaries to invest in the real economy. Since the decision to hold currency is dominated by the rate of return on long-term investment, in a model economy without shocks and without fears of a run on the banks, reserve savings generate dead-weight losses in the society.

3. Fixed Exchange Rates

In this section, we use $\overline{x}_t$ to denote the value that the endogenous variable x_t takes under a hard peg. This economy is identical to the one discussed in

[4] The comparative statistics are available on request from the authors.

Section 3, except for the exchange-rate regime. We focus on a hard peg where the nominal exchange rate, e, remains constant over time. The monetary authority holds reserves in the form of interest-bearing, foreign-reserve assets. These reserve holdings aim to back the dollar value of the domestic money supply so that speculative attacks on the domestic currency can be avoided or minimized. At period *t*, the monetary authority sets both e and θ where $\theta \in [0,1]$[5].

$$B_t^* = \theta \cdot \left(\frac{M_t}{e} \right). \tag{11}$$

$$\tau_t = \frac{M_t - M_{t-1}}{p_t} - \frac{B_t^* - \tilde{r} \cdot \left(p_t^* / p_{t-1}^* \right) \cdot B_{t-1}^*}{p_t^*} = \phi_d \cdot (w + \tau_t) - (p_{t-1} / p_t) \cdot \phi_d \cdot (w + \tau_{t-1}) - \left(b_t^* - \tilde{r} \cdot b_{t-1}^* \right). \tag{12}$$

The first two terms on the right-hand side of equation (12) represent the amount of real money supply necessary to sustain the fixed nominal exchange rate. The third term indicates the effects of changes in the real foreign-reserve position of the government. The rate of return on the domestic real-money balance changes accordingly under a hard peg as

$$\left(\overline{p}_t / \overline{p}_{t+1} \right) = \left(p_t^* / p_{t+1}^* \right) = \left(1 + \sigma^* \right)^{-1}. \tag{13}$$

Equation (13) reflects the lack of control of the domestic money supply. Under the hard peg, the dynamics of the system take place in monetary transfers τ_t instead of the domestic real-money balance z_t. The laws of motion regarding the dynamic system and the derivation of the steady-state equilibria under the fixed exchange-rate regime are available in Appendix B.

Stationary Equilibria and Social Welfare

Stationary equilibria under fixed exchange rates are defined by allocations such that $\left\{ \left(\overline{\tau}, \overline{z}, \overline{q}, \overline{b^*}, \overline{k} \right), \left(\overline{d}_{0,j}, \overline{d}_{1,j}, \overline{d}_{2,j} \right), \left(\overline{c}_{1,j}, \overline{c}_{2,j} \right) \middle| \, \overline{l} = 0 \right\} \in \mathbf{R}_{++}^5 \times \mathbf{R}_{+}^3 \times \mathbf{R}_{++}^2$, which satisfy all the conditions given above. We analyze the set of ***separating*** stationary equilibria, understanding that all households behave as the true type, and there are no panics or early liquidations. This second model economy, similar to the economy under the floating regime, violates two standard conditions of regularity. Regarding the number of equilibria, there is typically a

[5] A currency-board arrangement exists when the monetary authority sets $\theta = 1$ once-and-for-all at $t = 0$.

continuum of equilibria in this economy, meaning that mapping the vectors of relative prices with the corresponding demand is not unique.

We find that consumption and expected utility are monotonically decreasing under inflation rate σ^*. When the world inflation rate is high, banks have no incentive to borrow long-term funds from abroad because inflation would undermine the real return on the currency reserves. On the other hand, increasing domestic- and foreign-currency reserves, provided that $\phi_d = \phi_f$, leads to higher utility when the world inflation rate, σ^*, is sufficiently low; however, this causes a reduction in utility when world inflation is high. The intuition is that under a very hard peg, the domestic country inherits the world's inflation rate, contributing to a relatively quick stabilization. When the rate of return on currency is relatively high, holding more of it is profitable and thus will improve welfare. Boosting the backing of the money supply (θ) raises welfare, but the magnitude of these changes is very small.

4. Potential for Crises and Vulnerability of Banks

This section analyzes the effect of an unanticipated shock that hits the economy immediately after depositors learn their type. The shock that triggers financial crises in this model takes one of two forms: a shock to the depositors' beliefs (i.e., a bad dream) or a sudden drying up of foreign capital. In some cases, given the strategic interdependence and coordination problems in this environment, individuals realize that their personal welfare depends not only on their actions, but on the actions of other individuals in the economy as well. As a result, a self-fulfilling prophecy of a bank run is possible. In other cases, banks re-optimize and deviate from their *ex ante* contingent plan. In this paper, we focus on the latter situation. In the remainder of this section, the notation $\tilde{x}$ indicates the re-optimized value of the variable x.

At the beginning of period *t*, domestic banks would have chosen the state-contingent consumption $(c_{1,t}, c_{2,t+1}) >> 0$ and would have formulated a plan that involved $l_t = 0$, $(z_t, \tau_t, q_t, b_t^*, k_{t+1})$ and $(d_{0,t}, d_{1,t+1}, d_{2,t+1}) \geq 0$. The constraints on foreign credit $\{f_0, f_1\}$ are binding, and the *ex ante* choices of $d_{0,t}$ and $d_{2,t+1}$ are effective at this time. But the choices of $d_{1,t+1}$ and l_t are not. When a sudden stop hits the economy, it abruptly reduces resources available at the end of period t to f_1', where $0 < f_0 < f_1' < f_1$ is obtained. The borrowing constraint now becomes

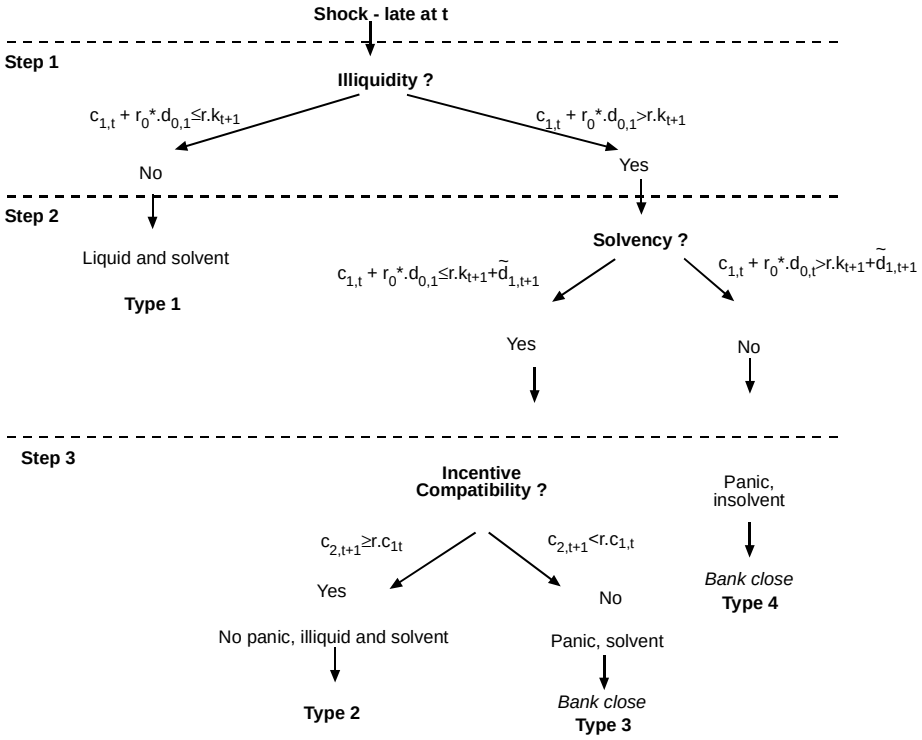
$$d_{2,t+1}+\tilde{d}_{1,t+1}=f_1' \tag{14}$$

where $\tilde{d}_{1,t+1}$ denotes the re-optimized value of $d_{1,t+1}$ [6]. Both banks and depositors will need to re-optimize to account for the change, leading to the Sequential Checking Mechanism.

4.1 The Sequential Checking Mechanism

Figure 2 presents the Sequential Checking Mechanism. This algorithm consists of three steps. The first is to evaluate the liquidity position of banks. Next, we check the banks' solvency, followed by evaluating whether the resulting allocations are incentive-compatible or not.

Figure 2. The Sequential Checking Mechanism



[6] One could also argue that unanticipated reductions in foreign credit may trigger a shock to the preferences of depositors. If such a shock induces a crisis of a self-fulfilling nature, this may only exacerbate the existing problems in this economy. In this paper, for simplicity, we do not consider this possibility.

Checking Liquidity. Chang and Velasco (2000a, 2000b, and 2001) were among the first in the literature to evaluate the liquidity position of banks in the context of financial crises in emerging markets, and this study adopts the same approach. The representative bank may have an illiquid position when the real value of its short-term obligations at the end of period *t*, $c_{1,t}+r_0^*\cdot d_{0,t}$, exceeds the liquidation value of the long-term investment, $r\cdot\tilde{l}_t=r\cdot k_{t+1}$, or equivalently, when the following inequality applies:

$$c_{1,t}+r_0^*\cdot d_{0,t}>r\cdot k_{t+1}. \tag{15}$$

When the inequality in (15) does not apply, the bank has a liquid position. The left-hand side of equation (15) and the following equation (16) represent the case of a bank run, and thus, depositors of all types rush to withdraw their funds.

Checking Solvency. We must note that an illiquid position is a necessary condition for a bank-run equilibrium, but on its own it is not sufficient to set matters rolling. A bank's illiquidity may be temporary, caused by a shock that might be neutralized if foreign lenders were to provide provisional liquidity of $0<\tilde{d}_{1,t+1}\leq f_1'$. The following inequality describes the condition for the insolvency:

$$c_{1,t}+r_0^*\cdot d_{0,t}>r\cdot k_{t+1}+\tilde{d}_{1,t+1} \tag{16}$$

The inequality in (16) means that if the real value of the new short-term foreign debt $\tilde{d}_{1,t+1}$ is not enough to alleviate the temporary liquidity problem, it would be in the best interest of foreign creditors to let the bank fold. In doing so, creditors may not recover the amount $d_{2,t+1}$ that they lent long-term to domestic banks at the beginning of period t. Foreign creditors tend to bail out solvent banks, but let insolvent ones go under. We summarize this idea with the following saying: *"Why throw good money after bad?"*

Checking Incentive Compatibility. In a situation where banks are illiquid but solvent, a fraction of the patient households may still have incentives to misrepresent their types and withdraw funds prematurely, leading to panics and closures. There is a coordination problem in which complementarity is present in the strategic interaction between individual depositors. We incorporate the incentive-compatibility constraint in (2).

