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**What is Minsky All About, Anyway?**

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The financial crisis has been billed a “Minsky moment” in the mainstream media, turning Hyman P. Minsky into a household name. One would think that this was at long last Minsky’s moment of posthumous vindication, and in a way it was. But, oddly, a couple of post-Keynesian luminaries would have none of it. Paul Davidson, the Editor of *JPKE*, and Jan Kregel, senior scholar at the Levy Institute of Bard College where Minsky had spent the last of his years, were both eager to set the record straight: the current financial debacle did not qualify as a Minskyan crisis because how it unfolded differed from Minsky’s depiction of crises in his writings (Davidson 2008, Kregel 2008a). Of course, whether we think Minsky is relevant for the current crisis or not depends on what we make of him. If *Minskyan* work means solely his own writings and their restatement, then, Davidson and Kregel are probably right – one cannot help but focus on what is different about the current crisis. But, if instead *Minskyan* refers to an evolving literature that emanate from but transcend his work, their arguments miss their mark.

In this paper our objective is to sketch out an alternative understanding of Minsky as an evolving research agenda.<sup>1</sup> At the most general level we hold that a Minskyan way of looking at the world boils down to few basic propositions: (i) in a financial capitalist economy, credit is procyclical in the absence of policies/institutions that actively neutralize it, and, that, in turn (ii) causes systemic risk to rise endogenously over an expansion (iii) in a way agents fail to recognize, (iv) and has the potential to blow up badly, ending in debt deflation. Defined thus, there is little question that the current financial crisis is a quintessential Minsky moment. If nothing else, the very fact that credit supply has become much more procyclical following financial deregulation has vindicated Minsky’s basic insight. Who can now in hindsight deny that financial liberalization played an important role in both stoking the speculative boom as well as the difficulty of containing deleveraging after the crisis?

Of course, at a less general level there is always a good deal that is unique about each crisis and every era, and that holds true for the current one as well. Among these particular characteristics, perhaps, the single most important one in terms of its relevance for what happened is the way the credit mechanism had been transformed in the neo-liberal era. Much of Minsky’s work refers to a time when commercial and industrial bank loans to nonfinancial firms made up the bulk of the overall credit supply in the economy. In that bygone era credit was essentially regulated by the loan officers of commercial banks. But, with financial deregulation the credit creation mechanism became transformed, came to be governed by financial markets rather than the banks. In this new world, about which Minsky (1987/2008) wrote presciently in the 1980s, asset prices and asset price expectations have become the overall regulator of credit supply - similar to the role played by bankers in the previous bank based credit system. That in our view is the salient characteristic of the neoliberal era that needs to be assimilated by Minskyan analysis at the general level.

No doubt, today the financial crisis has made it much easier to argue that finance can be destabilizing or that financial variables can have a decisive influence on real activity. Discredited is the conventional wisdom according to which aggregate price stability is all a central bank need be concerned with to promote financial stability. Little argument now that asset price bubbles are real, that the crisis had everything to do with the unwinding of financial imbalances and little to do with price inflation. But, in our view, what might need more discussion is the role asset price bubbles have come to play in the credit creation process, which is the focus of this paper. The next section lays out how the nature of the link between asset prices and credit had been transformed in the neoliberal era, and the section following next gives an overview of recent

advances in the theory of asset price bubbles, which in our view merit much closer scrutiny than what they have received so far among heterodox economists. We end with a few concluding comments on the import of a Minskyan perspective today

### Asset Price – Credit Nexus in the Neoliberal Era

According to Minsky (1986), the main driver of financial instability is the dynamic interaction between asset prices and bank credit. Rising profit expectations raise asset prices, increasing firms' collateral and thus the ability to borrow and invest. As output and investment expands, profits rise and validate the initial increase in asset prices. This makes the credit supply even more elastic mainly because bankers, convention-bound as they are, cannot help but lower their risk aversion as the general business conditions around them steadily improve. Many of Minsky's better-known disciples give rather lengthy descriptions – often recycling his own work - of how bankers and borrowers both tend to become overconfident, causing 'margins of safety' to erode during periods of sustained stability (Kregel 2008a, Kregel 2008b, Wray 2008, Wray & Tymoigne 2008, Papadimitriou & Wray 1998, Kregel 1997). As a result financial imbalances build up steadily over the expansion, setting the stage ultimately for crisis.

