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FINANCIAL CASCADES IN THE MENA REGION: THEORY, EMPIRICS AND POLICY

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Abstract

We develop a randomized analytical model of financial herds and cascades, which we first numerically simulate and later empirically test for a panel of 12 MENA countries among a sample of 35 markets from 2000 to 2009. Financial Cascades, i.e., information free riding behavior, occur when uncertainty is high and markets are opaque. Monte Carlo simulation of the model shows that when traders or investors readily update the “reservation price” and “reservation sell to buy ratio” (points at which they sell or to buy), based on new market data, an inverted-U pattern emerges, depicting the effect of market transparency on volatility. In this pattern, increased financial transparency actually increases market volatility at first, only to reduce it later at higher levels of financial transparency. This first (upward) portion seems consistent with the Furman-Stiglitz (1998) thesis that more frequent news and information intensifies volatility, while the second (downward) portion of the inverted-U follows the more conventional wisdom exemplified by the International Monetary Fund’s position on opacity as the cause of cascades. Of our two measures of financial transparency that we use, “the strength of audit”, and “the transparency of government policy”, the first variable provides strong support for our inverted U theory for the full sample of 35 countries and for our sample of 12 MENA countries. The transparency of government policy variable, while sometimes beneficial in promoting financial stability is neither as robust in this aspect, nor as robust in support of the inverted U theory.

JEL Classifications: G1, G3

Keywords: Cascades, information asymmetry, transparency financial volatility, Monte Carlo

ملخص

نقوم بانشاء نموذج تحليلي عشوائي لظاهرة التتبع والتلاحق المالي ، والتي اجرينا لها أولا محاكاة عددية واختبار تجريبي في وقت لاحق لإنشاء مجموعة من 12 من بلدان منطقة الشرق الأوسط وشمال أفريقيا بين عينة من 35 من الأسواق فى الفترة بين 2000 إلى 2009. التلاحقات المالية، أي سلوك استخدام المعلومات مجانا، تحدث عند ارتفاع حالة عدم اليقين وعدم شفافية الأسواق. محاكاة مونت كارلو للنموذج تبين أنه عندما يقوم التجار أو المستثمرين بتحديث المعلومات عن كل من"سعر التحفظ" و " نسبة التحفظ فى البيع للشراء " (النقاط التي يقومون عندها بالبيع أو بالشراء)، و ذلك استنادا إلى بيانات السوق الجديدة، يظهر نمط مقلوب U-، والتي تصور تأثير الشفافية على تقلبات السوق. في هذا النمط، زيادة الشفافية المالية في الواقع يزيد تقلبات السوق في البداية، وذلك فقط للحد منه في وقت لاحق للوصول لمستويات أعلى من الشفافية المالية. هذا الجزء الأول (تصاعدي) جزء يبدو منسجما مع أطروحة (1998) فورمان-ستيغليتز والتى تطرح فكرة أن تواتر الأخبار والمعلومات بكثرة يكثف تقلبات السوق، في حين أن الجزء الثاني (الهبوط) من نمط مقلوب U- يتبع الحكمة التقليدية والتي فسرت موقف صندوق النقد الدولي من التعتيم كونه سبب التلاحقات المالية. ومن قياسات الشفافية المالية التي نستخدمها، "قوة المراجعة"، و "شفافية السياسات الحكومية"، نجد أن المتغير الأول يقدم دعما قويا لنظريتنا عن نمط مقلوب U للعينة الكاملة من 35 بلدا والعينة التى لدينا من 12 دولة من الشرق الأوسط وشمال أفريقيا. أما عن متغير شفافية السياسات الحكومية ، ففي حين أنه مفيد أحيانا في تعزيز الاستقرار المالي فهو لا يدعم نظريتنا بقوة كما هو الحال في الجانب الأخر.

1. Introduction

Information asymmetry in financial markets and lack of financial transparency permeate many developing countries, but are particularly severe in those developing markets where modern financial institutions are still in their infancy. That is the case in many of the countries of the Middle East and North Africa (MENA) region, though not limited to this region. However, what does set this region conceptually apart is the influence of oil, and the potential for a natural resource curse mechanism to lead to poor governance (see for example ERF working paper by Elbadawi and Gelb 2010), and in turn poor for governance to undermine institutional and financial transparency.

At a theoretical level, a consequence of lack of transparency is "herd" behavior and the associated information cascades. Wikipedia defines information cascades as circumstances "when people observe the actions of others and then make the same choice that the others have made, independently of their own private information signals." This is precisely the implication of the classic Grossman-Stiglitz (1980) information free-ridership paradox. But what it implies is that cascades are likely to flourish in low transparency environments where uncertainty is high.

The underlying uncertainties that generate financial cascades reflect either an underlying lack of *institutional* transparency, or short-run uncertainties associated with underlying structural or financial crisis. An instance of the latter is fresh from the credit freeze of late 2008 while instances of the former are widely discussed in international policy circles. For example, the Mexican crisis of 1994-95 and the 1997-98 emerging market crisis have been blamed on "a lack of transparency" (IMF 2001). In this report, lack of transparency is characterized as "inadequate economic data, hidden weaknesses in financial systems, and a lack of clarity about government policies and policy formulation contributed to a loss of confidence that ultimately threatened to undermine global stability." (Ibid).

One might ask; what is the mechanism that actually links uncertainties (driven by either a lack of transparency or an underlying structural crisis) to financial cascades and the resulting volatility? The theoretical work has focused on herd behavior.[1] In this view, herd behavior is a link that connects informational asymmetry on one end, to financial cascades and stock market volatility on the other end. Thus, Bikhchandani et al. (1992) and Bikhchandani and Sharma (2000) develop a sequential Bayesian updating model where individuals follow others observed behavior regardless of their own private information (definition of herd behavior). In their model, however, all the information that underlies the non-imitated behavior is private information. Hence, public information, in the form of equity prices, does not enter into investor/trader decision. Lee (1993) investigated informational cascades in a sequential model in which agents updated their priors upon observing the actions of others. But, in Lee the observed state in not endogenous, whereas in equity markets, the observe state (price level) is itself a response to the action of the agents (prices fall if most agents short and rise if most agent long). The model in our paper takes the state as endogenous to the action of the agents (more on our contribution below). Chari and Kehoe (2004) on the other hand have preferred to maintain the

[1] The "flash crash" of the US stock market in May 6, 2010 has been attributed to program trading. Such trading could qualify as herd behavior if mass sell or buy occurs when one computer program follows another and another, so on. However, actually testing this claim is not an easy task.

continuous trading feature, but reproduce herd behavior by endogenizing the timing of investors.[2]

These explanations focus primarily on *how* herd behavior may be generated in a micro setting but in doing so they overlook the possibility that financial cascades may occur at a systems level and as a *systemic* phenomenon. For example, the fact that prices are exogenous in these models means that cascades cannot occur if they were due to the underlying dynamics of prices adjustments and thus by implication can only be a result of herd behavior. A second shortcoming of these models is that while they do take into account the information revelation property of prices, prices themselves are assumed to *accurately* reflect fundamentals.

But what happens if lack of institutional transparency of the type discussed for example by Gelos and Wei (2002) or the IMF (2001), imply that prices may not accurately reflect true market fundamentals in the first place? Is the kind of herd behavior that may arise in this case different? Furthermore, some have questioned the role of transparency in reducing volatility. Thus, Furman and Stiglitz (1998) have argued that more transparency, which they interpret as a higher frequency of information release, could imply a higher, rather than a lower, price volatility. Bushee and Noe (2000) provide a mechanism for this by finding a positive association between corporate transparency and the volatility of the firm's stock price. They argue that firms with higher levels of disclosure tend to attract certain types of institutional investors, which use aggressive, short-term trading strategies, which in turn can raise the volatility of the firm's stock price.

This paper tries to explain these conflicting outcomes. This paper has two tasks: First it provides a randomized analytical model in which financial volatility arises from the herd behavior of agents which is capable of producing cascades and is acute when transparency is limited and thus prices do not convey full information. It then simulates this model using Monte Carlo techniques. Second the paper tests that model's prediction in a dynamic panel of 12 economies of the MENA region for the years 2000 to 2009 and compares that with a full sample of 35 counties altogether.

The analytical model examines how herd behavior, driven by uncertainty about the accuracy of prices to reflect true fundamentals, can lead to financial cascades and dramatically larger stock market volatility.[3] The model is dynamic in the sense that the trading agents' actions are based on both the "previous period's" observed prices (public information) and on the behavior of other trading agents. There is a continuum of *heterogeneous* trading agents that randomly differ from one another in their *reservation values* of two key variables, the *equity price* and the aggregate *sell-to-buy ratio* of the equity. If the variables reach their reservation level, they trigger action on the part of agents of either buying or selling equities[4]. There is large literature on heterogeneous agents in financial markets (see Hommes 2006 for a survey). This paper is in the

[2] In Chari and Keho endogenous timing by investors leads to information being trapped, beyond the time point at which a decision to invest (rather than wait for new information) is made. This information trapping mechanism is what leads to herds.

[3] We may note here a distinction between asymmetric information and informational opacity (i.e., lack of transparency). Information asymmetry is the concept used for example in Bikhchandani et al. (1992), Bikhchandani and Sharma (2000) and Lee (1993). It is one in which agents' private information is distinguished from public information which is only observed by observing other agents' signals (herd behavior). Here, while we still model the herd behavior, whether agents choose to follow other agents or not depends on how much market participants *trust* the public pricing signals. It is the uncertainty about whether prices truly reflect markets that we take as an indicator of transparency/opacity of the market institutions.

[4] We do not assume that these two groups span the universe of market participants. A third group that is passive, i.e., that does not engage in either buying or selling equities at any point in time, is implicitly accounted for by *not* using the sum of buyers and sellers to normalize our ratios. Detailed development of the model will be discussed in this paper.

spirit of the behavioral model of Boswijk et.al (2007) in which agents differ, not in having private information, but in their different interpretation of public information. While Boswijk et.al focus on different estimation technologies or algorithms, we focus on inherent differences among individuals in their preferences. The extent to which agents rely on the aggregate buy/sell ratio reflects their herd behavior and stems from uncertainties about the accuracy of the price mechanism. We allow for agents preferences to be endogenous in the sense of being updated over time, upon observing the market. Our theoretical results are as follows: When traders update their preferences frequently, we find a U pattern depicting the effect of market transparency on volatility, i.e., for some limited range, increased transparency actually increases volatility, but beyond a certain point, for sufficiently large increases in market transparency, volatility declines. Thus, the first (upward) portion seems to be consistent with the Furman-Stiglitz (1998) thesis that more frequent news and information intensifies volatility, while the second (downward) portion of the inverted-U follows the more conventional wisdom exemplified by the quote from the International Monetary Fund cited earlier. The fact that different patterns emerge and are highly sensitive to whether traders readily update their preferences or not, is consistent with what we know from the chaos literature.

To empirically test our results we must isolate the impact of financial and transparency (or lack of) in financial volatility. For this, we need to control for other drivers of financial volatility. In the MENA countries, the influence of oil is likely to produce an additional complication, not only for the oil-rich group, but also for the non-oil (e.g., Egypt) that indirectly benefit from wage repatriations of their migrant labor to the oil producing states of the region (for example see Elbadawi and Gelb 2010). Of the several natural resource curse channels that are outlined and analyzed by Elbadawi and Gelb (2010) through which oil has the potential to influence the economies of this region, two channels are relevant to our analysis: One is the size of oil rents themselves that may potentially influence governance structures (e.g., corruption) and thus transparency of information, and the second is oil price volatility which has been shown to be associated with economic performance in select MENA countries (ibid). Thus, we include both these variables also. Another driver of the financial volatility, unrelated to herd behavior and lack of transparency, is the *international* dimension of financial volatility. To control for this effect we include 3-month LIBOR rate that reflects risk premium and is thus a good indicator of financial uncertainty. This instrument has also a key advantage over regional country specific instruments (e.g. domestic interest rates) in that it is *independent* of domestic financial markets in a way that the volatility domestic interest rates are not.

Testing the predictions of our model for a panel of 35 countries including 12 MENA countries for 2000-2009, and using financial market transparency data from the World Economic Forum (strength of audit, and transparency of government policy), our findings provide strong and robust support, in both the full sample and the MENA subsample, for the inverted U theory in the case of the strength of audit variable, and less robust support in the case of the transparency of government policy variable. We also find higher oil price volatility generally implies greater financial volatility; but the effects of higher oil rents on financial volatility are more mixed.

There are two key overall policy lessons that stem from our research: The first lesson is that *targeted* reforms that address financial transparency directly, such as the strengthening of auditing practices, are more critical and effective in promoting financial stability than are general macro policies, though the latter can also be useful. The second lesson is that even such targeted reforms as the strengthening of auditing practices are effective *only* when they are *extensive:*

Limited transparency reforms may in fact worsen financial instability as indicated by the inverted U pattern. One example of reforms that are extensive the banking reforms and the regulatory compliance of the banking systems with BASEL rules (BASEL II and III). These rules entail, among other elements, the strengthening of auditing practices but go much beyond. Such reforms should go a long way in producing greater financial stability.

In what follows, Section II describes the analytical model; Section III presents the Monte Carol simulations; Section IV presents the empirical evidence; and section V provides the concluding remarks and policy lessons.

2. Model

The focus of our model is the actual act of trading in equity markets since it is ultimately the action of buying and selling that determines the equity prices. Thus traders are not a unique class in this paper. This differs from some in the literature, such as Bruenmeir and Pederson (2008), where differences between traders, speculators, and others are of key consequence. This is because in Bruenmeir and Pederson, a key source of systemic risk is the liquidity of traders. Thus, traders play a unique role in that paper. By contrast in our paper, the key systemic risk factor is one that is associated with herd behavior under imperfect information. Thus, for us traders do not play a unique role since it is the collective of trading activity that has the potential to produce cascades.