4.2 Type of Equilibria and Equilibrium Selection Rules

After a shock hits our model economy, banks may need to formulate a new plan. In the case of extrinsic uncertainty, then $\left(\tilde{d}_{1,t+1},\tilde{l}_t\right)=\left(d_{1,t+1},l_t\right)$, since no fundamentals have changed. However, in the case of intrinsic uncertainty, $\left(\tilde{d}_{1,t+1},\tilde{l}_t\right)\neq\left(d_{1,t+1},l_t\right)$, and one would typically expect that $\tilde{d}_{1,t+1}<d_{1,t+1}$ and $\tilde{l}_t>l_t=0$. There are four different sets of equilibrium outcomes:

a) Equilibria of Type 1: This equilibrium is seen when (15) is not present. Liquidity implies solvency, and (2) must apply. Thus, banks have a liquid and solvent position, and the allocation is incentive-compatible. There are no panics in equilibrium and thus no need for a bail-out. This outcome is a *separating non-panic equilibrium with liquid banks*.

b) Equilibria of Type 2: This equilibrium occurs when (15) and (2) exist, but not (16). Banks have an illiquid position, but they are solvent and incentive-compatible. Foreign creditors choose to support domestic banks, and, subsequently, depositors choose not to engage in a run on banks. Thus, no panics occur. This outcome is a *separating non-panic equilibrium with illiquid banks*.

c) Equilibria of Type 3: This equilibrium emerges when (15) is satisfied, but (16) and (2) are not. Banks have an illiquid and solvent position, but their solvency is not incentive-compatible. Foreign creditors choose not to bail out such banks if they anticipate that depositors will institute a run on them, and the banks must then shut down. This equilibrium will display panics and is called a *pooling equilibrium with panics but solvent banks*.

d) Equilibria of Type 4: This outcome occurs when (15) and (16) are both valid, and (2) is not. Banks have an illiquid and insolvent position. Foreign creditors choose not to bail them out, and domestic depositors, finding their initial beliefs verified, choose to assemble for a run on the banks. This equilibrium will display panics, and it is a *pooling equilibrium with panics, illiquid and insolvent banks.*

The sequential checking mechanism re-evaluates (15), (16), and (2) given $\tilde{d}_{1,t+1}$, and determines the equilibria obtained accordingly. Banks maximize expected utility by choosing $\left(\tilde{d}_{1t+1},\tilde{l}_t\right)$, subject to a new budget constraint (14), the relevant budget constraints, and the exchange-rate regime. To proceed, we first set $\tilde{d}_1=f_1^{'}-d_2<d_1$, and $\tilde{l}\neq 0$, and solve for c_1 and c_2, respectively, as functions of $\tilde{l}$. Next, we impose equality in (2) and solve for $\tilde{l}$.

In summary, the equilibria of Types 1 and 2 are good separating ones where depositors behave according to their true type. Panics do not occur in good separating equilibria, since the allocations are incentive-compatible. However, the equilibria of Types 3 and 4 are pooling ones in which foreign creditors do not bail out the banks, and domestic depositors choose to misrepresent their types and tend to make runs on banks. Different levels of social welfare will be attached to each type of equilibria, and social welfare will be positively related to the amount of resources available to banks when shocks are realized.

4.3 The Role of Monetary Policy

This section examines how changes in monetary-policy parameters alter the ranges of existence for different equilibria. We calculate the comparative status of several policy parameters, σ, ϕ_d, ϕ_f and θ, among the results from banks' re-optimization (c_1, c_2, d_1, l). Then, we re-examine the sequential checking mechanism (15), (16), and (2) to find the scope for existence of each type of equilibria. The details are described in Appendix C. Table 2 summarizes the results.

Table 2. Policy Effects and Trade-Offs on the Scope for Existence of Equilibria after a Sudden Stop

				Scope for Existence	
Policy	Welfare	Type 1	Type 2	Type 3	Type 4
Floating					
$\uparrow\sigma$	Increase	n.a.	Narrow	Narrow	n.a.
$\uparrow\phi_d \uparrow\phi_f$	Decrease	n.a.	Widen	Widen	n.a.
$\uparrow\theta$	Decrease	n.a.	Widen	Narrow	n.a.
Fixed					
$\uparrow\sigma$*	Decrease	n.a.	Widen	Widen	n.a.
$\uparrow\phi_d \uparrow\phi_f$	Increase	n.a.	Narrow	Widen	n.a.
$\uparrow\theta$	Increase	n.a.	Widen	Narrow	n.a.

Note: Social welfare and the scope of equilibria are associated with the underlying policy regime and the built-in Sequential Checking Mechanism, including liquidity, solvency, and incentive-compatibility constraints in the model. Under illiquidity, the credit crunch among foreign creditors will directly impact banks' solvency. In solving for long-term debt, the vector $(d_{0,2}, \tilde{d}_{1,2}, d_{2,2}) = (f_0 - d_{2,2}, f_1' - d_{2,2}, d_{2,2})$ emerges. Banks must liquidate prematurely the amount of $l > 0$. In this particular subset of the pa-

rameter space, equilibria of Type 1 and Type 4 are not present, so the economy will not experience the best non-panic equilibria, but neither the worst panic equilibria.

Under floating exchange rates, we find that an increase in σ reduces the range of existence of Type 2 and Type 3 equilibria, while a jump in reserve requirements leads to a heightening of the scope for equilibria of Type 2 and 3. Hence, policymakers face tough decisions, since the range of non-panic equilibria will expand and shrink together with the magnitude of panic equilibria when σ, ϕ_d and ϕ_f move. An informative policy suggestion would be to augment θ so that the scope for non-panic Type 2 equilibria grows and the likelihood of panics in equilibrium subsides. The "magic bullet" (i.e., the ideal combination of policy parameters) that would maximize the likelihood of achieving equilibria of Type 2 and minimize that of panic equilibria under a floating regime is hard to identify—that is, beyond promoting a strong backing of the domestic money supply.

Under fixed exchange rates, one of the advantages of pegging the domestic currency to an international currency or currencies is that the economy inherits the world inflation rate, which is usually smaller than the domestic inflation rates for economies embarked on stabilization policies. We find that a rise in the world inflation rate, σ^*, increases the scope for non-panic Type 2 and panic Type 3 equilibria. Boosting the currency reserves, ϕ_d and ϕ_f, reduces the range of non-panic Type 2 equilibria but widens the possibility of panic Type 3 equilibria. On the other hand, Type 2 equilibria are more likely to occur when reinforcing θ, the backing of the domestic money supply. The combination of policy parameters that maximizes the likelihood of equilibria of Type 2 and minimizes that of panic equilibria under a hard peg is one with very low but positive reserve requirements and a high backing of the domestic money supply[7].

Discussion

In view of the high complexity of policy implementation, the monetary authority faces a clear trade-off between *ex ante* welfare and *ex post* financial fragility in alternative exchange-rate regimes. Pumping up the rate of domestic money growth under a floating regime is beneficial in terms of greater welfare and lesser scope for panic equilibria. If, instead, there is a hard peg in place, high world inflation rates create more stability and widen the scope for

7 A low to medium world inflation rate would also be desirable, but this is beyond the control of the domestic monetary authority.

equilibria of Type 2, but at the cost of lowered welfare and higher scope for panic equilibria of Type 3.

Expanding the domestic money supply will result in more monetary transfer, long-term investment, and welfare improvement. Once a sudden stop hits the economy, however, a higher money-growth rate implies a lower rate of return on the domestic-currency reserves, which function as a backstop for patient depositors.

We also observe trade-offs regarding the effects of multiple reserve requirements. If the goal is to maximize the scope for non-panic equilibria and at the same time minimize panic equilibria, the monetary authority must choose relatively low values for reserve requirements under both exchange-rate regimes, although this policy forces down welfare under a hard peg. The function of multiple reserve requirements is to avoid unnecessary panics due to insufficient inter-period liquidity. Without financial crises, this mechanism cuts down on the resources that can be invested long-term and shows up as a fall in welfare. Once a sudden stop gets hold of the economy, the reverse in the movement of capital flows pushes up the cost of borrowing. The resulting contraction is followed by depreciation of the domestic currency. Foreign-currency reserves that hedge part of the foreign-exchange fluctuation risk ease the liquidity of financially stressed banks and lessen the possibility of panic withdrawals under a floating exchange-rate regime. However, under a fixed regime, more resources are needed to sustain the nominal exchange rate, and the mechanism to ensure non-panic equilibria fades away.

Finally, strengthening support for the domestic money supply maximizes the scope for non-panic equilibria and minimizes panic equilibria under both exchange-rate regimes. Under a floating regime, this comes with the down side of welfare reduction. Under a fixed-rate regime, backing the domestic money supply is an essential tool in managing the currency's value. As the crisis unfolds, the pressure of the currency's depreciation and its impact on the financial intermediaries can be kept to a minimum if there are sufficient resources in place. That explains why increases in the fraction of domestic currency that the central bank chooses to back can successfully widen the range of non-panic equilibria.

5. Conclusion

Regulatory agencies and creditors are still drawing the lessons of the mistake-laden recent past, so the production of sophisticated new macroeconomic policies and truly rigorous financial regulations is far from complete. Shifts in investors' expectations lead to the depreciation of currencies, bank runs, rapid

foreign capital outflows, and dramatic economic downturns. Private-sector over-expansion activates the investment boom-bust cycle. This study includes these variables in investigating the effect of monetary policy on a model economy.

At a methodological level, this paper adds to the literature and provides a framework for analyzing the interaction among key factors in forging monetary policy: fixed versus floating exchange-rate regimes, rates of domestic money growth, regulation of domestic- and foreign-reserve requirements, and the backing for the domestic money supply. We are fully aware that in the aftermath of a financial crisis, the policy considerations assume far greater importance than is standard, and the trade-offs being weighed become correspondingly more complex. We compare policies from the standpoint of steady-state welfare, stability, and the scope for existence of panic and non-panic equilibria. Accounting as it does for the complexity of the interactions among various policy proposals, the model is suitable for predicting volatility and stability along dynamic paths, the possibility of cyclical fluctuations, and the endogenously-arising volatility (Wang and Hernandez, 2011).