The trouble with this story, however, is its emphasis on bankers. It ignores the fact that bank loan officers' importance as arbiters of credit has waned with financial liberalization as the progressive intrusion from nonbank financial organizations into banks' traditional turf forced them to reinvent themselves.<sup>2</sup> In fact, the recent decades saw the rapid decline of commercial and industrial bank loans' importance in overall credit (Ozgur & Erturk 2008). Real estate loans, off-balance sheet activities, backup lines of credit and guarantees and lending for corporate takeovers and leveraged buyouts have all gained at the expense of traditional lending (Boyd and Gertler, 1995). The story is rather well-known. At the end of it all the link between asset prices and credit supply has actually become stronger, but the nature of the relationship changed. The crucial link between the two became the influence asset prices exert on banks' level of capitalization rather than the endogenous variation in risk aversion over the cycle.

For in this new brave world, banks themselves have become dependent on financial markets just as much as have their own customers. Neither bank deposits nor reserves were any longer a constraint on their ability to supply credit. The certificates of deposits, increased access to the federal funds markets and use of credit market instruments in liability management had already lowered their dependence on deposits in the 1980s, if not earlier. And, in the 1990s, the Fed abolished reserve requirements for time deposit accounts, reduced them for checkable deposits and later introduced retail sweep accounts, following of which required reserves ceased to be a constraint as well (Bennett and Peristani, 2002). The only thing left was capital requirements. Consistent with the prevailing dogma of the time, they were meant to be the lynchpin of a system where bank credit was supposed to be regulated by market forces. (Basset and Zakrajsek, 2003). Thus the only real constraint left was banks' net worth, their level of capitalization, and that applied for investment banks firms as well.

Higher asset prices were instrumental in relaxing this constraint, while at the same time making it easier for firms to borrow directly in financial markets at lower cost. Thus, they not only increased the borrowers' collateral and willingness to borrow but also raised banks' own

collateral with their investors' in financial markets, thus raising their ability and willingness to underwrite more lending in one shape or another.<sup>3</sup> Also, just as higher asset prices stimulated credit, the increase in credit in turn stimulated spending as well as speculation, pushing up asset prices further. However, contrary to the traditional accounts of the Minsky cycle, the erosion of 'margins of safety' was hardly a hallmark of the expansion. On the contrary, as asset prices rose and credit became more elastic the indicators of risk and prudential standards such as loan-to-value ratios only fell. The driver of the credit boom was thus not so much the increased appetite for risk as it was the endogenous fall in indicators of risk. As long as asset prices continued to increase units faced what appeared to be diminishing *ex-ante* risk, while the risk of a systemic collapse rose (Borio and White 2003, Danielsson & Shin 2003, Danielsson 2002).<sup>4</sup>

For Minsky the external financing of fixed investment was the main cause of rising indebtedness over a business cycle expansion which eventually became the main source of the problem when interest rates began to increase.<sup>5</sup> Thus he foresaw a unilinear transition in his famous financing profiles, from *hedge*, to *speculative* and to *Ponzi* finance, culminating in a crisis when finally units are forced to sell their assets to meet their financial obligations. He defined *margins of safety* in terms of expected excesses of cash receipts over payment commitments, or, alternately, in terms of the excess of expected asset values over capitalized payment commitments with the presumption that the two definitions are for all intents and purposes interchangeable. However, note that during times of surging asset prices they often cease to be interchangeable. What is Ponzi finance from the point of the former definition can actually be hedge finance from the point of view of the latter. The discrepancy is a symptom of the fact that economic units have become constrained more by their asset price expectations than their cash flow in the neoliberal era, and that the two can diverge substantially - as was the case in the dotcom bubble, for instance.. Or, put differently, the commodification of credit accorded firms much greater scope to defy the forces of gravity as credit became highly responsive to the expectations of increasing asset prices. Oddly, the world had become much more Minskyan just when what happened in the stock market began to matter much more than Minsky ever suspected. Likewise on the downside; more often than not, the expansion came to an end – both in the US and elsewhere - not through the corrosive effect of rising interest rates, but through a sudden collapse of asset valuations in the stock market. Firms' financial obligations became *excessive* only when a large swath of anticipated future wealth ceased to exist because of lowered expectations.<sup>6</sup>

### Asset Price Bubbles

Despite his interest in asset prices, Minsky dwelled little on bubbles *per se*. That might have been because bubbles were in little evidence during the period of financial regulation when his ideas matured. Yet, there was also a long running debate that went on in the late 1950s and the 1960s about whether destabilizing asset price speculation was unprofitable as Milton Friedman (1953) had contended.<sup>7</sup> It appears that the rise of the *efficient market hypothesis* to prominence among economists helped Friedman's position carry the day back then. However, the critics were to have the last word as it turns out they were the harbinger of an intellectual sea change that began after the 1987 stock market crash in the US.