The behavior of market participants (i.e., traders at large) is governed by their preference structure. There is a continuum of agents who are randomly distributed and who differ only in this respect. This preference structure is expressed by the continuum of reservation prices and reservation sell-to-buy ratios above and below which decisions must be made to buy or sell equities. Each trader may engage in both sell and buy strategies over the course of a *finite* trading period, for example one day, and thus his or her portfolio will consist of both long and short positions. However, at any given moment in time and for any single observed price, P_t, a profit maximizing trader would engage in either a sell action or a buy action, but cannot engage in both[5]. Preferences are updated each period, given market information in the previous period. The introduction of sell-to-buy ratios reflects the key notion that when the environment is sufficiently uncertain, as a consequence either of stress states or of inadequate institutional framework for transparency, then the belief that prices reflect full information is weak, thus partially supplanted by the consideration of the behavior of other market participants. In practice, this is consistent with evidence from trading algorithms and trading behavior. It is of course also related to the classic information free rider problem known as the Grossman-Stiglitz paradox, originally associated with the critique of the efficient market hypothesis (Grossman and Stiglitz 1980).

2.1 The Price Channel

We begin with the treatment of the more intuitive price channel and leave the treatment of the more unusual *herd channel* for the next subsection, even though both treatments are similar. To pin down the ideas, let *m* and *n* denote the observed number of sellers and buyers, respectively, at any given market price. For ease of analysis, each seller or buyer is assumed to engage in the sale or purchase of only one unit of equity. It is not too difficult to generalize this to the case

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[5] While a trader may engage in, for example, a sell action given at the price, P_t and a buy action at the observed price $P_t + \varepsilon$ note that these are two *different* prices. While simultaneous options strategies, such as buy put and sell call or buy call and sell put, do occur, a call option is a distinct product from a put option with distinct prices.

where volume matters and sellers and buyers vary in the volume of orders, but adding this factor will only complicate the salience of the model without adding additional insight or substance.

Agents are randomly distributed according to their unique *reservation* price P_r with a probability density function, $g(p_r)$ at any given time (though as we shall see, $g(p_r)$ changes over time, reflecting changes in preferences). This is depicted in Figure 1a.

For any *observed* price P_t at any moment in time, agents are divided into two types; those with a reservation price less than or equal to the observed ratio, $P_r \le P_t$ and those with a reservation price exceeding P_t, that is $P_r > P_t$. Since P_r represents the agent's subjective valuation of what the stock is worth, it follows that upon observing the actual price P_t agents of the first type will engage in selling (offering) their position and those of the second type will engage in buying a new position: For agents of the first type, this follows a general upward sloping supply behavior where more is offered as price rises, while for agents of the second type a rise is perceived to constitute a signal of higher innate value of the equities, leading these agents to engage in further buying of equities. This is depicted in Figure 1b[6]. (We have assumed that P is strictly positive.)

To understand the process better suppose the price increases. This results in two effects: First, given a stable and unchanging (over time) preference structure, the mass of the distribution to the left of the P_t line increases and that to its right declines. This simply means that given their original reservation price, some agents who wanted to buy are no longer buying and more agents are willing to sell. Let us call this, the *"probability-mass transfer effect"*. However, as stated previously, preferences are likely to change and be updated over time, given the change in price level. This leads to a second effect, which shows up *next* period. Upon observing the increase in P_t, some agents who would have wanted to sell their positions, will have second thoughts because observing the actual price increase, their reservation price P_r at which they would have sold their position will increases, delaying a sell decision. This affects the probability mass of agents to the left of the observed price (and also by implication the probability mass of those to the right of the observed price). Putting this in probability terms, we can write $g(P_r \mid P_r \le P_t < P_{t+1}) < g(P_r \mid P_r \le P_t)$. We call this effect, the *"preference update effect"*. Note that the two effects work in opposite direction: a rise in the price will induce some to sell (a normal upward sloping supply response), while it will induce others to hold their positions or to buy more. Since prices are also affected by supply or demand for stocks, as we will see later, this means that the price channel itself may be stabilizing or destabilizing. It is stabilizing if the mass transfer effect dominates, but destabilizing if the preference updates effect dominates. This is an important point since it has the potential implication that cascades can be produced as a result of price effects as well as the herd effect. Verifying this potential will have to await the full model development and its simulation.

Two points are worth noting. First, exiting the market by neither selling nor buying does not pose a problem for our distribution. This is because the support for the distribution does not assume a fixed number of participants. All that is required is that at any given time and for any observed

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[6] Note that placing the position of line P_t in Figure 1b, as it is shown, is entirely arbitrary since P_t is seen by each agent as an exogenous random event, which is independent of P_r. Thus P_t could be anywhere along the support of $g(P_r)$.

value of P_t, there are g fraction of market participants whose preference is given by $P_r \le P_t$ and 1-g fraction of market participants whose preference is given by $P_r > P_t$. Second, whether or not prices have risen or fallen from the last period will change the distribution *via* the preference update effect only when g is compared to its value in the *last* period. But the contemporaneous shape of g will *not* be affected. Later, when we choose a Pareto distribution to represent g, this is reflected by a change over time in the value of the parameter of Pareto distribution itself depending on whether prices have risen or not from previous period. But the contemporaneous integrity of Pareto is not affected at any moment in time.

The above results can be written as follows:

$$m_{t+1}(P_t)\,|_{price\ \ channel} = \int_{\underline{P}}^{P_t} g(P_r \mid P_t)dP_r \tag{1}$$

$$n_{t+1}(P_t)\,|_{price\ \ channel} = \int_{P_t}^{\infty} g(P_r \mid P_t)dP_r \tag{2}$$

Let η denote the ratio of sellers to buyers at any time, t, such that $\eta_t = m_t / n_t$. Then we can write:

$$\eta_{t+1}(P_t)\,|_{price\ \ channel} = \frac{m_{t+1}(P_t)}{n_{t+1}(P_t)} = \frac{\int_{\underline{P}}^{P_t} g(P_r \mid P_t)dP_r}{\int_{P_t}^{\infty} g(P_r \mid P_t)dP_r} \tag{3}$$

We will return to this when calibrating the model for a specific distribution.

2.2 The Herd Channel

We now turn to the herd channel. The methodology here is similar, but produces a unique outcome when applied to the herd channel. As in the price channel, agents are randomly distributed along a variable η_r (explained below), with a probability density function $f(\eta_r)$. The variable η_r now denotes agents "reservation value" of the *sell-to-buy ratio*. For any *observed* value of η_t at any time t agents are distinguished by two types, those with a reservation ratio *less* than or equal to the observed ratio, $\eta_r \le \eta_t$ and those with a reservation ratio *exceeding* the observed ratio, $\eta_r > \eta_t$. For agents of the first type the current observed number of sellers relative to buyers is too high, given their risk perspective. Thus, upon observing η_t agents of the first type will engage in selling their position. Agents of the second type consider the current observed sell-to-buy ratio η_t not high enough, given *their* risk perspective. Thus they continue to engage in buying stocks. This is depicted in Figure 2, which is analogous to Figure 1b.[7]

Note that any exogenous increase in η_t will increase the number of agents of the first type and reduce those of the second type as the probability mass moves from left of η_t to the right of η_t.

[7] As was the case with Figure 1b, we note that the position of η_t line where it has been placed in Figure 2 is entirely arbitrary as η_t is seen by each agent as a random event independent of η_r.

This is the "probability mass transfer effect" as was in the case of the price channel. The higher value of η_t this period then *increases* next period's observed ratio, η_{t+1} creating a vicious cycle that is at the heart of financial cascades. Because action here is predicated upon observing the action of others, we call this channel the "herd channel". As in the case of the price channel, changes in agents' preferences, i.e., their reservation value η_r upon observing η_t must also be considered. As before, call this the preference update effect. Let us once more re-examine the effect of an increase in η_t. This increase would cause agents, potentially on the buy side ($\eta_r > \eta_t$), to reduce their reservation value of η_r and thus postpone/cancel their purchase decisions. An inequality relationship in probability mass similar to the price mechanism holds such that $f(\eta_r \mid \eta_r > \eta_t; \eta_t < \eta_{t+1}) < f(\eta_r \mid \eta_r > \eta_t)$. But unlike the Price channel this preference update effect actually *reinforces* the probability mass transfer effect thus intensifying the potential for a cascade. (In Figure 2 both effects reduce the probability mass to the right of the observed η_t.) Thus, the herd mechanism is unambiguously destabilizing.

From the above description, focusing on the cascading channel, the total number of sellers and buyers at t+1, given the behavior of market participants at t, is given by:

$$m_{t+1}(\eta_t)\,|_{herd\ \ channel} = \int_{\underline{\eta}}^{\eta_t} f(\eta_r \mid \eta_t) d\eta_r \tag{4}$$

$$m_{t+1}(\eta_t)\,|_{herd\ \ channel} = \int_{\eta_t}^{\infty} f(\eta_r \mid \eta_t) d\eta_r \tag{5}$$

where $\underline{\eta}$ in equation (1) stands for the minimum (threshold) value of η. (We assume that there are always some, if very few, sellers, i.e., $\underline{\eta}$ >0). From equations (4) and (5) it follows that,

$$\eta_{t+1}\,|_{herd\ \ channel} = \frac{m_{t+1}}{n_{t+1}} = \frac{\int_{\underline{\eta}}^{\eta_t} f(\eta_r) d\eta_r}{\int_{\eta_t}^{\infty} f(\eta_r) d\eta_r} \tag{6}$$

Finally, agents' behavior is a combination of both the price mechanism and the cascading mechanism:

$$\Theta\eta_{t+1}\,|_{herd\ \ channel} + (1-\Theta)\eta_{t+1}\,|_{price\ \ channel} = \Theta\frac{\int_{\underline{\eta}}^{\eta_t} f(\eta_r) d\eta_r}{\int_{\eta_t}^{\infty} f(\eta_r) d\eta_r} + (1-\Theta)\frac{\int_{\underline{P}}^{P_t} g(P_r) dP_r}{\int_{P_t}^{\infty} g(P_r) dP_r} \qquad 0 \le \Theta \le 1 \tag{7}$$

where $0 \le \Theta \le 1$. One can think of Θ as an indication of the weight that market participants would put on their decision when that decision is based on the action of other market participants. Naturally 1-Θ is the weight that traders would put on the observed prices. Since in highly uncertain times, or highly non-transparent states of the market, prices are not as informative, agents will also rely on others' behavior utilizing the herd channel as a carrier of information. Thus, a large Θ would indicate inefficient market signal transmissions for either reason. Later, we model this aspect by linking a parameter that indicates uncertainty about the accuracy of the price mechanism to the herd coefficient, Θ. We will then take advantage of that linkage to construct our empirical test of the implications of the model.

2.3 Price adjustment mechanism

Another key component of the model is the role of the price adjustment mechanism. We assume that prices are subject to two forces; (1) the usual Geometrical Brownian Motion as indicated by the Wiener process and a (2) response function to the sell-to-buy ratio, analogous to economists' excess demand function. To integrate these two forces, we rely on the modified form of a recent innovation by Jarrow and and Protter (2005). Jarrow and Protter consider the pricing of equity at time t to be a function of given the stock holdings of the trader, and decompose this into a competitive, and what they call, a supply function. Adopting their approach to the problem at hand, the price $P(t,\eta_t)$ can be decomposed into two components, an inverse response function of prices to the sell-to-buy ratio say $G(\eta_t)$ (*G'<0*) which is similar in behavior to an "excess demand function" and generates stability in the system when tied to the supply mechanism in equation 7; and a "base" function $P(t,\eta_t = 0)$ that follows the classic Geometric Brownian Motion and is represented by the Wiener process. Thus we have:

$$P(t,\eta_t) = P(t,0).G(\eta_t) \qquad G' < 0 \tag{8}$$

$$dP(t,0) = P(t,0)\mu dt + Pt,0)\sigma\varepsilon\sqrt{dt} \qquad \varepsilon \sim N(0,1) \tag{9}$$

where, μ is the drift and σ is volatility of the equity. We convert both these equations to a discrete format so as to conform to a dynamic simulation approach, which we will be utilizing later:

$$P_t(\eta_t) = P(0).G(\eta_t) \tag{10}$$

$$\Delta P_t(0) = P_t(0)\mu\Delta t + P_t(0)\sigma\varepsilon\sqrt{\Delta t} \qquad \varepsilon \sim N(0,1) \tag{11}$$

We may note that instead of assuming a stochastic volatility form (e.g., GARCH) the stick price volatility of *P(0)* is constant here, given σ constant. This is because we want to focus on volatilities that are *endogenously* generated at the aggregate level by the model, showing up ultimately in $P_t(\eta_t)$. Thus, we want to abstract from imposing any other volatility generating form exogenously. As we will see, our final volatility of $P_t(\eta_t)$ does depict stochastic volatility characteristics under some specifications. With this discrete representation, we now add the final *dynamic* price equation, i.e.:

$$P_{t+1}(0) = P_t(0) + \Delta P_t(0) \tag{12}$$

2.4 Specifying the functions

To evaluate this model we will need the explicit form of the distributions. First we focus on the distribution of market participants according to their reservation values of sell-to-buy ratio and price, i.e., $f(\eta_r)$ and $g(P_r)$. We assume that both $f(\eta_r)$ and $g(P_r)$ can be reasonably characterized by a Pareto distribution. There are at least three reasons for this. First, we must have a left-bounded distribution. Second, the distribution should allow for tail behavior. This means two things: the possibility of large observed sell-to-buy ratio or prices (a bubble), and the possibility that no matter how large are these observed values, there are always some agents that would be buyers (agents with a tail attitude!). Third, in financial markets, Gabaix, et al. (2006, 2008) find that the process underlying the distributions of the volume and returns follow the Power Laws for large trades and explain that by the existence of large "market makers" (a process akin to ours). The key discovery in physics, known as Scale Invariance, has allowed both economists and physicists to be able to generalize the presence of the Power Law in numerous physical and financial phenomena. Newman (2005) describes many such instances, ranging from word frequencies, to web hits, to magnitudes of earthquakes, and the intensities of wars. Spagat and Johnson and Spagat (2005) show the Power Law at work in describing the number of attacked in a war, applying their analysis to the US war in Iraq. Mohtadi and Murshid (2009a, 2009b) show that a form of the Power Law, in the form of extreme value distributions describes the instances of terrorism attacks. Thus the present perspective on the examination of the Power Law follows a rich background of analysis and examination by physicists and economists. Finally, Pareto distribution is extremely analytically tractable.