In conclusion, we observe a continuum of stationary equilibria. Local uniqueness and determinacy are lacking when no crises are present. We examine the potential for crises in the case of a sudden stop in a small open economy that is a net borrower. We show that the existence of equilibria of four types can be ranked based on the information constraints and on social welfare. The goals of the monetary authority are to maximize the likelihood of non-panic equilibria and to minimize that of panic equilibria. Under a floating regime, the policy combinations consistent with this goal display a high rate of domestic money growth, high reserve requirements, and a strong backing of the domestic money supply. Under a hard peg, this goal is accomplished by instituting low reserve requirements and a higher backing of the domestic money supply.

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Appendix A: The General Equilibrium System under a Floating Exchange Rate

The general equilibrium system is characterized by equilibrium variables. The domestic price level $\hat{p}_t$ clears the market for domestic real-money balances:

$$\hat{M}_t / \hat{p}_t = \hat{z}_t = \phi_d \left(w + \hat{\tau}_t \right). \tag{A.1.1}$$

It leads to the equilibrium return of domestic real-money balances

$$\hat{p}_t / \hat{p}_{t+1} = (1+\sigma)^{-1} \left(\hat{z}_{t+1} / \hat{z}_t \right) \tag{A.1.2}$$

and, using also the government budget constraint in equation (5), to the equilibrium laws of motion of z_t and τ_t, respectively.

$$\hat{z}_t = a_0(\sigma) + a_1(\sigma) \cdot \hat{z}_{t-1}, \tag{A.1.3}$$

$$\hat{\tau}_t = b_0(\sigma) + b_1(\sigma) \cdot \hat{z}_{t-1}, \tag{A.1.4}$$

where the reduced-form coefficients are given by

$$a_0 \equiv \frac{\phi_d \cdot w \cdot (1+\sigma)}{\left\{1+\theta \cdot \phi_d + \sigma \cdot \left[1-\phi_d \cdot (1-\theta)\right]\right\}}, a_1 \equiv \frac{\theta \cdot \phi_d \cdot \varepsilon \cdot (1+\sigma)}{\left\{1+\theta \cdot \phi_d + \sigma \cdot \left[1-\phi_d \cdot (1-\theta)\right]\right\}},$$

$$b_0 \equiv \frac{a_0}{\phi_d} - w, b_1 \equiv \frac{a_1}{\phi_d}.$$

The representative bank's long-term investment in equilibrium follows

$$\hat{k}_{t+2} = k\left(\hat{z}_t\right) = c_0 + c_1 \cdot \hat{z}_t, \tag{A.1.5}$$

where $c_0 \equiv f_0 + \left(1-\phi_d-\phi_f\right) \cdot \left(w + b_0\right), c_1 \equiv \left(1-\phi_d-\phi_f\right) \cdot b_1$.

The market for foreign currency also clears when $\hat{q}_t \equiv \left(e_t \cdot \hat{Q}_t / \hat{p}_t\right) = \phi_f \cdot (w + \hat{\tau}_t) = \phi_f \cdot \hat{z}_t / \phi_d$. In equilibrium, q_t and b_t^* are governed by the following two reduced-form equations

$$\hat{q}_t = q\left(\hat{z}_t\right) = d_0 + d_1 \cdot \hat{z}_{t-1}, \tag{A.1.6}$$

$$\hat{b}_t = b\left(\hat{z}_t\right) = e_0 + e_1 \cdot \hat{z}_{t-1}, \tag{A.1.7}$$

where $d_0 \equiv \phi_f \cdot \left(w + b_0\right), d_1 \equiv \phi_f \cdot b_1$ and $e_0 \equiv \theta \cdot a_0, e_1 \equiv \theta \cdot a_1$.

Moreover, the endogenous growth rate of the supply of foreign currency in the domestic economy is given by

$$\left(\hat{Q}_{t+1} / \hat{Q}_t\right) = \left[\left(1+\sigma^*\right) \cdot \hat{z}_{t+1}\right] / \hat{z}_t, \tag{A.1.8}$$

while the nominal exchange rate follows:

$$\left(e_{t+1} / e_t\right) = \left[(1+\sigma) \cdot \hat{z}_t\right] / \left[\left(1+\sigma^*\right) \cdot \hat{z}_{t+1}\right]. \tag{A.1.9}$$

Finally, there are several conditions that characterize deposit contracts in equilibrium. One, the truth-telling condition in (2) applies. Two, the constraints on foreign credit must be combined, and thus

$$\hat{d}_{0,t} + \hat{d}_{2,t+1} = f_0 \quad \text{and} \quad \hat{d}_{1,t+1} + \hat{d}_{2,t+1} = f_1. \tag{A.1.10}$$

A.1. Stationary Equilibrium

The core dynamic system is de-coupled, inheriting its dynamics from $\hat{z}_t$. The stationary values of core variables are:

$$\begin{aligned}
&\hat{z} = \left\langle \phi_d \cdot w \cdot (1+\sigma) / \left(\sigma \cdot \left[1 - \phi_d \cdot (1 + \theta \cdot (\tilde{r} - 1))\right] + 1 - \phi_d \cdot \theta \cdot (\tilde{r} - 1)\right)\right\rangle \\
&\hat{\tau} = \left\langle w \cdot \left\{\theta \cdot \phi_d \cdot (\tilde{r} - 1) + \sigma \cdot \phi_d \cdot \left[\theta \cdot (\tilde{r} - 1) + 1\right]\right\} / \left(\sigma \cdot \left[1 - \phi_d \cdot (1 + \theta \cdot (\tilde{r} - 1))\right] + 1 - \phi_d \cdot \theta \cdot (\tilde{r} - 1)\right)\right\rangle \\
&\hat{q} = \left[\phi_f \cdot w \cdot (1+\sigma) / \left(\sigma \cdot \left[1 - \phi_d \cdot (1 + \theta \cdot (\tilde{r} - 1))\right] + 1 - \phi_d \cdot \theta \cdot (\tilde{r} - 1)\right)\right] \\
&\hat{b}^* = \left[\theta \cdot \phi_d \cdot w \cdot (1+\sigma) / \left(\sigma \cdot \left[1 - \phi_d \cdot (1 + \theta \cdot (\tilde{r} - 1))\right] + 1 - \phi_d \cdot \theta \cdot (\tilde{r} - 1)\right)\right] \\
&\hat{k} = \xi_1(\sigma) + \xi_2(\sigma) \cdot \hat{z}
\end{aligned} \tag{A.1.11}$$

where $\xi_1(\sigma) \equiv f_0 + \left[\left(1 - \phi_d - \phi_f\right) \cdot w \cdot \left\{2 + \theta \cdot \phi_d + \sigma \cdot \left[2 - \phi_d \cdot (1-\theta)\right]\right\}\right] / \left\{1 + \theta \cdot \phi_d + \sigma \cdot \left[1 - \phi_d \cdot (1-\theta)\right]\right\}$ and $\xi_2(\sigma) \equiv \left[\left(1 - \phi_d - \phi_f\right) \cdot \theta \cdot \tilde{r} \cdot (1+\sigma)\right] / \left\{1 + \theta \cdot \phi_d + \sigma \cdot \left[1 - \phi_d \cdot (1-\theta)\right]\right\}$. Notice that $\left(\hat{z}, \hat{q}, \hat{b}^*\right)$ are increasing in the policy parameters $\left(\sigma, \phi_d, \theta\right)$ and that, as expected, $\hat{q}$ is increasing in ϕ_f. In addition, $\hat{\tau}$ is nonlinear in both σ and ϕ_d but monotonically increasing in θ. Finally, $\hat{k}$ is increasing in σ, but nonlinear in $\left(\phi_d, \phi_f\right)$. With respect to the steady-state gross returns on domestic and foreign real-money balances, the rise of the nominal exchange rate, and the

strengthening of the real exchange rate, they are all constant and equal to $(1+\sigma)^{-1}$, $(1+\sigma^*)$, $(1+\sigma)\cdot(1+\sigma^*)^{-1}$ and 1, respectively.

The steady-state consumption vector and the steady-state expected utility follow

$$\begin{aligned}
&\lambda\cdot\hat{c}_1 = f_1 - r_0^*\cdot f_0 + \left(r_0^* - 1\right)\cdot\left[\Theta_0(\sigma)+\Theta_2(\sigma)\right] + \hat{z}\cdot\left[\Theta_1(\sigma)+\Theta_3(\sigma)+\Theta_4(\sigma)\right]\\
&(1-\lambda)\cdot\hat{c}_2 = \text{Ж}_0(\sigma) - \left(R - r_1^*\right)\cdot\Theta_0(\sigma) + \Theta_2(\sigma) + \hat{z}\cdot\left[\Theta_1(\sigma)+\Theta_3(\sigma)+\Theta_4(\sigma)\right]\\
&\hat{U} = \lambda\cdot\ln\left(\hat{c}_1\right) + (1-\lambda)\cdot\ln\left(\hat{c}_2\right)
\end{aligned} \tag{A.1.12}$$

where the intercept is $\text{Ж}_0(\sigma) \equiv \left[r_2^*\cdot\xi_1(\sigma)\cdot(1-\lambda)^{-1} + \phi_d\cdot w\cdot(1-\lambda)^{-1}\cdot\left(1+\sigma^*\right)^{-1} - r_1^*\cdot f_1\right]$. The reduced-form coefficients are given by $\Theta_1(\sigma) \equiv r_2^*\cdot\xi_2(\sigma)$, $\Theta_2(\sigma) \equiv \left[\phi_d\cdot w \big/ \left(1+\sigma^*\right)\right]$, $\Theta_3(\sigma) \equiv (1+\sigma)^{-1}$ and $\Theta_4(\sigma) \equiv \phi_f\cdot\left[\phi_d\cdot\left(1+\sigma^*\right)\right]^{-1}$.