Until then most mainstream economists were comfortable in believing that bubbles are highly improbable. The view that asset prices as a rule reflect fundamental values relied on an argument

of backward induction and a belief in the effectiveness of arbitrage. The worth of any security in the period before the final payoff date would simply be equal to the discounted value of its terminal value. Extending this argument backwards it could then be shown that at any period the value of a security would simply be equal to the present discounted value of its future stream of revenue. Otherwise, an arbitrage opportunity would arise and the price would be pushed back to its *true* fundamental value. Admittedly, less than rational, so-called, noise-traders always exist in financial markets, but it was argued that informed arbitrageurs would undo any mispricing caused by them when their effect is not canceled out by each other (Fama 1965, 1970; Malkiel 2003). Thus, the argument was that uninformed noise-traders, while making losses themselves, would create riskless arbitrage opportunities that informed traders profit from.

Both Friedman's argument on speculation and the idea that stock prices are completely unpredictable in an efficient market – in the sense of the *Efficient Market Hypothesis* which holds that markets always incorporate all available public information in its more widely accepted semi-strong form - rest on the belief that arbitrage is quick and effective, underpinning the view that asset price bubbles were highly improbable if not implausible. Thus, from this point of view, it is the changes in fundamental values that must have caused both the recent dotcom (DeMarzo *et al.* 2008; and Pastor and Veronesi 2006) as well as the historical episodes of 'bubbles' such as the Dutch Tulip Mania (1634-7), Mississippi Bubble (1719-20), South Sea Bubble (1720), etc. (Garber 1990). Otherwise, bubbles could plausibly arise only in assets with an infinite horizon that lacked a terminal value, where backward induction did not apply.<sup>8</sup> This case has defined pretty much the limits of initial theoretical interest in bubbles, going back to Samuelson (1958), and is the foundation of what often goes under the name "rational bubbles",<sup>9</sup> which has nothing to do – as we shall see - with the more recent breed of bubble models that do not rely on any irrational behavior.

Since the recent rise of behavioral finance theory the view that asset prices always equal the discounted present value of future streams of revenue has been questioned on both theoretical and empirical grounds.<sup>10</sup> In fact, with the waning influence of the Efficient Market Hypothesis much of the theoretical literature on asset pricing has been in a "vibrant flux" (Hirshleifer 2001). It is now widely recognized that the power of arbitrage is severely limited in the real world markets.<sup>11</sup> For instance, when traders have relatively short trading horizons, those who sell overvalued assets short can find that by the time they close their position the *true* value has further increased or that the assets in question have become even more overpriced. In either situation informed traders would make losses by shorting assets they thought were overvalued. Thus, arbitrage almost always involves at least some degree of risk, and that can cause informed agents to limit the positions they would take in an over or undervalued asset, preventing current price from smoothly adjusting to its *true* value as Friedman (1953) had originally envisioned. In fact, it can pay for informed traders to act like noise traders themselves in the short run, bidding prices further away from what they think are *true* values rather than help close the gap between the two (De Long *et al* 1990a and Griffin *et al.*, 2003).<sup>12</sup>

Of course, this skeptical view of arbitrage is quite consistent with Keynes's (1936, Ch. 12) famous "beauty contest" argument, where speculators base their expectations of future asset prices not only on what they think the true value is, but, more importantly, on what they think the average opinion about the average opinion is. This, in turn, implies that agents must not only form higher order expectations (i.e., on what others think others think) but also decide how much

weight to assign them relative to what they themselves think the *true* value is (Hirota and Sunder, 2007). An agent observing the price of an already overpriced asset continue to rise would be led to think that either her opinion about the *true* value is off the mark or that price is rising on account of market sentiment. In either case, the information and opinion of others as revealed in current price changes are likely to gain in importance in how the trader forms his/her expectation about the future price. Such information becomes either a proxy for the higher order expectations or a corrective on opinions about the *true* value, or, some combination of both. Under these conditions whether speculation is stabilizing or not crucially depends on the relative weight traders assign to their higher order expectations (i.e., what they think others think others think) relative to their own assessment of what the *true* value is. This basic idea in its simplest form goes back to Kaldor (1939), where whether speculation is stabilizing or not depends on the elasticity of future price expectations with respect to current price changes.<sup>13</sup> In more recent analyses, destabilizing speculation likewise involves traders with elastic future price expectations who buy (sell) assets when the price is rising (falling). They are called ‘momentum-investors’ - and their actions ‘positive-feedback’ strategies - in these examples, where short trading horizons, sequential nature of trades and information costs are the real world market attributes that are emphasized.

