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THE "BIG C": IDENTIFYING CONTAGION

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ABSTRACT

This paper surveys and assesses the academic literature on defining, measuring, and identifying financial contagion and the various channels by which it can occur. It also includes new empirical analysis of recent trends and causes of contagion, highlighting contagion risks in the euro area. The paper defines "interdependence" as high correlations across markets during all states of the world and "contagion" as the spillovers from extreme negative events. Interdependence has increased dramatically over time, especially within the euro area, even after controlling for global shocks and changes in volatility. Not surprisingly, negative events in one country also quickly affect others. Regression analysis shows that a country is more vulnerable to contagion if it has a more levered banking system, greater trade exposure, weaker macroeconomic fundamentals, and larger international portfolio investment liabilities. Countries are less vulnerable, however, if they have larger international portfolio investment assets (which can provide a buffer against shocks) and are less reliant on debt (versus equity) for international financing. These results have important implications for understanding contagion and for analyzing policies designed to mitigate contagion, especially for the current crisis in the euro area.

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I. Introduction

In the Showtime TV series "The Big C", the main character is diagnosed with a deadly cancer—the "Big C". In response, this suburban housewife suddenly takes out-of-character, impulsive actions—from buying a bright red sports car to putting a large pool in her tiny backyard to having an affair with a painter. She denies the severity of her disease and undergoes alternative treatment (such as being stung by bees) rather than follow the standard protocol. All of these actions can provide a temporary distraction, but they often have unintended consequences and in the end do nothing to stop the "Big C". Eventually the main character comes to grips with the inevitability of her disease and undergoes treatment—an extremely difficult decision that may not succeed, but is her best chance for long-term survival.

Similarly, the "Big C" that is the focus of this paper—Contagion—can be deadly. Contagion can cause a negative shock in one country to quickly spread to others through numerous real and financial channels—precipitating turmoil in global financial markets and sharp declines in output and standards of living. This legitimate fear of contagion can cause policymakers to take actions that they would not normally consider. This paper will argue, however, that countries have become so interdependent in both good and bad times that contagion is extremely difficult to stop. Many measures aimed at minimizing contagion provide only a temporary reprieve and can aggravate contagion risks through other channels. Just as the main character in the "Big C" eventually admits the inevitability of her disease and undertakes painful treatment, policymakers concerned about contagion must fully address the underlying vulnerabilities and adopt difficult measures. On a more positive note, just as lifestyle changes can reduce the risks of many diseases in the future, policymakers concerned about contagion in the future can adopt structural reforms to reduce (although not completely remove) contagion risks in the long term.

This paper is divided into six sections. The remainder of this section summarizes the key points and results of the paper. Section II then discusses various definitions of contagion and how use of the term has evolved over time. It also provides an overview of the different empirical strategies for measuring contagion. The discussion shows that debate on these fundamentally important issues of how to define and measure contagion is complicated and unresolved. The rest of the paper focuses on the definition of contagion preferred by many policymakers (although not many in the academic community) — when an extreme negative event in one country affects others. This type of "contagion" is distinct from "interdependence"—when events in one country affect others in all states of the world and not just after negative events. This section on the definitions and measurement of contagion can be skipped for readers who would like to move directly to the new analysis.

Section III uses these definitions to evaluate whether interdependence and contagion have increased over time based on two methodologies. First, it analyzes bilateral correlations in stock market returns around the world since 1980. It shows that markets have become significantly more correlated and

this does not result from global shocks or increased volatility. Moreover, this comovement has increased substantially more between countries in the euro area than in other countries. Markets around the world, and especially in the euro area, are now more interdependent through good times as well as bad. The second part of the analysis measures only the transmission of negative shocks across countries. It uses extreme value analysis to document that countries today are more likely to experience extreme negative stock market returns than in the past, especially in the euro area, and these extreme negative returns are more likely when other countries are also experiencing negative returns. There continues to be robust evidence of this contagion even after controlling for global shocks.

Section IV then moves to the critically important issue of why countries' markets are so closely linked and how contagion occurs. It summarizes the theoretical and empirical literature and divides this extensive literature into four main channels of contagion: trade, banks, portfolio investors, and wake-up calls/fundamentals reassessment. There are other ways to categorize the channels for contagion, but this framework is useful later in the paper when assessing how contagion occurs. A graphical analysis shows a striking increase in integration through trade, banking and portfolio investment across countries over time—especially in the euro area. Given this increase in integration, it is not surprising that interdependence and contagion have increased over time—especially in the euro area.

These trends are confirmed in a more formal regression analysis of how extreme negative returns are transmitted across countries. There is evidence that all four channels of contagion (trade, banks, portfolio investment and fundamentals reassessment) are significant determinants of a country's vulnerability to extreme returns in other countries. Contagion in the euro area does not exhibit any different patterns than for the full sample. The empirical results, however, also suggest that the simplistic interpretation that "more integration = more contagion" misses important subtleties. Although greater international exposure through portfolio investment liabilities can increase vulnerability to contagion, greater exposure through portfolio assets can reduce vulnerability. This may result from better risk diversification or the ability of countries with large international investment positions to "retrench" by selling foreign assets after negative shocks to provide stability at home. The results also suggest that greater reliance on debt (versus equity) tends to increase country vulnerability, undoubtedly due to the natural risk sharing properties of equity. A final important result is the role of leverage in the domestic banking system. Leverage is a significant determinant of a country's vulnerability to contagion—and even more consistently important than the country's overall international banking exposure.

The results of this empirical analysis have important implications for evaluating various policies to mitigate contagion. This paper, however, does not discuss the pros and cons of various policies that can mitigate contagion. Instead, a full discussion of the policy implications is available in a longer version of this paper available at: http://www.kansascityfed.org/publicat/sympos/2012/kf.pdf. This longer version of

the paper discusses measures that could be taken *a priori* to reduce contagion over the long term as well as situations when contagion risks are imminent and policies are aimed at providing immediate relief.

While this paper focuses on contagion around the world, Section V ends by discussing special considerations in the euro area.[1] It is not surprising that the area's high levels of integration through trade, banking and portfolio investment—integration that was a key goal of union—correspond to high levels of interdependence and contagion within the region today. The unique structure of the euro area, however, creates additional considerations. For example, the lack of an independent currency and central bank complicates countries' adjustment to negative shocks that originate elsewhere and highlights the importance of having flexible economies. The lack of a traditional lender-of-last resort to back large international bank exposures increases vulnerability to contagion through bank runs and highlights the importance of this channel of contagion. The institutional and macroeconomic similarities between many euro area countries increase contagion risks through "wake-up calls." This highlights the importance of considering externalities to other countries when designing policies. For example, policies which impose additional fiscal liabilities on other countries (even through joint institutions such as the ECB, ESM or EFSF) can create additional risks by increasing their vulnerability to contagion through negative reassessments of their debt sustainability.

The discussion in this paper highlights why it is so difficult—if not impossible—to stop contagion. Contagion can take many forms and most of the channels of contagion result from a healthy interdependence between countries in good times, as well as bad. Although there are steps that can be taken to reduce vulnerabilities to contagion in the future, once a negative shock occurs in one country, there are no easy fixes for ending contagion in an integrated world. But this does not mean that the risks should be ignored. Just as the other "Big C" can be deadly, contagion can be devastating. Just as there are legitimate protocols that can successfully fend off certain types of cancer, there are policies that can effectively fend off certain forms of contagion. A careful evaluation of options to address both "Big C's" needs to thoroughly consider not only what the action can realistically accomplish, but also if there will be any side effects that increase contagion risks in the future.

II. Defining and Measuring Contagion

A. What Do We Mean by Contagion?

Although "contagion" is currently part of the standard lexicon of economists and investors, use of the term to describe the international transmission of financial turmoil is fairly recent. Figure 1 shows

[1] There is, however, minimal discussion of contagion to low income countries. This does not imply that contagion to these countries is unimportant, especially given their more limited ability to respond to negative shocks. Data for these countries is more limited so they drop from the empirical analysis. Most contagion to lower income economies is also generally more predictable, more easily addressed through standard policies, and generates fewer spillovers to the rest of the world. IMF (2011) discusses contagion from the euro area to low income countries.

results from a Factiva search of monthly use of the term "contagion" in articles in the economics or financial/commodities press since 1990.[2] The term contagion was rarely used before 1995, after which it occasionally appeared in articles discussing the impact of the Mexican Peso crisis on other countries in Latin America. Use of the term was extremely limited, however, and barely visible on the figure without a magnifying glass. It was not until Thailand's 1997 devaluation affected other countries in Asia, and then Russia's 1998 devaluation affected global financial markets, that contagion became standard economics terminology and fears of contagion became a regular concern of policymakers. These events prompted a series of academic papers in the early 2000's attempting to measure, understand, predict, and prevent international financial contagion.

Despite the numerous papers on this topic and widespread use of the term "contagion" to describe the international spread of financial crises, there is extensive disagreement on exactly what the term means.[3] Table 1 shows the diversity in definitions adopted in academic papers on the subject. Most papers agree that if a shock to one country is transmitted to another country to which it is not traditionally linked through channels such as trade, bank loans or other investment flows, then this qualifies as contagion. A common example of this obvious case of contagion is when the 1998 Russian crisis affected stock markets as diverse as Brazil, Thailand, and the United States. Some economists have proposed using the more specific terms "shift-contagion" or "pure contagion" to describe this scenario when there is a significant increase or "shift" in cross-market linkages after a shock to an individual country. Most economists also agree that a major global shock—such as a sharp increase in commodity prices—does not qualify as contagion, even if it causes increased comovement in markets around the world.

The disagreements on how to define contagion are more numerous. When a shock to one country spreads to others that are economically similar or that are closely linked through trade or financial flows—is this contagion? For example, if U.S. growth falters and equity markets decline and this affects Canada, would this necessarily constitute contagion? Another set of disagreements is on whether only certain types of cross-market linkages constitute contagion. More specifically, some economists argue that only the transmission of the most extreme negative events should qualify as contagion. Others argue that only any residual transmission of shocks after controlling for "fundamentals" is contagion. Still others argue that "rational" investor behavior that transmits shocks through financial markets is not contagion, but "irrational" behavior is. Even if there was agreement on what constituted "fundamental linkages" or "rational behavior", these stricter definitions of contagion are extremely difficult to implement and measure in practice. For example, if mutual funds respond to a fall in Brazil's market by

[2] There are several earlier examples of use of the term financial contagion in the academic literature, such as King and Wadhwani (1990), Allen and Gale (2000), and the literature on domestic banking collapses.
[3] For more information on different definitions of contagion, see Claessens and Forbes (2001), Claessens, Dornbusch, and Park (2001), Forbes and Rigobon (2002), Karolyi (2003), and Dungey et al. (2010).

selling investments in Bulgaria in order to satisfy investor withdrawals, does this qualify as a "fundamental" linkage between the countries (that share little other than their names starting with a "B")?

Finally, one issue which has received little attention in the debate on how to define contagion is what constitutes a "global shock". In earlier work on contagion, changes in U.S. growth or U.S. interest rates were considered "global" shocks and were not classified as contagion. But would a shock to the United States (such as the subprime crisis in 2007) that spreads to other countries qualify as contagion? Taking this one step further, what if a shock to a smaller country triggers a global or systemic shock?[4] In earlier work on contagion, changes in global liquidity, global risk, or global interest rates were not considered contagion. Many of the recent academic papers analyzing the spread of the GFC avoid the term "contagion"—undoubtedly due to this difficulty in classifying these global shocks that were a key transmission mechanism for the crisis and inherently different than the bilateral linkages that were previously the focus of academic work.[5] Most policymakers today, however, would consider global shocks which originate in the world's largest economies or result from shocks to smaller economies as examples of contagion. This suggests that even aspects of the definition of contagion on which there was initial agreement have evolved over time.