Focusing on the structure of foreign debt issued by domestic banks, we observed multiple stationary equilibria in this model economy with floating exchange rates. The general properties of the interior solution displayed by the stationary debt-structure in equilibrium depend on different values of the policy parameter σ .Thus, σ is a bifurcation parameter of the steady-state allocation given by $\left\{\left(\hat{z},\hat{\tau},\hat{q},\hat{b}^*,\hat{k}\right),\left(\hat{d}_0,\hat{d}_1,\hat{d}_2\right),\left(\hat{c}_1,\hat{c}_2\right)\middle|\ \hat{l}=0\right\}$, and so is the structure of the interest rates $\left(r_0^*,r_1^*,r_2^*\right) >> 1$. Note that the core in the steady state $\left(\hat{z},\hat{\tau},\hat{q},\hat{b}^*,\hat{k}\right)$ is always unique and determinate, since it is not associated with the vector $\left(r_0^*,r_1^*,r_2^* = R\right)$. However, for a fixed point in the parameter space and for each stationary debt-structure vector $\left(\hat{d}_{0,j},\hat{d}_{1,j},\hat{d}_{2,j}\right)$, there is typically a continuum of vectors of interest rates satisfying the equilibrium conditions.

Appendix B: The General Equilibrium System under a Fixed Exchange Rate

The equilibrium laws of motion in equations (A.1.3) must be modified, and the following two equations come into play:

$$\overline{\tau}_t = \eta_1(\sigma^*) + \eta_2(\sigma^*)\cdot\overline{\tau}_{t-1}, \tag{B.1.1}$$

$$\overline{z}_t = \rho_1(\sigma^*) + \rho_2(\sigma^*)\cdot\overline{\tau}_{t-1}, \tag{B.1.2}$$

where the coefficients are $\eta_1(\sigma^*) \equiv \left\langle \phi_d \cdot w \cdot \left\{ (1+\sigma^*)\cdot[\theta\cdot(\tilde{r}-1)+1]-1 \right\} \Big/ И(\sigma^*) \right\rangle$, $\eta_2(\sigma^*) \equiv \left\{ \phi_d \cdot \left[\theta\cdot\tilde{r}\cdot(1+\sigma^*)-1 \right] \Big/ И(\sigma^*) \right\}$, $\rho_2(\sigma^*) \equiv \phi_d \cdot \eta_2(\sigma^*)$, $\rho_1(\sigma^*) \equiv \phi_d \cdot [w+\eta_1(\sigma^*)]$, and $И(\sigma^*) \equiv (1+\sigma^*)\cdot[1-\phi_d\cdot(1-\theta)]$. Notice that the equations above are first-order linear difference equations in τ_t. Under this hard peg, the dynamics of the system originate in τ_t instead of z_t, as was the case under floating exchange rates. We modify the equilibrium laws of motion to represent the hard peg and obtain:

$$\overline{q}_t = \chi_1(\sigma^*) + \chi_2(\sigma^*)\cdot\overline{\tau}_{t-1}, \tag{B.1.3}$$

$$\overline{b}_t^* = \psi_1(\sigma^*) + \psi_2(\sigma^*)\cdot\overline{\tau}_{t-1}, \tag{B.1.4}$$

where $\chi_1(\sigma^*) \equiv \phi_f \cdot \rho_1(\sigma^*) \big/ \phi_d$, $\chi_2(\sigma^*) \equiv \phi_f \cdot \rho_2(\sigma^*) \big/ \phi_d$, $\psi_1(\sigma^*) \equiv \theta\cdot\rho_1(\sigma^*)$ and $\psi_2(\sigma^*) \equiv \theta\cdot\rho_2(\sigma^*)$. Next, the nominal exchange rate becomes

$$(\overline{e}_{t+1}/\overline{e}_t) = (e/e) = 1. \tag{B.1.5}$$

The equilibrium conditions related to the deposit contract offered by banks are as follows. One, the truth-telling constraint in (2) applies. Two, the constraints on foreign credit in (6) and (7) continue in force. Three, the equilibrium law of motion for the long-term investment is now given by

$$\overline{k}_{t+1} = \varsigma_1(\sigma^*) + \varsigma_2(\sigma^*)\cdot\overline{\tau}_{t-1}, \tag{B.1.6}$$

where $\varsigma_1(\sigma^*) \equiv f_0 + (1-\phi_d-\phi_f)\cdot\rho_1(\sigma^*)\big/\phi_d$ and $\varsigma_2(\sigma^*) \equiv (1-\phi_d-\phi_f)\cdot\rho_2(\sigma^*)\big/\phi_d$. Four, the total return on domestic- and foreign-currency reserves under this policy regime is given, respectively, by the following two equations:

$$\phi_d \cdot \left(\overline{p}_t / \overline{p}_{t+1}\right) \cdot \left(w + \overline{\tau}_t\right) = \mu_1\left(\sigma^*\right) + \mu_2\left(\sigma^*\right) \cdot \overline{\tau}_{t-1}, \tag{B.1.7}$$

$$\phi_f \cdot \left(p_t^* / p_{t+1}^*\right) \cdot \left(w + \overline{\tau}_t\right) = \upsilon_1\left(\sigma^*\right) + \upsilon_2\left(\sigma^*\right) \cdot \overline{\tau}_{t-1}, \tag{B.1.8}$$

where the coefficients are $\mu_1\left(\sigma^*\right) \equiv \rho_1\left(\sigma^*\right) / \left(1+\sigma^*\right)$, $\mu_2\left(\sigma^*\right) \equiv \rho_2\left(\sigma^*\right) / \left(1+\sigma^*\right)$, $\upsilon_1\left(\sigma^*\right) \equiv \chi_1\left(\sigma^*\right) / \left(1+\sigma^*\right)$ and $\upsilon_2\left(\sigma^*\right) \equiv \chi_2\left(\sigma^*\right) / \left(1+\sigma^*\right)$. Five, the space-contingent commodities are governed by

$$\lambda \cdot \overline{c}_{1,t,j} = f_1 - r_0^* \cdot f_0 + \left(r_0^* - 1\right) \cdot \overline{d}_{2,t+1,j} \tag{B.1.9}$$

$$(1-\lambda) \cdot \overline{c}_{2,t+1,j} = \omega_1\left(\sigma^*\right) + \omega_2\left(\sigma^*\right) \cdot \overline{\tau}_{t-1} - r_1^* \cdot f_1 - \left(r_2^* - r_1^*\right) \cdot \overline{d}_{2,t+1,j}, \tag{B.1.10}$$

where the parameters are $\omega_1\left(\sigma^*\right) \equiv r_2^* \cdot \varsigma_1\left(\sigma^*\right) + \mu_1\left(\sigma^*\right) + \upsilon_1\left(\sigma^*\right)$ and $\omega_2\left(\sigma^*\right) \equiv r_2^* \cdot \varsigma_2\left(\sigma^*\right) + \mu_2\left(\sigma^*\right) + \upsilon_2\left(\sigma^*\right)$.

B.1. Stationary Equilibria

The five variables that belong to the core, $\left(\overline{\tau}_t, \overline{z}_t, \overline{q}_t, \overline{b}_t^*, \overline{k}_{t+1}\right)$, are determinate under a fixed exchange-rate regime whenever an equilibrium exists, since they do not depend on the foreign interest rates $\left(r_0^*, r_1^*, r_2^*\right)$. We obtained the steady-state values for the variables in the core in the following five expressions:

$$\begin{aligned}
\overline{\tau} &= \eta_1\left(\sigma^*\right) / \left[1 - \eta_2\left(\sigma^*\right)\right] = \left\langle \phi_d \cdot w \cdot \left\{\left(1+\sigma^*\right) \cdot \left[1 + \theta \cdot \left(\tilde{r} - 1\right)\right] - 1\right\} / {}_{\mathrm{M}}\left(\sigma^*\right) \right\rangle \\
\overline{z} &= \left[\phi_d \cdot w \cdot \left(1+\sigma^*\right) / {}_{\mathrm{M}}\left(\sigma^*\right)\right] \\
\overline{q} &= \left[\phi_f \cdot w \cdot \left(1+\sigma^*\right) / {}_{\mathrm{M}}\left(\sigma^*\right)\right] \\
\overline{b^*} &= \left[\theta \cdot \phi_d \cdot w \cdot \left(1+\sigma^*\right) / {}_{\mathrm{M}}\left(\sigma^*\right)\right] \\
\overline{k} &= f_0 + \left(1 - \phi_d - \phi_f\right) \cdot w + \left\langle \phi_d \cdot \left(1 - \phi_d - \phi_f\right) \cdot \left\{\left(1+\sigma^*\right) \cdot \left[\theta \cdot \left(\tilde{r} - 1\right) + 1\right] - 1\right\} / {}_{\mathrm{M}}\left(\sigma^*\right) \right\rangle
\end{aligned} \tag{B.1.11}$$

Here, ${}_{\mathrm{M}}\left(\sigma^*\right) \equiv \left(1+\sigma^*\right) - \phi_d \cdot \left\{\left(1+\sigma^*\right) \cdot \left[1 + \theta \cdot \left(\tilde{r} - 1\right)\right] - 1\right\}$, where $\left(1+\sigma^*\right) \cdot \left[1 + \theta \cdot \left(\tilde{r} - 1\right)\right] > 1$ is the case, $\forall \sigma^* > -1$. Given the latter, we found it reasonable to restrict our attention to allocations where $\left(1+\sigma^*\right) > \phi_d \cdot \left\{\left(1+\sigma^*\right) \cdot \left[1 + \theta \cdot \left(\tilde{r} - 1\right)\right] - 1\right\} > 0$ is present, $\forall \sigma^* > -1$. It follows that $\overline{\tau} > 0$, and $\left(\partial \overline{\tau} / \partial \sigma^*\right) > 0$.

Stationary equilibria under fixed exchange rates are defined by allocations such that $\left\{\left(\overline{\tau},\overline{z},\overline{q},\overline{b}^{*},\overline{k}\right),\left(\overline{d}_0,\overline{d}_1,\overline{d}_2\right),\left(\overline{c}_1,\overline{c}_2\right)\middle|\ \overline{l}=0\right\}\in \mathbf{R}^5_{++}\times\mathbf{R}^3_{+}\times\mathbf{R}^2_{++}$, which satisfy all the conditions given above. Of course, the particular case of equilibrium that arises and its properties will depend on the composition of the vector $\left(\overline{d}_0,\overline{d}_1,\overline{d}_2\right)$ as we will see when checking for existence, uniqueness, and determinacy.