In contrast to standard models of asset pricing that implicitly assume long term horizons, short term trading horizons play an important role in explaining how asset prices can deviate from *true* values (Dow & Gorton 1994, Tirole 1982). In a world characterized by market “imperfections” and uncertainty speculators who tie their resources in long term investments can fail to exploit profitable investment opportunities that would unexpectedly arise (Shleifer & Summers 1990). Professional traders also shun long term arbitrage opportunities for fear that price would deviate even more from its fundamental value within a time frame within which they would have to report to their clients (Shleifer & Vishny 1997). Moreover, the incentive structure that defines fund managers’ employment gives rise to agency problems, making it rational for speculators to have short trading horizons (Allen & Gorton 1993).

Also, because trading is sequential in real world markets - unlike in the Arrow-Debreu world of standard models where all trades occur simultaneously - traders observe and can learn from each other. By acting faster than the next trader, investors can rationally exploit information revealed by the actions of other agents, creating incentives for herding (Bikhchandani & Sharma 2001, Bikhchandani & Hirshleifer 1998). Profit-maximizing traders can thus successfully focus on what other traders also know rather than trying to learn information others do not have. A narrow set of information can then become the primary focus of attention even when it has little bearing on fundamentals (Froot, Scharfstein & Stein 1992, Scharfstein & Stein 1990). Finally, especially in foreign exchange markets, gathering information requires large fixed costs which generate economies of scale for large investors. Thus, the greater the cost of acquiring information the higher is the incentive for uninformed small traders to imitate large investors (Calvo 1999, Calvo & Mendoza 2000). This also can cause small investors to be much more aggressive, especially, in their selling in markets where large investors have a significant presence (Corsetti et al 2001), accentuating asset price volatility.

It is often supposed that less than rational traders and irrational euphoria are the main cause of bubbles. However, in these models this is only true in the sense that noise traders’ behavior is often exogenously given, but otherwise not the case. In fact, in quite a few models all agents are

rational, and, yet, live in an “imperfect” world. The destabilizing asset price dynamics stem from the state of the world *itself*, characterized by attributes such as agency problems that give rise to short trading horizons and risk shifting from fund managers to the investor who are their clients.<sup>14</sup> For instance, in more recent body of work the main cause of the bubble is the uncertainty about higher order beliefs, i.e. rational agents not knowing what other rational agents will do (Allen *et al.* 2003). In Abreu & Brunnermeier (2002, 2003) fully rational traders know that the bubble will eventually burst, but in the meantime they can make profits riding it. They realize that they would not be able to individually bring down the price for lack of sufficient funds, but collectively could if they were to act in tandem. In other words, they all know that a common ‘arbitrage’ opportunity exists, yet they are in the dark as to when the other traders would act on it, if at all. Thus, the challenge traders face turns into an optimal timing problem under uncertainty where each one has to determine when is the right time to exit the market without any knowledge of the exit strategy of the others.<sup>15</sup> The bubble persists as long as the opinion as to when one should exit remains dispersed among investors. Often, some news event can have a disproportionately strong effect beyond what its intrinsic information value would warrant by causing traders to synchronize their exit strategies, leading to a precipitous fall in price.<sup>16</sup>

However, irrationality - in the real sense of the word, as opposed to the artificial meaning neoclassical economics has given it – can also matter. Other behavioral models show that cognitive biases can cause destabilizing asset price dynamics as well. For instance, Lei *et al.* (2001) report results from experiments in laboratory asset markets where agents are precluded from reselling securities and thus from speculating. Bubbles and crashes are still observed even though speculation is not possible, suggesting that elements of irrationality can cause bubbles even when uncertainty about higher order beliefs is ruled out. A vast literature now exists on various cognitive biases that are thought to give rise to irrational agent behavior, such as *overconfidence* (Gervais & Odean 2001), *overreaction* (DeBondt & Thaler 1986), *hyperbolic discounting* (Laisbon 1997), *loss aversion* (Odean 1998), and *regret* (Clarke et al. 1994), among others.<sup>17</sup>