If X is a random variable, a Pareto distribution is defined as $\Pr(X \geq x) = (x_m / x)^{\beta}$ where x_m is the minimum admissible (threshold) value of X. The corresponding cumulative distribution function is $G(X < x) = 1 - (x / x_m)^{\beta}$. If we let the random variable X be identified by the trader's reservation price, X= P_r , the upper point x by the observed (actual) price, $x = P_t$ and the lower threshold by $x_m = \underline{P}$. Then $\Pr(P_r \geq P_t) = (\underline{P} / P_t)^{\beta}$, and the corresponding cumulative distribution function is, $G(P_r < P_t) = 1 - (\underline{P} / P_t)^{\beta}$ with β as the parameter of the Pareto distribution. However, as we have seen preferences might evolve over time, given an observation of a price change. We saw before that for the case of the price channel, this preference update effect works in reverse to the probability mass transfer effect. (Higher observed price give some sellers pause). To capture this evolution of tastes, let $\beta = \beta(P_{t+1} / P_t)\, with \quad \beta' \geq 0$ with equality reflecting a no preference update case. In this formulation, while $\partial G / \partial P_t$ remains positive reflecting the mass transfer effect, $\partial G / \partial P_{t+1} \leq 0$ reflecting the effect of preference update on *reducing* the fraction of sellers in response to the price increase. The probability mass of sellers, buyers and their ratio (via the price channel) is given by:

$$m_{t+1} |_{price \quad channel} = G(P_r < P_t) = 1 - (\underline{P} / P_t)^{\beta(P_{t+1} / P_t)} \tag{13}$$

$$n_{t+1} |_{price \quad channel} = \Pr(P_r \geq P_t) = (\underline{P} / P_t)^{\beta(P_{t+1} / P_t)} \tag{14}$$

$$\eta_{t+1} |_{price \quad channel} = \frac{G(P_r < P_t)}{\Pr(P_r \geq P_t)} = \frac{1 - (\underline{P} / P_t)^{\beta(P_{t+1} / P_t)}}{(\underline{P} / P_t)^{\beta(P_{t+1} / P_t)}} \tag{15}$$

Similarly, if we let the random variable X denote the trader's reservation sell-to-buy ratio, X= η_r the upper point x by the observed (actual) sell to buy ratio, $x = \eta_t$ and the lower threshold by $x_m = \underline{\eta}$, then from Pareto and its corresponding cumulative distribution the probability mass corresponding to the number of sellers and buyers (via the herd channel) are identified as $\Pr(\eta_r \geq \eta_t) = (\underline{\eta} / \eta_t)^{\gamma}$ and $F(\eta_r < \eta_t) = 1 - (\underline{\eta} / \eta_t)^{\gamma}$. The preference update effect is modeled similarly, with one notable difference. A rise in η_{t+1} must lower the probability mass to the right of η_t. This would be achieved if $\gamma = \gamma(\eta_{t+1} / \eta_t)\, with \quad \gamma' \leq 0$. The probability mass of sellers, buyers and their ratio (via the herd channel) is given by:

$$m_{t+1}\,|_{herd} = F(\eta_r < \eta_t) = 1 - (\underline{\eta} / \eta_t)^{\gamma(\eta_{t+1}/\eta_t)} \tag{16}$$

$$n_{t+1}\,|_{herd} = \Pr(\eta_r \geq \eta_t) = (\underline{\eta} / \eta_t)^{\gamma(\eta_{t+1}/\eta_t)} \tag{17}$$

$$\eta_{t+1}\,|_{herd} = \frac{F(\eta_r < \eta_t)}{\Pr(\eta_r \geq \eta_t)} = \frac{1 - (\underline{\eta} / \eta_t)^{\gamma(\eta_{t+1}/\eta_t)}}{(\underline{\eta} / \eta_t)^{\gamma(\eta_{t+1}/\eta_t)}} \tag{18}$$

The weighted average of the two mechanisms is given, as in equation (7) can now be specified using the Pareto functional form:

$$\eta_{t+1} = \Theta \frac{1 - (\underline{\eta} / \eta_t)^{\gamma(\eta_{t+1}/\eta_t)}}{(\underline{\eta} / \eta_t)^{\gamma(\eta_{t+1}/\eta_t)}} + (1 - \Theta) \frac{1 - (\underline{P} / P_t)^{\beta(P_{t+1}/P_t)}}{(\underline{P} / P_t)^{\beta(P_{t+1}/P_t)}} \tag{19}$$

2.5 The price response

A general equilibrium focus on how price are determined in the aggregate is often missing in the herd literature whose focus has been to model the herd behavior rather than to fully integrate that behavior into the economy. To close this gap and to also tie the aggregate market uncertainties to herd behavior, we assume an " excess demand function" that specifies the relation between prices and the sell-to buy ratio. We assume a constant elasticity format for this function, as follows:

$$G(\eta_t) = 1 + \eta_t^{-\alpha} \quad , \tag{20}$$

where α is a random variable,

$$\alpha \sim N(\alpha_o, \sigma_\alpha^{\;2}), \tag{21}$$

and where,

$$\sigma_a = m.\Theta \Rightarrow \Theta = (1/m)\sigma_a, \tag{22}$$

with *m* as a constant parameter. To explain, there is an uncertainty in the efficiency of the price response mechanism, which is what leads to a financial cascade (i.e., free riding of information off others) in the first place. Thus the uncertainty about the efficiency of price response, and herd behavior are linked through this equation. This becomes clearer if we view 22 in its equivalent form $\Theta = \sigma / m$..

With this specification of the agents' behavior in equation 19, the stochastic price adjustment process in equations (10)-(12) and the stochastic inverse price response process in equations (20)-(22), we are in a position to examine how this system evolves. To do this, we formulate a simulation as described below.

3. Monte Carlo Simulation

The simulation revolves around randomizing two stochastic processes: the price adjustment process via the Wiener process and the herd process. We used Matlab to carry out the simulation program. For each choice of parameter value (see below) we ran up to 10,000 simulations for 100 time periods (corresponding roughly to 100 trading days). For a specific set of parameters described in Table 1 we choose three values for Θ that vary from zero to 0.75. As explained before, Θ reflect agents "subjective" probability of an underlying imperfection in the market, thus triggering use of other agents behavior as data points. Equation 22 makes it clear that Θ and the uncertainty about the market are linked. The value of daily volatility σ that is used in the Wiener process in (11) is chosen to correspond to the annual volatility of 16% ($.01\times\sqrt{256}$ for 256 trading days on average). The drift parameter, as in the case of volatility parameter, is based on an annualized rate of return for stocks. This long-term historical rate of return on stocks is about 8% leading to a daily value of .0003 ($.08 \div 256 \cong .0003$). Parameter α_o is the base (mean) value of α per equations (20) and (21) representing the elasticity of inverse supply response. But the uncertainty that is associated with the market efficiency may trigger a cascading phenomenon. Linking α in 20 with the cascading behavior captures this Θ. The parameter *m* that ties the stochasticity of α to cascading behavior Θ is chosen to be 2 (thus $\Theta = (1/2)\sigma_\alpha$). We experimented with higher values of m such as 3 but they produced completely explosive outcomes. The functions $\beta(P_{t+1}/P_t)$ with β' ≥0 and $\gamma(\eta_{t+1}/\eta_t)$ with γ'≤0 in equations 15 and 18 that represent the evolving coefficients of the Pareto distribution over time are specified as follows: We would like to capture *how rapidly/frequently* agents update their preference structure represented by their reservation values of P_r and η_r. To do so we specify the function forms of β and γ to reflect an *elasticity* value which we call ν and which we can increase or decrease to examine the impact of the agents' speed of preference update in our model. As it turns out, this single variable has the greatest impact in our model and one that is consistent with the evidence on OECD and emerging market. To keep the system simple we will assume that β and γ have the same functional form and parameter size with one being the negative of the other. This means the following:

$$\beta(P_{t+1}/P_t) = (P_{t+1}/P_t)^{\nu}, \qquad \gamma(\eta_{t+1}/\eta_t) = (\eta_{t+1}/\eta_t)^{-\nu} \; with \quad \nu \geq 0 \qquad (23)$$

We then allow the parameter ν to vary from zero (no preference update) to about 0.7 (rapid speed of preference update). In this way our Parto distribution will have a variety of tails. The values of $\underline{\eta}$ and $\underline{P}$ are the threshold values of these parameters for use in their respective Pareto distribution. In the program that is written for this purpose, the evolution of prices and η are constrained to stay above these threshold values.

3.1 Simulation outcome

Two clear patterns are discerned: The first pattern is an inverted U as reported in the first three panels in Figure 3. These correspond to the case of moderate to high preference update parameter (ν=0.3, 0.5, 0.7). The vertical axis is the volatility (i.e., Standard deviation) of the prices as they emerge from the full model (i.e., not same as σ, as we discussed), while the horizontal axis (titled transparency) is inversely related to the standard deviation of alpha and thus also inversely related to the value of Θ. Results for this group point to an inverted U: A rise in transparency initially increases volatility before it brings it down. In the first leg of the figures, we have high values of Θ (herd behavior). With greater transparency Θ falls, however, the inherent volatility in prices means that the greater reliance on the price channel (as 1-Θ increases) does *not* necessarily lower volatility and in fact increases it. However, eventually greater transparency eventually reduces price volatility (second leg). The explanation for the first leg of the curve is consistent with the Furman-Stiglitz effect (Furman and Stiglitz 1998) in which more transparency (which they interpret as a higher frequency of information release) increases price volatility. However, our finding suggest that this is not because of what Bushee and Noe (2000) called the competition among fund managers (a form of herd behavior) but because of the inherent price fluctuations. Undoubtedly herd behavior plays some role in this process but the entire rise in volatility for the first leg of the inverted U is unlikely to be entirely due to herd behavior.

The second pattern is seen in Figure 4 Panels A and B that report the simulation outcomes for the case of zero to mid preference update parameter (ν). This is a generally a downwardly sloping pattern, with some short-lived upward slope for mid transparency values in the case of $\nu = .1$. That one may detect two distinct patterns here is consistent with chaotic outcomes where a small change in the parameter values alters the results radically. The story here must be that less frequent update in prices must make the herd behavior more pernicious, thus increasing transparency, and removing this effect reduces volatility greatly. To check this result we compare both the herd and the price volatility over 100 periods among the five cases. This is reported in several panels of Figures 5 and 6. It is clear that the preference update mechanism provides a way in which cascades, even when they are formed, as shown by spikes in Figure 5, are eventually dampened. When this mechanism is weak or completely absent, the spikes in herd behavior (sell-to-buy ratios) is much more frequent and in the case of no preference updating actually grows in time. These are seen in Figure 6. It is this explanation that implies the important role that transparency plays in eventually reducing volatility as we saw in Figure 3.

Finally, consistent with this story, in the cases of low to no preference updating mechanism, price volatility appears to follow the stochastic volatility criterion of an EWMA (exponentially weighted moving average model) with no long-run pivot that would characterize a GARCH model (Figure 6).

4. Empirical Analysis

To test some of these predictions we use stock market data for a panel of 12 MENA economies and compare that with a total of 35 OECD and emerging market economies (see Table 2) for 2000 to 2009 from Bloomberg and Yahoo, along with specific indicators of financial transparency from the World Economic Forum. We use two such measures that are closely associated with our concept of financial market transparency: the strength of audit, and the transparency of government standards. Additional controls such as stock market turnover (to control of degree of liquidity) and volume of trade, as well as a number of other controls, are taken from Word Development Indicators. We choose the year 2000 as the starting point to allow sufficient number of emerging market economies to also be included in our sample. When combined with the number of countries this yields a sample of 337 observations. A more detailed description of the data can be found in the appendix. Table 3 provides a descriptive statistic of the variables used.

4.1 Methodology

We use a fixed effect panel estimator with heteroscedasticity robust standard errors to account for error clustering since some of the variables such a LIBOR, etc. are common among countries.

Using a fixed-effects model instead of a random effects model is also supported by results from the Hausman test. But to decide whether a country-fixed effect or a time fixed effect is more appropriate; we study the structure of the variance of our dependent variables. This is reported in the following table.

Variable	Mean	Std. Dev.	Min	Max	Observations
strength of audit:					
overall	5.44	.736	3.4	6.6	N = 245
between		.686	3.97	6.3	n = 34
within		.233	4.70	6.2	T-bar=7.2
Transparency of government policy:					
overall	4.59	.810	2	6.3	N = 214
between		.715	2.6	6.1	n = 34
within		.362	3.41	5.4	T-bar=6.29

As it can be seen from this ANOVA table, much more of the variation in volatility arises from cross-country differences than within-country variations over time. This is, as one would expect, from a slowly evolving pace of financial and instructional variables. Within the panel structure of the data, this means that we should examine our findings *both* with time-fixed effects with country-fixed effects. While we will include both effects in our regressions, one at a time, we do find a generally higher explanatory power from the time-fixed than from the country fixed effects.

To more rigorously examine the non-linearity associated with the inverted U (or U) effects, a method known as the extreme point is used. Extreme point is simply the solution to a quadratic equation using the coefficients. Lind and Mehlum (2007) compute an extreme value (solution to quadratic equation), within the data range when a coefficient on the linear and nonlinear term is significant. But as they argue, this is a necessary, but not a sufficient condition for existence of u-shape. Thus, the standard test of joint significance of the linear and quadratic term is not completely adequate, and one needs more than just the joint significance of the two coefficients. Because of the composite nature of the hypothesis (a positive slope to the left of the extreme value and a negative slope to the right of the extreme value), Sasabuchi (1980) apply a likelihood ratio test to examine the non-linearity hypothesis. Our table of results, discussed below, shows both the value of the extreme, based on Lind and Mehlum (2007) as well as the likelihood ratio test based on Sasabuchi (1980).