We observed the foreign-debt-structure vector $\left(\overline{d}_0,\overline{d}_1,\overline{d}_2\right)=\left(f_0-\overline{d}_2,\ f_1-\overline{d}_2,\overline{d}_2\right)>>0$. The foreign long-term debt in a stationary equilibrium with a hard peg is given by

$$\overline{d_2}=\Omega_0\left(\sigma^*\right)+\Omega_1\left(\sigma^*\right)\cdot\overline{\tau}, \tag{B.1.12}$$

where $\Omega_0\left(\sigma^*\right)\equiv\left\{\lambda\cdot\left(1+\sigma^*\right)r_2^*\cdot\varsigma_1\left(\sigma^*\right)+\lambda\cdot\left(\phi_d+\phi_f\right)\left[\eta_1\left(\sigma^*\right)-w\right]-r_1^*\cdot\left(1+\sigma^*\right)\cdot\left(r_0^*-r_1^*\right)\right\}\Big/\left[r_1^*\cdot\left(1+\sigma^*\right)\cdot\left(r_0^*-r_1^*\right)\right]$, and $\Omega_1\left(\sigma^*\right)\equiv\lambda\cdot\left[\left(1+\sigma^*\right)\cdot r_2^*\cdot\varsigma_2\left(\sigma^*\right)+\left(\phi_d+\phi_f\right)\cdot\eta_2\left(\sigma^*\right)\right]\Big/\left[r_1^*\cdot\left(1+\sigma^*\right)\cdot\left(r_0^*-r_1^*\right)\right]$. The vector of state-contingent consumption and the expected utility are obtained from

$$\lambda\cdot\overline{c}_1=f_1-r_0^*\cdot f_0+\left(r_0^*-1\right)\cdot\Omega_0\left(\sigma^*\right)+\left(r_0^*-1\right)\cdot\Omega_1\left(\sigma^*\right)\cdot\overline{\tau}, \tag{B.1.13}$$

$$(1-\lambda)\cdot\overline{c}_2=\Sigma_0\left(\sigma^*\right)-\left(R-r_1^*\right)\cdot\Omega_0\left(\sigma^*\right)+\left[\Sigma_1\left(\sigma^*\right)-\left(R-r_1^*\right)\cdot\Omega_1\left(\sigma^*\right)\right]\cdot\overline{\tau}, \tag{B.1.14}$$

$$\overline{U}=\lambda\cdot\ln\left(\overline{c}_1\right)+(1-\lambda)\cdot\ln\left(\overline{c}_2\right) \tag{B.1.15}$$

Appendix C: Re-optimization

In this section, we describe new equilibria after re-optimization that resulted from the sequential checking process. The sequential checking mechanism re-evaluates (15), (16), and (2) given $\tilde{d}_{1,t+1}$, and determines the equilibria obtained accordingly. Banks maximize expected utility by choosing $\left(\tilde{d}_{1t+1}, \tilde{l}_t\right)$, subject to a new budget constraint (14), the relevant budget constraints, and the exchange-rate regime. To proceed, we first set $\tilde{d}_1 = f_1^{'} - d_2 < d_1$, and $\tilde{l} \neq 0$ and solve for c_1 and c_2, respectively, as functions of $\tilde{l}$. Next, we impose equality in (2) and solve for $\tilde{l}$. Below, we present the results for early liquidation after a sudden stop, under floating and fixed exchange rates, respectively.

$$\hat{l}_j = \frac{\lambda\cdot(1-\lambda)\left[r\cdot\left(r_0^*-1\right)\cdot f_0 - r_1^*\cdot f_1'\right]}{(1-\lambda)\cdot r^2+\lambda R} + \left[\frac{\lambda}{(1-\lambda)\cdot r^2+\lambda R}\right]\cdot\left\{R\cdot\hat{k}+(w+\hat{\tau})\left[\frac{\phi_d}{(1+\sigma)}+\frac{\phi_f}{\left(1+\sigma^*\right)}\right]\right\} - \left[\frac{\lambda\cdot\left(R-r_0^*\right)+(1-\lambda)\cdot\left(r_0^*-1\right)}{(1-\lambda)\cdot r^2+\lambda R}\right]\cdot\hat{d}_{2,j} \quad , \text{(C.1)}$$

$$\bar{\tilde{l}}_j = \frac{\lambda\cdot(1-\lambda)\left[r\cdot\left(r_0^*-1\right)\cdot f_0 - r_1^*\cdot f_1'\right]}{(1-\lambda)\cdot r^2+\lambda R} + \left[\frac{\lambda}{(1-\lambda)\cdot r^2+\lambda R}\right]\cdot\left\{R\cdot\hat{k}+\frac{(w+\hat{\tau})\cdot\left(\phi_d+\phi_f\right)}{\left(1+\sigma^*\right)}\right\} - \left[\frac{\lambda\cdot\left(R-r_0^*\right)+(1-\lambda)\cdot\left(r_0^*-1\right)}{(1-\lambda)\cdot r^2+\lambda R}\right]\cdot\bar{d}_{2,j} \quad . \text{(C.2)}$$

We must point out that $\tilde{l}$ is monotonically decreasing in $f_1^{'}$, which ensures a positive amount of early liquidation in equilibrium after the economy is hit by a sudden stop. Also, $\tilde{l}$ is a monotonically decreasing function of d_2, indicating that economies that borrow larger long-term amounts may experience smaller amounts of early liquidation of long-term investments.

When the sudden withdrawal of access to foreign credit appears on the scene, anxious domestic depositors and foreign creditors start checking a bank's capacity of operation. Under illiquidity, the credit crunch among foreign creditors will directly impact banks' solvency. In solving for long-term debt, the vector $\left(d_{0,2}, \tilde{d}_{1,2}, d_{2,2}\right) = \left(f_0 - d_{2,2},\ f_1^{'} - d_{2,2}, d_{2,2}\right)$ becomes relevant. Banks must prematurely liquidate the amount of $\tilde{l} > 0$. In this particular subset of the parameter space, equilibria of Type 1 and Type 4 are not applicable, so the economy will not experience the best non-panic equilibria, but neither

the worst panic equilibria. Even though foreign lending could serve as a last resort for the illiquid bank, the depositors' beliefs may deteriorate and take the economy into a panic equilibrium. Thus, equilibria of Type 3 may exist, since incentive compatibility is violated for particular values of f_1, σ , and world interest rates. We observe that a change in borrowing constraints or in policy parameters illustrates a fragile and highly volatile environment faced by the financial system, which could lead to panics and generalized bankruptcies.

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The Debate over Sovereign Risk, Safe Assets, and the Risk-Free Rate: What are the Implications for Sovereign Issuers?[*]

Hans J. Blommestein[**]

Abstract

This paper seeks to dispel or at least reduce the confusion surrounding the related key concepts of the risk-free rate, safe assets, and sovereign risk, which are central to policy and academic discussions. This confusion gives rise to a lack of consensus as to how to define, measure, and price "sovereign risk," thus creating a major obstacle to assessing sovereign borrowers' stress.

In this paper, safe assets are considered to be those that are virtually default-free. These so-called safe assets function as "information-insensitive" instruments (they serve as "money" and have the associated basic functions of money, such as collateral and backing of checkable deposits of commercial banks and money-market funds). The return on these assets is the (relatively) risk-free rate.

The pricing of risky assets involves assessing or evaluating the risk dimensions of relative asset safety. A significant complication in carrying this out is the fact that the market is often driven by emotions, or animal spirits. Sometimes these market emotions change rapidly, having a knock-on effect on the (mis)pricing of relatively safe assets and sovereign risk. The track record of

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[**] Head of the Bond Market and Public Debt Management Unit, OECD, Paris, France. www.oecd.org/daf/publicdebtmanagement; hans.blommestein@oecd.org

sovereign-risk pricing is not very impressive, characterized by prolonged periods of risk under-pricing (excessively compressed spreads) followed by risk overpricing (sudden widening of spreads). Market measurements (including ratings) thus seem somewhat unreliable. *One should, therefore, be extremely cautious in concluding that the sovereign debt of an OECD country has indeed lost its "risk-free" status.* At the same time, the overarching strategic objective of debt managers is to raise funds at the lowest possible cost within the boundaries of a preferred risk level. *This implies for the sovereign borrower a two-part goal: issuing (relatively) risk-free sovereign debt and preserving this relatively risk-free status.* Reinforcing government borrowers' focus on this strategic objective is the knowledge that a steady supply of safe sovereign assets is essential for the smooth functioning of the worldwide financial system (for allocating resources, pricing benchmarks, and as a collateral source).

Clarity and consistency are necessary conditions for the proper pricing of sovereign risk. Beyond that, 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" to a (relatively) "risky asset" has therefore major macro and micro financial ramifications.

JEL Codes: E43, E61, E62, F34, G18, H63, H68

Key words: Risk-Free Rate, Safe Assets, Sovereign Risk, Mispricing, Sovereign Issuers

1. Introduction

A lack of consensus arising from widespread confusion as to how to define, measure, and price "sovereign risk" is hobbling current attempts to assess sovereign borrowers' stress[1]. This is doubly unfortunate because it is happening at a time when sovereign stress is occupying centre-stage in the concerns of market participants and policymakers in several OECD countries. Indeed, recent fears of a possible breakup of the entire Euro area resulted in high borrowing rates and fragmentation among sovereign funding markets.

This situation is being further aggravated by confusion about the related key concepts of sovereign risk, safe assets, and the risk-free rate. This confusion, in turn, complicates the correct assessment of changes in the supply of safe public assets.

Since the track record of sovereign-risk pricing is far from impressive, the prevailing market measures of this risk (including ratings) should be regarded with great caution. One should, therefore, be wary of concluding that the sovereign debt of an OECD country has indeed lost its "risk-free" or "ultra-safe" status. Moreover, debt-quality downgrades by the rating agencies for several OECD sovereign borrowers and changes in the interest rates attached to their borrowings may give conflicting signals. Clearly, rating downgrades in and of themselves should not be taken at face value; rather, their implications for the overall supply of safe sovereign assets should be carefully scrutinized.

Against this backdrop, this paper argues that the overarching strategic objective of debt managers should be to raise funds at the lowest possible cost within the boundaries of a preferred risk level. *This implies for the sovereign borrower a two-part goal: issuing (relatively) risk-free sovereign debt and preserving this relatively risk-free status.* Reinforcing government borrowers' focus on this strategic objective is the knowledge that a steady supply of safe sovereign assets is essential for the smooth functioning of the worldwide financial system (for allocating resources, pricing benchmarks, and as a collateral source). Furthermore, the transition from a (relatively) risk-free asset to a (relatively) risky asset brings with it major macro and micro financial ramifications.