This debate on exactly how to define contagion is not just academic; it has important implications for measuring contagion and evaluating policy responses. Many economists argue a more restrictive definition of contagion is useful in order to better understand how crises are transmitted and what should be done. They highlight the importance of differentiating between cross-country linkages that exist at all times—what is often called interdependence—versus linkages that only exist briefly after shocks. For example, if a crisis in one country spreads to others through fundamental trade linkages that exist in all states of the world, policies that provide liquidity or financial assistance will be less effective in reducing contagion and just delay a necessary adjustment. But if the crisis spreads through transmission channels that only exist briefly after shocks—such as panicked selling by investors or a temporary withdrawal of liquidity by banks—then policies to provide liquidity or financial assistance until economic relationships stabilize could potentially avoid an unnecessary and painful adjustment.

On the other hand, most citizens and government officials prefer a broader definition of contagion. For example, ECB (2005) writes: "When a crisis in the stock market of one country causes a crisis in the stock market of another country this can be thought of as financial market contagion." If a country's economic outlook suddenly deteriorates after a crisis in a neighboring country, citizens do not generally care how the shock has been transmitted to them. They simply know that they are being affected

[4] In a paper ahead of its time, de Bandt and Hartmann (2000) discuss how a shock to one country can cause contagion and systemic risks through bank failures, financial markets, and payment and settlement risks.
[5] Different papers focus on different global shocks, such as to international banking, liquidity, risk aversion, demand, and counterparty risk. For examples, see Eichengreen et al. (2009), Chudik and Fratzscher (2011), Forbes and Warnock (2012), Fratzscher (2012), and Calomiris et al. (2010).

by problems that originated in another country and classify any spillover effects as contagion. Blaming contagion—even if it occurred through fundamental linkages that exist at all times—can be a powerful justification for policy action to support an economy. Moreover, even if policymakers wished to use a stricter definition, identifying the various forms of contagion can be extremely difficult in real time.

This paper will adopt what has evolved into the most common usage of the term contagion—the transmission of an extreme negative shock in one country to another country (or group of countries). This definition is broader than the terminology used in much of the academic literature and includes the spread of crises through trade, banks, and other fundamental linkages between countries that exist in stable as well as crisis periods. It also includes examples in which a shock to one country evolves into a global shock—such as a contraction in global liquidity or increase in risk aversion. This broad definition of contagion is closest to the use by governments, citizens and policymakers—the fear that negative events in another country, outside of their control, could spread and have deleterious effects at home. While this definition of contagion only focuses on spillovers from extreme negative events, the paper will also use the term "interdependence" to capture cross-country spillovers in all states of the world.

B. Measuring Contagion

Table 1 shows not only the different definitions of contagion in the academic literature, but also the range of approaches for measuring it. Much of the earlier literature focused on the fundamental question of whether contagion actually occurred during major crises—an apparently straightforward question complicated by several statistical issues. This section briefly summarizes the advantages, disadvantages and key insights of the five general strategies for measuring contagion: probability analysis, cross-market correlations, VAR models, latent factor/GARCH models, and extreme value analysis.[6] Most of these papers focus on contagion across equity markets because data is available at a high frequency for a large sample of countries over long periods of time. Equity valuations are also useful if they reflect expectations about future economic activity. A few papers also consider contagion in bond markets, interest rates, and exchange rates. This section only summarizes the literature measuring contagion in general and leaves a discussion of the specific channels of contagion (such as through trade, banks, etc.) to Section IV.

1. Probability analysis: One of the earliest approaches for evaluating the existence and importance of contagion used probability models to assess whether a crisis occurring in a "ground zero" country affected the likelihood that another country would have a crisis.[7] These papers generally find evidence

[6] More detailed reviews of the literature measuring contagion include: Claessens et al. (2001), Forbes and Rigobon (2001), and Dungey et al. (2010).
[7] See Eichengreen, Rose and Wyplosz (1996), De Gregorio and Valdés (2001) and Forbes (2002).

that the probability of a country having a crisis increases if there is a crisis elsewhere—their definition of contagion—especially for countries in the same region. This general approach has been extended more recently to test for a role of contagion in explaining sharp movements in capital flows (i.e., Forbes and Warnock, 2012) and default probabilities derived from credit default swaps (i.e., Constancio, 2012). These papers generally find evidence of contagion, although they have limited success in controlling for endogeneity (feedback effects) and omitted variables that could simultaneously cause events to occur in multiple countries.

2. Cross-market correlations: In the late 1990's, the most popular framework for analyzing contagion was to test if correlations in equity returns (or interest rates, exchange rates, or sovereign spreads) across different economies increased significantly after a crisis.[8] These studies generally found evidence that market comovement increased significantly during most crises—which was interpreted as evidence of contagion. Forbes and Rigobon (2002), however, show that the increased volatility during crises automatically generated an upward bias in correlation coefficients. They show that markets are highly "interdependent" in all states of the world, and we are simply more aware of this usual interdependence during periods of high volatility. Corrections for this heteroskedasticity in asset price movements lead to much less evidence of contagion—although different corrections require fairly restrictive assumptions that are often not satisfied in practice.[9] Moreover, even if this challenge of adjusting for heteroscedasticity in returns is resolved, tests for contagion based on correlation coefficients also have challenges controlling for any feedback effects (endogeneity) and common shocks (omitted variables) when estimating the effect of a crisis in one country on another. These econometric challenges in using correlation coefficients to measure contagion caused most academics to stop using cross-market correlations to analyze the transmission of crises.

3. VAR models: Closely related to using correlation coefficients to analyze contagion is to use a vector autoregression (VAR) framework.[10] These models generally predict stock market returns or yield spreads while controlling for global factors and country-specific factors, as well as for the persistence of these factors through error-correction techniques. Contagion is then measured with an impulse-response function predicting the impact of an unanticipated shock to one country on others. These tests are less conservative than those based on correlation coefficients as they generally do not adjust for the

[8] For early examples of this approach, see King and Wadhwani (1990) and Bordo and Murshid (2001).
[9] For different approaches to resolving these issues, see Forbes and Rigobon (2002), Boyer, Gibson, and Loretan (1997), and Boyer, Kumagai, and Yuan (2006).
[10] Examples of this approach are: Favero and Giavazzi (2002), and Constancio (2012).

heteroskedasticity in returns (and attempts to make this adjustment generate fragile results). Not surprisingly, papers using VARs generally find more evidence of contagion.

4. Latent factor/GARCH models: The challenges of using correlation coefficients and VARs to analyze contagion prompted a series of papers using latent factor and GARCH models that allow return variances to change across regimes.[11] Many of these papers focus on estimating spillovers in volatility, i.e., cross-market movements in the second moments of asset prices, instead of spillovers in prices. Studies using this approach generally find evidence of contagion from one country to others in certain circumstances, but not in all crises. Most of these studies also attempt to control for fundamental factors in their analysis and define contagion more strictly as the "excess correlation" after controlling for fundamentals. Since this measure of contagion is based on the correlation in the model residuals, this raises some questions about what is actually being captured in the residuals and whether any contagion could be caused by global shocks or any other omitted variables not captured in the model.

5. Extreme Values/Co-exceedance/Jump approach: A final approach to measuring contagion builds on the initial probability approach by using multivariate extreme value theory to test whether tail observations in returns are correlated across countries.[12] The extreme moments analyzed in these papers are periods when realizations of certain variables exceed a large threshold value (either in absolute value or relative to the distribution of returns)—with different approaches used to define these "exceedances". A closely related literature focuses on periods when there is a significant "jump" (i.e., large movement) in prices. These approaches have a number of advantages. They do not assume the transmission of shocks is linear or focus on daily relationships between markets. Instead they only focus on the impact of large (usually negative) shocks—which is closer to the broader definition of contagion of concern to policymakers. These approaches are also robust to different distributional assumptions about returns and therefore can avoid many of the econometric problems with other approaches (such as VAR and correlation analyses). Papers using this approach generally find evidence of contagion during some crises (such as the Russian crisis), but not all. This approach has two disadvantages: the sample of extreme moments is often small and it is difficult to control for any global shocks that could cause an extreme value in multiple markets at once and therefore be interpreted as contagion.

[11] For examples of this literature, see Hamao et al. (1990), Bekaert et al. (2005), Dungey et al. (2010), and Bekaert et al. (2011).

[12] Morgenstern (1959) appears to be the first example of this approach—although he does not use the term contagion. More recent examples of papers using extreme value theory are: Bae et al. (2003), Longin and Solnik (2001), Hartman et al. (2004) Boyer et al. (2006), and Boyson et al. (2010). Papers analyzing jumps include: Ait-Sahalia, Cacho-Diaz, and Laeven (2010) and Pukthuanthong and Roll (2012).

Each of these approaches for measuring contagion has its advantages and disadvantages. The preferred strategy depends largely on the operational definition of contagion being tested. For example, correlation analysis is useful for measuring the interdependence between markets in all states of the world and factor models are useful for measuring spillovers in volatility across markets after controlling for measurable fundamentals. Extreme-value analysis is emerging as potentially the cleanest approach to measuring the most common definition of contagion—any transmission of extreme negative shocks. Each approach has the imposing challenge, however, of controlling for global shocks that simultaneously cause a crisis in one country while increasing comovement between many countries. More important, even when these approaches are successfully used to identify whether contagion does or does not occur, they still do not answer the fundamental question of why a negative shock is transmitted internationally and through what channels contagion occurs.

III. Contagion over Time

Figure 1 shows that use of the term "contagion" in the business press has increased sharply since 1997—and especially since 2007. But has contagion actually increased over time? Even though the term is relatively new to the lexicon of international economists, examples of contagion have existed for 200 years (if not longer). Kindleberger (1989) and Bordo and Murshid (2001) document historic examples of financial panics in one country spreading globally. For example, in 1825 a banking crisis started in Britain and quickly spread to continental Europe and then to Latin America. In 1857 the direction of transmission reversed, when a banking panic in the United States spread to the United Kingdom and continental Europe, and then affected regions as far away as South America, South Africa and the Far East. Crises which start in one country and spread internationally, especially through banking and other financial channels, are not a new phenomenon.

Ironically given this long history of crises being transmitted globally, much of the discussion about contagion in the mid-2000's argued that contagion risks had permanently declined.[13] This discussion was prompted by the fact that recent crises had much weaker international repercussions. For example, although the 1997 and 1998 crises in Thailand and Russia both spread internationally, the 2001 crises in Argentina and Turkey had minimal spillover effects. One reason cited for reduced contagion was that investors had improved their risk analysis and country assessment tools. Another reason was that emerging markets had improved their macroeconomic policies in ways that would reduce their vulnerability to external events (such as greater exchange rate flexibility). Didier et al. (2008) discuss

[13] For example, JP Morgan (2004) writes: "there has been a structural decline of contagion across emerging market credits as evidenced by the lack of volatility following Argentina's 2001 default."

these arguments and show that when contagion is measured as bilateral correlations in bond spreads, there was less contagion in emerging markets in 2000-2007 relative to 1994-1999.

The last few years, however, have unfortunately shown that these forecasts of diminished contagion were optimistic. A crisis that began in the U.S. subprime market in 2007 had global ramifications. Events in the euro area have been a key driver of global markets throughout 2010-2012. The remainder of this section tests whether interdependence and contagion across global markets have increased over time and whether these relationships have evolved differently in the euro area. Section A uses a framework popular in the academic and investor literature—examining patterns in cross-market correlations—to test for changes in interdependence between countries in all states of the world. Section B then builds on the recently-popular approach of focusing on the coincidence of extreme returns to measure contagion from extreme negative events. Although a number of papers in the 2000s examined the evolution of contagion over time, many reached conflicting results and did not address the econometric issues discussed in Section II.[14] This is the first analysis (to my knowledge) that: (1) uses extreme value analysis to study the evolution of contagion over time; and (2) examines whether interdependence and contagion within the euro area has evolved differently than in other countries.