### What Have We Yet to Re-Learn from Minsky?

Before the crisis, the Fed policy has been to ignore surging asset prices as long as it did not cause price inflation, and that appears to have reflected a consensus among mainstream economists as well (Gertler *et al.* 1998, Vickers 1999, and Bernanke and Gertler 1999).<sup>18</sup> A Turkish proverb appears to capture the gist of thinking behind this rather well - which in loose translation says, “it is all too easy to show the way once the car is toppled off the road.” Indeed, because an asset price bubble could not be identified *ex-ante*, the argument went, the only thing to do was to focus on neutralizing its impact on aggregate demand to the extent they affected goods’ prices. While it is true that the future can never be predicted with certainty, there was ample reason to believe the car was about to tip over. For instance, Borio and Lowe (2002), using a data set compiled by the Bank of International Settlements (BIS) for 16 advanced market economies since the 1970s, had used the deviations of variables from their trend values to help predict financial instability by building on a “noise/signal” procedure first developed by Kaminsky and Reinhart (1999).<sup>19</sup> Their index could show that credit supply and asset prices were *excessive*, signaling trouble ahead.<sup>20</sup> More explicit warnings were issued repeatedly by the *Bank of International Settlements* during the housing bubble years (BIS 2002, 2003, 2004).

Now, in the aftermath of the crisis it is hard to think that monetary authorities will ever again ignore asset prices with such abandon, or that the mainstream consensus on asset prices will survive. Yet, there is the danger that the different bubble episodes we have gone through in the neoliberal era in the US and the rest of the world will be seen as aberrations tied to the breakdown of prudential supervision or some other idiosyncratic event or policy, rather than the very outcome of financial liberalization. For instance, it is true that the Gramm-Leach-Bliley Bank Reform Act in 1999 in the US played an important role in weakening the constraint posed by banks' capital base. As both Kregel (2008a, 2008bb) and Davidson (2008) relate in detail, US banks could as a result unload with much greater ease the securitized mortgages and loans they initiated off their balance sheets to the special trusts – the so-called, special investment vehicles - they set up for the purpose, all of which made it possible to extend themselves way beyond what was warranted by their capital base. Unsurprisingly, lending shifted even more heavily towards loans collateralized by real estate and a two-way relationship emerged between property prices and bank credit (Goodhart and Hoffman 2008), not to say anything about the explosive increase in credit default swaps and derivatives about which we learned so much more only after the crisis.

But, in our view, it would be missing the forest for the trees to conclude that the current financial crisis is caused by the housing bubble which had in turn resulted from a breakdown in macro prudential supervision under the conditions brought about by the Gramm-Leach-Bliley Bank Reform Act. Nor would we go far enough by focusing solely on the steady erosion of public control over credit (Greider 2009, D'Arista 2008) and permissive Fed policy, either its response to the stock market crash of 2000, the Greenspan's "put", or Bernanke's overconfident reliance on "Big Moderation." For equally important were the surge in the capital inflow that recycled international trade surpluses through the US, feeding the dotcom bubble, and, the fact that Bank of Japan and other Asian central banks underwrote the housing bubble by monetizing US debt after the dotcom crash with the aid of the carry trade. But, they alone would fail to give a satisfactory explanation either.

In our view, a Minskyan approach is needed more than ever to help connect all these dots and learn anew the lesson that capital markets sooner or later self-destruct when left to their own devices. That however calls for a vibrant evolving research agenda with a focus on what is happening in the real world rather than repetitive restatements of his work. Minsky had all along argued that finance had to be kept under tight wraps to keep it from destabilizing the real economy. And, once again, when the genie was let loose by financial deregulation, the destruction predictably followed - with the difference that this time around asset price bubbles became the very mechanism of destabilizing finance under the changing conditions of the 1990s just as they were in the pre-WWII era. As heterodox economists our focus ought to be to show how the institutional evolution of the financial system in the neoliberal was in fact *endogenous*, the very outcome of the cumulative political and economic pressures that were unleashed by liberalization itself, in the hope of having an influence on how the financial system is reformed.

Notes:

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<sup>1</sup> However, lest it touches off another inane debate about who is a true Minskyan, we make no claims to that title nor insist that our interpretation is the right one.