2. Concerns about sovereign stress

The slow recovery in the OECD economies is making fiscal adjustment more challenging (in particular within the Euro area). Nonetheless, there has

[1] Blommestein and Ibarlucea Flores (Forthcoming).

been progress in strengthening OECD fiscal balances during the past two years. For the OECD area as a whole, deficits fell by around 1% of GDP in 2011 and 2012 (standing at 6.5% in 2011, while they are estimated to have reached 5.5% in 2012[2], and are projected to fall to 4.6% of GDP in 2013). However, in many countries, deficits and gross borrowing needs are not declining enough to stop the rise in public debt (including in relation to GDP).

As a result, general government gross debt outstanding increased by 5.8% of GDP in 2012 (in 2011, the debt-to-GDP ratio was 102.9% and is estimated to have reached 108.7% in 2012)[3]. In 2014, general government debt as a percentage of GDP is projected to touch 112.5 %, up from 111.4 % in 2013.

Ever since markets became nervous about perceived higher sovereign-risk levels, policymakers have been shifting more of their attention to government debt and deficit figures. While it is welcome, this greater focus on sovereign risk has had a down side: it has amplified the potential for trouble developing in governments' borrowing operations, including (ultra-)high interest rates and auction failures. Roll-over risk has emerged as another main policy concern for debt managers, in particular in countries with (perceived) debt-sustainability problems.

3. Confusion surrounding the concept of sovereign risk

Since 2010, the sovereign-debt crisis in the Euro area has fuelled a debate among rating agencies, policymakers (including public-debt managers, bank regulators, fiscal authorities, and central bankers), and academics that has only added to the existing confusion. At its heart is a fundamental lack of agreement on what exactly sovereign risk is, but equally challenging to all stakeholders is the question of to what extent and in what way related concepts, such as the risk-free rate, safe assets, and sovereign risk, interact with one another.

3.1 How to define sovereign risk?

Sovereign risk can be defined as the absence of safe sovereign assets[4]. The most common and simplest approach is to define relatively safe sovereign assets as being virtually default-free in nominal terms (that is, credit risk is absent). Such relatively safe sovereign assets are part of the universe of safe assets having relatively risk-free interest rates. They are considered to have

[2] OECD (2012).
[3] OECD (2012).
[4] Blommestein and Ibarlucea Flores (Forthcoming).

low (virtually zero) sovereign risk. This universe of safe assets ranges from absolutely safe Arrow-Debreu securities to relatively safe sovereign assets that have (very) low risk in terms of one or more risk dimensions.

The most simplistic definition of sovereign risk can then be stated as follows; sovereign risk is associated with national government borrowers that issue debt that is not (or no longer) viewed as being virtually default-free in nominal terms. These sovereign issuers do not possess (or have lost) the risk-free interest-rate status.

3.2 How to measure sovereign risk?

More complex versions of sovereign risk can be defined in terms of additional risk dimensions[5]. Recent contributors to the ongoing debate have been touting a set of indicators that supposedly capture sovereign risk; these diagnostic criteria range from macroeconomic formulas to financial ones through to credit ratings[6]. All in all, however, despite the presence of both strengths and weaknesses in each of the recommended approaches, no single one has emerged as entirely satisfactory. In particular, those attempting to assess sovereign risk first need to understand what each indicator is actually revealing and realize that certain indicators are influenced by outside factors[7].

3.3 How useful are suggested market measurements of sovereign risk?

Clearly, there is no one-size-fits-all solution to the challenge of pricing sovereign risk in a reliable and comprehensive fashion. For example, while both credit ratings and credit-default swap (CDS) spreads claim to reflect the expected risk of default, the fact that CDS spreads are determined not just by economic fundamentals but also by (at times elusive) market factors of supply and demand like global risk aversion means that there may be times (perhaps quite frequently) when these indicators give contradictory messages. Moreover, research shows that so-called animal spirits dominate fundamentals in explaining CDS spreads, especially during financial crises[8].

Credit rating agencies (CRAs) claim that their pronouncements on countries' creditworthiness represent fundamental assessments of underlying sovereign credit risk. Interestingly, several empirical studies have documented that market indicators of risk, such as credit-default swaps or swap spreads,

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5 Blommestein and Ibarlucea Flores (Forthcoming).
6 Blommestein, Guzzo and Holland (2010).
7 Blommestein, Guzzo and Holland (2010).
8 Blommestein, Eijffinger and Qian (2012).

start to move when credit quality deteriorates and improve well ahead of a sovereign rating action. This implies that the market often leads decisions by rating agencies and calls into question the very value of credit ratings[9]. This has sparked calls for a new focus on market indicators of sovereign risk on the part of debt managers, investors, and policymakers, instead of relying on the traditional credit rating agencies.

However, these market indicators should also be regarded with care. For example, *sovereign interest-rate spreads* have been judged *unreliable*. A study of the link between sovereign bond yield spreads and the risk of debt restructuring supports this point of view, in particular its main conclusion that "markets sounded false alarms in the vast majority of episodes."[10]

CDS spreads are also potentially unreliable predictors of defaults and sovereign debt restructurings. Theoretical research shows that the relationship between CDS spreads and bond yield spreads holds fairly well for corporations[11]. Likewise, empirical studies demonstrate that the link between sovereign CDS spreads and sovereign bond yield spreads is fairly tight[12]. This means that, like sovereign bond yield spreads, *sovereign CDS spreads* have to be considered *unreliable predictors* of (potential) defaults in sovereign debt markets.

Yet, sovereign CDS prices are widely interpreted as probabilities of default[13]. However, these spreads, just like any other asset price, depend on the global level of risk aversion in addition to the actual probability of default of the sovereign[14]. Risk aversion (and other global macroeconomic and financial market risks) constantly fluctuates. Hence, it is very likely that over the past few years, risk-averse investors revised the price they were willing to pay for receiving income in such uncertain and challenging times. Clearly, this development has influenced the price of sovereign protection, without implying any higher or lower default probabilities.

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9 See also Blommestein and Ibarlucea Flores (Forthcoming).

10 Cottarelli, Forni, Gottschalk and Mauro (2010).

11 Hull, Predescu and White (2004).

12 See the estimates using various econometric methodologies in Blommestein and Ibarlucea Flores (Forthcoming).

13 By simply dividing the level of the swap spread by its recovery rate.

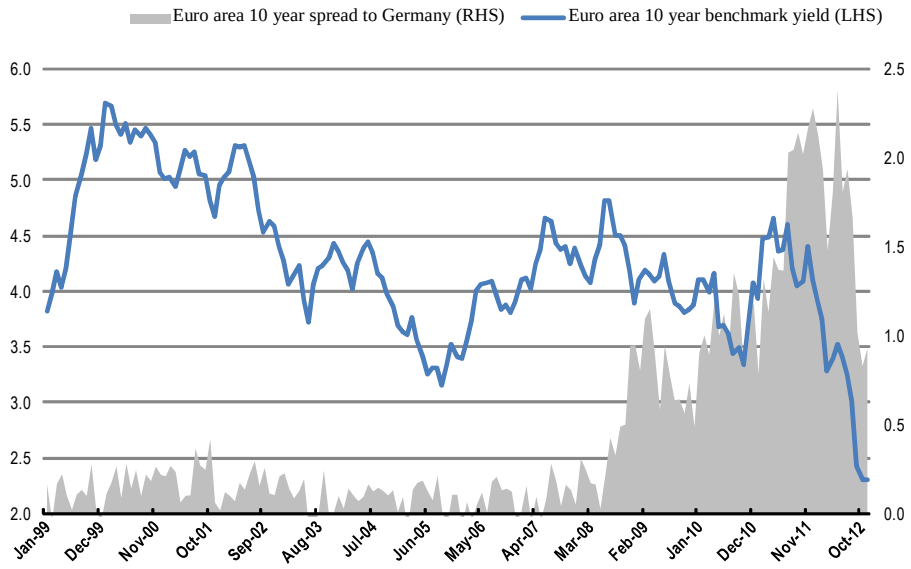
14 The interpretation of what CDS spreads actually convey as information is further complicated by suggestions that there are different potential common sources of global or systemic macroeconomic and financial market risks (i.e. global market factors, investment flows, global risk premiums) in addition to sovereign-specific fundamentals. (See Vilmunen (2011), and Longstaff, Pan, Pedersen and Singleton (2011)). Longstaff and Ang (2011) find that US and European systemic sovereign risk is strongly related to financial market variables (rather than macroeconomic fundamentals).

4. Mispricing of sovereign risk?

Another (and related) reason why analysts should be leery of market measurements of sovereign risk is their lackluster track record. It has been marked by long periods of complacency (or optimism), during which risk premiums and risk perceptions were unusually low, while—in reality—risks were building up. Thus, a prolonged period of risk underpricing, seen in excessively compressed spreads, would be followed by a sudden widening of spreads, reflecting systematic overpricing of sovereign risk[15] (Figures 1 and 2). *One should, therefore, be very cautious before concluding that the sovereign debt of an OECD country has indeed lost its risk-free status.*

Figure 1. Euro area 10-year government bond yield and spread to Bund (1999-2012)

(Percentage)



Note: Cut-off date is 1 December 2012.
Source: ECB, Datastream, and calculations by the author.

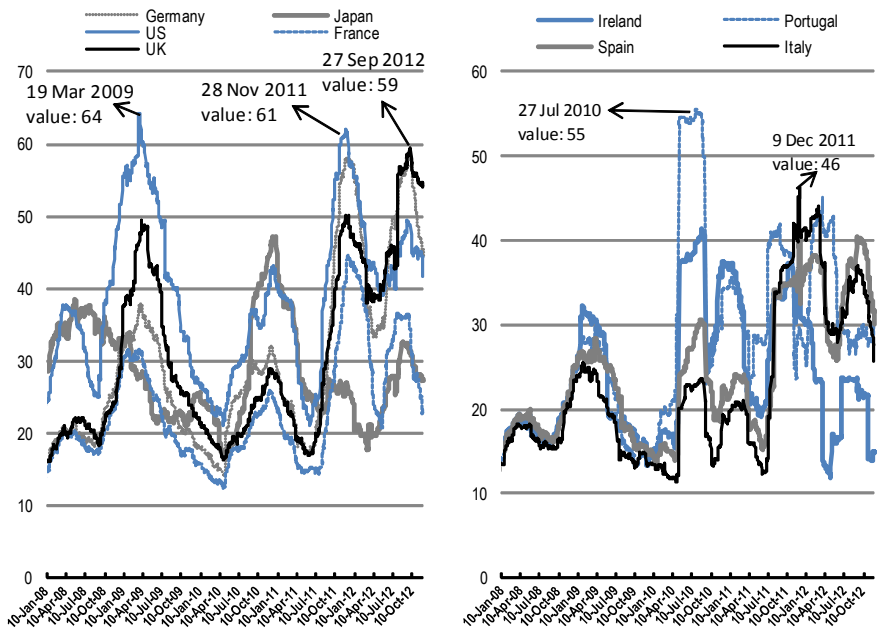
The mispricing of sovereign risk arises from various sources: (i) disagreements (and uncertainty) over how to define and measure the very concept of sovereign risk; (ii) periods marked by dysfunctional debt markets, characterized by high uncertainty (see Figures 2 and 3) and great instability[16]; (iii)

[15] Hannoun (2011).
[16] Bini Smaghi (2011).

sudden market mood swings between optimism and pessimism (aka animal spirits), leading to sustained periods of under- and over-pricing of sovereign risk[17]. As a result, market discipline does not operate consistently but spasmodically[18].