A. Correlation Analysis

This section analyzes the bilateral correlations in equity returns from 1980 through June 2012 in a sample of 48 countries around the world. Equity returns are a useful basis for this analysis as they should incorporate all available information on the expected future profitability of companies in a country—and therefore capture expected changes in real indicators. Equity returns are also available at a high frequency; this ability to better identify the effect of various shocks is critically important during crises when events have rapid effects. Finally, although other high frequency measures are useful (such as CDS or bond spreads), many of these are not available for as long a time series or for as broad a set of countries as equity returns.

To calculate the comovement in stock returns across the 48 countries in the sample (listed in Appendix A), I begin by calculating the moving 52-week correlations between each pair of countries for each week possible.[15] This generates a large matrix of bilateral correlations—of up to 1,128 country-pairs

[14] Noteworthy papers analyzing whether contagion has changed over time include: Bekaert and Harvey (1995), Karolyi (2003), Bordo and Murshid (2001), Goetzmann et al. (2005), Quinn and Voth (2008), and Bekaert et al. (2011). There is some disagreement across papers on whether contagion has increased over time.

[15] Weekly stock returns are calculated based on the Friday closing price for each index as retrieved from Global Financial Data, Inc., accessed 06/12. The broadest index available is used for each country. Each country must have return data for the previous 52 weeks to calculate a correlation. Country groups are based on their classification by the International Monetary Fund as of April 2012. Countries remain in their group for the full period.

by 1,638 weeks. I calculate this matrix using stock returns in local currency and then in U.S. dollars.[16] Then I calculate the average 52-week correlation each week for: (1) the full sample of countries; (2) only current members of the euro area (and only their correlations with other euro area countries); and (3) other advanced economies that are not currently in the euro area (and only their correlations with other members of the group).

Figure 2 graphs correlations for these three groups over time and shows several noteworthy trends. First, correlations within all three groups generally increase over time, especially since the mid-1990's, despite substantial fluctuations around this upward trend. Second, correlations between current euro area countries have increased by more than for other countries, including other advanced economies. Finally, correlations between current euro area countries have been substantially higher than for other countries since the early 1990's. Columns 1-3 of Table 2 report correlations for each group of countries in 5-year intervals over the same period and confirm these trends. Average correlations have increased steadily over each five-year window for each group of countries since 1985. These correlations have also increased more in the euro area than in other advanced economies. Even though correlations within the euro area were lower than in other groups at the start of the sample, they increased quickly to be higher over most of the period, including today.

This increase in correlations over time (and within the euro area) may result purely from increased volatility (over time and within the euro area) and not necessarily any change in cross-country linkages. As shown in Forbes and Rigobon (2001, 2002), higher volatility in one country's stock market will automatically increase the unconditional correlation in returns between the two countries for purely statistical reasons. If volatility in one country increases, even if the transmission mechanism between the two countries is constant, a larger share of the return in the 2nd country will be driven by the larger, idiosyncratic shocks in the first country. Although this would still qualify as contagion using the broad definition of contagion in this paper (albeit not in many academic papers), it is still useful to understand if the increased correlations in Figure 2 and Table 2 are simply an artifact of increased market volatility.

To analyze the impact of changes in volatility over time, I calculate the 52-week, moving-average standard deviation in stock returns for the same sample of 48 countries from 1980 through June-2012. Figure 3 graphs average volatilities for the same three groups of countries. The graph shows that volatility increases during key crisis periods as expected—such as during the 1987 U.S. stock market crash, 1998 LTCM collapse, and peak of the GFC. The graph also shows, however, that there is no steady upward trend in volatility over time as for the cross-market correlations in Figure 2. There is also no evidence of a

[16] In the analysis below, I focus on local currency returns in order to exclude any increase in correlations resulting purely from similar exchange rate movements relative to the dollar. Cross-market correlations based on U.S. dollar returns tend to be slightly higher than those based on local currency returns due to this exchange rate effect. All of the key trends reported below, however, are unchanged when calculations are based on U.S. dollar returns.

greater increase in volatility in the euro area relative to other countries (except in the last few months) or of higher levels of volatility within the euro area throughout the sample. These trends are confirmed in columns 4-6 of Table 2. Therefore, the increase in cross-market correlations for the full sample (and the euro area) since 1980 does not simply result from greater market volatility over time (or in the euro area).

An alternative explanation for this increase in cross-market correlations could be a greater role of global shocks in determining equity returns. This could result from global shocks that are larger in magnitude (such as greater swings in commodity prices) or from countries becoming more vulnerable to these global shocks. Either of these effects could cause cross-market correlations to increase, even if there is no change in the direct linkages between economies. To test if global shocks could explain the correlation patterns in Figure 2 and Table 2, I recalculate the bilateral correlations between each pair of markets, except now control for global shocks. I use several controls for global shocks: the change in commodity prices, the change in U.S. interest rates, the TED spread, and the VXO.[17] The resulting graphs of average, cross-market correlations are virtually identical to Figure 2 (and therefore not shown). Columns 7-9 of Table 2 report the resulting correlations over 5-year windows with controls for global shocks. Controlling for these global shocks slightly reduces average cross-market correlations (as expected), but does not affect the main trends discussed above.

To summarize, Figures 2 and 3 and Table 2 show that cross-market correlations have increased over time for the full sample of countries, and by even more within the euro area, so that correlations within the euro area are now higher than in other groups. These increases in correlations do not result from changes in volatility or from global shocks. Instead, countries' markets appear to have become more closely linked and more interdependent over time, especially within the euro area. As discussed in Section II.B, however, these correlations capture comovements between markets during boom years as well as after negative events and crises. Correlations calculated over long windows may also miss important links between markets that only exist during short windows after a shock. Therefore, although the results in this section document trends in interdependence over time and within the euro area, this does not necessarily capture contagion when defined as the transmission of extreme negative events.

B. Extreme Value Analysis

To better capture contagion, this section uses a form of extreme-value analysis to examine the incidence and cross-country patterns in extreme negative returns over time. More specifically, I identify

[17] Some measures of global shocks may capture contagion resulting from the transmission of a negative event in one country to global variables. Data measuring the global shocks are from Global Financial Data, Inc., accessed 06/12. Commodity prices are measured as the change in the *Economist* All-Commodity Dollar Index. U.S. interest rates are measured as the change in the 10-year constant-maturity government bond. Following the stock market data, all weekly prices are measured as the Friday market close. I do not include the VXO in the reported results as it is only available since 1986 and shortens the time series. They main results, however, are unchanged.

the weeks from 1980 through end-June 2012 when each country has an extreme-negative return, defined as a return in the bottom 5% of that country's return distribution. If countries' extreme negative returns result purely from idiosyncratic shocks and are not related to events in other countries or global shocks, than about 5 percent of the sample should experience extreme negative returns in each week. If extreme negative returns are more likely when other countries have negative returns (due to either contagion or global shocks), then the percent of countries with extreme returns should vary across time.

The top panel of Figure 4 graphs the percent of countries in the full sample with an extreme negative return in each week. There is clearly not an even distribution with a steady 5% of the sample experiencing extreme negative returns each week. Instead, there is substantial volatility in the coincidence of extreme returns and several spikes when a large percentage of the sample has extreme negative returns—such as 86% of the sample in the week ending on 10/24/87 (after "Black Monday") and 90% for the week ending on 10/11/08 (during the GFC). There also appears to be an increase in extreme negative values over time—with more frequent spikes later in the sample. These patterns are confirmed in column 1 of Table 3, which reports the average percent of the sample with an extreme value each week over five-year windows. The percent of the sample experiencing extreme negative returns has steadily increased over time (at least until 2010), nearly doubling from only 3.3% of the sample from 1981-84 to 6.5% from 2005-2009. Countries have become more likely to experience extreme negative returns simultaneously.

Next, to test if countries in the euro area were more or less likely to experience extreme returns simultaneously and whether this has changed over time, the middle and bottom panels of Figure 4 graph the percent of countries in the euro area and in other advanced economies, respectively, that experienced extreme negative returns each week. These graphs are similar to that for the full sample in the top panel. One noteworthy difference, however, is that the graph for the euro area has taller spikes, showing that a larger share of this group has extreme negative returns at the same time. There are six weeks when 100% of euro area countries had an extreme negative return simultaneously (compared to only one week for the other advanced economies). Table 3 confirms these observations. Although countries in the euro area were less likely to experience extreme negative returns simultaneously in the 1980s and 1990s, since then they have had a greater increase in the joint coincidence of extreme returns. As a result, countries in the euro area are now more likely than other advanced economies to experience extreme negative returns simultaneously.

The coincidence of extreme negative returns, however, is only a rough proxy for contagion across countries. As mentioned above, a number of countries could experience large negative returns simultaneously due to a global shock. To disentangle the effect of global shocks from linkages between markets, I next estimate a series of regressions. More specifically, I estimate the conditional probability that a country has an extreme negative return in any week as a function of the percent of the sample that

also has an extreme negative return and global shocks. I include different combinations of global shocks: the change in a commodity price index, the change in U.S. long-term interest rates, and the TED spread (with all variables defined in Section III.A.). The formal specification is:

$$Prob(ENR_{it} = 1) = F\left(\alpha + \beta * Global_t + \gamma * ENR_t^{All}\right) \ , \qquad (1)$$

where ENR_{it} is a dummy equal to one if country *i* is experiencing an extreme negative return in week *t*, with an extreme negative return defined above. $Global_t$ measures global shocks during week *t*. ENR_t^{All} is the percent of the sample that has an extreme negative return during week *t*. The appropriate methodology to estimate equation (1) is determined by the distribution of the cumulative distribution function, $F(\cdot)$. Because extreme negative returns occur irregularly (95 percent of the sample is zeros), $F(\cdot)$ is asymmetric. Therefore I estimate the equation using the complementary logarithmic (or cloglog) framework, which assumes that $F(\cdot)$ is the cumulative distribution function (cdf) of the extreme value distribution.[18] I also cluster the standard errors by country.

Table 4 reports regression results without any controls for global shocks and then with different combinations of controls.[19] It also reports results for the full sample of countries, for countries currently in the euro area and for other advanced economies. For each specification and group of countries, the estimates show that the percent of the sample with extreme negative returns is significantly and positively correlated with a country's probability of having an extreme negative return in each week.[20] These results are stable even after controlling for global shocks, suggesting that much of this joint coincidence of extreme negative returns results from linkages between these economies and contagion.

To summarize, Section III provides evidence of increased interdependence and contagion over time. The evidence for interdependence is based on cross-market correlations and for contagion is based on extreme value analysis. The increases in cross-market correlations and the coincidence of extreme returns do not result from global shocks or changes in volatility. Therefore, interdependence during all states of the world, as well as contagion after negative events, appears to be greater today than in the past and greater for countries in the euro area than in other advanced economies (and the world as a whole). These results, however, do not answer the fundamental question: what causes these trends in interdependence and contagion across time and countries?

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[18] This estimation strategy assumes that $F(z) = 1 - exp[-exp(z)]$. An alternative is to use a logit or probit model but these assume that the distribution of $F(\cdot)$ is logistic or normal, respectively, and therefore symmetric around zero.

[19] I have also included a control for changes in global risk as measured by the VXO. This has no effect on the key results but shrinks the sample size significantly because it is only available starting in 1986.

[20] Since this is a non-linear probability function, interpreting the magnitude of the coefficients is not straightforward and requires calculating exponentiated coefficients (which are hazard ratios for the cloglog estimator). These ratios are the marginal effects in multiplicative form after controlling for differences in the baseline odds of experiencing an extreme negative return for each country. The exponentiated coefficients are similar for the different groups.