4.2 Results

Tables 4-6 report the results in pairs. In each pair, one table is for volatility and coefficient of variation as measure of the dependent variables, and the other table is for their logarithms as measures of the dependent variables. Further, for each measure of the dependent variable in each table, a 2-column pair, (one with U effect terms only, and one will full set of controls), is estimated for country-fixed effects, to be followed by a second 2-column pair for time-fixed effects. Tables 4A and 4B and Tables 6A and 6B correspond to the full sample, while the middle pair (Tables 5A and 5B) report the results for the MENA subsample. Since the difference between the last pair (6A and 6B) and the first pair (4A and 4B) is only the addition of the "oil curse" variables, we will postpone that discussion for now, focusing instead on a comparison of the first pair for the full sample (4A and 4B) and the middle pair for the MENA group (Tables 5A and 5B). First, both groups indicate *strong* and *generally robust* support for the inverted-U effect as reflected in the indicator, "strength of audit," though this variable appears even more robust (to model variation) in the full sample in than in the MENA subsample. Of particular significance is the fact that MENA countries show a significant U effect of transparency on financial volatility only in the time-fixed effects models (Table 5A, columns 3, 4, 11 and 12; Table 5B, columns 3 and 4), but not in country-fixed effects models, whereas the full sample shows this effect to be present in both time-fixed and country fixed effects models. Thus in the MENA group supports that the U theory is found when controlling for unobserved time-specific heterogeneity rather than unobserved country specific heterogeneity.

The government transparency variable seems to provide some but *weaker* and *less robust* support for the inverted U hypothesis: For example, it shows up only for two of our four measures of financial volatility; it is significant only in the absence of other variables. This is unlike the audit variable, which remains significant regardless of inclusion or exclusion of other controls. (One exception is Table 4B, columns 7 and 8). Notice that there is some evidence that improving government transparency may reduce financial volatility (Table 4A 4B, and 5A, last two columns). While this suggests that the U effect hypothesis has less clear support using the transparency of government policy indicator than the strength of audit indicator, taken altogether it does suggest that even the transparency of government policy indicator can be useful in reducing financial instability.

As for other regressors, one variable of interest is the dummy variable associated with the 2008 crisis. This variable takes on the value of 1 post-2008 (including 2008) and zero otherwise. Financial crisis seems to have significantly impacted financial volatility for both the MENA countries and for the full sample of countries. The result seems robust. Finally, trade provides some stabilizing influence on financial volatility, but the result is not very robust and depends somewhat on model specification. An similar statement can be said of the 3-month Libor that captures the global risk premium.

Let us now focus on the oil curse variables. For this purpose, we introduce two additional variables to the full sample, oil rents as a fraction of GDP, and oil price volatility. Oil price volatility plays a more systematic role in raising financial volatility than oil rents. Oil rents seem to be associated with a higher level of financial volatility for some model specifications but lower for other model specifications. Thus, no general conclusion can be reached with respect to the direct effect of the natural resource curse on financial instability via the channel of poor governance[8]. But the resource volatility channel does seem to be supported by the evidence. As for other variables, both the inverted U effect (via the strength of audit variable) and the 2008 crisis variable remain the same as before, reinforcing the robustness of these two findings.

It should be noted, as can be seen from all the tables, that in nearly all cases in the above discussion, the Sasabuchi (1980) test indicates a true inverted U pattern in which the pattern is not merely concave but turns downward. To illustrate this we have developed a scatter plot of

[8] Ascribing poor governance channel of oil curse with oil rent directly is based on the potential for mismanagement and corruption in distribution of the oil revenues.

the result for the strength of audit variable for the full sample (Figure 9). As can be seen, the curve does indeed show an inverted U pattern.

5. Summary and Conclusion

We have developed a randomized model of financial cascades, i.e., information free ridership, in circumstances when uncertainty is high and markets are informationally opaque. We have numerically simulated this model, using a Monte Carlo method. We have discovered that at very limited transparency, an initial increase in transparency may initially increase volatility, but will eventually reduce volatility.

Since financial cascades flourish under extreme forms of uncertainty, they are likely to flourish in informationally and institutionally imperfect markets. Of the two empirical measures of transparency that we have presented the "Strength of Audit and Accounting Standards" is found to provide solid support for the ideas in the theory for the 35 sample countries and the MENA group.

To the extent that the "volatility bump" associated with the initial rise in transparency is consistent with the Furman-Stiglitz (1998) thesis (more information leading to more short term trade and thus more volatility) the mechanism at work, within the structure of our model, is that traders can update their preferences rapidly. In our model this has do to with higher values of the parameter ν. Higher values of ν clear the markets better and reduce *information traps* described by Chari and Kehoe (2004). Thus our theoretical results in Figure 3 for high ν values are consistent with our empirical findings for the strength of audit variable. That the transparency variable associated with government policy does not provide as robust a support for the inverted U hypothesis, may indicate that our traders preferences update parameter adjusts *less* rapidly when new information arrives from government policy, making this set of results actually more consistent with the theoretical pattern that we found in Figure 4 for low ν values, than those we found in Figure 3 for high ν values.

There are two key overall policy lessons that stem from our research: The first lesson is that *targeted* reforms that address financial transparency directly, such as the strengthening of auditing practices, are more critical and effective in promoting financial stability than are general macro policies, though the latter can also be useful. The second lesson is that even such targeted reforms as the strengthening of auditing practices are effective *only* when they are *extensive.* Limited transparency reforms may in fact worsen financial instability as indicated by the inverted U pattern. It is in this range where the Furman and Stiglitz (1998) hypothesis, that higher transparency can worsen financial volatility, finds validity. One example of extensive reforms is banking reforms and the regulatory compliance of the banking systems with BASEL rules (BASEL II and III). These rules entail, among other elements, the strengthening of auditing practices but go much beyond. Such reforms should go a long way in producing greater financial stability.

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Figure 1a: Probability Distribution of Agents Based on their Preference

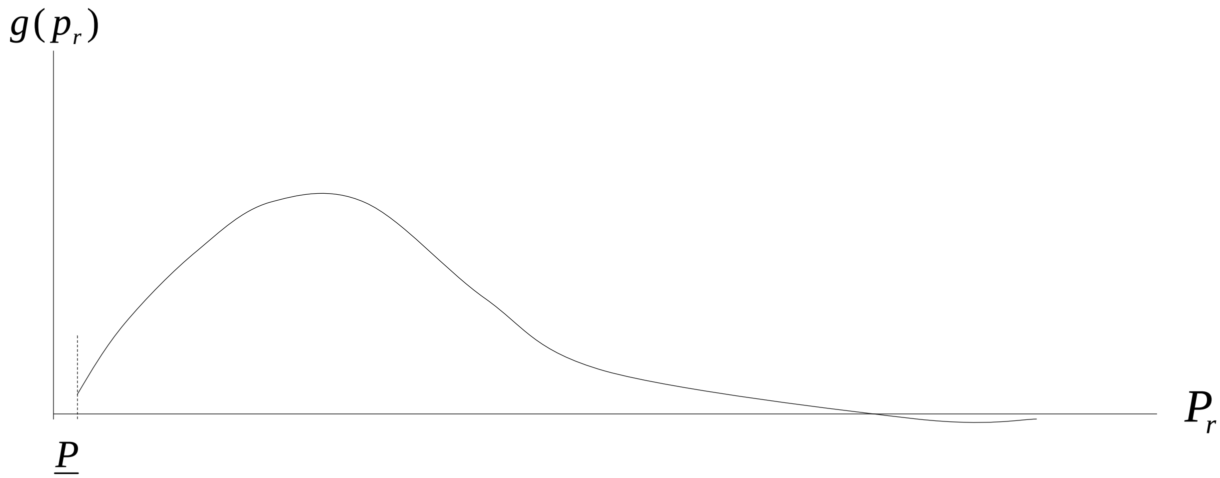


Figure 1b: Probability Distribution of Agents Based on their Preference

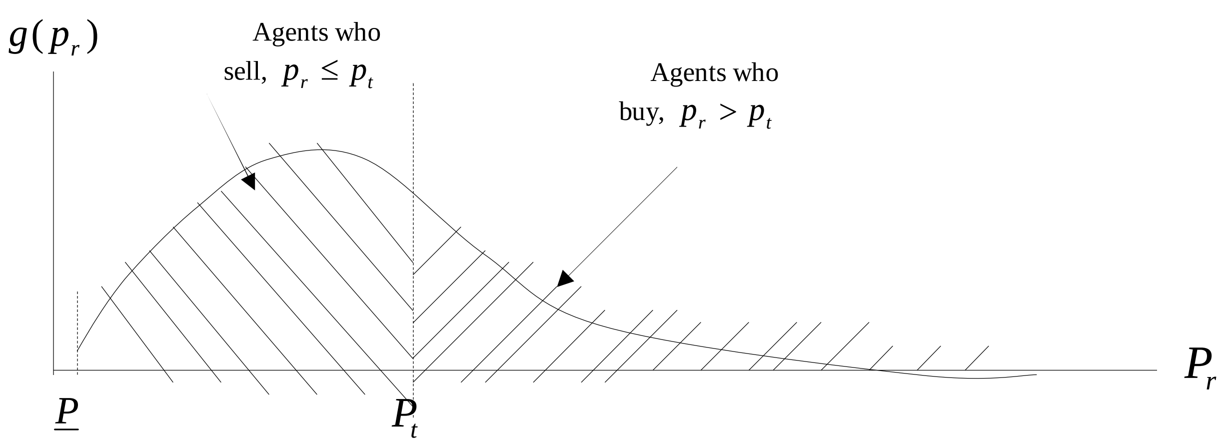


Figure 2: Probability Distribution of Agents Based on their Preference

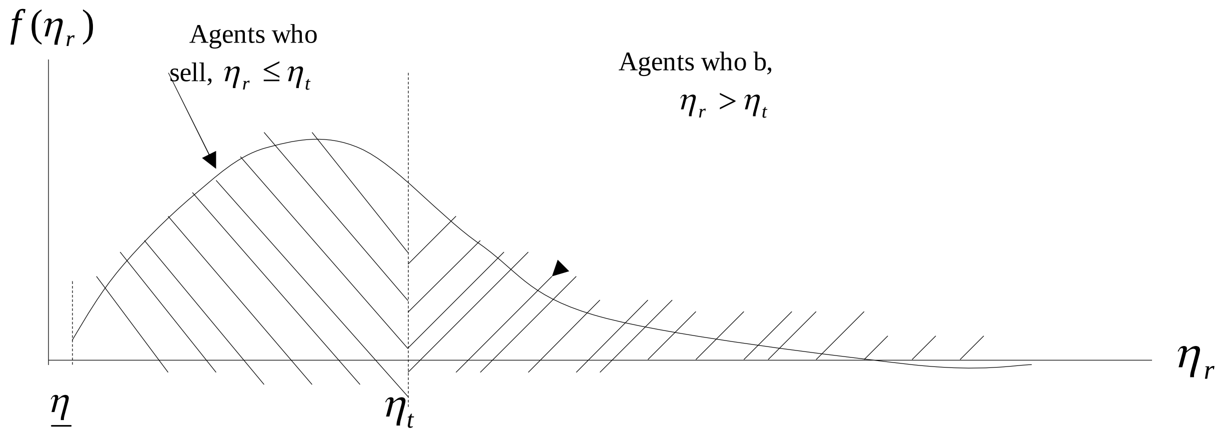
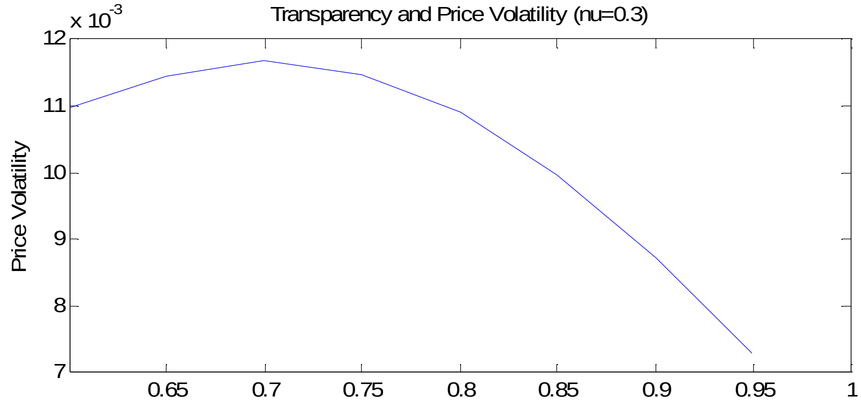
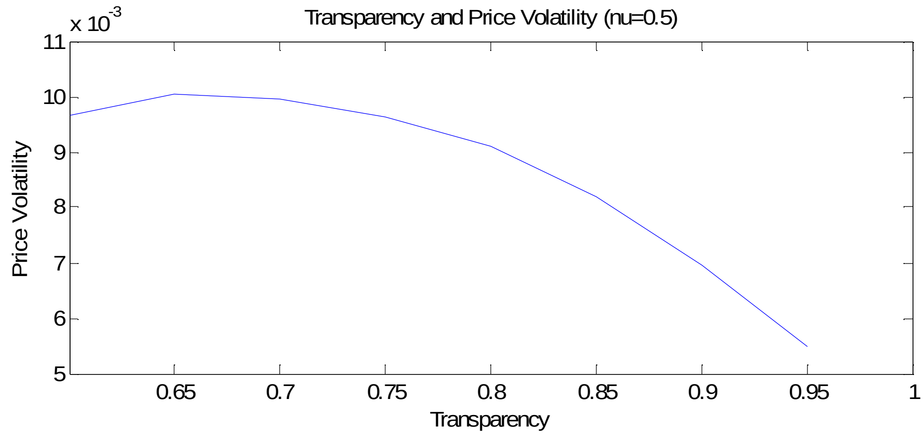