Figure 2. Historical volatility of 10-year benchmark yields (2008-2012)

(Percentages)



Note: Historical volatility is the annualized standard deviation of the change in daily yields of 10-year benchmark government bonds. The calculation uses a 90-day moving standard deviation.

Yield volatility is an indicator of risk arising from movements in interest rates. High volatility suggests less predictability of daily movements in bond yields. A number near zero indicates that daily bond yields are clustered around the average yield.

Source: Datastream and calculations by the author.

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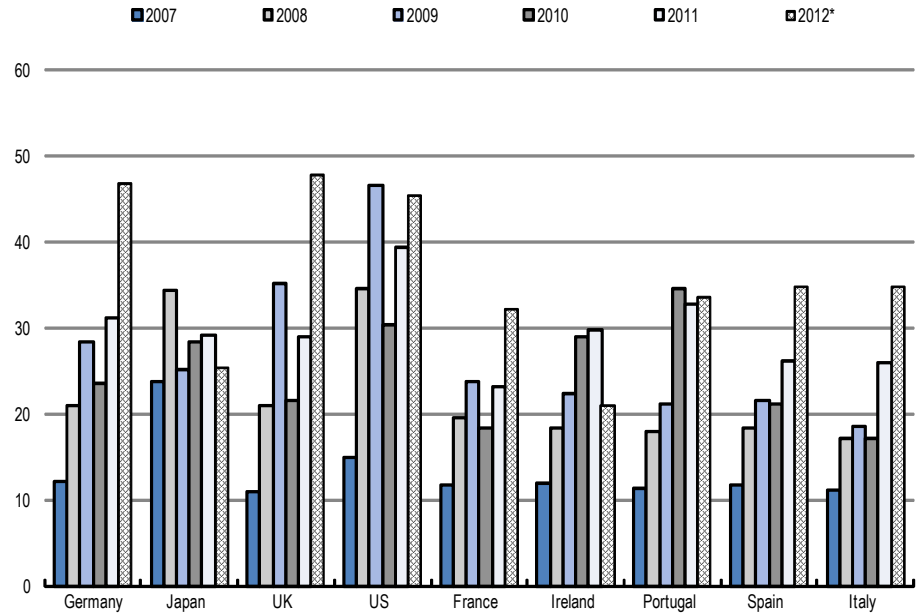
[17] De Grauwe and Ji (2012) found evidence that a large part of the surge in the spreads of the peripheral Euro area countries during 2010-2011 was disconnected from underlying changes in fundamentals (i.e., debt-to-GDP ratios). The authors state that instead, the increase in spreads "was the result of negative market sentiments…"

[18] This also implies that one cannot rely on markets to exert proper policy discipline. For example, "market discipline cannot be relied upon to foster fiscal rectitude." Hannoun, (2011, p. 2).

Figure 3. Historical volatility of 10-year benchmark yields, 2007-2012

(Percentages)



Note: Average of the historical volatility. The calculation of historical volatility uses 90-day moving standard deviation (annualized) of the change in daily yields of 10-year benchmark government bonds.
Yield volatility is an indicator of risk arising from movements in interest rates. High volatility suggests less predictability of daily movements in bond yields. A number near zero indicates that daily bond yields are clustered around the average yield.
* Average as of 30 November 2012
Source: Datastream and calculations by the author.

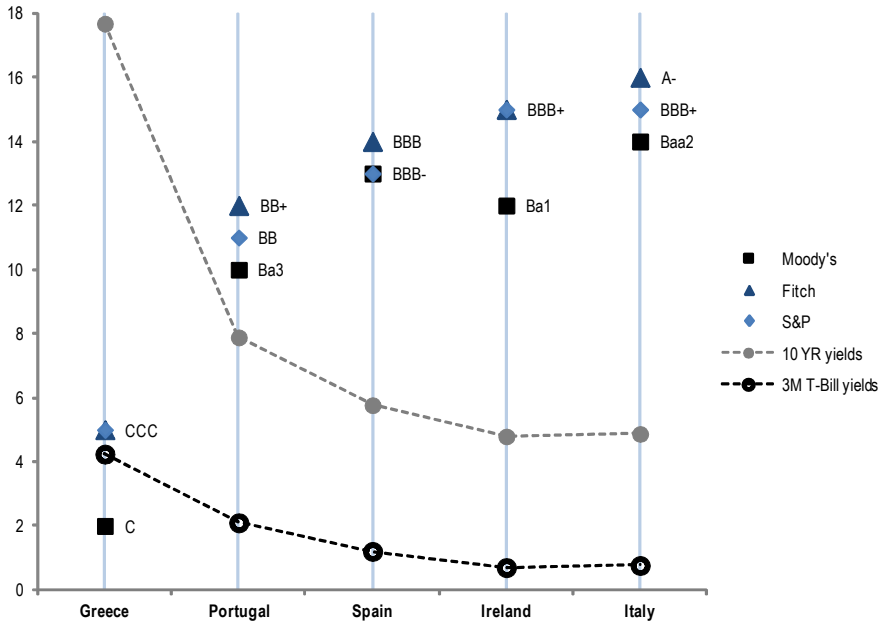
Yet another explanation for the existence of mispricing of soverign-issued debt instruments is abrupt changes in the supply of and demand for safe public assets. Such volatility, where, for example, a perceived shortage of safe assets emerges, could adversely impact market functioning. Nervousness[19] about the safety of assets and the related uncertainty over the correct pricing of a particular risk-free asset could lead to alarming market distortions and misalignments in the pricing of sovereign risk.

[19] This is *Knightian uncertainty*, as it reflects a situation where it is not possible to assign (objective) probabilities to measure risk.

5. Demand for and supply of safe sovereign assets

The demand for safe *sovereign*[20] assets has increased for several reasons: regulatory changes[21], non-conventional balance-sheet policies by central banks, heightened risk aversion (leading to the use of high-grade collateral in support of funding and other transactions), and a build-up of foreign-exchange reserves in certain countries.

Figure 4. Changes in credit ratings and yields



Note: Three-month T-bill rates are based on the latest issuance operations as of 17 October 2012.
Source*:* Datastream, credit ratings from Moody's, Fitch, and Standard and Poor's, and OECD staff estimates.

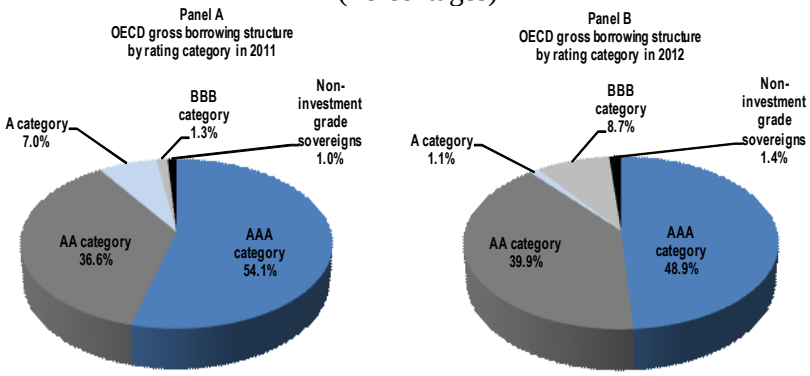
At the same time, the perception has been gaining ground that the supply of safe sovereign assets has fallen. In the wake of the Euro area sovereign-debt

[20] Since the focus is on public assets, this analysis does not take into account so-called safe *private* assets, such as securitized assets and corporate bonds of very high credit quality.

[21] For example, new requirements to change risk weights, set up liquidity buffers (for banks), obtain high- grade collateral, and begin greater use of central counterparties (CCPs) in OTC derivatives markets.

crisis that began in May 2010, the three big credit rating agencies (CRAs) began to downgrade sovereigns. Downgrades for the so-called peripheral countries of the Euro area are shown in Figure 4. This figure also shows that lower sovereign credit ratings are broadly associated with higher borrowing costs[22].

Figure 5. Structure of gross borrowing by rating category
(Percentages)



Note: The data used for the credit rating country groupings are from the three main credit rating agencies: Moody's, Fitch, and Standard and Poor's. The classification of an issuer as AAA is based on two of three best rating grades, that is, if a sovereign issuer has been granted triple-A status by two rating agencies, the country is classified as triple-A. For details, see the table of sovereign ratings in Annex A: Methods and Sources. Credit ratings and other data are as of 30 November 2012.
Source: 2012 Survey of central government marketable debt and borrowing by the OECD Working Party on Debt Management; credit ratings from Moody's, Fitch, and Standard and Poor's, and OECD staff estimates.