IV. The Channels of Contagion

A. Theory and Trends

Understanding the channels through which shocks are transmitted across countries is the key issue for policymakers hoping to mitigate any negative effects. A large literature models and tests various channels of contagion.[21] There are several ways in which these channels can be categorized—such as by the theoretical models that explain why actors make certain decisions (i.e., imperfect information, information cascades, compensation structures, etc.) or by the actors that cause contagion (i.e., banks, investors, etc.). For this paper, I divide this extensive literature into four main channels of contagion: trade, banks, portfolio investors, and wake-up calls. These categories are broad and there are important links between them. For example, portfolio investors may be a key source of funding for banks; a "wake-up call" can cause portfolio investors to liquidate positions; banks may withdraw credit and therefore affect trade. These four categories are useful, however, to directly link the discussion of contagion channels to the empirical analysis and evaluation of policy responses. This section briefly summarizes the theoretical and empirical evidence on each channel and examines trends showing how these channels have evolved over time for the full sample and the euro area. The second part of the section then uses this framework to estimate the role of these four channels in causing contagion around the world since 1980.

1. Trade: Trade can cause contagion through two effects: bilateral trade and competition in third markets.[22] A crisis in one country can reduce income and the corresponding demand for imports, thereby affecting exports from other countries through bilateral trade. In addition, if a country devalues its currency, this can improve the country's relative export competitiveness in third markets. The greater use of global supply chains could magnify these effects. Most empirical papers find that trade channels are significant and play an important role in transmitting crises. They also find that trade does not explain all of the contagion observed during recent crises and other transmission channels are also important.

The top two graphs in Figure 5 show the median and mean trade exposures (measured as imports plus exports relative to GDP) for the different groups of countries in the sample from 1980 through 2011.[23] The graphs show the well-known trend that trade exposure has increased substantially for countries around the world since 1990. It also shows that trade has increased relatively more for euro area

[21] For overviews of various channels of contagion and different ways to categorize them, see Claessens et al. (2001), Karolyi (2003), Forbes (2004), Allen et al. (2009), and Didier et al. (2010).
[22] For a theoretical model, see Gerlach and Smets (1995). For empirical evidence, see: Glick and Rose (1999), Forbes (2002, 2004), and Claessens et al. (2011). For evidence on the role of global supply chains, see Burstein et al. (2008).
[23] This section focuses on median values for each group of countries in order to reduce the effect of several extreme outliers. Mean values (when reported) are calculated after dropping the largest and smallest two values in each year.

economies, so that these economies are now more exposed to trade than other advanced economies (especially when compared using average exposures). This is not surprising; one of the key goals of the European Union was to reduce barriers to trade between members. These trends in trade exposure could be a factor causing increased contagion over time, especially in the euro area.

2. Banks and Lending Institutions: One important financial channel for contagion is through banks and other financial intermediaries.[24] A shock to one country can cause banks to reduce the supply of credit in other countries, reducing liquidity and raising the cost of credit. This could occur in a number of different ways. For example, the initial shock could occur because individuals withdraw bank deposits, because a weak economy increases non-performing loans and reduces asset values, and/or because a bank's holdings of sovereign debt lose value. Any of these effects could force the bank to reduce lending in other countries in order to restore capital adequacy, meet other regulations, or adjust exposures to follow VaR models. The reduction in credit in other countries could occur through: (1) a contraction in direct, cross-border lending by the foreign banks; (2) a contraction in local lending by the foreign banks' affiliates; and/or (3) a contraction in lending by domestic banks resulting from the funding shock to their balance sheets from declines in interbank, cross-border lending.

Moreover, the role of banks in causing contagion can be aggravated by characteristics of banks: their close relationship to the solvency of their sovereign, their high degree of leverage, and their extensive interconnections. As recently seen in Ireland and shown in Acharya et al. (2011), a shock to a country's banking system can not only cause contagion directly through bank lending, but also indirectly through increased risks to country solvency. As shown in Greenwood et al. (2011), Van Wincoop (2011), and Shin (2012), any negative shocks to banks are magnified in the presence of leverage, causing an even greater reduction in loans and unwinding of positions. This has been called "liquidation spirals", "rapid deleveraging", or a "diabolic loop". As shown in Allen et al. (2012), common asset holdings and similar funding maturities across banks can aggravate contagion and systemic risk.

The middle two graphs in Figure 5 show key characteristics of banking systems from 1980 through 2011: gross international bank exposure (measured as international bank assets plus liabilities relative to GDP) and bank leverage (measured as the ratio of private credit by deposit money banks and other financial institutions to bank deposits, including demand, time and saving deposits in nonbanks). There is a striking increase in international bank exposure in the euro area and advanced economies since the mid/late 1990s. There is also a steady increase in bank leverage in the euro area over the same period.

[24] An extensive literature models or tests different mechanisms of contagion through banks. Allen and Gale (2000) provides the first model and Peek and Rosengreen (1997) the first empirical evidence. Other influential papers include: Van Rijckeghem and Weder (2001), Cetorelli and Goldberg (2010, 2012), and Shin (2012). An excellent discussion of mechanisms linking banks, crises and contagion is Allen et al. (2009).

These high levels of international bank exposure and leverage have been slower to adjust after the GFC in the euro area relative to in other advanced economies. These trends of increased international banking exposure and banking leverage in euro area countries could be another factor causing increased contagion over time, especially in the euro area.

3. Portfolio Investors: Another financial channel for contagion is portfolio investors.[25] An extensive literature explains various mechanisms by which investors can transmit shocks across countries.[26] In the simplest versions, an idiosyncratic shock to one country reduces the value of investors' portfolios, forcing them to sell assets in other countries to meet margin calls or cash requirements or to rebalance portfolios according to VaR models. More complicated models show how increased risk aversion after a negative shock or informational asymmetries and other forms of imperfect information can cause investors to sell assets across countries and "overreact". For example, investors may find it less costly to "herd" and follow other investors, especially if they are unable to differentiate between idiosyncratic shocks and informed trading by others, or if they are evaluated relative to an index. These models can be further complicated in situations of self-fulfilling expectations and multiple equilibria. For example, Masson (1999) shows how investors could suddenly withdraw from a country if they fear that others may sell first and they will be left with no claim on a limited pool of foreign exchange reserves. Allen and Carletti (2006) show how the creation of new financial instruments—such as to transfer credit risk—can aggravate contagion through portfolio investors. Several papers use detailed fund-level information to document contagion through portfolio investors and find that these effects can be substantial.[27]

Moreover, recent research highlights that it is not just the net value of a country's international portfolio flows and investment positions which determines contagion, but instead it is the gross flows and positions.[28] Even if a country's current account is relatively balanced, if this masks large capital inflows balanced by large outflows, the country is still vulnerable to any disruption in capital inflows, counterparty risk, or breakdown in international payments. Similarly, even if a country has a moderate net international investment position, large underlying gross investment assets and liabilities make the country vulnerable to shocks which affect the relative values or liquidity of its assets and liabilities.

[25] Portfolio investors include a range of investors, such as hedge funds, mutual funds, pension funds, individuals, and some sovereign wealth funds. This includes their investments in equities and debt (government and corporate). It does not include investments classified as foreign direct investment (FDI)—when the investor owns 10 percent or more of the entity. Including FDI in the definition of portfolio investment does not change the paper's main results.
[26] For excellent surveys of this literature, see Gelos (2011) and de Bandt and Hartmann (2000). Important papers in this literature include: King and Wadhwani (1990), Kodres and Pritsker (2002), and Kyle and Xiong (2001).
[27] For evidence, see Fratzscher (2009) and Raddatz and Schmukler (2012).
[28] See Lane and Milesi-Ferretti (2007), Gourinchas and Rey (2007), Forbes and Warnock (2012), and Gourinchas (2012). This point also applies to contagion through banks, as highlighted in Shin (2012).

The bottom two graphs in Figure 5 graph gross portfolio investment positions (equity and debt) and gross portfolio inflows (both relative to GDP) from 1980 through 2011. The graphs show an increase in international investment positions and portfolio inflows in the 2000's for the group of other advanced economies, and a much sharper increase for countries in the euro area starting in the mid-1990's (although portfolio inflows fell sharply during the GFC for all groups). The much greater increase in international portfolio investment exposure in the euro area is not surprising as one of the key goals of the euro was to increase financial integration across members. These trends of increased exposure to international portfolio investment and inflows, especially for the euro area, could be another factor causing increased contagion over time, especially in the euro area.

4. Wake-up Calls/Fundamentals Reassessment: A final (and closely related) mechanism by which contagion can occur is "wake-up calls"— when additional information or a reappraisal of one country's fundamentals leads to a reassessment of the risks in other countries.[29] Wake-up calls could happen because investors were not focused on or aware of certain vulnerabilities, or because fundamentals only become problematic during a crisis—thereby generating multiple equilibria. Weaker fundamentals—or even just increased concern about a country's fundamentals—could also strengthen various channels of contagion. For example, if a shock to banks in one country reduces funding for banks in other countries, this would be more likely to generate a wake-up call and bank runs for a country with a weaker financial system. The risk of these types of wake-up calls is also greater when there is more uncertainty –especially about economic fundamentals or financial institutions in the country.

These wake-up calls can involve many forms of reassessment—including not only the macroeconomic, financial or political characteristics of the country—but also the functioning of financial markets or the policies of international financial institutions. For example, if a shock to one country increases uncertainty about the ability of major financial institutions to trade assets or provide liquidity, financial markets could freeze up.[30] Or one country's terms for its debt restructuring or financial support package could provide information on how other countries would be treated in a similar situation. Chen (1999) shows that generous financial support for one country could even be interpreted as evidence that other countries might receive less instead of more support if a package depletes a limited supply of funds. Any such reassessment of the functioning of financial markets or policies of international institutions could cause investors to sell assets across countries, thereby causing contagion.

[29] Goldstein (1998) coined this term to capture the sudden awareness of risks in Asian financial systems during the 1997-98 crisis. For evidence of the role of wake-up calls and macroeconomic variables in transmitting crises, see Forbes (2004), Fratzscher (2009, 2012), Didier et al. (2010), and Bekaert et al. (2011).

[30] See de Bandt and Hartmann (2000) for a more detailed discussion of this risk and review of literature.

B. Regression Results

The last section discusses four important channels for contagion: trade, banks, portfolio investors and wake-up calls. Recent increases in trade, international bank exposure, and international investment positions for many countries in the world would therefore be expected to increase linkages between countries in all states of the world as well as after extreme negative events. This is especially true for the euro area where integration has proceeded even more quickly along most of these measures than in other advanced economies. But how important are these channels in explaining recent episodes of contagion? Since many of these trends of increased integration occurred simultaneously, are certain types of integration more important than others? This section empirically tests if these four channels for contagion can explain the coincidence in extreme negative stock returns around the world since 1980.

For this analysis, I estimate the conditional probability that a country has an extreme negative return in each week as a function of global shocks and the four channels of contagion. Each channel is interacted with the percent of the sample that has an extreme negative return that week. The equation is:

$$Prob(ENR_{it} = 1) = F(\beta * Global_t + \gamma_1 * ENR_t^{All} Trade_{it} + \gamma_2 * ENR_t^{All} Banks_{it} + \gamma_3 * ENR_t^{All} Portfolio_{it} + \gamma_4 * ENR_t^{All} WakeUp_{it}) , \quad (2)$$

where ENR_{it} is a dummy equal to one if country *i* is experiencing an extreme negative return in week *t*. Extreme negative returns are defined as weeks when the country's return is in the lowest 5% of its distribution for the sample period (as discussed in Section III.B). $Global_t$ measures global shocks during week *t*, such as the change in commodity prices, change in U.S. interest rates, or a measure of risk and/or volatility—such as the TED spread or VXO. ENR_t^{All} is the percent of the entire sample that has an extreme negative return during week *t*. $Trade_{it}$, $Banks_{it}$, $Portfolio_{it}$, and $WakeUp_{it}$ are measures of the four channels of contagion for country *i* at time *t*. I estimate equation (2) using the complementary logarithmic (or cloglog) framework and cluster standard errors by country (as discussed in Section III.B.)