<sup>2</sup> It appears that Minsky (1981) himself was a keen observer of the diminishing importance of traditional banking and the bank loan officer. On the changing role of bank credit, see also: Rogers and Sinkey, 1999; Saldenberg and Strahan, 1999; Samolyk, 2004; and Bradley and Shibut, 2006.

<sup>3</sup> Despite their restrictive emphasis on agency problems, Bernanke and Gertler 1989 and Kiyotaki and Moore (1997) capture well the gist of the asset price – credit interaction in deregulated financial markets. Their analysis, featuring net worth as the pivotal variable in business cycle dynamics, has an unmistakable family resemblance to Kalecki's (1937) principle of increasing risk.

<sup>4</sup> Making a similar distinction between “cross-sectional” risk *versus* intertemporal risk, Borio & White (2004) argue that the latter rose while the former fell over the expansion.

<sup>5</sup> Minsky has often been criticized for not explaining adequately why the interest rate would rise over an expansion. Here, he could have benefited from staying closer to Keynes in his *Treatise on Money* (Erturk 2007). The argument there resembles Keynes' (1936: 316) chapter on the trade cycle in GT, where he emphasized the sudden collapse of marginal efficiency of capital rather than the steady rise of the interest rate in explaining the onset of a crisis.

<sup>6</sup> See, also, Toporowski (2000, Ch.1) for a similar argument. I thank Doyoun Won for bringing it to my attention.

<sup>7</sup> Baumol (1957), Telser (1959), Sohmen (1961) Kemp (1963), Farrel (1966) and among others.

<sup>8</sup> It is also shown that bubbles can still emerge with a finite horizon if there are an infinite number of trading opportunities (Allen & Gorton 1993).

<sup>9</sup> For a comprehensive survey, see Santos & Woodford (1997).

<sup>10</sup> See, among others, Campbell & Kyle (1993), Lo & MacKinlay (1999) and Shleifer (2000).

<sup>11</sup> For general surveys of behavioral finance theory, see: Shleifer (2000), Shefrin (2000), and for a collection of recent papers, see, Shefrin (2001), Thaler (2003).

<sup>12</sup> In De Long et al. (1990b), informed traders induce noise traders to buy the stock by aggressively pushing up the price following some favorable initial news, only to sell their positions at a profit in the subsequent trading periods.

<sup>13</sup> In this early formulation, stability requires traders to revise their expected future price proportionally less than the change in current price, i.e., exhibit a less than unitary elasticity of expectation of the future price with respect to changes in the current price. However, it can be shown that speed of adjustment matters as well (Erturk 2007).

<sup>14</sup> Arguably, Keynes' (1936) had in mind something more than agency problems when he commented that “it is better for reputation to fail conventionally than to succeed unconventionally” (1936: 158)

<sup>15</sup> “The actual, private object of the most skilled investment to-day is ‘to beat the gun’, as the Americans so well express it, to outwit the crowd, and to pass the bad, or depreciating, half-crown to the other fellow” (Keynes 1936: 155).

<sup>16</sup> This again brings to mind Keynes' famous remark that the conventional asset valuations in financial markets are “liable to change violently as the result of a sudden fluctuation of opinion

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due to factors which do not really make much difference to the prospective yield” (Keynes 1936: 154).

<sup>17</sup> See Kahneman & Riepe (1998) for a summary account.

<sup>18</sup> See Cechetti et al. (2000) for a dissenting view from within the mainstream.

<sup>19</sup> In order to consider only *ex-ante* information, they use a rolling Hodrick-Prescott Filter to detrend three variables - credit/GDP, aggregate asset prices, and investment - and examine their cumulative ability, separately and in different combinations, to predict crises at different time horizons. In other words, instead of estimating one trend and one deviation for a variable for the whole sample they estimate a separate trend and a deviation by HP Filter for each observation year. Every time a variable deviates from its trend by a certain threshold it is said to produce a “signal”, which is called “noise” when it is not followed by a financial crisis over the specified time horizon. Thus, the “noise/signal” rate gives the conditional probability of a signal giving a false alarm, or, put differently, a lower ratio implies a higher probability of a certain single accurately predicting a crisis.

<sup>20</sup> See also, Borio & Lowe (2004) and Borio (2005, 2006). Likewise, a similar index to predict crises is developed by Goodhart & Hofmann (2007, Ch. 8) who examine the two-way causation between property prices and credit during the housing bubble.

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