The big three CRAs use similar rating scales, with the highest-quality issuers receiving a triple-A grade. On the basis of the rating scales of these three CRAs, we have calculated average ratings as measures of safety (riskiness) of sovereign assets. We presumed that an AAA sovereign rating was a reliable representation of the "safest" sovereign assets. We further established that a sovereign issuer would be one classified as AAA when two out of the three main CRAs assign a triple-A rating (Rule #1) to it. According to our Rule #1, the recent downgrade of France, by two of the three leading CRAs, reduces the triple-A part of total marketable gross issuance by OECD *central* governments in 2012 from almost US$ 5.8 trillion[23] to US$ 5.3 trillion.[24]

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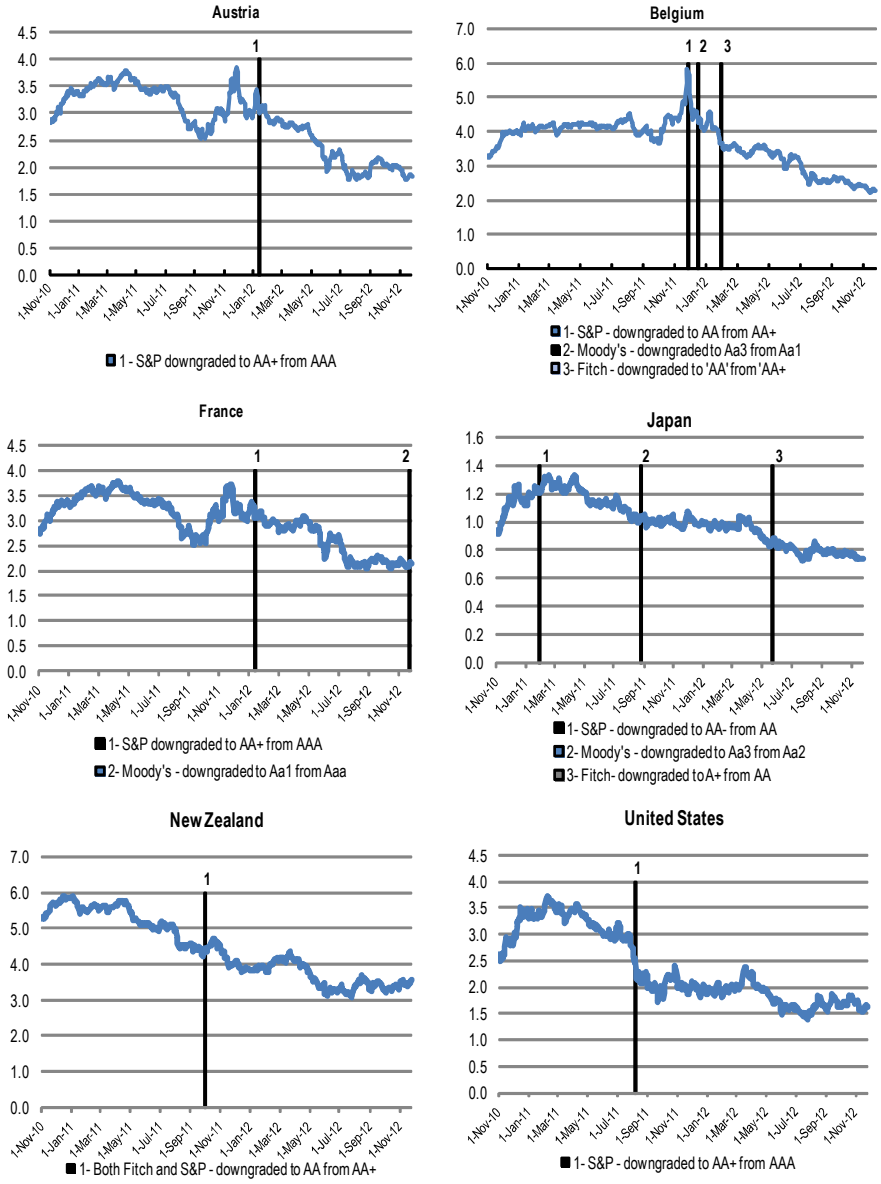
[22] Calculations using different econometric methodologies confirm this broad association.
[23] This amount represents about 54% of total marketable gross borrowing issuance (OECD (2013)).
[24] Or 49% of total marketable gross borrowing issuance by central OECD governments (OECD (2013)).

Figure 6. 10-year benchmark bond yields and credit events for selected OECD sovereigns

(Percentages)



Source: Datastream and credit ratings from Moody's, Fitch, and Standard and Poor's.

As a result of such rating downgrades during 2012, the gross borrowing structure by rating category has been transformed (compare Figure 5, panels A (situation in 2011) and B (new situation in 2012).

However, the market reaction to (many of) these rating downgrades has been quite extraordinary. In fact, many sovereigns experienced *lower* bond yields in the wake of the downgrade. Figure 6 shows the evolution of long-term borrowing costs (using 10-year benchmark bond yields) in response to sovereign rating downgrades. Naturally, these conflicting signals are raising fundamental questions about the inherent worth of sovereign credit-risk ratings.

How are we to reconcile the discrepancy in price signals? A recent report by one of the rating agencies provides some insight into how the CRAs themselves assess the usefulness of market indicators in arriving at a decision on credit ratings:

"Market indicators are useful but imperfect: While Fitch Ratings bases its ratings principally on underlying fundamentals, it also tracks market indicators to provide additional context as to markets' perception of risk and as an indication of future funding costs. However, market indicators need to be viewed cautiously, given the markets' tendency at times to overshoot and undershoot to levels that, in retrospect, may prove to be fundamentally unjustifiable."[25]

To repeat, this rating agency tracks market indicators to "provide additional context as to markets' perception of risk" but also (quite crucially) "as an indication of future funding costs." This means that market information is judged as important. At the same time, however, that same market information "may prove to be fundamentally unjustifiable." It remains, therefore, unclear how rating agencies can integrate into a single consistent framework both "underlying fundamentals" (to justify ratings) and key market indicators (that may prove to be fundamentally unjustifiable).

Against such a backdrop, can (or should) we then fully rely on the triple-A standard to confidently measure the safety of sovereign assets? In view of the contradictory signals coming from the CRAs on the one hand and the market indicators on the other, we re-calculated the change in the supply of safe sovereign assets by relaxing our *two-out-of-three rule*. This new rule—#2—is as follows: *If a sovereign is rated by one of the major agencies AAA or AA, then its issued debt is considered "safe."*

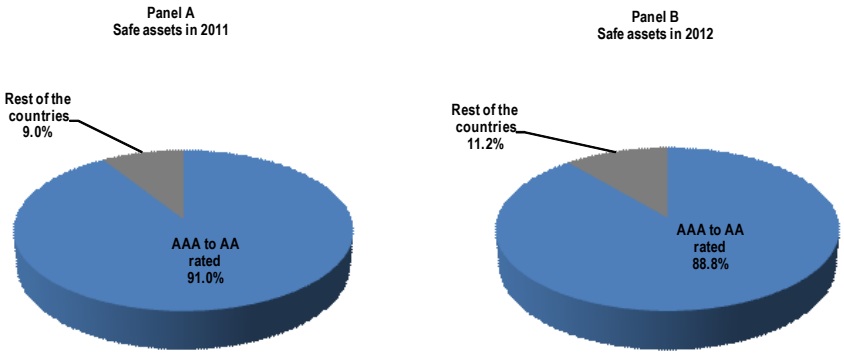
Using Rule #2 yields the following results. Combined AAA- and AA-rated OECD gross borrowing amounts are estimated to have reached US$ 9.6 tril-

[25] Fitch Ratings (2012).

lion at the end of 2012, or 88.8% of the total issuance by OECD governments, down from 91% in 2011 (see panels A and B of Figure 7 on OECD gross borrowing by rating). For 2013, the combined triple-A and double-A borrowing amounts are projected to remain almost the same as in 2012. In other words, according to Rule #2, the supply of relatively safe assets will not change much.

Figure 7. OECD gross borrowing by rating

(Percentages)



Note: The data used for the credit rating country groupings are from the three main credit rating agencies: Moody's, Fitch, and Standard and Poor's. If a sovereign is rated by one of the major agencies AAA or AA, then the asset is considered "safe." For details, see the table of sovereign ratings in Annex A on Methods and Sources. Credit ratings and other data are as of 30 November 2012.
Source: 2012 Survey on central government marketable debt and borrowing by the OECD Working Party on Debt Management; credit ratings are from Moody's, Fitch, and Standard and Poor's, and OECD staff estimates.

6. What are the implications for sovereigns?

Safe sovereign assets play a pivotal role in the financial sector. They function as so-called information-insensitive instruments (they serve as "money" and have the associated basic functions of money, such as collateral and backing of checkable deposits of commercial banks and money-market funds). In effect, relatively risk-free government paper is a core public good (allocating resources, pricing benchmarks, and collateral sources).

We have shown that the track record of sovereign-risk pricing leaves a lot to be desired. Prolonged periods of risk under-pricing (excessively com-

pressed spreads) have been followed by risk overpricing (sudden widening of spreads). We have argued that sovereign-risk mispricing is a natural concomitant of widespread confusion over the very concept of risk; indeed, there is not even agreement among all those concerned on the definition of sovereign risk (with multiple definitions circulating), making the measurement and pricing of this risk highly problematic. Even worse, market measurements of sovereign risk often cancel each other out, making their information value dubious and of little value to policymakers.

One should, therefore, exercise the utmost restraint before concluding, on the basis of such flawed measurements, that the sovereign debt of an OECD country has indeed lost its risk-free status.

What are the implications of these conclusions for the core objective of sovereign issuers or governmental Debt Management Offices (DMOs)? DMOs are in the business of raising funds at the lowest possible cost within the boundaries of a preferred risk level (interest-rate risk and refinancing risk). Clearly, relatively risk-free government instruments will carry a lower yield than riskier government debt. Moreover, as noted, relatively risk-free government paper can be considered a core public-good. Therefore, both the objective of having lower borrowing costs and the commitment to ensuring the wide availability in the markets of relatively risk-free investment instruments support the notion that sovereign governments need to aim to issue *(relatively) risk-free sovereign debt.* In other words, the risk-free status of sovereign debt should be seen as a core objective.

This implies that the sovereign should do everything in its power to *guard this risk-free status*. Announcing (*ex ante*) private-sector involvement (PSI) schemes and other debt-restructuring facilitating features are in principle *inconsistent* with upholding the supply of relatively risk-free debt. Restructuring of outstanding government debt has been compared to shooting oneself in the foot—especially when most sovereign assets are held by domestic institutions, such as pension funds. The evidence is compelling: since the autumn of 2010, "certain Euro area countries have been paying a specific risk premium, which effectively penalizes them."[26] In response, EU leaders decided on 9 December 2011 to dramatically alter their approach to PSI. In sum, investors should not be exposed to arbitrary restructuring actions. Restructuring should therefore only be contemplated in extreme situations caused by traumatic exogenous events.

[26] Bini Smaghi (2011).

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