There are a number of different ways to measure these channels of contagion, so I begin with a parsimonious specification that follows the discussion in the previous section. More specifically, the trade channel is measured by the country's total exposure to trade. The banking channel is measured with two variables: gross international banking exposure and banking leverage. The portfolio investor channel is also measured by two variables: gross international portfolio investment exposure and gross portfolio inflows. All variables except leverage are calculated as a share of the country's GDP and are defined in more detail in Section IV.A. The wake-up call channel is measured by two dummy variables: "medium credit rating" (which is equal to one if the country's average credit rating is below investment grade but

above "Substantial Risks") and "low credit rating" (which is equal to one if the country's average credit rating is "Substantial Risks" or below).[31]

Table 5 reports estimates of equation 2 with and without controls for global shocks (which have no effect on the key results). Columns 1-3 report results for the full sample, and column 4 includes only the euro area. The estimates show that several channels of contagion are significant and follow theoretical predictions—while others are insignificant. The estimates for the euro area generally mirror those for the full sample, suggesting that contagion in the euro area does not occur through significantly different channels than in other countries.[32] The positive and significant coefficients on *Trade* and *Leverage* indicate that countries with greater trade exposure and more leveraged banks are more likely to have extreme negative returns when other countries are also experiencing extreme negative returns. The positive coefficients on the credit rating variables indicate that countries with weaker credit ratings are more vulnerable than the most highly rated countries to extreme negative shocks elsewhere in the world. The insignificant coefficients on a country's international exposures through banks and portfolio investment suggest that total exposure through these channels may not affect vulnerability to extreme returns occurring elsewhere—at least after controlling for leverage in the banking system.

Since international financial exposure through banks and portfolio investors is believed to be an important determinant of country vulnerability to contagion, Table 6 further explores these channels. Columns 1 and 2 break bank exposure into gross international bank assets and liabilities. It also controls for gross international bank inflows and outflows in column 1. Column 3 performs the same breakdown for international portfolio investment. The coefficient estimates from these disaggregated international positions and flows are reported near the bottom of the table. The coefficients on international banking positions tend to fluctuate in significance—as shown by the changes in columns 1 and 2 (as well as in a number of unreported sensitivity tests). The coefficients on international portfolio investment positions, however, are more robust (including in a number of unreported sensitivity tests). Countries with greater portfolio investment liabilities are more vulnerable to contagion, but this vulnerability can be reduced if the country holds greater international portfolio assets. These results highlight the importance of separating out gross assets and liabilities and not just looking at net or total positions.

International portfolio investment can be further disaggregated into the proportion of this investment in the form of debt versus equity. Columns 4 and 5 of Table 6 control for the share of total portfolio investment or flows in the form of debt. The results suggest that countries with a greater share of

[31] Credit ratings are constructed as the average rating on the country's sovereign foreign-currency bonds as reported by S&P, Moodys and Fitch. All available ratings are incorporated in the average at each week. The cutoff for investment grade is BBB- for S&P and Fitch and Baa3 for Moodys. "Substantial Risk" is below B- for S&P and Fitch and below B3 for Moodys.

[32] The only exceptions are coefficients on credit ratings for the euro area; these estimates fluctuate in sign and significance across specifications due to the limited observations of euro area countries with low credit ratings.

international portfolio investment or flows in debt tend to be more vulnerable to contagion. It is also worth noting that in column 4, the coefficients on gross investment liabilities and assets become insignificant when a control for the debt share of portfolio investment is included. Although not a definitive test, this may indicate that the form of any portfolio investment may be even more important than the volume of investment in determining a country's risk of contagion.

C. Implications of Regression Results

This series of regression results has a number of important implications. First, there is evidence that contagion through all four channels—trade, banking, portfolio investors and macroeconomic fundamentals/wake-up calls can be important in explaining a country's vulnerability to extreme returns in other countries. (The evidence on wake-up calls, however, is weakest given the challenges in formulating a clear test for this channel.) Therefore, it is not surprising that as international integration through trade, banking, and portfolio investment has increased over time, contagion has also increased. Second, there is no evidence that contagion in the euro area occurs through different channels than in the full sample. Third, leverage in the domestic banking system plays a critically important role. In each regression and with a variety of controls (including several tests not reported), leverage is a highly significant determinant of country vulnerability to extreme events elsewhere in the world.

Finally, these results also indicate that the simple interpretation that "more integration = more contagion" is not accurate and there are important subtleties in how integration affects country vulnerability. Although greater international portfolio investment liabilities increase vulnerability, greater international portfolio investment assets reduce vulnerability. This supports analysis in Milesi-Ferretti and Tille (2011) and Forbes and Warnock (2012) that countries with large international asset positions can liquidate foreign assets after negative shocks and this "retrenchment" of funds can provide stability during crises. The results also suggest that greater reliance on debt (versus equity) tends to increase country vulnerability. The natural risk sharing properties of equity may reduce country vulnerability after extreme negative events. Therefore, it is not just the level of financial integration, but its structure that determines a country's vulnerability to contagion.

V. Implications and Contagion in the Euro Area

The high levels of interdependence in global stock markets generally do not concern policymakers—except during periods of contagion when an extreme negative shock in one country affects others. Many channels of contagion, however, result from healthy trends toward greater integration in the global economy. Can the risks from contagion be mitigated without reversing these trends? Will attempts to reduce contagion lead to even greater costs—such as generating additional

contagion through other channels? The longer version of this paper, written for the Federal Reserve Bank of Kansas City's annual symposium in Jackson Hole, Wyoming includes a detailed evaluation of various policy options for mitigating contagion.[33]

Policies discussed in this paper include measures that could be taken *a priori* to reduce contagion over the long term, focusing on the underlying structural trends that determine the channels for contagion, as well as situations when contagion risks are imminent and policies are aimed at providing immediate relief. Various long-term structural policies discussed include: reducing leverage in the banking system, diversifying trade across countries and industries, supporting portfolio investment abroad to balance portfolio liabilities, ensuring that portfolio flows are not distorted by an over-reliance on debt, improving macroeconomic fundamentals, and better advance communication of the policies of international financial institutions. Various shorter-term responses to immediate contagion risks that are discussed include: deposit insurance, policies that ensure liquidity and well functioning markets, policies to address key macroeconomic vulnerabilities, capital controls, and easing banking regulations. Any discussion of how to best address immediate contagion risks should also consider two additional considerations. Can the policy effectively stop a form of contagion that would not otherwise occur (such as a bank run) or simply delay an inevitable adjustment (such as through changes in relative prices affecting trade)? Does the policy effectively internalize an externality that might not otherwise be considered in one country's or investor's cost-benefit analysis?

A thorough discussion of these various policy options helps establish a clear hierarchy of policies that can be adopted to address contagion risks—both in the long- and short-term. Most of these policies can mitigate contagion risks without reducing real and financial integration across borders. This discussion also shows that some of the mechanisms aimed at mitigating contagion in the short term (such as reducing bank regulations or increasing fiscal liabilities for at-risk countries) can directly contradict recommendations to reduce vulnerability to contagion in the longer term. Any evaluation of policy responses to mitigate contagion should carefully consider these unintended consequences, as financial crises can have various phases so that contagion risks persist for an extended period of time.

A. A Closer Look at Contagion in the Euro Area

Although the primary goal of this paper is to analyze contagion around the world, the analysis also applies to the current challenges in the euro area. This section assimilates the key results from throughout the paper to show that contagion from current events in Europe should come as no surprise and follows the same channels documented for the rest of the world. An evaluation of contagion in the

[33] This discussion of policy responses is not included in this working paper in order to comply with NBER guidelines on not supporting specific policies but is available at http://www.kansascityfed.org/publicat/sympos/2012/kf.pdf .

euro area, however, also involves several additional considerations resulting from the unique structure of the euro area.

Section III showed that interdependence and contagion have increased steadily since 1980 for the full sample of countries, and especially for countries within the euro area. This trend is particularly striking in measures of interdependence. The euro area has experienced a substantial increase in cross-market correlations since 1980, so that these markets now show very high degrees of comovement in all states of the world. This is not surprising given the trends documented in Figure 5. Many factors linking countries—such integration through trade, banks and portfolio investment—have increased more rapidly within the euro area than in other advanced economies. This rapid increase in integration within the euro area is also not surprising as it naturally follows from the requirements to join the common European market and adopt the common currency—such as requirements for removing barriers to the cross-border movement of goods and capital, regulatory harmonization, and the freedom of establishment.

Not only should high levels of interdependence and contagion within the euro area be expected, but contagion from the euro area to other countries should also come as no surprise. If the euro area is treated as a single country, it would have the second largest economy in the world, the largest share of world trade, and the largest international banking exposures. It is highly integrated with countries around the world through trade, banking flows, and portfolio investment—three of the primary channels through which shocks are transmitted internationally. A number of studies have analyzed the expected spillovers through these channels from moderate changes to growth in the euro area (i.e., IMF, 2011). These spillover effects resulting from interdependence in normal times can be challenging enough for other countries, even without a crisis or extreme negative event.

It is contagion from these extreme negative events, however, which presents the greatest challenges. Several papers have already attempted to measure contagion from the recent crisis in the euro area using several different definitions of contagion and measurement strategies.[34] The evidence suggests that contagion within the euro area is occurring through the standard channels discussed throughout this paper. For example, several papers highlight the role of euro area banks in transmitting the crisis across borders, others focus on portfolio investors, and others highlight the "wake-up call" effects from new information in one country on others. Column 4 of Table 5 reports results that support this conclusion; the regressions testing the channels of contagion find similar results for the euro area as the full sample. There is no evidence that contagion within the euro area is occurring through any new mechanisms, or that the level of contagion within the euro area is greater than would be expected given the high degree of trade and financial integration in the region.

[34] See Constancio (2012), De Santis (2012), and Caceres et al. (2010) for evidence of contagion from the euro crisis. Aizenman et al. (2012) finds that there has been little contagion from Europe to other countries.

Policy proposals to mitigate contagion in the euro area should also incorporate the same considerations as for contagion anywhere in the world—both in terms of long-term structural reforms to reduce contagion risks *a priori* as well as short-term policies to mitigate imminent risks. Just as for contagion in other regions, it is critically important to assess whether any policy response will prevent a bad equilibrium and thereby avoid a form of contagion that would not otherwise occur (such as bank runs or markets that stop functioning) versus a policy response that would simply delay an inevitable adjustment resulting from interdependence between countries. The key considerations for evaluating different policies to mitigate contagion are thoroughly discussed in the longer version of this paper and apply to the euro area as well as to the rest of the world.[35]

There are, however, several additional considerations unique to the euro area that are important when evaluating responses to contagion in this region. First, each country lacks a national currency and independent central bank. Currency depreciations and monetary easing can provide key mechanisms by which countries adjust to negative shocks. Since individual euro area countries do not have these adjustment mechanisms, they may need to undergo more prolonged and painful internal adjustments to shocks that originate elsewhere. This makes it more important for euro area countries concerned about contagion to support flexible economies that can more easily adjust to external shocks. In extreme circumstances, the more limited tools for adjustment in the euro area may justify additional policy support through other mechanisms to avoid slipping into a negative equilibrium. On a more positive note, the lack of independent currencies within the euro area will prevent sudden currency devaluations that cause contagion through trade. Even if relative prices adjust over time through internal devaluations, trading competitors should have more time to adjust to this slow-moving contagion.

A second consideration for the euro area is the relatively large international exposures of the banks backed by sovereign governments which cannot provide the traditional "lender of last resort" function available in most countries. This aggravates the risk of contagion through banks—especially through bank runs. Since contagion through bank runs is a form of contagion that can be prevented through prompt policy action, euro area officials could build a strong argument to take action to prevent this avoidable form of contagion. In any country, it is critically important to restore confidence that money deposited in banks will be accessible in the future. The most straightforward alternative for restoring this confidence is well-designed deposit insurance combined with appropriate banking regulations and supervision. This is likely to require support from an entity other than the sovereign, one with large enough financial resources that the financial backing is credible and sufficient to restore confidence.