Figure 3-Transparency and Price Volatility: Mid to High Values of nu parameter

Panel A



Panel B



Panel C

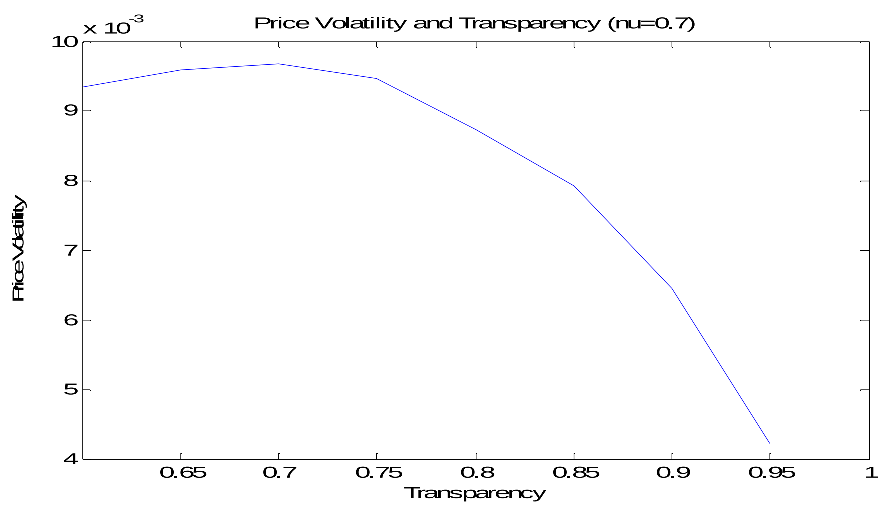
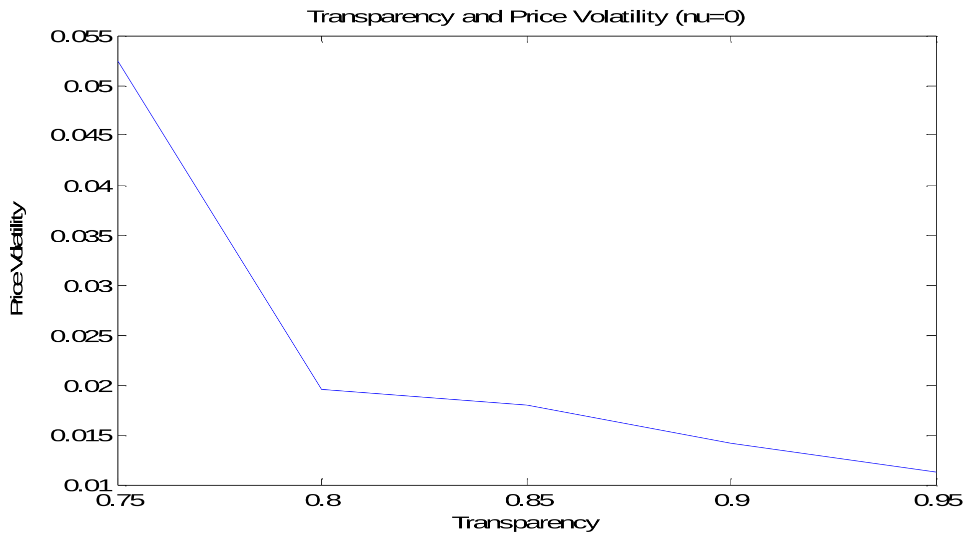


Figure 4: Transparency and Price Volatility: Low Values of nu Parameter

Panel A



Panel B

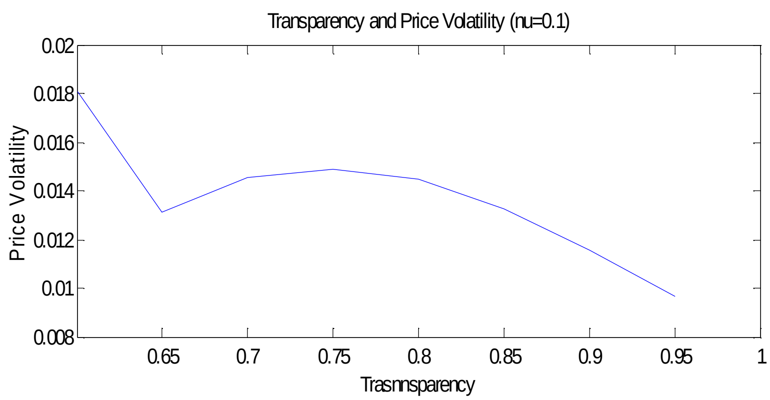
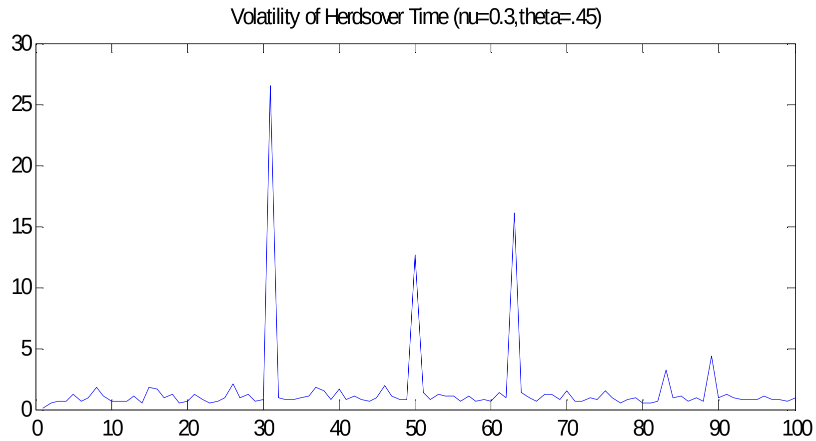
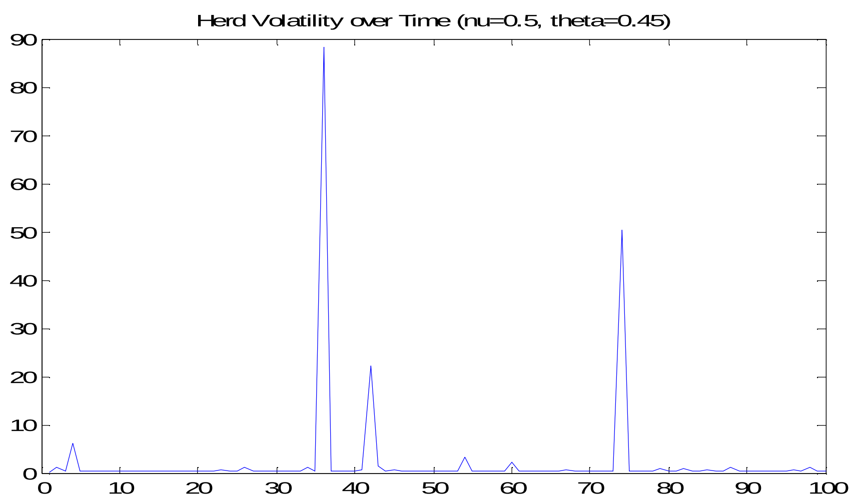


Figure 5: Herd Volatility over Time: Mid to High Values of nu parameter

Panel A



Panel B



Panel C

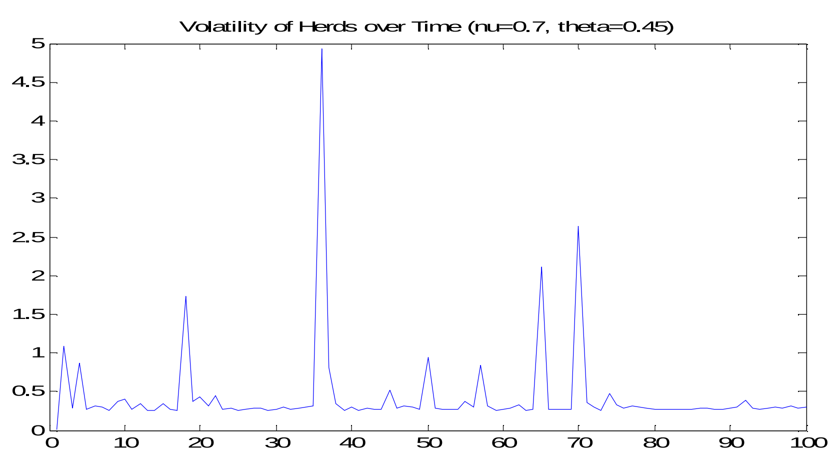
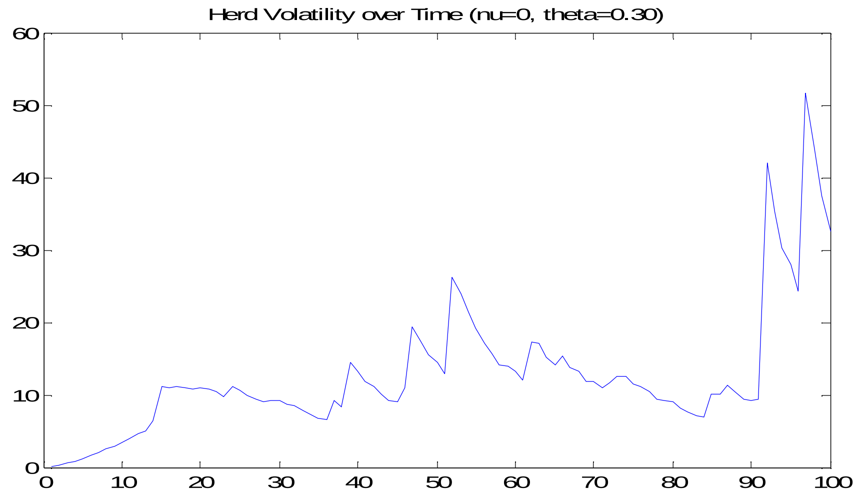


Figure 6: Herd Volatility over Time: Low Values of nu Parameter

Panel A



Panel B

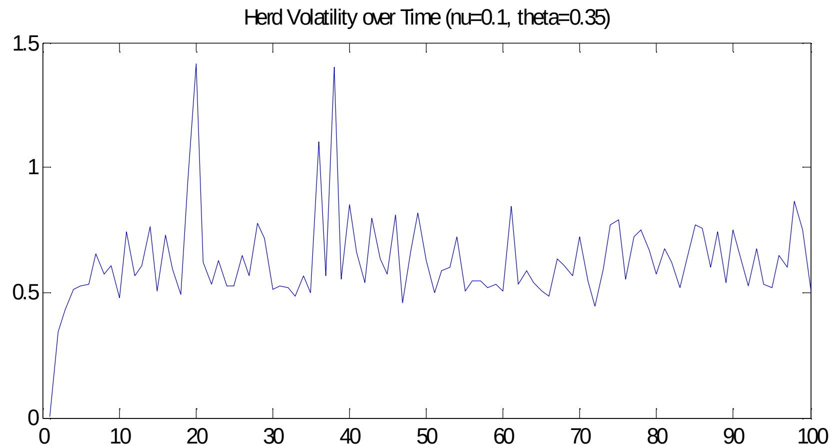
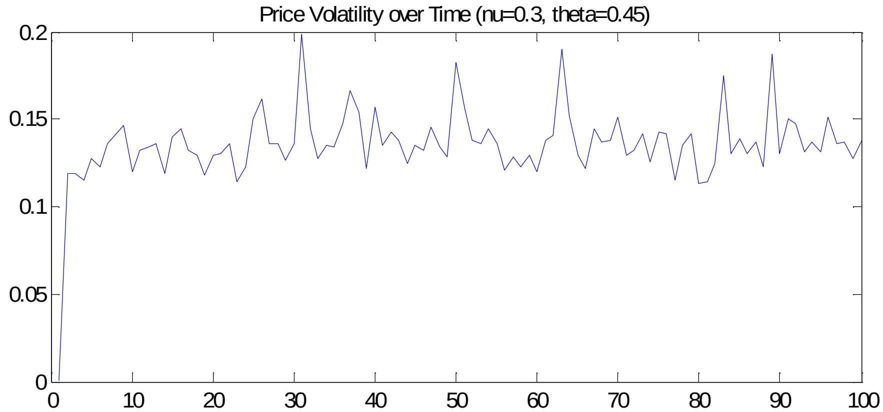
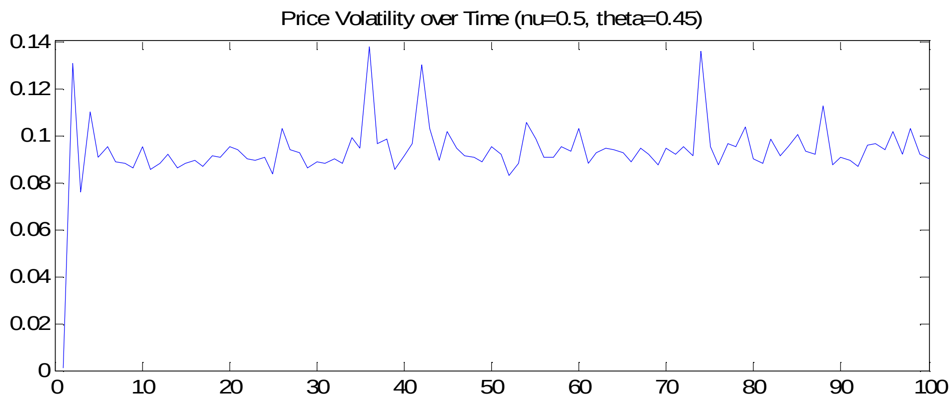