[35] See http://www.kansascityfed.org/publicat/sympos/2012/kf.pdf

A third issue that merits special consideration for the euro area is the heightened risk that policies and information in one country generate contagion through wake-up calls/reassessments about others. Although there are important differences between euro area countries, they also share a number of macroeconomic and institutional similarities—including shared governance over a number of policies. Any new information about the actions and treatment of one country will provide information about prospects for other euro area countries. These externalities should be incorporated when evaluating various policy responses to contagion. For example, the treatment of different bondholders in Ireland's bank restructuring was closely watched to provide information about how bondholders would be treated in other countries. These types of externalities should be considered when evaluating any policy responses to mitigate contagion, but they are especially important in the euro area where the shared governance and institutional similarities aggravate the risks of contagion through wake-up calls.

A final (and closely related) consideration is the current structure for sharing certain liabilities through institutions such as the ECB, ESM and EFSF. In other regions, financial support to help mitigate contagion generally comes from sources (such as the IMF) that have sufficiently large resources and widely shared liabilities that any increase in financial support does not increase solvency risks for individual nations. In the case of the euro area, however, much of the financial support is being provided (implicitly or explicitly) from other euro area nations that are vulnerable to contagion through "wake-up calls" about their own fiscal situation. For example, if Spain or Italy requires a large increase in financial support to prevent contagion and this support is provided by the ESM or EFSF, this could substantially increase the fiscal liabilities of countries such as France. This could generate contagion to France through a negative reassessment of its fiscal solvency. There could be further feedback effects on the credit ratings and borrowing costs of the institutions intended to provide financial support. As a result, any financial support provided by euro area nations and their joint institutions must be carefully evaluated based not only on the benefit to the country receiving the support and any corresponding reduction in contagion, but also on the additional externalities arising from the fiscal liabilities and corresponding risks of contagion through wake-up calls to other countries in the future.

V. Conclusions

Global integration has increased dramatically since 1980 when measured by countries' international exposures through trade, banking, and portfolio investment. Not surprisingly, this increased integration has caused countries' financial markets to move together more closely during good times and bad. This increased interdependence causes extreme negative events in one country to quickly affect others. These extreme negative events, and their joint coincidence across countries, have increased over time, creating substantial challenges for countries affected by contagion.

But exactly how does this contagion occur? This paper analyzes extreme negative stock returns to show that contagion occurs through several channels—including trade, banks, portfolio investors, and "wake-up calls"/ fundamentals reassessments. Countries with more leveraged banking systems, greater trade exposure, and weaker macroeconomic fundamentals are significantly more vulnerable to contagion. A country's total international exposure through portfolio investment does not increase country vulnerability, but countries with greater international portfolio liabilities are more vulnerable, while countries with greater international portfolio assets are less vulnerable to contagion.

These results highlight that a country's financial integration with the rest of the world does not automatically increase contagion risks. Instead, holding portfolio assets in other countries can reduce vulnerability, most likely by providing resources that can be "retrenched" when the domestic economy is under pressure. International bank exposure is less important than domestic bank leverage in determining country vulnerability. The type of international investment exposure is also important. A larger share of portfolio inflows or investment in the form of equity (versus debt) reduces the probability of contagion—undoubtedly as equity has more automatic risk sharing properties. Therefore, although increased financial integration over time has increased interdependence and contagion between countries, certain forms of financial integration can also help reduce contagion risks.

Since contagion can occur through so many channels—can anything be done to mitigate the risks? For a foresighted policymaker, the best approach to minimizing contagion risks is through fundamental structural reforms before a negative shock occurs and contagion is imminent. The empirical analysis suggests a number of priorities that would not involve reducing international integration through trade and financial channels. Policymakers also need to carefully evaluate if a proposal could effectively stop contagion—or have the unintentional effect of creating additional contagion through other channels.

Finally, this analysis has a number of direct implications for current challenges in the euro area. Integration through trade, banks, and portfolio investment has proceeded even more quickly in this region than in the rest of the world. This has yielded substantial benefits for Europe and naturally increased the interdependence between euro area economies in all states of the world. This has also increased vulnerabilities to contagion after negative events in the region. There is no evidence, however, that contagion in the euro area occurs through any different channels or than would be expected given the high degree of regional interdependence. This does not mean that the euro area is powerless to mitigate contagion without sacrificing the integration that was a key goal of the common market and euro. Instead, European policymakers need to consider several aspects of their unique institutional arrangements when evaluating how best to mitigate the risk of contagion in the future.

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Appendix A
Country Groups for Empirical Analysis

Euro Area	Other Advanced Economies	Rest of Sample
Austria	Australia	Argentina
Belgium	Canada	Brazil
Finland	Czech Republic	Chile
France	Denmark	China
Germany	Hong Kong	Colombia
Greece	Israel	Hungary
Ireland	Japan	India
Italy	Korea	Indonesia
Luxembourg	New Zealand	Malaysia
Netherlands	Norway	Mexico
Portugal	Singapore	Pakistan
Spain	Sweden	Peru
	Switzerland	Philippines
	Taiwan	Poland
	United Kingdom	Russia
	United States	Saudi Arabia
		South Africa
		Thailand
		Turkey
		Venezuela

Notes: Country groupings based on IMF classifications as of April 2012.
Several current members of the euro area are not included in this base sample due to data availability.

Table 1
Definitions of Contagion

Paper	Definition of Contagion
King and Wadhwani (1990)	a model in which correlations between markets increase after an idiosyncratic shock to one market because information is imperfectly revealed
Masson (1999)	the residual in a model of market comovement; the comovement that is not explained by global shocks, linkages through normal trade and economic relationships, and country-specific shocks
Forbes and Rigobon (2002)	"a significant increase in cross-market linkages after a shock to one country (or group of countries)"
Kodres and Pritsker (2002)	"a price movement in one market resulting from a shock in another market"
Karolyi (2003)	"irrational comovements" which are the residual in a model after controlling for "fundamentals-based co-movements" (from real and financial linkages) and "rational investor-based co-movements" (from rational investment decision making by financial agents)
Bae, Karolyi and Stulz (2003)	the fraction of "exceedance events" in a region that are not explained by the covariates (exchange rates, interest rates, market volatility) but are explained by "exceedance events" from another region; "exceedance events" are extreme returns shocks (above or below the 5^{th} or 95^{th} quantile of the marginal return distribution) in equity indices
Hartmann, Straetmans, and de Vries (2004)	a significant increase in the conditional probability of having a crash in one market, given one occurred in another
Boyer, Kumagai and Yuan (2006)	"excess correlation" between stock markets during periods of high volatility, with "excess" defined as a significant increase in cross-market correlations for investable stocks (relative to less accessible stocks)
Dungey, Fry, González-Hermosillo, and Martin (2010)	"the effects of contemporaneous movements in asset returns across countries having conditioned on a range of factors as represented by the common factors, regional and idiosyncratic factors"
Bekaert, Ehrmann, Fratzscher, and Mehl (2011)	"the co-movement in excess of that implied by the factor model, i.e. above and beyond what can be explained by fundamentals taking into account their natural evolution over time"
Forbes and Warnock (2012)	large changes in a country's gross capital inflows or outflows "resulting from circumstances in another country or group of countries (but not the entire world)"

Table 2
Stock Market Correlations and Volatility Over Time

	Correlations			Volatility			Correlations with controls for global shocks		
	Full Sample (1)	Euro Area (2)	Other Advanced (3)	Full Sample (4)	Euro Area (5)	Other Advanced (6)	Full Sample (7)	Euro Area (8)	Other Advanced (9)
1981-1984	0.155	0.119	0.231	0.024	0.024	0.024	0.153	0.127	0.218
1985-1989	0.158	0.210	0.195	0.032	0.025	0.027	0.155	0.206	0.184
1990-1994	0.229	0.449	0.252	0.034	0.024	0.027	0.220	0.444	0.238
1995-1999	0.293	0.497	0.294	0.033	0.025	0.026	0.288	0.491	0.283
2000-2004	0.333	0.582	0.400	0.032	0.030	0.028	0.312	0.546	0.378
2005-2009	0.491	0.759	0.554	0.032	0.028	0.027	0.472	0.730	0.527
2010-Jun 2012	0.567	0.802	0.659	0.028	0.032	0.025	0.481	0.728	0.556
Change from 1981/84 to:									
2010/12	***0.412***	***0.683***	***0.428***	***0.004***	***0.009***	***0.002***	***0.328***	***0.601***	***0.338***
2005/09	***0.336***	***0.640***	***0.323***	***0.008***	***0.004***	***0.004***	***0.319***	***0.603***	***0.309***

Notes: Columns 1-3 and 7-9 report average 52-week bilateral correlations in weekly stock market returns based on indices in local currency. Columns 4-6 report average 52-week standard deviations for the same returns. "Full Sample" is the full sample of 48 countries. "Euro Area" is all current members of the euro area in the sample. "Other Advanced" is advanced economies other than those in the euro area as specified by the IMF in April 2012. Countries in each group are listed in Appendix A. Columns 7 –9 include controls for three global shocks: changes in the *Economist* All-Commodity Dollar Index, changes in U.S. interest rates (on a 10-year constant maturity government bond) and the TED spread.

Table 3
Percent of Group with Extreme Negative Returns

	Full Sample (1)	Euro Area (2)	Other Advanced (3)
1981-1984	3.3%	2.6%	3.9%
1985-1989	4.3%	3.7%	4.1%
1990-1994	4.7%	3.0%	4.5%
1995-1999	5.2%	3.3%	4.3%
2000-2004	5.1%	6.7%	6.0%
2005-2009	6.5%	7.7%	6.8%
2010-Jun 2012	4.7%	8.3%	5.3%
Change from 1981/84 to:			
2010/12	***1.5%***	***5.7%***	***1.3%***
2005/09	***3.3%***	***5.1%***	***2.9%***
# of weeks with an extreme negative return for:			
100% of group	***0***	***6***	***1***
80% of group	***4***	***17***	***8***
50% of group	***22***	***44***	***38***

Notes: Top of table reports the percent of each group of countries that has an extreme negative return each week in the specified period. Extreme negative returns are local currency stock returns in the bottom 5% of the return distribution for each country over the full period. "Full Sample" is the full sample of 48 countries. "Euro Area" is all current members of the euro area in the sample. "Other Advanced" is advanced economies other than those in the euro area as specified by the IMF in April 2012. See Appendix A for members of each group.

Table 4
Extreme Value Analysis: Regression Results

	Full Sample			Euro Area			Other Advanced Economies		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
% with an extreme	6.092**	6.187**	6.206**	6.366**	6.407**	6.371**	6.317**	6.448**	6.446**
negative return	(0.222)	(0.230)	(0.229)	(0.297)	(0.325)	(0.332)	(0.362)	(0.380)	(0.393)
Commodity prices		0.017**	0.019**		0.017	0.021		0.029**	0.034**
		(0.006)	(0.006)		(0.016)	(0.017)		(0.011)	(0.012)
U.S. interest rates			0.137			-0.197			0.145
			(0.134)			(0.355)			(0.333)
TED spread			0.030			0.090			0.097
			(0.044)			(0.099)			(0.076)
Observations	***69,190***	***69,190***	***68,758***	***18,226***	***18,226***	***18,118***	***25,549***	***25,549***	***25,405***

Notes: Dependent variable is a dummy variable equal to one if a country has an extreme negative return in any week. Extreme negative returns are local currency stock returns in the bottom 5% of the return distribution for each country. Regressions estimated using the complementary logarithmic estimator with standard errors clustered by country. *"% with an extreme negative return*" is the percent of the group with an extreme negative return in the given week. *Commodity prices* is the change in the *Economist* All-Commodity Dollar Index. *U.S. interest rates* are changes in the interest rate on a 10-year constant maturity government bond. "Full Sample" is the full sample of 48 countries. "Euro Area" is all current members of the euro area in the sample. "Other Advanced" is advanced economies other than those in the euro area as specified by the IMF in April 2012. See Appendix A for members of each group.

Table 5
Channels of Contagion: Regression Results

	Full Sample			Euro Area
	(1)	(2)	(3)	(4)
*Trade * ENR^{All}*	1.592**	1.580**	1.479**	3.436**
	(0.373)	(0.371)	(0.357)	(1.116)
*Bank exposure * ENR^{All}*	0.231	0.229	0.180	-0.288
	(0.157)	(0.158)	(0.161)	(0.568)
*Leverage * ENR^{All}*	2.776**	2.764**	2.578**	2.194**
	(0.271)	(0.270)	(0.271)	(0.467)
*Portfolio investment exposure * ENR^{All}*	-0.058	-0.058	-0.044	0.050
	(0.051)	(0.050)	(0.046)	(0.116)
*Portfolio inflows * ENR^{All}*	0.383	0.398	0.369	-0.130
	(0.608)	(0.602)	(0.525)	(0.190)
*Middle credit rating * ENR^{All}*	1.157**	1.144**	0.986**	-4.674**
	(0.555)	(0.548)	(0.487)	(2.290)
*Lowest credit rating * ENR^{All}*	0.870*	0.873*	0.800*	3.246**
	(0.528)	(0.523)	(0.466)	(1.218)
Commodity prices		-0.007	0.004	-0.007
		(0.009)	(0.011)	(0.016)
U.S. interest rates			-1.594**	-1.850**
			(0.302)	(0.396)
TED spread			0.126	-0.315**
			(0.080)	(0.124)
Observations	***23,459***	***23,459***	***23,350***	***7,994***

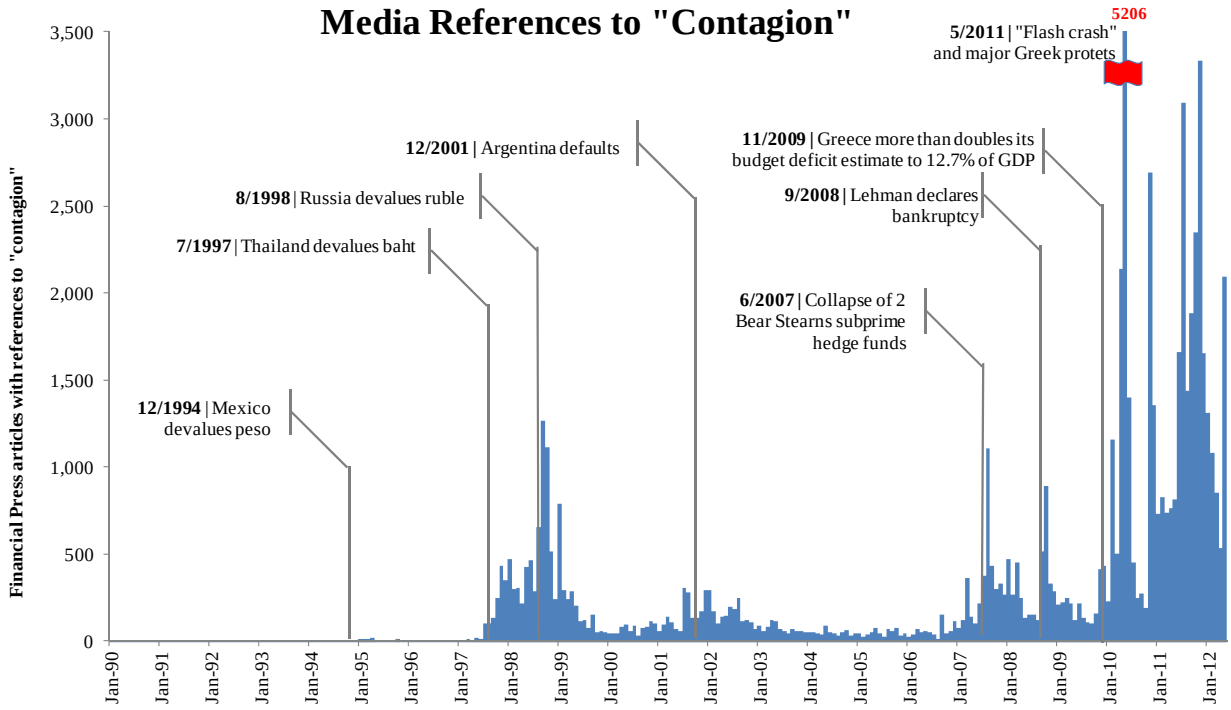
Notes: Dependent variable is a dummy variable equal to one if a country has an extreme negative return. Extreme negative returns are local currency stock returns in the bottom 5% of the return distribution for each country in any week. Estimated using the complementary logarithmic estimator with standard errors clustered by country. *ENR^{All}* is the percent of the sample with an extreme negative return in the given week and this variable is interacted with each of the channels for contagion. *Trade* is (imports + exports) / GDP. *Bank exposure* is (gross banking assets + liabilities) / GDP. *Leverage* is the ratio of private credit by deposit money banks and other financial institutions to bank deposits, including demand, time and saving deposits in nonbanks. *Portfolio investment exposure* is (gross portfolio assets + liabilities) / GDP. *Portfolio inflows* is gross portfolio inflows / GDP. *Middle credit rating* is a dummy variable equal to 1 if countries have a credit rating below investment grade but above "substantial risks" and *Lowest credit rating* is countries with a credit rating of "substantial risk" and below. *Commodity prices* is the change in the *Economist* All-Commodity Dollar Index. *U.S. interest rates* are changes in the interest rate on a 10-year constant maturity government bond.

Table 6
A Closer Look at Financial Channels of Contagion

	Breakout Banking		Breakout Portfolio Investment		
	(1)	(2)	(3)	(4)	(5)
*Trade * ENR^{All}*	1.088**	1.352**	1.694**	1.239**	1.825**
	(0.370)	(0.386)	(0.299)	(0.318)	(0.288)
*Bank exposure * ENR^{All}*			0.995**	0.509	0.800**
			(0.358)	(0.345)	(0.303)
*Leverage * ENR^{All}*	2.795**	2.726**	2.201**	1.165**	2.083**
	(0.291)	(0.278)	(0.243)	(0.339)	(0.235)
*Portfolio investment exposure * ENR^{All}*	-0.096	-0.073			
	(0.065)	(0.063)			
*Middle credit rating * ENR^{All}*	0.608	0.834	0.982*	-0.597	0.738
	(0.870)	(0.577)	(0.525)	(0.860)	(0.545)
*Lowest credit rating * ENR^{All}*	1.181	0.885*	1.041**	-0.347	1.061**
	(0.749)	(0.507)	(0.471)	(0.654)	(0.478)
Commodity prices	0.010	0.004	0.006	0.015	0.003
	(0.013)	(0.011)	(0.011)	(0.010)	(0.011)
U.S. interest rates	-1.849**	-1.587**	-1.528**	-1.160**	-1.645**
	(0.330)	(0.301)	(0.309)	(0.256)	(0.289)
TED spread	0.114	0.147*	0.138	0.033	0.106
	(0.102)	(0.087)	(0.087)	(0.087)	(0.088)
Gross assets	1.952**	1.381*	-2.609**	-1.216	-2.423**
	(0.685)	(0.825)	(0.883)	(0.944)	(0.739)
Gross liabilities	-1.165**	-0.817	1.815**	0.887	1.737**
	(0.573)	(0.620)	(0.626)	(0.710)	(0.551)
Gross inflows	1.221		0.858	-0.384	1.008
	(1.072)		(1.507)	(1.037)	(1.542)
Gross outflows	-1.983		0.714	1.005	0.359
	(1.369)		(1.145)	(1.066)	(1.325)
Share of debt in portfolio positions				4.903**	
				(1.204)	
Share of debt in portfolio flows					0.293**
					(0.117)
Observations	***16,060***	***23,350***	***23,142***	***23,056***	***22,476***

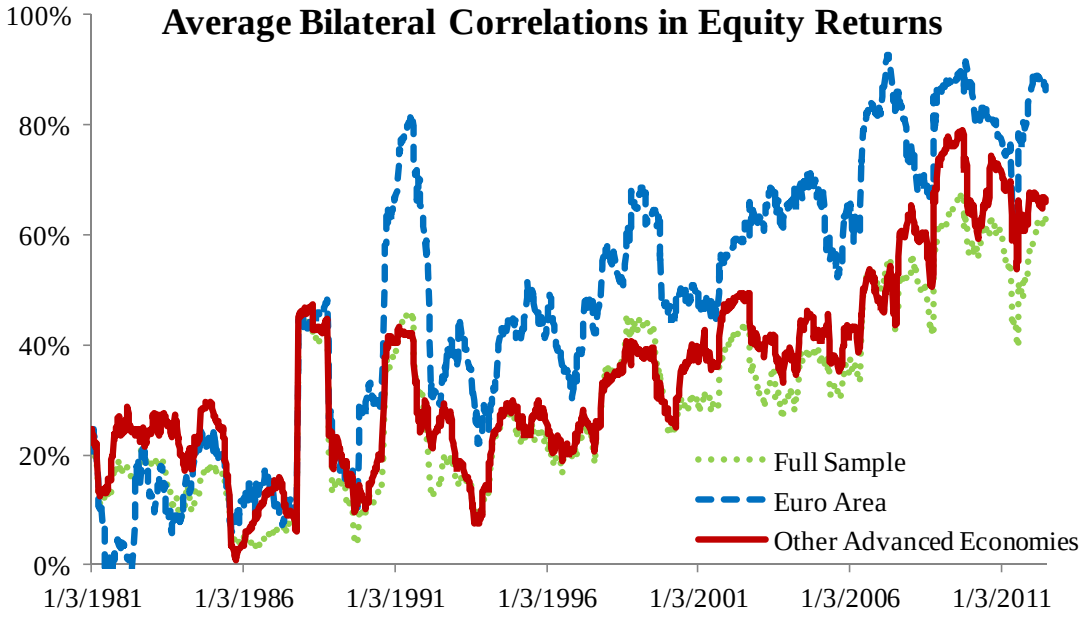
Notes: See notes to Table 5 for estimation strategy and variable definitions. Gross assets, gross liabilities, gross inflows, and gross outflows all report coefficient estimates when the gross position or flow is measured for banking or portfolio investments as specified at the top of the column. Share of debt in portfolio positions or flows is the share of total portfolio investment positions or flows in the form of debt (instead of equity).

Figure 1
Media References to "Contagion"



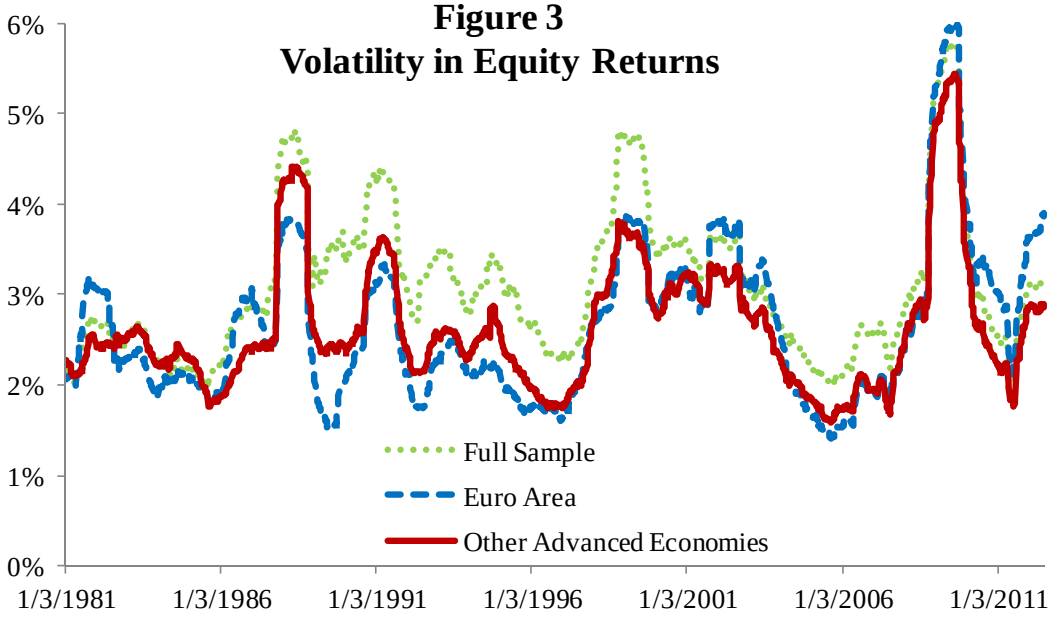
Sources: Factiva monthly search for number of articles using the term "contagion" in the *Commodity/Financial News* or *Economic News*.