Figure 7: Price Volatility over Time: Mid to High Values of nu parameter

Panel A



Panel B



Panel C

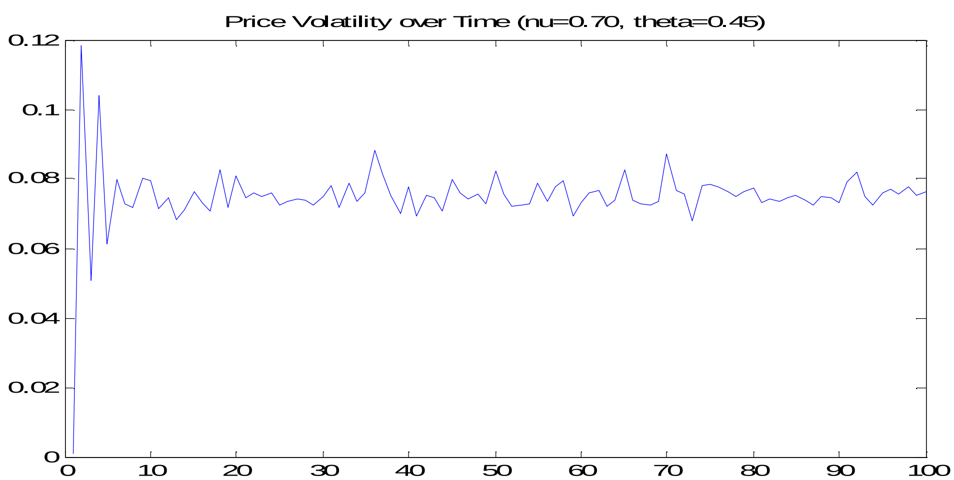
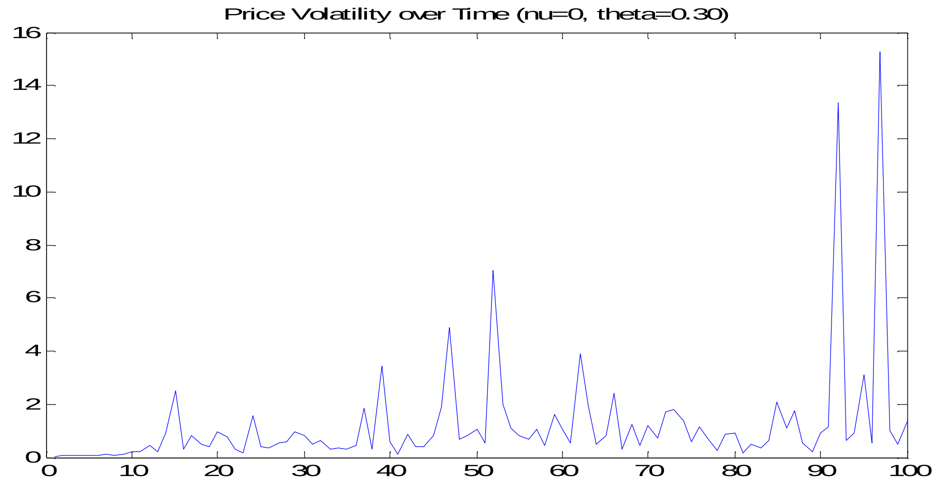


Figure 8: Price Volatility over Time: Low Values of nu Parameter

Panel A



Panel B

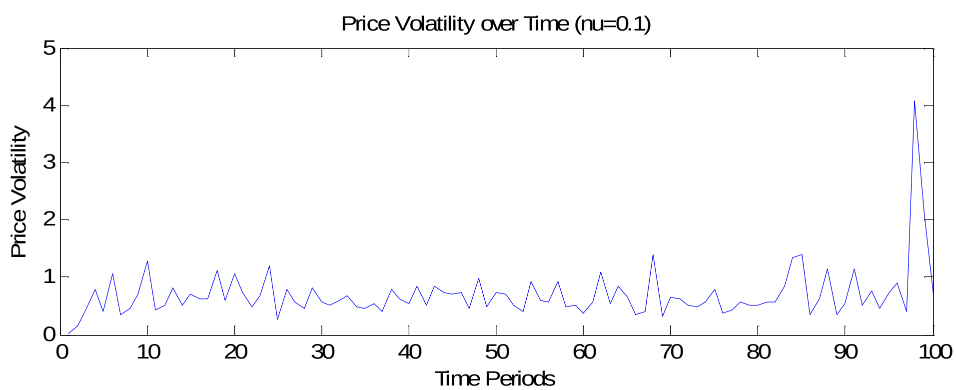


Figure 9: Scatter Plot of the Impact of Accounting on Audit Standards on Price Volatility for full sample

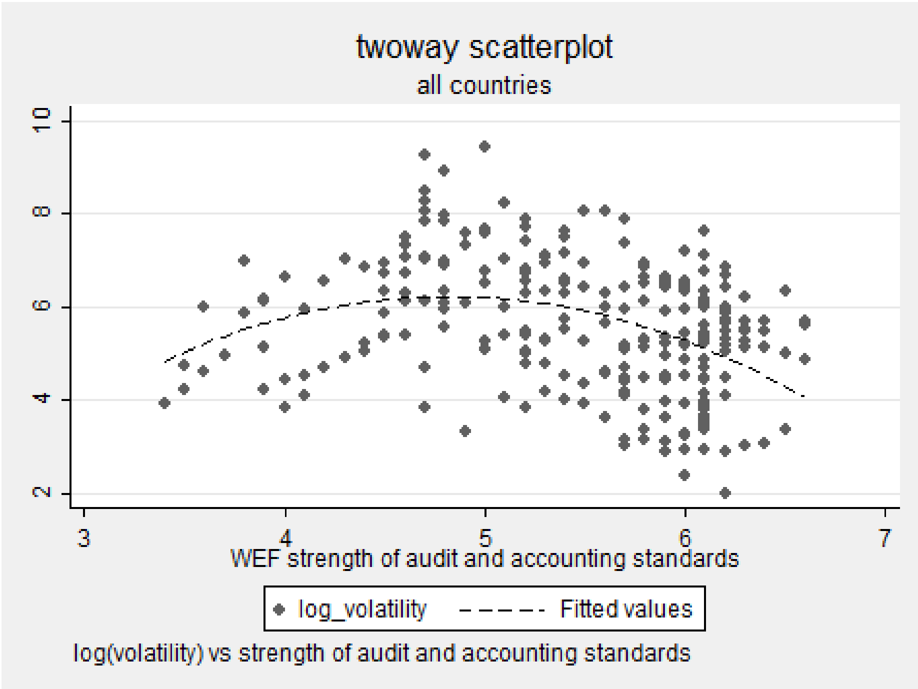


Table 1: Parameters and Initialization

Preference update	ν	0-.70
Daily volatility of stock price	σ	0.01
Initial value of price efficiency indicator α subject to randomization (its SD indicates high uncertainty about the price mechanism, thus low transparency)	α_o	1.00
Initial value of Pareto of Pareto distribution parameter for reservation price tied to preference update (ν) and price changes	β_o	0.9
Initial value of Pareto di Pareto distribution parameter for reservation sell-buy ratio tied to preference update (ν) and changes in sell-buy ratio	δ_o	0.9
Weight on herd versus price channel (tied to α)	Θ	0.05-0.80
Drift of stock price on daily basis	μ	0.0003
Lower bound threshold value of Pareto distribution for sell-buy ratio	$\underline{\eta}$	0.1
Lower bound threshold value of Pareto distribution for stock price	$\underline{P}$	0.1
Factor tying Θ to α	M	2
Initial price and sell-buy ratio for the dynamics		1

Table 2: List of Sample Countries

Argentina	Indonesia	Oman
Australia	Israel	Qatar
Austria	Japan	Saudi Arabia
Bahrain	Jordan	Singapore
Belgium	Kuwait	Spain
Brazil	Lebanon	Sweden
Canada	Malaysia	Switzerland
China	Mexico	Tunisia
Egypt	Morocco	UAE
France	Netherlands	United Kingdom
Germany	New Zealand	United States
India	Norway	

Table 3: Descriptive Statistics

Panel A: Full sample of all 35 countries, 2000-2009

Variable	Observations	Mean	Std. Deviation.	Min	Max
Volatility	331	597.0451	1179.519	7.413905	12465.63
Coefficient of Variation	331	0.110041	0.064852	0.01743	0.328198
GDP per Capita	330	18798.01	14515.47	452.969	86435.82
Trade	323	87.59078	65.36311	20.4854	438.092
Turnover Ratio	335	73.82976	59.36593	0	348.581
Stocks Traded	337	67.95105	76.68334	0	409.522
Libor 3-month (mean)	331	3.221514	1.836048	0.69214	6.528167
Oil Price Volatility	338	0.148302	0.060532	0.08608	0.298077
Oil & Gas Rent per GDP	295	0.120517	0.225124	0	2.62
Strength of Audit and Accounting Standards	245	5.446531	0.7361	3.4	6.6
Transparency of Government Standards	214	4.593458	0.809135	2	6.3

Panel B: Sample of 11 MENA countries, 2000-2009

Variable	Observations	Mean	Std. Deviation.	Min	Max
Volatility	113	518.6573	681.8706	12.93168	3855.599
Coefficient of Variation	113	0.117639	0.065953	0.019375	0.328198
GDP per Capita	112	16121.54	17172.02	1041.296	86435.82
Trade	108	92.7014	31.52055	39.01794	175.9588
Turnover Ratio	117	41.4768	46.49363	0	288.4
Stocks Traded	119	35.93218	60.05092	0	393.412
Libor 3-month (mean)	113	3.197369	1.83161	0.692142	6.528167
Oil Price Volatility	120	0.147279	0.059988	0.08608	0.298078
Oil & Gas Rent per GDP	108	0.231450	0.223164	0	0.694042
Strength of Audit and Accounting Standards	67	5.122388	0.503569	3.8	6.2
Transparency of Government Standards	58	4.517241	0.559492	3.3	5.6

Table 4A: Transparency and Volatility: All Countries Sample (Dependent Variables; volatility and coefficient of variation)

	Volatility								Coefficient of Variation							
	(1) Strength of Audit		(2) Strength of Audit		(3) Transp. of Gov't Policy		(4) Transp. of Gov't Policy		(5) Strength of Audit		(6) Strength of Audit		(7) Transp. of Gov't Policy		(8) Transp. of Gov't Policy	
Transparency	1197.063**	-624.8905	4537.922***	5126.8617***	1443.6921	887.9238	935.1229*	936.7645	0.3142***	0.1194	0.0859	0.1104	0.0331	-0.0450	-0.0697**	-0.0504*
	(475.8156)	(1305.8253)	(1010.3725)	(1114.1540)	(982.4486)	(857.0716)	(547.2026)	(607.9659)	(0.0827)	(0.0752)	(0.0750)	(0.0773)	(0.0546)	(0.0476)	(0.0294)	(0.0282)
Transparency2	-117.680***	41.9199	-472.4599***	-508.1536***	-135.7232	-95.3151	-158.31***	-137.226**	-0.032***	-0.0130*	-0.0108	-0.0131*	-0.0043	0.0040	0.0050	0.0027
	(40.2240)	(113.4207)	(103.1357)	(107.4176)	(100.4273)	(89.1435)	(60.5894)	(66.3461)	(0.0079)	(0.0072)	(0.0070)	(0.0071)	(0.0063)	(0.0048)	(0.0033)	(0.0032)
Trade		-2.9264		-4.3106***		-5.6247		-2.7555**		-0.0005		0.0000		-0.0004		0.0001**
		(8.4961)		(1.3327)		(9.5577)		(1.2546)		(0.0004)		(0.0000)		(0.0005)		(0.0000)
Turnover Ratio		-1.3247		-3.0414**		-1.0293		-3.7204***		-0.0003		0.0002*		-0.0001		0.0002*
		(4.9118)		(1.3385)		(5.0005)		(1.3800)		(0.0002)		(0.0001)		(0.0002)		(0.0001)
Stocks Traded		3.3913		0.5526		2.4573		0.9785		0.0003		-0.0001**		0.0002		-0.0001*
		(2.9222)		(0.7514)		(2.9010)		(0.8471)		(0.0002)		(0.0001)		(0.0002)		(0.0001)
Log (GDP per Capita)		958.5001*		-71.0416		983.0262*		-77.2935		0.0147		-0.0009		0.0375		-0.0050
		(477.8842)		(58.0333)		(494.7904)		(50.4661)		(0.0361)		(0.0039)		(0.0462)		(0.0038)
Libor 3-month (mean)		-44.7606*		-20.8802		-28.4704		-59.9391		-0.012***		-0.012***		-0.012***		-0.014***
		(23.2560)		(94.5636)		(27.6678)		(96.2615)		(0.0027)		(0.0029)		(0.0026)		(0.0028)
Financial Crisis Dummy (2008=1)		707.60***		620.8328		726.610***		595.3655		0.0920***		0.0791***		0.0892***		0.0756***
		(230.3464)		(428.1540)		(233.6718)		(434.4611)		(0.0089)		(0.0122)		(0.0087)		(0.0120)
Constant	-2290.7821	-5992.7862	-10078.26***	-10417.582***	- 2988.8065	-10130.52**	-537.3982	1003.6254	-0.630***	-0.2137	-0.0279	-0.0553	0.0597	-0.0614	0.3348***	0.3656***
	(1506.9523)	(4272.4786)	(2395.0960)	(2526.5295)	(2339.917 5)	(4499.7345)	(1302.5473)	(1547.6425)	(0.2170)	(0.3519)	(0.1961)	(0.2045)	(0.1160)	(0.3404)	(0.0645)	(0.0702)
Time Fixed	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Country Fixed	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No
R2	0.0027	0.1523	0.1551	0.2096	0.0173	0.1588	0.1558	0.1841	0.0462	0.4568	0.4480	0.4713	0.0026	0.4602	0.4640	0.5050
N	245.0000	238.0000	245.0000	238.0000	214.0000	207.0000	214.0000	207.0000	245.0000	238.0000	245.0000	238.0000	214.0000	207.0000	214.0000	207.0000
U-shape joint significance p-value	0.0184		0.0000	0.0000			0.0005	0.0079	0.0006	0.0815		0.0000				
Sasabuchi test of u-shape p-value	0.0152		0.0000	0.0000			0.0768	0.0841	0.0003	0.0676		0.0919				
estimated extreme point, bounds of Fieller interval	5.086123 [2.59; 6.69]		4.802442 [4.63, 4.94	5.044599 [4.83, 5.20]			2.953446 [-1.71, 3.93]	3.413233 [-19.0, 4.3]	4.902966 [4.3, 5.29]	4.60669 [-inf,+inf]		4.200362 [-inf,+inf]				

Notes: * p<0.10, ** p<0.05, *** p<0.01, Panel Estimation with Heteroscedasticity Robust Standard Errors; Standard Errors are presented in parenthesis; U-test was done using a u-test command in STATA, the interval for u-test was set to 1-7 the value range for strength of audit and transparency of government policy; we also report Fieller interval for extreme point. Countries in the sample: Argentina, Australia, Austria, Bahrain, Belgium, Brazil, Canada, China, Egypt, Arab Rep., France, Germany, India, Indonesia, Israel, Japan, Jordan, Kuwait, Lebanon, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Oman, Qatar, Saudi Arabia, Singapore, Spain, Sweden, Switzerland, Tunisia, United Arab Emirates, United Kingdom, United States

Table 4B: Transparency and Volatility: All Countries Sample (Dependent Variables; log of volatility and log of coefficient of variation)