Figure 2
Average Bilateral Correlations in Equity Returns



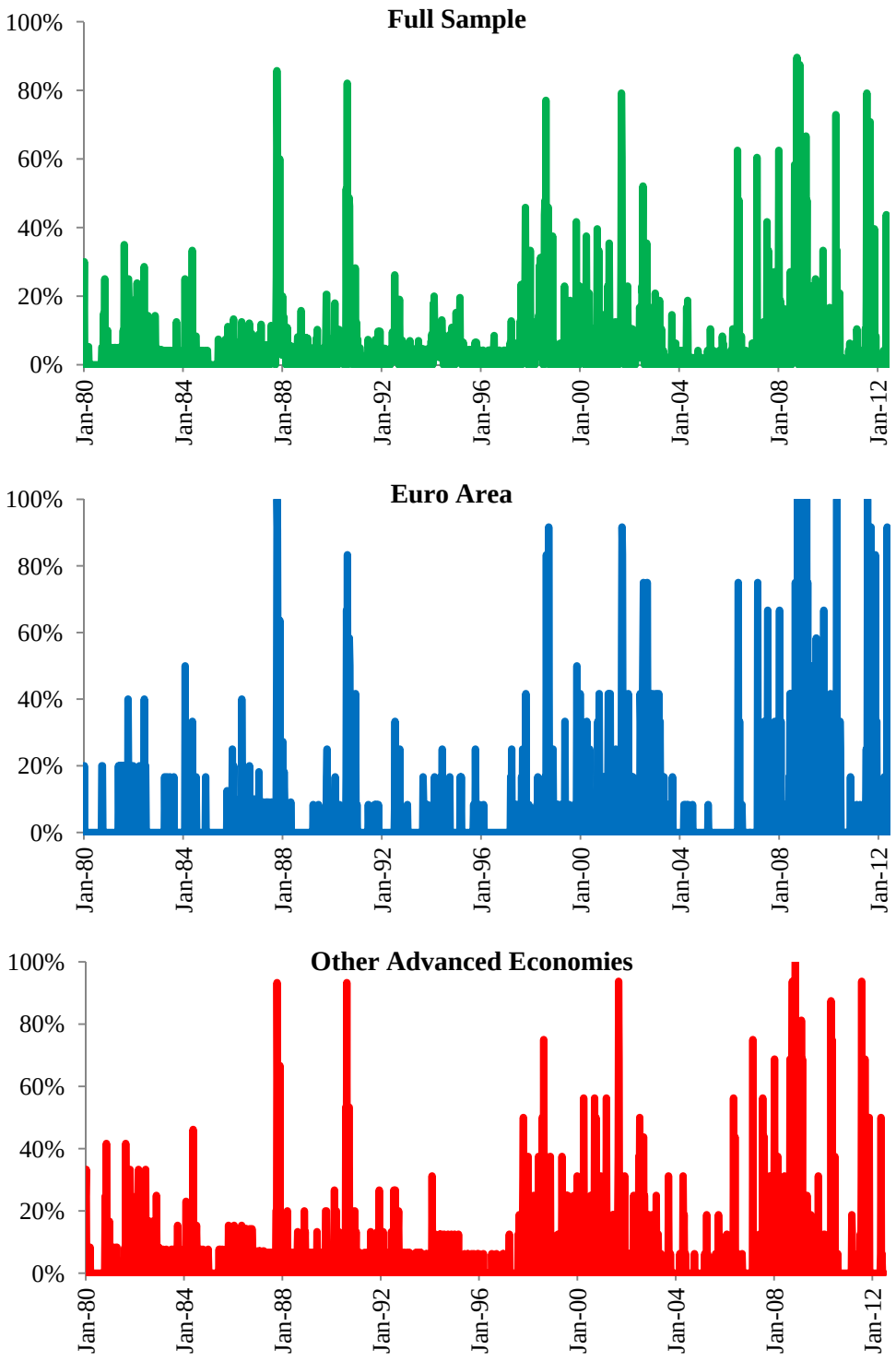
Notes: Averages are 52-week moving averages of the bilateral correlations in equity returns based on local currency stock indices for all countries in the specified group. "Euro Area" is the group of countries currently in the euro area. "Other Advanced Economies" is advanced economies other than those in the euro area as specified by the IMF in April 2012.

Figure 3
Volatility in Equity Returns



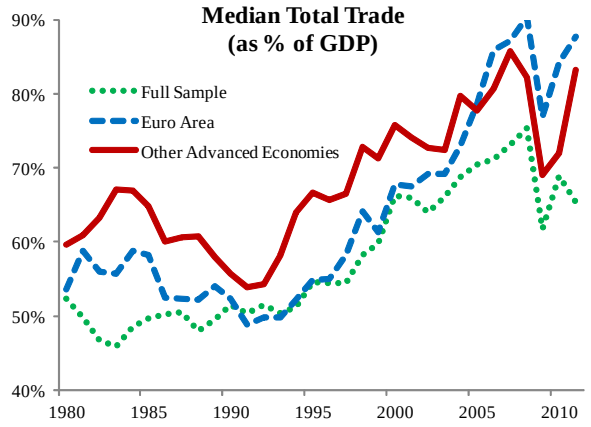
Notes: Volatility is the 52-week standard deviation in equity returns based on local currency stock indices for all countries in the specified group. "Euro Area" is the group of countries currently in the euro area. "Other Advanced Economies" is advanced economies other than those in the euro area as specified by the IMF in April 2012.

Figure 4
Percent of Sample with Extreme Negative Returns

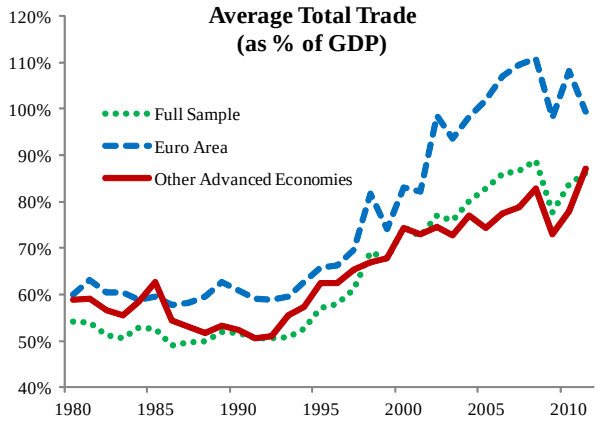


Notes: Extreme negative returns defined as weeks when a country's weekly stock market return is in the bottom 5% of each country's return distribution over the full sample. “Euro Area” is the group of countries currently in the euro area. "Other Advanced Economies" is advanced economies other than those in the euro area as specified by the IMF in April 2012.

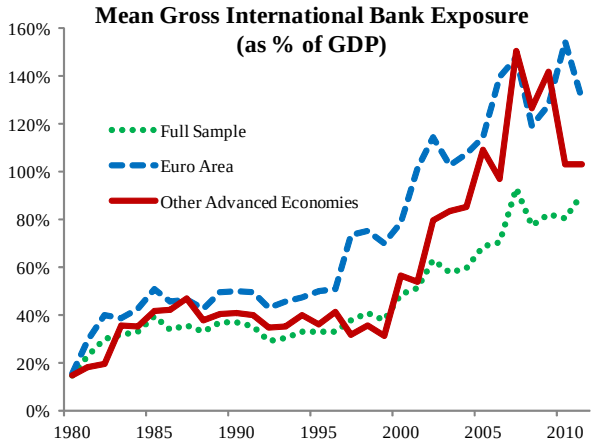
Figure 5
Channels of Contagion



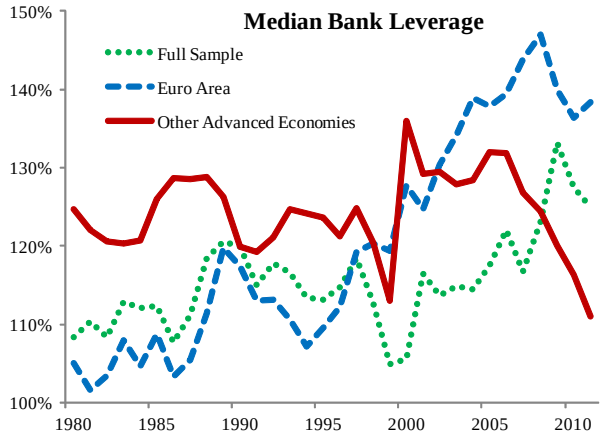
Notes: Sum of imports plus exports as a percent of GDP.



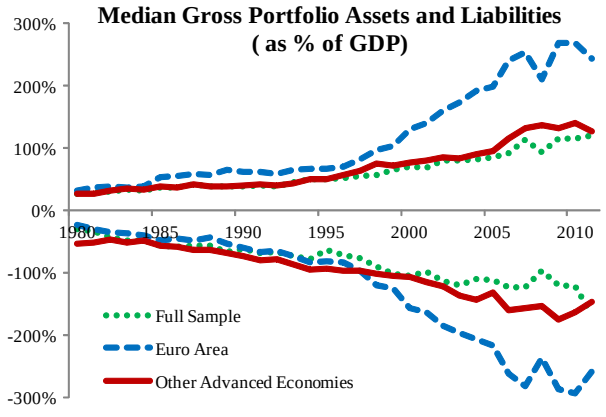
Notes: Sum of imports plus exports as a percent of GDP. Mean values exclude the two largest and smallest values for each country group.



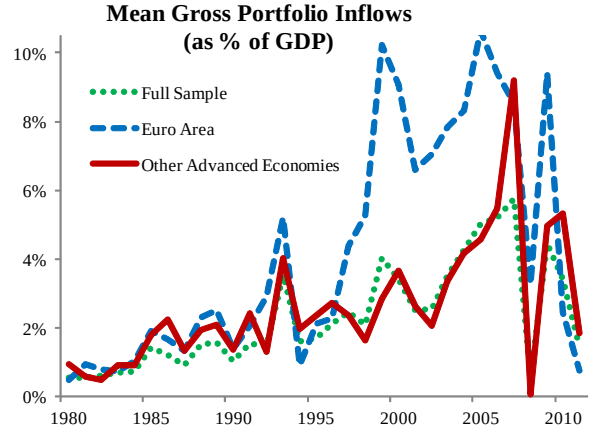
Notes: Sum of gross international banking assets plus liabiliites as a percent of GDP. Mean values exclude the two largest and smallest values for each country group.



Notes: Ratio of private credit by deposit money banks and other financial institutions to bank deposits, including deamnd, time and saving deposits in nonbanks.



Notes: Gross portfolio assets (positive) and liabilities (negative) as a percent of GDP.



Notes: Gross portfolio inflows (equity plus debt) as a percent of GDP. Mean values exclude the two largest and smallest values for each group.