	Log Volatility								Log Coefficient of Variation							
	(1) Strength of Audit		(2) Strength of Audit		(3) Transp. of Gov't Policy		(4) Transp. of Gov't Policy		(5) Strength of Audit		(6) Strength of Audit		(7) Transp. of Gov't Policy		(8) Transp. of Gov't Policy	
Transparency	4.3219***	2.2904*	5.4635***	5.8879***	0.6710	-0.1801	1.5470**	1.9916***	3.3976***	1.6639**	1.4135**	1.6063**	0.0479	-0.7085	-0.6078**	-0.3853
	(1.3486)	(1.3252)	(1.2742)	(1.2630)	(1.0517)	(0.7662)	(0.6908)	(0.7296)	(0.7467)	(0.6176)	(0.6852)	(0.6993)	(0.5329)	(0.5057)	(0.2742)	(0.2616)
Transparency2	-0.4156***	-0.2436*	-0.5746***	-0.5950***	-0.0373	0.0250	-0.2335***	-0.2643***	-0.3605***	-0.1868***	-0.1611**	-0.1816***	-0.0155	0.0700	0.0430	0.0151
	(0.1270)	(0.1207)	(0.1258)	(0.1234)	(0.1121)	(0.0803)	(0.0812)	(0.0859)	(0.0755)	(0.0619)	(0.0648)	(0.0652)	(0.0622)	(0.0535)	(0.0313)	(0.0309)
Trade		0.0000		-0.0052***		-0.0009		-0.0028*		-0.0049		0.0003		-0.0026		0.0014***
		(0.0081)		(0.0014)		(0.0074)		(0.0016)		(0.0053)		(0.0004)		(0.0053)		(0.0004)
Turnover Ratio		-0.0008		-0.0072***		0.0009		-0.0081***		-0.0006		0.0022**		0.0009		0.0020*
		(0.0036)		(0.0023)		(0.0036)		(0.0024)		(0.0024)		(0.0010)		(0.0025)		(0.0010)
Stocks Traded		0.0027		0.0030*		-0.0001		0.0033*		0.0012		-0.0019***		-0.0005		-0.0019**
		(0.0030)		(0.0015)		(0.0027)		(0.0017)		(0.0020)		(0.0006)		(0.0019)		(0.0007)
Log (GDP per Capita)		1.3865***		-0.0342		1.7988***		-0.0733		-0.0502		0.0165		0.2108		-0.0309
		(0.4554)		(0.0804)		(0.5467)		(0.0745)		(0.3329)		(0.0385)		(0.4216)		(0.0355)
Libor 3-month (mean)		-0.0329		-0.0442		-0.0299		-0.0894		-0.1093***		-0.1335***		-0.1214***		-0.1589***
		(0.0281)		(0.0691)		(0.0271)		(0.0703)		(0.0250)		(0.0310)		(0.0239)		(0.0309)
Financial Crisis Dummy (2008=1)		0.8140***		0.8661***		0.7939***		0.8229***		0.7806***		0.6628***		0.7453***		0.6271***
		(0.0787)		(0.2427)		(0.0743)		(0.2468)		(0.0673)		(0.0889)		(0.0696)		(0.0874)
Constant	-5.3968	-12.6561***	-7.2280**	-7.0484**	3.3366	-10.9653***	3.0957**	4.1180**	-9.9787***	-4.7045	-5.0922***	-5.4888***	-2.2199*	-2.1638	-0.3424	-0.2680
	(3.6316)	(4.5238)	(3.1418)	(3.2175)	(2.4293)	(3.8515)	(1.4615)	(1.6403)	(1.8558)	(3.0136)	(1.7706)	(1.8398)	(1.1236)	(2.9637)	(0.5940)	(0.6368)
Time Fixed	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Country Fixed	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No
R2	0.0532	0.4284	0.2542	0.3208	0.0346	0.4510	0.2601	0.3179	0.0706	0.3936	0.4469	0.4760	0.0035	0.3967	0.4540	0.5024
N	245.0000	238.0000	245.0000	238.0000	214.0000	207.0000	214.0000	207.0000	245.0000	238.0000	245.0000	238.0000	214.0000	207.0000	214.0000	207.0000
U-shape joint significance p-value	0.0097	0.0189	0.0000	0.0000			0.0000	0.0021	0.0001	0.0059	0.0000	0.0000				
Sasabuchi test of u-shape p-value	0.00299	0.0532	0.0000178	0.0000			0.0216	0.00491	0.000043	0.00689	0.0254	0.0151				
estimated extreme point,	5.199735	4.701462	4.753865	4.947558			3.312659	3.768237	4.71289	4.453629	4.387785	4.421426				
bounds of Fieller interval	[4.44, 5.29]	[-inf,+inf]	[4.45, 4.92]	[4.67,5.17]			[1.22,3.82]	[2.72, 4.22]	[4.28, 5.07]	[3.12, 5.01]	[0.94, 4.84]	[2.11,4.89]				

Notes: * p<0.10, ** p<0.05, *** p<0.01, Panel Estimation with Heteroscedasticity Robust Standard Errors; Standard Errors are presented in parenthesis; U-test was done using a u-test command in STATA, the interval for u-test was set to 1-7 the value range for strength of audit and transparency of government policy; we also report Fieller interval for extreme point. Countries in the sample: Argentina, Australia, Austria, Bahrain, Belgium, Brazil, Canada, China, Egypt, Arab Rep., France, Germany, India, Indonesia, Israel, Japan, Jordan, Kuwait, Lebanon, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Oman, Qatar, Saudi Arabia, Singapore, Spain, Sweden, Switzerland, Tunisia, United Arab Emirates, United Kingdom, United States

Table 5A: Transparency and Volatility: MENA Countries Sample (Dependent Variables; volatility and coefficient of variation)

	Volatility								Coefficient of Variation							
	(1) Strength of Audit		(2) Strength of Audit		(3) Transp. of Gov't Policy		(4) Transp. of Gov't Policy		(5) Strength of Audit		(6) Strength of Audit		(7) Transp. of Gov't Policy		(8) Transp. of Gov't Policy	
Transparency	778.6485	1304.9632	3735.293***	4710.338***	3999.7910*	1968.3041	-706.8095	-90.3647	0.1209	-0.0762	0.3774**	0.4950**	0.2030	0.1308	-0.3965*	-0.4080*
	(1819.44)	(1083.713)	(1378.8430)	(1381.9025)	(2120.564)	(1872.407)	(1443.921)	(1466.104)	(0.1985)	(0.1502)	(0.1652)	(0.1965)	(0.1163)	(0.2099)	(0.2152)	(0.2296)
Transparency2	-71.7696	-144.2611	-396.948***	-511.9572***	-428.5553*	-228.9947	53.5400	-19.1280	-0.0113	0.0063	-0.0387**	-0.05***	-0.0231	-0.0152	0.0419*	0.0416
	(166.0955)	(107.4274)	(139.2490)	(136.2244)	(222.4816)	(199.2028)	(168.7852)	(170.3451)	(0.0198)	(0.0158)	(0.0165)	(0.0189)	(0.0141)	(0.0228)	(0.0240)	(0.0253)
Trade		8.0165		-5.9525***		4.0806		-5.1975*		-0.0006		-0.0004*		-0.0006		-0.0002
		(7.4013)		(2.0229)		(5.8298)		(2.5930)		(0.0009)		(0.0003)		(0.0010)		(0.0003)
Turnover Ratio		14.3738**		3.5548		13.5201**		6.0802		0.0000		0.0007*		0.0000		0.0008*
		(5.3761)		(3.2549)		(4.9995)		(4.3333)		(0.0006)		(0.0004)		(0.0006)		(0.0004)
Stocks Traded		-3.7661		0.3576		-5.2195		-3.9304		0.0003		-0.0002		0.0001		-0.0004
		(2.9819)		(2.6029)		(3.2248)		(3.8352)		(0.0003)		(0.0003)		(0.0003)		(0.0004)
Log (GDP per Capita)		-47.8648		202.6214***		12.8959		93.6392		-0.0415		0.0085		-0.0375		0.0095
		(187.7237)		(67.3904)		(235.6373)		(80.3072)		(0.0382)		(0.0079)		(0.0694)		(0.0074)
Libor 3-month (mean)		-7.0806		62.0040		15.7687		60.2039		-0.0056		0.0006		-0.0037		-0.0010
		(21.9438)		(43.7985)		(28.8680)		(49.3837)		(0.0049)		(0.0057)		(0.0054)		(0.0056)
Financial Crisis Dummy (2008=1)		560.619***		810.4853***		618.7003**		807.4640**		0.086***		0.0729***		0.0873***		0.0729***
		(160.0746)		(276.7858)		(203.0569)		(309.0489)		(0.0181)		(0.0238)		(0.0221)		(0.0251)
Constant	-1456.6235	-3145.0734	-8372.797**	-11668.12***	-8570.5625	-4588.6278	2186.8502	772.4246	-0.1933	0.7696	-0.7534*	-1.1427**	-0.3137	0.2329	1.0636**	1.0139*
	(4935.351)	(3965.742)	(3421.7122)	(3249.7605)	(4980.228)	(3394.037)	(3060.567)	(3096.523)	(0.4988)	(0.4611)	(0.4100)	(0.4793)	(0.2396)	(0.1649)	(0.4802)	(0.5032)
Time Fixed	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Country Fixed	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No
R2	0.0025	0.6379	0.4426	0.6657	0.1168	0.6564	0.4384	0.5723	0.0044	0.4075	0.3167	0.4515	0.0221	0.4288	0.3752	0.4731
N	67.0000	62.0000	67.0000	62.0000	58.0000	53.0000	58.0000	53.0000	67.0000	62.0000	67.0000	62.0000	58.0000	53.0000	58.0000	53.0000
U-shape joint significance p-value			0.0038	0.0000	0.1620						0.0555	0.0102				
Sasabuchi test of u-shape p-value			0.00492	0.000867	0.0451						0.0136	0.00842				
estimated extreme point, bounds of Fieller interval			4.705011 [4.02, 4.94]	4.600324 [3.96, 4.88]	4.666599 [-inf, +inf]						4.873812 [3.8, 5.3]	4.870297 [3.7, 5.2]				

Notes: * p<0.10, ** p<0.05, *** p<0.01, Panel Estimation with Heteroscedasticity Robust Standard Errors; Standard Errors are presented in parenthesis; U-test was done using a u-test command in STATA, the interval for u-test was set to 1-7 the value range for strength of audit and transparency of government policy; we also report Fieller interval for extreme point. Countries in the sample: Bahrain, Egypt, Arab Rep., Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, United Arab Emirates

Table 5B: Transparency and Volatility: MENA Countries Sample (Dependent Variables; log of volatility and log of coefficient of variation)

	Log Volatility								Log Coefficient of Variation							
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Strength of Audit		Strength of Audit		Transp. of Gov't Policy		Transp. of Gov't Policy		Strength of Audit		Strength of Audit		Transp. of Gov't Policy		Transp. of Gov't Policy	
Transparency	1.0088	1.2059	7.5444***	6.7315**	5.8532**	1.1309	-1.4800	0.0345	0.1336	-1.0904	2.4354	2.9627	1.2777	0.5902	-2.8307	-3.0333
	(4.5521)	(2.4026)	(2.4495)	(2.8512)	(1.9621)	(2.5580)	(3.3940)	(3.5984)	(1.7819)	(1.7665)	(1.6991)	(2.0584)	(1.4257)	(2.4178)	(2.0895)	(2.1913)
Transparency2	-0.1038	-0.1409	-0.8358***	-0.8031***	-0.6072**	-0.1283	0.1088	-0.0712	-0.0026	0.1041	-0.2497	-0.3138	-0.1378	-0.0635	0.2977	0.3038
	(0.4495)	(0.2516)	(0.2486)	(0.2814)	(0.2423)	(0.2846)	(0.3936)	(0.4186)	(0.1859)	(0.1892)	(0.1688)	(0.1978)	(0.1726)	(0.2696)	(0.2371)	(0.2444)
Trade		0.0225*		-0.0060*		0.0224*		-0.0060		-0.0018		-0.0036		0.0007		-0.0014
		(0.0113)		(0.0035)		(0.0122)		(0.0058)		(0.0104)		(0.0024)		(0.0120)		(0.0029)
Turnover Ratio		0.0070		-0.0018		0.0041		0.0037		0.0006		0.0052		0.0011		0.0061
		(0.0079)		(0.0054)		(0.0083)		(0.0086)		(0.0051)		(0.0034)		(0.0049)		(0.0038)
Stocks Traded		0.0031		0.0075*		0.0021		-0.0021		0.0033		-0.0000		0.0027		-0.0026
		(0.0048)		(0.0044)		(0.0041)		(0.0076)		(0.0027)		(0.0028)		(0.0025)		(0.0040)
Log (GDP per Capita)		0.7089		0.3689***		0.8709		0.0871		-0.4559		0.1140		-0.5031		0.1206*
		(0.4691)		(0.1148)		(0.9053)		(0.1413)		(0.4251)		(0.0745)		(0.7529)		(0.0698)
Libor 3-month (mean)		-0.0216		0.0402		-0.0095		0.0471		-0.0374		0.0029		-0.0390		-0.0085
		(0.0412)		(0.1008)		(0.0556)		(0.1238)		(0.0440)		(0.0701)		(0.0578)		(0.0674)
Financial Crisis Dummy (2008=1)		0.4343**		0.8502**		0.4430*		0.8247**		0.6722***		0.5589***		0.6519***		0.5447***
		(0.1857)		(0.3208)		(0.2079)		(0.4040)		(0.1671)		(0.1905)		(0.1857)		(0.1896)
Constant	3.4231	-5.7094	-11.3634*	-10.4503	-8.0478*	-7.0129*	9.2413	6.9672	-2.8485	4.7211	-7.8657*	-10.1775*	-5.1610	0.7055		4.5202
	(11.5267)	(6.1597)	(6.0125)	(6.7247)	(3.9389)	(3.1946)	(7.1972)	(7.7301)	(4.2487)	(4.7008)	(4.2329)	(5.0942)	(2.9288)	(1.9678)	(4.5519)	(4.7737)
Time Fixed	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Country Fixed	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No
R2	0.0016	0.5958	0.5241	0.6717	0.1346	0.5867	0.4320	0.4917	0.0036	0.2696	0.2365	0.3915	0.0111	0.2740	0.2840	0.4074
N	67.0000	62.0000	67.0000	62.0000	58.0000	53.0000	58.0000	53.0000	67.0000	62.0000	67.0000	62.0000	58.0000	53.0000	58.0000	53.0000
U-shape joint significance p-value			0.0000	0.0000	0.0033											
Sasabuchi test of u-shape p-value			0.00196	0.015	0.0507											
estimated extreme point,			4.513239	4.191165	4.819652											
bounds of Fieller interval			[3.83,4.73]	[2.07, 4.63]	[4.30,11.4]											

Notes: * p<0.10, ** p<0.05, *** p<0.01, Panel Estimation with Heteroscedasticity Robust Standard Errors; Standard Errors are presented in parenthesis; U-test was done using a u-test command in STATA, the interval for the u-test was set to 1-7 the value range for strength of audit and transparency of government policy; we also report Fieller interval for extreme point. Countries in the sample: Bahrain, Egypt, Arab Rep., Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, United Arab Emirates

Table 6A: Role of natural resource Curse: All Countries Sample (Dependent Variables; volatility and coefficient of variation)

	Volatility								Coefficient of Variation							
	(1) Strength of Audit		(2) Strength of Audit		(3) Transp. of Gov't Policy		(4) Transp. of Gov't Policy		(5) Strength of Audit		(6) Strength of Audit		(7) Transp. of Gov't Policy		(8) Transp. of Gov't Policy	
Transparency	1197.0628**	-434.9718	4537.922***	5006.909***	1443.6921	800.4730	935.1229*	913.3711	0.3142***	0.1043	0.0859	0.0997	0.0331	-0.0732	-0.0697**	-0.0483*
	(475.8156)	(848.0089)	(1010.3725)	(1341.4366)	(982.4486)	(836.4376)	(547.2026)	(574.6082)	(0.0827)	(0.0915)	(0.0750)	(0.0773)	(0.0546)	(0.0679)	(0.0294)	(0.0284)
Transparency2	-117.679***	34.2359	-472.460***	-499.499***	-135.7232	-109.8134	-158.311***	-134.2331**	-0.032***	-0.0102	-0.0108	-0.0119	-0.0043	0.0063	0.0050	0.0025
	(40.2240)	(81.4415)	(103.1357)	(131.9925)	(100.4273)	(98.2589)	(60.5894)	(64.5751)	(0.0079)	(0.0091)	(0.0070)	(0.0072)	(0.0063)	(0.0075)	(0.0033)	(0.0034)
Trade		-9.0802		-3.5964***		-11.9910		-2.0614*		-0.0009**		0.0000		-0.0008*		0.0001***
		(10.1323)		(1.2235)		(11.9013)		(1.1413)		(0.0004)		(0.0000)		(0.0004)		(0.0000)
Turnover Ratio		-4.6417		-2.1094		-4.2827		-3.1441*		-0.0002		0.0003**		-0.0002		0.0003*
		(5.3498)		(1.5220)		(5.5323)		(1.6084)		(0.0003)		(0.0001)		(0.0002)		(0.0001)
Stocks Traded		2.8592		0.1678		1.7332		0.6434		0.0004		-0.0001		0.0002		-0.0001
		(2.9496)		(0.8102)		(2.9334)		(0.8505)		(0.0002)		(0.0001)		(0.0002)		(0.0001)
Log (GDP per Capita)		98.2012		-27.9327		222.3394		-44.9805		0.0293		-0.0046		0.0539		-0.0087**
		(637.1289)		(53.9798)		(640.0718)		(47.9581)		(0.0533)		(0.0043)		(0.0551)		(0.0042)
Libor 3-month (mean)		45.3044		-2.8966		89.3794		22.4933		-0.0027		-0.016***		-0.0023		-0.015***
		(47.3052)		(45.1913)		(72.0227)		(49.6275)		(0.0028)		(0.0030)		(0.0035)		(0.0030)
Financial Crisis Dummy (2008=1)		602.2839*		0.0000		704.2206**		0.0000		0.2204***		0.0000		0.2108***		0.0000
		(301.1771)		(.)		(288.7623)		(.)		(0.0263)		(.)		(0.0249)		(.)
Log (1+Oil & Gas Rent per GDP)		405.4439		-213.7586		-1400.3017		11.0608		-0.2297**		0.0997***		-0.2442*		0.1230***
		(2816.599)		(759.4509)		(3471.395)		(802.6717)		(0.1068)		(0.0317)		(0.1253)		(0.0354)
Oil Price Volatility		21.0328		39.1400**		20.8583		45.9562**		-0.006***		0.0027***		-0.005***		0.0030***
		(31.4102)		(17.0589)		(30.4184)		(18.6930)		(0.0015)		(0.0006)		(0.0014)		(0.0005)
Constant	-2290.7821	1565.3989	-10078.3***	-11078.1***	-2988.8065	-1941.0430	-537.3982	-305.0545	-0.629***	-0.3064	-0.0279	-0.0140	0.0597	-0.0926	0.335***	0.3553***
	(1506.9523)	(7810.430)	(2395.0960)	(3137.9163)	(2339.918)	(6343.231)	(1302.5473)	(1327.8742)	(0.2170)	(0.6198)	(0.1961)	(0.2013)	(0.1160)	(0.4572)	(0.0645)	(0.0724)
Time Fixed	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Country Fixed	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No
R2	0.0027	0.2122	0.1551	0.2311	0.0173	0.2324	0.1558	0.1992	0.0462	0.5079	0.4480	0.5017	0.0026	0.5353	0.4640	0.5428
N	245.0000	203.0000	245.0000	203.0000	214.0000	173.0000	214.0000	173.0000	245.0000	203.0000	245.0000	203.0000	214.0000	173.0000	214.0000	173.0000
U-shape joint significance p-value	0.0184		0.0000	0.0008			0.0005	0.0189	0.0006							
Sasabuchi test of u-shape p-value	0.0152		0.0000	0.000132			0.0768	0.0767	0.000361							
estimated extreme point, bounds of Fieller interval	5.086123 [2.59,6.69]		4.802442 [4.63,4.94]	5.01193 [4.79,5.19]			2.953446 [-1.71,3.93]	3.402182 [-14.9,4.34]	4.902966 [4.33,5.29]							

Notes: * p<0.10, ** p<0.05, *** p<0.01, Panel Estimation with Heteroscedasticity Robust Standard Errors; Standard Errors are presented in parenthesis; U-test was done using u-test command in STATA, the interval for u-test was set to 1-7 the value range for strength of audit and transparency of government policy; we also report Fieller interval for extreme point. Countries in the sample: see Table 4A and 4B

Table 6B: Sample: Role of natural resource Curse: All Countries Sample (Dependent Variables; log of volatility and log of coefficient of variation)

	Log Volatility								Log Coefficient of Variation							
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Strength of Audit		Strength of Audit		Transp. of Gov't Policy		Transp. of Gov't Policy		Strength of Audit		Strength of Audit		Transp. of Gov't Policy		Transp. of Gov't Policy	
Transparency	4.3219***	1.8322	5.4635***	5.6101***	0.6710	-0.2529	1.5470**	1.7979**	3.3976***	1.3604	1.4135**	1.4600**	0.0479	-0.7052	-0.6078**	-0.3493
	(1.3486)	(1.1633)	(1.2742)	(1.3675)	(1.0517)	(0.7619)	(0.6908)	(0.7288)	(0.7467)	(0.8215)	(0.6852)	(0.7285)	(0.5329)	(0.6024)	(0.2742)	(0.2622)
Transparency2	-0.416***	-0.1838	-0.575***	-0.5691***	-0.0373	0.0144	-0.234***	-0.2453***	-0.361***	-0.1466*	-0.1611**	-0.1662**	-0.0155	0.0612	0.0430	0.0109
	(0.1270)	(0.1116)	(0.1258)	(0.1355)	(0.1121)	(0.0834)	(0.0812)	(0.0878)	(0.0755)	(0.0834)	(0.0648)	(0.0688)	(0.0622)	(0.0664)	(0.0313)	(0.0326)
Trade		-0.0044		-0.0039***		-0.0044		-0.0014		-0.0086**		0.0005		-0.0064		0.0016***
		(0.0064)		(0.0012)		(0.0054)		(0.0014)		(0.0042)		(0.0004)		(0.0040)		(0.0005)
Turnover Ratio		-0.0023		-0.0041		-0.0012		-0.0053*		-0.0006		0.0026**		0.0004		0.0024*
		(0.0046)		(0.0027)		(0.0044)		(0.0027)		(0.0032)		(0.0012)		(0.0032)		(0.0013)
Stocks Traded		0.0033		0.0023		0.0005		0.0027		0.0022		-0.0014**		0.0009		-0.0012
		(0.0031)		(0.0016)		(0.0027)		(0.0017)		(0.0020)		(0.0007)		(0.0018)		(0.0008)
Log (GDP per Capita)		0.8871**		-0.0253		1.2958***		-0.0703		0.2016		-0.0188		0.4123		-0.0726*
		(0.4311)		(0.0900)		(0.4186)		(0.0806)		(0.4044)		(0.0430)		(0.4188)		(0.0389)
Libor 3-month (mean)		0.1018***		0.0203		0.1159***		0.0554		0.0072		-0.1509***		0.0026		-0.1390***
		(0.0364)		(0.0760)		(0.0391)		(0.0784)		(0.0327)		(0.0267)		(0.0352)		(0.0271)
Financial Crisis Dummy (2008=1)		1.9351***		0.0000		1.7602***		0.0000		2.5207***		0.0000		2.4008***		0.0000
		(0.4024)		(.)		(0.4271)		(.)		(0.3648)		(.)		(0.3668)		(.)
Log (1+Oil & Gas Rent per GDP)		0.9102		0.4622		-0.2688		0.7948		-2.1506**		0.8247***		-2.1118*		1.2057***
		(1.8995)		(0.6990)		(1.5734)		(0.6952)		(0.9794)		(0.2971)		(1.1404)		(0.3253)
Oil Price Volatility		-0.0391*		0.0450***		-0.0295		0.0527***		-0.0745***		0.0203***		-0.0688***		0.0233***
		(0.0199)		(0.0110)		(0.0203)		(0.0111)		(0.0175)		(0.0039)		(0.0171)		(0.0037)
Constant	-5.3968	-7.0832	-7.2280**	-7.4084**	3.3366	-5.5531	3.0957**	3.0365*	-9.9787***	-6.1254	-5.0922***	-4.9032**	-2.2199*	-3.4350	-0.3424	-0.3253
	(3.6316)	(4.5749)	(3.1418)	(3.4155)	(2.4293)	(3.5795)	(1.4615)	(1.6173)	(1.8558)	(4.7774)	(1.7706)	(1.8969)	(1.1236)	(3.6406)	(0.5940)	(0.6501)
Time Fixed	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Country Fixed	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No
R2	0.0532	0.5190	0.2542	0.2923	0.0346	0.5753	0.2601	0.2925	0.0706	0.4487	0.4469	0.4887	0.0035	0.4818	0.4540	0.5332
N	245.0000	203.0000	245.0000	203.0000	214.0000	173.0000	214.0000	173.0000	245.0000	203.0000	245.0000	203.0000	214.0000	173.0000	214.0000	173.0000
U-shape joint significance p-value	0.0097		0.0000	0.0002			0.0000	0.0070	0.0001	0.2064	0.0000	0.0000				
Sasabuchi test of u-shape p-value	0.00299		0.0000178	0.0000343			0.0216	0.0101	0.000043	0.0572	0.0254	0.0291				
estimated extreme point, bounds of Fieller interval	5.199735 [4.44,5.92]		4.753865 [4.45,4.92]	4.929017 [4.62,5.19]			3.312659 [1.22,3.82]	3.664861 [2.30,4.20]	4.71289 [4.28,5.07]	4.639911 [-inf,+inf]	4.387785 [0.94,4.84]	4.391028 [0.38,4.91]				

Notes: * p<0.10, ** p<0.05, *** p<0.01, Panel Estimation with Heteroscedasticity Robust Standard Errors; Standard Errors are presented in parenthesis; U-test was done using a u-test command in STATA, the interval for u-test was set to 1-7 the value range for strength of audit and transparency of government policy; we also report Fieller interval for extreme point. Countries in the sample: see Table 4A and 4B

Appendix: Definitions and Sources of Variables used in the Regression Analysis

Variable	Definition and Construction	Source
Coefficient of Variation	Monthly Stock Market Index Data, standard deviation of monthly stock index divided by monthly mean of stock index	Bloomberg, Yahoo
Volatility	Monthly Stock Market Index Data, standard deviation of monthly stock index	Bloomberg, Yahoo
Strength of auditing and accounting standards	Financial auditing and reporting standards regarding company financial performance in your country are (1=extremely weak, 7=extremely strong)	World Economic Forum, Global Competitiveness Report 2000-2009
Financial Market Sophistication	The level of sophistication of financial markets in your country is (1=lower than international norms, 7=higher than international norms)	World Economic Forum, Global Competitiveness Report 2000-2009
Transparency of government policymaking	Are firms in your country usually informed clearly by the government of changes in policies and regulations affecting your industry? (1=never informed, 7=always informed)	World Economic Forum, Global Competitiveness Report 2000-2009
Trade	Ratio of sum of Exports and imports to GDP	WDI, 2011
Turnover ratio	Total value of shares traded during the period divided by the average market capitalization for the period	WDI, 2011
Stocks traded, total value (% of GDP)	Ratio of total value of stocks traded to GDP	WDI, 2011
GDP per capita	Ratio of total GDP to population in constant 2000 US$	WDI, 2011
LIBOR 3 month	Mean of Annual LIBOR data for 3-months	Wall Street Journal and www.mortgate-x.com
Oil Price Volatility	Annual average Europe Brent Spot Price FOB (Dollars per Barrel) - Coefficient of variation	U.S. Energy Information Administration, http://www.eia.gov
Oil & Gas Rents	log of rents from oil + gas as share of GDP.. Rents are defined as the price minus the average extraction costs. The data are described in Hamilton and Clemens (1999).	World Bank's adjusted net savings dataset.